Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

CMD 26-H105.1-REF2
Part 1 of 4

Date: 2026-06-29

Written Submission from Orano Canada Inc.

Mémoire d' Orano Canada Inc.

In the matter of

À l'égard d'

Orano Canada Inc.

Orano Canada Inc.

Application to renew the McClean Lake Operating Licence for 2-year term

Demande pour le renouvellement du permis d'exploitation de McClean Lake pour une période de deux ans

Hearing in writing based on written submissions

Audience par écrit fondée sur des mémoires

September 2026

Septembre 2026

Document ID: QQQVZZNDK725-166150894-13315 (PDF)

Canada

Reference 2 - CMD 26-H105.1

December 19, 2025

Mr. Salman Akhter
Senior Project Officer
Uranium Mines and Mills Division
Canadian Nuclear Safety Commission
#520, 101-22nd Street East
Saskatoon, SK S7K 0E1

Ms. Casey Frantik
Environmental Protection Officer
Northern Region
Ministry of Environment
#319 – 800 Central Avenue
Prince Albert, SK S6V 6Z2

Orano Canada Inc.

100-833 45th Street West
Saskatoon SK S7L 5X2
Tel.: +1 (306) 343-4500

Dear Mr. Akhter & Ms Frantik,

Re: McClean Lake Operation – 2025 Environmental Performance Technical Information Document Volume 1

On behalf of Orano Canada Inc. (Orano), please find enclosed Volume 1 of the 2025 Environmental Performance Technical Information Document (EP TID). Volume 1 of the 2025 EP TID assesses the McClean Lake Operation environmental performance based on the most recent monitoring and operational data with the focus on the 2022-2024 period. It summarizes key environmental aspects of the McClean Lake Operation and Midwest Project areas as well as results of the supplementary studies and follow-up programs.

Volume 1 of the 2025 EP TID fulfils requirements for environmental performance reporting, as per Condition 7.5.1 of Approval to Operate PO24-012 (Frantik to Huffman, January 31, 2024) and was performed in line with the Saskatchewan Environmental Performance Reporting Guideline (EPB 453) as required by the approval.

The EP TID Volume 1 is a companion document to EP TID Volume 2 – Environmental Risk Assessment submitted in December 2025 (Hughes to Akhter and Frantik, December 5, 2025) which focuses on updating the McClean Lake Operation Environmental Risk Assessment (ERA).

It is Orano's view that the 2025 EP TID Volume 1 satisfies regulatory requirements for environmental performance reporting, demonstrates that the McClean Lake Operation stays within bounds of the approved environmental assessments and provides necessary information to facilitate the ongoing McClean Lake Operation licensing process.

Should you have any questions, please contact me at (306) 343-4619 or Lesley Schmalz, Regulatory Manager at (306) 343-4525.

Sincerely,



Kebbi Hughes
Manager Environment and Geosciences

Attachment: McClean Lake Operation — Environmental Performance Technical Information Report Volume 1 – Environmental Performance Assessment

cc: Orano Distribution
ummd-dmucu@cnsc-ccsn.gc.ca
forms-formulaires@cnsc-ccsn.gc.ca

Orano Canada Inc.

McClean Lake Operation

Environmental Performance Technical Information Document

Volume 1 of 2 – Environmental Performance Assessment

Version 1 Revision 0

December 2025

Orano Canada Inc.

orano

Distribution List

Recipient	No. of Copies
Canadian Nuclear Safety Commission	Electronic
Saskatchewan Ministry of Environment	Electronic

Approval for Use

Editor:		
Marian Igwe	Environmental Scientist	
Name	Title	Signature

Contributions from:

- Elizaveta Petelina, Environmental Lead
- Aliah Noormahamod, Junior Environmental Scientist
- Tyler Lohman, Geo-Environmental Technician
- Alexandr Valyaev, Environmental Document Technician
- Svetlana Kurakina, Regulatory Specialist
- Kebbi Hughes, Manager, Environment and Geoscience
- CanNorth Environmental Services
- SRK Consulting (Canada) Inc.
- Independent Environmental Consultants

Approver:		
Colin Braithwaite	Vice President, Safety, Health, Environment and Regulatory	
Name	Title	Signature

History of Revisions

Version	Date	Details of Revision
Version 1 Revision 0	December 2025	Initial submission to Canadian Nuclear Safety Commission and Saskatchewan Ministry of Environment.

Table of Contents

1 Introduction 1-1

1.1 Background 1-1

1.1.1 Site Layout 1-2

1.2 Environmental Assessment and Authorized Activities 1-3

1.3 McClean Lake Operation History 1-5

1.3.1 1995-2021 Operational History 1-5

1.3.2 2022-2024 Operational Performance 1-6

1.3.3 Decommissioning Plan and Financial Assurance 1-7

1.4 Environmental Effects Science Evolution 1-7

1.5 Sustainable Development Framework 1-8

1.6 Current Environmental Performance Assessment 1-9

1.6.1 Objectives 1-9

1.6.2 Assessment Approach 1-10

1.6.2.1 Baseline Studies 1-10

1.6.2.2 Valued Components 1-10

1.6.2.3 Environmental Monitoring Program 1-12

1.6.2.4 Constituents of Potential Concern 1-12

1.6.3 Spatial Boundaries 1-13

1.6.3.1 Regional Study Area 1-13

1.6.3.2 Local Study Areas and the Local Assessment Boundary 1-14

1.6.4 Temporal Boundaries 1-14

1.6.4.1 Pre-development Baseline 1-14

1.6.4.2 Operational Period 1-14

1.7 Supplementary Studies 1-15

1.8 Report Organization 1-15

1.9 References 1-17

2 Physical Environment 2-1

2.1 Introduction 2-1

2.2 Hydrogeology 2-1

2.2.1 Study Area 2-2

2.2.2 Hydrostratigraphic Units 2-2

2.2.2.1 Basement Rock 2-2

2.2.2.2 Athabasca Sandstone 2-3

2.2.2.3 Quaternary (Overburden) Deposits 2-4

2.2.3 Regional Groundwater Flow 2-4

2.2.4 Study Design and Objectives 2-5

2.2.4.1 JEB Site 2-5

2.2.4.2 Sue Site....2-7
2.2.4.3 Moffat Domestic Landfill....2-7
2.2.4.4 Sink Dam....2-7
2.2.4.5 McClean Mining Site (former SABRE Test Site)....2-7
2.2.5 Impact Predictions....2-8
2.2.5.1 Dewatering of JEB Pit....2-9
2.2.5.2 Dewatering of Sue Pits....2-9
2.2.5.3 Groundwater Quality....2-9
2.2.6 Operational Monitoring....2-10
2.2.6.1 Sampling Methods....2-10
2.2.6.2 Data Analysis....2-10
2.2.6.3 Results....2-16
2.2.7 Monitoring Adjustments and Supplementary Studies Recommendations....2-42
2.2.8 Supplementary Studies....2-42
2.2.8.1 2023 Background Groundwater Sampling Campaign....2-43
2.2.8.2 2024 Additional Groundwater Sampling for Bena Lake Study....2-43
2.3 Hydrology....2-43
2.3.1 Study Design and Objectives....2-44
2.3.2 Impact Predictions....2-44
JEB Pit Dewatering....2-45
Sue Pits Dewatering....2-45
Other Dewatering Activities....2-45
Treated Effluent and Dewatering....2-46
Midwest Project....2-46
2.3.3 Operational Monitoring....2-46
2.3.3.1 Methods....2-46
2.3.3.2 Evaluation Criteria....2-48
2.3.3.3 Results....2-50
2.3.4 Monitoring Adjustments and Supplementary Studies Recommendations....2-56
2.3.5 Supplementary Studies....2-56
2.3.5.1 2022-2024 Collins Creek Bankfull Capacity Review.....2-56
2.4 Overall Summary and Conclusions....2-57
2.4.1 Hydrogeology....2-57
2.4.2 Hydrology....2-61
2.5 References....2-62

3 Climate and Air Quality....3-1

3.1 Climatology and Meteorology....3-1
3.1.1 Study Design and Objectives....3-1
3.1.2 Impact Predictions....3-1
3.1.3 Methods....3-2

3.1.3.1 Sampling Methods 3-2
3.1.3.2 Data Analysis 3-2
3.1.4 Results 3-3
3.1.4.1 Monitoring Performance 3-3
3.1.4.2 Temperature 3-3
3.1.4.3 Precipitation 3-4
3.1.4.4 Surface Winds 3-5
3.1.5 Monitoring Adjustments Recommendations 3-5
3.2 Air Quality 3-5
3.2.1 Total Suspended Particulate Matter 3-6
3.2.1.1 Pre-development Baseline 3-6
3.2.1.2 Study Design and Objectives 3-6
3.2.1.3 Impact Predictions 3-6
3.2.1.4 Operational Monitoring 3-7
3.2.1.5 Supplementary Studies 3-12
3.2.2 Radon 3-12
3.2.2.1 Pre-development Baseline 3-12
3.2.2.2 Study Design and Objectives 3-12
3.2.2.3 Impact Predictions 3-13
3.2.2.4 Operational Monitoring 3-13
3.2.3 Acid Precipitation Monitoring 3-16
3.2.3.1 Pre-development Baseline 3-16
3.2.3.2 Study Design and Objectives 3-16
3.2.3.3 Impact Predictions 3-16
3.2.3.4 Operational Monitoring 3-17
3.2.4 Sulphur Dioxide 3-17
3.2.4.1 Pre-development Baseline 3-17
3.2.4.2 Study Design and Objectives 3-17
3.2.4.3 Impact Predictions 3-18
3.2.4.4 Operational Data 3-19
3.2.5 Stack Emissions 3-20
3.2.5.1 Pre-development Baseline 3-20
3.2.5.2 Study Design and Objectives 3-20
3.2.5.3 Impact Predictions 3-21
3.2.5.4 Operational Monitoring 3-21
3.2.6 NPRI Reporting 3-23
3.2.7 Halocarbon Reporting 3-24
3.2.8 Monitoring Adjustments and Supplementary Studies Recommendations 3-24
3.3 Overall Summary and Conclusions 3-24
3.4 References 3-27

4 Aquatic Environment 4-1
4.1 Introduction 4-1
4.2 Study Area 4-2
4.3 Surface Water Quality 4-3
4.3.1 Pre-development Baseline 4-3
4.3.2 Study Design and Objectives 4-4
4.3.3 Impact Predictions 4-5
4.3.4 Operational Monitoring 4-6
4.3.4.1 Sampling Methods 4-6
4.3.4.2 Data Analysis 4-6
4.3.4.3 Results 4-10
4.3.5 Monitoring Adjustments and Supplementary Studies Recommendations 4-16
4.3.6 Summary and Conclusions 4-16
4.4 Sediment Quality 4-17
4.4.1 Pre-Development Baseline 4-17
4.4.2 Study Design and Objectives 4-18
4.4.3 Impact Predictions 4-19
4.4.4 Operational Monitoring 4-19
4.4.4.1 Sampling Methods 4-19
4.4.4.2 Data Analysis 4-21
4.4.4.3 Results 4-24
4.4.5 Monitoring Adjustments and Supplementary Studies Recommendations 4-26
4.4.6 Summary and Conclusions 4-26
4.5 Benthic Invertebrate Community 4-27
4.5.1 Pre-Development Baseline 4-28
4.5.2 Study Design and Objectives 4-28
4.5.3 Impact Predictions 4-29
4.5.4 Operational Monitoring 4-29
4.5.4.1 Field and Laboratory Methods 4-29
4.5.4.2 Data Analysis 4-30
4.5.4.3 Results 4-38
4.5.5 Monitoring Adjustments and Supplementary Studies Recommendations 4-50
4.5.6 Summary and Conclusions 4-50
4.6 Fish 4-52
4.6.1 Fish Community and Habitat 4-52
4.6.1.1 Pre-Development Baseline 4-52
4.6.1.2 Operational Monitoring 4-53
4.6.2 Fish Chemistry 4-54
4.6.2.1 Pre-development Baseline 4-54
4.6.2.2 Study Design and Objectives 4-55

4.6.2.3 Impact Predictions 4-55
4.6.2.4 Sampling Methods 4-56
4.6.2.5 Data Analysis 4-57
4.6.2.6 Results 4-61
4.6.2.7 Monitoring Adjustments and Supplementary Study Recommendations 4-66
4.6.2.8 Summary and Conclusions 4-67
4.6.3 Fish Population 4-68
4.6.3.1 Overview of Recent Studies and Data Gaps 4-68
4.6.3.2 Study Design and Objectives 4-70
4.6.3.3 Field Data Collection Methods 4-71
4.6.3.4 Data Analysis 4-71
4.6.3.5 Results 4-75
4.6.3.6 Monitoring Adjustments Recommendations 4-80
4.6.3.7 Summary and Conclusions 4-81
4.7 Supplementary Studies 4-82
4.7.1 2018-2023 University of Saskatchewan Research on Selenium Trophic Transfer 4-83
4.7.2 2021-2022 Plume Delineation in McClean Lake East Basin 4-83
4.7.3 2021-2023 Fox and Pat Lake Sediment Study 4-83
4.7.4 2023-2024 Sink Upper Compartment Investigation 4-84
4.7.5 2024 Aquatic Surveys at Candy Creek and Caribou Lake 4-84
4.7.6 2024 Aquatic Vegetation Surveys 4-85
4.7.7 2024 Aquatic Vegetation and Sediment Sampling 4-86
4.7.8 2024 S/V TEMS Water Quality Monitoring Optimization 4-87
4.8 Overall Summary and Conclusions 4-88
4.9 References 4-90

5 Terrestrial Environment 5-2
5.1 Introduction 5-2
5.2 Wildlife and Wildlife Habitat 5-2
5.2.1 Impact Predictions 5-3
5.2.2 Land Cover Composition and Disturbance 5-3
5.2.3 Supplementary Studies 5-5
5.2.3.1 2023 Rare Plant Checks 5-5
5.2.3.2 2024 Terrestrial Vegetation Surveys 5-6
5.2.3.3 2024 Semi-Aquatic Furbearers Surveys 5-8
5.2.3.4 2024 Small Mammal Surveys 5-10
5.2.3.5 2024 Great Blue Heron and Pileated Woodpecker Habitat Assessment 5-13
5.2.3.6 2024 Environmental DNA surveys for Northern Leopard Frog 5-14
5.2.3.7 2024 Wildlife Camera Surveys 5-15
5.2.3.8 2023-2024 University of Saskatchewan Bat Collaborative Research 5-16
5.2.3.9 2024 University of Saskatchewan Large Mammal Collaborative Research 5-20

5.2.4 2024 Wildlife Supplementary Observations....5-21
5.2.5 Summary and Conclusions....5-21
5.3 Species at Risk....5-21
5.3.1 Plants....5-21
5.3.1.1 Methods....5-21
5.3.1.2 Results....5-22
5.3.2 Wildlife....5-22
5.3.2.1 Methods....5-22
5.3.2.2 Results....5-23
5.4 Overall Summary and Conclusions....5-24
5.5 References....5-25

6 Culture....6-1

6.1 Introduction....6-1
6.2 Culture History....6-1
6.2.1 Precontact Period in the Regional Study Area....6-2
6.2.2 Historic Period....6-3
6.2.2.1 Fur Trade....6-3
6.2.2.2 Adhesion to Treaties 10 and 8....6-3
6.2.2.3 Mining and Prospecting....6-4
6.2.3 Summary....6-4
6.3 Heritage Assessment....6-4
6.3.1 Introduction....6-4
6.3.2 Methods....6-5
6.3.3 Results....6-6
6.3.3.1 Local Assessment Boundary....6-6
6.3.3.2 McClean Lake Operation Surface Lease Area....6-7
6.3.3.3 Midwest Project Surface Lease Area....6-8
6.3.4 Summary....6-9
6.4 Ethnohistory, Land Use, and Traditional Knowledge....6-9
6.4.1 Introduction....6-9
6.4.2 Background....6-10
6.4.3 Traditional Activities in the Regional Study Area....6-11
6.4.3.1 Seasonal Round....6-12
6.4.3.2 Hunting....6-13
6.4.3.3 Trapping....6-15
6.4.3.4 Fishing....6-15
6.4.3.5 Plant Gathering....6-16
6.4.3.6 Traditional Land Use and Occupancy Research....6-16
6.4.4 McClean Lake Operation and Midwest Project Surface Lease Areas....6-17
6.4.5 Regional Monitoring Programs....6-18

6.4.6 Summary....6-19
6.5 Summary and Conclusions....6-19
6.6 References....6-21
7 Waste and Substance Data Analysis....7-1
7.1 Introduction....7-1
7.2 Waste Management....7-1
7.2.1 Waste Rock....7-1
7.2.2 Tailings....7-2
7.2.3 Treated Effluent....7-3
7.2.4 Domestic Waste....7-6
7.2.5 Industrial Waste....7-7
7.2.6 Chemically or Radiologically Contaminated Waste....7-7
7.2.7 Waste Dangerous Goods....7-7
7.2.8 Hydrocarbon Landfarm....7-8
7.2.9 Recycled Materials....7-8
7.2.10 Sewage....7-8
7.2.11 Segregation Procedures....7-9
7.2.12 Waste Management Program Enhancements and Modifications....7-9
7.3 Summary....7-9
7.4 References....7-11
8 Conclusions....8-1
Executive Summary....xxxv

List of Tables

Table 1.2-1	McClean Lake Operation – Environmental Assessment History
Table 1.2-2	Licences Issued by the Canadian Nuclear Safety Commission (CNSC), and its Predecessor, the Atomic Energy Control Board (AECB)
Table 1.3-1	Key Events That Have Occurred at the McClean Lake Operation Since 1995
Table 1.3-2	2022-2024 Mill Operation Data
Table 1.3-3	Water Flow Volumes at the McClean Lake Operation from 2022 to 2024
Table 1.6-1	Concordance of 2025 Environmental Performance Technical Information Document to Environmental Performance Report Guideline (EPB 453, 2013)
Table 2.2-1	Hydrostratigraphic Units
Table 2.2-2	Summary of Hydraulic Conductivity Testing for the Local Assessment Boundary
Table 2.2-3	Groundwater Monitoring Locations at the JEB Site
Table 2.2-4	Groundwater Monitoring Locations at the Sue Site
Table 2.2-5	Groundwater Monitoring Locations at the Moffat Domestic Landfill
Table 2.2-6	Groundwater Monitoring Locations at Sink Dam
Table 2.2-7	Groundwater Monitoring Locations at the McClean Mining (former SABRE Test) Site
Table 2.2-8	Performance Criteria for Groundwater Level Measurements with and without Problematic Wells
Table 2.2-9	Performance Criteria for Groundwater Quality Monitoring with and without Poor Performing wells
Table 2.2-10	Comparison of Mean Reference Groundwater Data at the McClean Lake Operation to Saskatchewan Environmental Quality Guidelines
Table 2.2-11	COPC Selection Screening results for Groundwater at the JEB Site for 2022 to 2024
Table 2.2-12	COPC Selection Screening results for Groundwater at the Sue Site for 2022 to 2024
Table 2.2-13	COPC Selection Screening results for Groundwater at the Moffat Site for 2022 to 2024
Table 2.2-14	COPC Selection Screening results for Groundwater at the McClean Mining (former SABRE Test) Site for 2022 to 2024
Table 2.2-15	Summary Statistics for Background Monitoring Locations at the McClean Lake Operation
Table 2.2-16	JEB Site Groundwater Levels - Pre-Development (1995) and Current Operations
Table 2.2-17	Summary Statistics for JEB Site Baseline Groundwater Chemistry

Table 2.2-18 Summary of Mean Groundwater Chemistry data for 2022 to 2024 and Statistical Trend Analysis results for 2011-2024 at JEB Mill and Ore Pad Wells

Table 2.2-19 Summary of Mean Groundwater Chemistry data for 2022 to 2024 and Statistical Trend Analysis for 2011-2024 at JEB TMF Area Wells

Table 2.2-20 Summary of Mean Groundwater Chemistry data for 2022 to 2024 and Statistical Trend Analysis for 2011-2024 at JEB Clean Waste Rock and Landfill Wells

Table 2.2-21 Sue Site Groundwater Levels - Pre-Development (1997) and Current Operations

Table 2.2-22 Summary Statistics for Sue Baseline Monitoring

Table 2.2-23 Summary of Mean Groundwater Chemistry data for 2022 to 2024 and Statistical Trend Analysis for 2011-2024 at the Sue Site

Table 2.2-24 Moffat Domestic Landfill Groundwater Levels - Pre-Development and Current Operations

Table 2.2-25 Summary of Mean Groundwater Chemistry data and Statistical Trend Analysis for 2011-2024 at Moffat Domestic Landfill

Table 2.2-26 Summary of Baseline Groundwater Chemistry for the McClean Mining (former SABRE Test) Site

Table 2.2-27 Summary of Mean Value for Reporting Period and Statistical Trend Analysis for 2011-2024 for the McClean Mining (former SABRE Test) Site

Table 2.3-1 Annual Mean and Extreme Lake Elevation Values for Lakes in the McClean Lake Operation LSA (1995 to 2024)

Table 2.3-2 Performance Criteria for Surface Water Hydrology Measurements - Data Availability in 2022 - 2024

Table 2.3-3 Mean and standard deviation of the Collins Creek rating curves' residuals

Table 2.3-4 Annual Inputs to Collins Creek (2011 to 2024)

Table 2.3-5 Monthly and Annual Mean Flow (m^3/s) at Sink Reservoir Outflow, Station CM03 (1999 to 2024)

Table 2.3-6 Monthly and Annual Mean Flow (m^3/s) at Vulture Lake Outflow, Station CM04 (1997 to 2024)

Table 2.3-7 Estimated Monthly and Annual Mean Discharge and Extreme Values for Collins Creek Below McClean Lake (SG08E), (1979 to 2024)

Table 3.1-1 Temperature Values, McClean Lake, Saskatchewan, 2000 to 2021

Table 3.1-2 Temperature Values, McClean Lake, Saskatchewan, 2022 to 2024

Table 3.1-3 Temperature Values, Collins Bay, Saskatchewan, 2022 to 2024

Table 3.1-4 Temperature Normals, Key Lake, Saskatchewan, 1991 to 2020

Table 3.1-5 Precipitation Values, McClean Lake, Saskatchewan, 2000 to 2021

Table 3.1-6 Precipitation Values, McClean Lake, Saskatchewan, 2022 to 2024

Table 3.1-7 Precipitation Values, Collins Bay, Saskatchewan, 2022 to 2024

Table 3.1-8 Precipitation Normals, Key Lake, Saskatchewan, 1991 to 2020

Table 3.2-1 Air Quality Monitoring Stations at the McClean Lake Operation

Table 3.2-2 Predicted Concentrations of Select Ambient Air Quality Parameters in the McClean Lake Operation LSA

Table 3.2-3 COPC Selection Screening Results for 2022 to 2024

Table 3.2-4 Total Suspended Particulate (TSP) Concentrations at Reference and Exposure Monitoring Stations at the McClean Lake Operation, 2022 to 2024

Table 3.2-5 Metal and Radionuclide Concentrations at Reference and Exposure Monitoring Stations at the McClean Lake Operation, 2022 to 2024

Table 3.2-6 Average Metal and Radionuclide Concentrations at the McClean Lake Operation, 2022 to 2024 Compared to Historical Data and ERA Predictions

Table 3.2-7 Special Projects Comparison of Total Suspended Particulate (TSP) Concentrations from New and Old HVAS Units

Table 3.2-8 Baseline Ambient Radon Concentrations at Reference and Exposure Areas for the McClean Lake Operation, 1988 to1990

Table 3.2-9 Radon Concentrations at Reference and Exposure Stations at the McClean Lake Operation, 2022 to 2024

Table 3.2-10 Monthly Acid Precipitation Monitoring at the McClean Lake Operation Meteorological Station, AR02, 2022 to 2024

Table 3.2-11 Summary of the Ambient Hourly SO_2 Concentrations (ppb) at the McClean Lake Operation, 2000 to 2024

Table 4.3-1 A History of Baseline Surface Water Quality Sampling Programs

Table 4.3-2 Summary of Baseline Surface Water Limnology from 1993 to 1995

Table 4.3-3 Summary of Baseline Surface Water Major Ion Concentrations from 1993 to 1995

Table 4.3-4 Summary of Baseline Surface Water Nutrient Concentrations from 1993 to 1995

Table 4.3-5 Summary of Baseline Surface Water Metals Concentrations from 1993 to 1995

Table 4.3-6 Summary of Baseline Surface Water Radionuclide Concentrations from 1993 to 1995

Table 4.3-7 Waterbodies Sampled in the McClean Lake Operation LSA for the Water Quality Monitoring Program

Table 4.3-8 Predicted Maximum Mean and 95th Percentile Water Quality Concentrations of Modelled Constituents

Table 4.3-9 Environmental Quality Guidelines for Surface Water COPCs

Table 4.3-10 COPC Selection Screening Results for the 2022 to 2024 EP TID Period

Table 4.3-11 Time Periods for Surface Water Data Analysis

Table 4.3-12 Summary of Water Chemistry Data from Primary Exposure Areas within the McClean Lake Operation LSA, January 2022 to December 2024

Table 4.3-13 Statistical Analysis and Benchmark Comparison Results for the Primary Exposure Areas at the McClean Operation, Time Period 1, 2015 to 2024

Table 4.3-14 Statistical Analysis and Benchmark Comparison Results for the Primary Exposure Areas at the McClean Operation, Time Period 2, 2000 to 2024

Table 4.3-15 Summary of Water Chemistry Data from Secondary Exposure and Reference Areas within the McClean Lake Operation LSA, January 2022 to December 2024

Table 4.3-16 Statistical Analysis and Benchmark Comparison Results for the JEB Secondary Exposure Areas at the McClean Operation, Time Period 1, 2000 to 2024

Table 4.3-17 Statistical Analysis and Benchmark Comparison Results for the JEB Secondary Exposure Areas at the McClean Operation, Time Period 2, 1996 to 2024

Table 4.3-18 Statistical Analysis and Benchmark Comparison Results for the Sue Secondary Exposure Areas at the McClean Operation, Time Period 1, 2009 to 2024

Table 4.3-19 Statistical Analysis and Benchmark Comparison Results for the Sue Secondary Exposure Areas at the McClean Operation, Time Period 2, 1998 to 2024

Table 4.3-20 Statistical Analysis and Benchmark Comparison Results for the Reference Areas at the McClean Operation, Time Period 1, 2015 to 2024

Table 4.3-21 Statistical Analysis and Benchmark Comparison Results for the Reference Areas at the McClean Operation, Time Period 2, 1996 to 2024

Table 4.4-1 Sediment Quality Criteria

Table 4.4-2 Summary of Baseline Sediment Chemistry in the McClean Lake Operation LSA - Major Ions

Table 4.4-3 Summary of Baseline Sediment Chemistry in the McClean Lake Operation LSA – Nutrients

Table 4.4-4 Summary of Baseline Sediment Chemistry in the McClean Lake Operation LSA – Metals

Table 4.4-5 Summary of Baseline Sediment Chemistry in the McClean Lake Operation LSA – Radionuclides

Table 4.4-6 Predicted Maximum Mean and 95th Percentile Concentrations of Select Parameters in the Sediment of Sink, Vulture, McClean, and Kewen Lakes

Table 4.4-7 Sediment Sampling Areas for the McClean Lake Operation EMP, 1999 to 2024

Table 4.4-8 Identification of COPC in Sediment from the Primary Exposure Area in the McClean Lake Operation LSA

Table 4.4-9 Summary of Sediment Chemistry from Lake Depositional Sampling Areas in the McClean Lake Operation LSA, February/March 2024

Table 4.4-10 Summary of Sediment Particle Size from Lake Depositional Sampling Areas in the McClean Lake Operation LSA, February/March 2024

Table 4.5-1 Benthos Sampling Design for Primary Exposure Area

Table 4.5-2 Relative Abundances of Benthic Macroinvertebrates in the Four Reference Lakes

Table 4.5-3 Relative Abundances of Benthic Macroinvertebrates in the Four Exposure Lakes

Table 4.5-4 Percent Composition of Major Taxa in the Riverine Erosional Benthic Invertebrate Samples from Collins Creek

Table 4.5-5 Results of ANOVA Testing for Significant Variations in Indices of Benthic Community Composition of Lake Depositional Areas

Table 4.5-6 Relative Abundances, Density, and Taxon Richness of Benthic Macroinvertebrates in Fox Lake

Table 4.5-7 Analysis of Variance Testing for Variations in Indices of Composition Between Reference and Exposure Riverine Erosional Benthic Invertebrate Samples from Collins Creek

Table 4.5-8 Percent Composition of Major Taxa in the Riverine Depositional Benthic Invertebrate Samples Collected from Collins Creek

Table 4.5-9 Summary of Riverine Depositional Benthic Invertebrate Biotic Indices Calculated at the Lowest Practical Level of Taxonomic Identification

Table 4.5-10 Analysis of Variance Testing for Variations in Indices Composition (at Lowest Practical Level) Between Reference and Exposure Riverine Depositional Benthic Invertebrate Samples from Collins Creek, 2022

Table 4.5-11 Analysis of Variance Testing for Variations in Indices Composition (at Lowest Practical Level) Between Reference and Exposure Riverine Depositional Benthic Invertebrate Samples from Collins Creek, 2008, 2013, 2016, 2019, and 2022

Table 4.5-12 Results of the Mantel Test for Spatial and Temporal Differences in the Bray-Curtis Index (at the Lowest Practical Level) from the Riverine Depositional Area of Collins Creek

Table 4.6-1 Fish Species Identified During Baseline and Operational Period Fish Surveys in the McClean Lake Operation LSA and Associated Reference Areas

Table 4.6-2 Catch per Unit Effort of Short-length Gill Netting in the operational Monitoring Period at the McClean Lake LSA and Associated Reference Areas

Table 4.6-3 Catch per Unit Effort of Half Standard Gang Gill Netting in the operational Monitoring Period at the McClean Lake LSA and Associated Reference Areas

Table 4.6-4 Catch per Unit Effort Electrofishing in Collins Creek and Associated Reference Areas during the operational Monitoring Period

Table 4.6-5 Summary of Baseline Fish Tissue Metal Concentrations from the 1994 Surveys, McClean Lake Operation

Table 4.6-6 Summary of Baseline Fish Tissue Radionuclide Levels from the 1994 Surveys, McClean Lake Operation

Table 4.6-7 Predicted Maximum Mean and 95th Percentile Concentrations of Select Parameters in Fish Flesh from the 2016 ERA

Table 4.6-8 Predicted Maximum Mean and 95th Percentile Selenium Concentrations in Fish Tissue, 2018 ERA

Table 4.6-9 COPC screening in Fish Tissue from the Primary Exposure Area in the McClean Lake Operation LSA

Table 4.6-10 Correlations of Individual Analytes with Principal Component Axis Scores, Fish Tissues, All Lakes

Table 4.6-11 Aluminum Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-12 Antimony Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-13 Arsenic Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-14 Barium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-15 Beryllium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-16 Cadmium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-17 Chromium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-18 Cobalt Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-19 Copper Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-20 Lead Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-21 Iron Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-22 Manganese Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-23 Molybdenum Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-24 Nickel Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-25 Selenium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-26 Silver Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-27 Strontium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-28 Thallium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-29 Titanium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-30 Uranium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-31 Vanadium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024

Table 4.6-32 Summary of McClean Lake Operation Fish Tissue Muscle, Whole-body, and Egg/Ovary Selenium Levels

Table 4.6-33 Summary of McClean Lake Operation EMP Northern Pike and White Sucker Converted Selenium in Muscle to Selenium in Ovary Data for Comparison to Ovary Tissue Guidelines

Table 4.6-34 Statistical Analyses Used to Test for Effects on EEM Endpoints

Table 4.6-35 Summary Statistics of YOY and Non-YOY Burbot from the Reference Area and Exposure Area of Collins Creek, October 2022

Table 4.6-36 Results of Various Analyses Testing for Differences in Body Size and Condition of YOY and Non-YOY Burbot Collected in the Reference and Exposure Areas of Collins Creek, October 2022

Table 4.6-37 Results of Various Analyses Testing for Differences in Body Size and Condition of Non-YOY Burbot Among years (2008, 2013, 2016, and 2022) Collected in the Reference and Exposure Areas of Collins Creek, October 2022

Table 4.6-38 Summary Statistics of YOY and Non-YOY Slimy Sculpin in Reference Area and Exposure Area in Collins Creek, October 2022

Table 4.6-39 Results of Various Analyses Testing for Differences in Body Size and Condition of YOY and Non-YOY Slimy Sculpin Collected in the Reference and Exposure Areas of Collins Creek, October 2022

Table 4.6-40 Results of Various Analyses Testing for Differences in Body Size and Condition of Slimy Sculpin among years (2002, 2005, 2008, 2013, 2016, and 2022) Collected in the Reference and Exposure Areas of Collins Creek, October 2022

Table 4.7-1 Sediment Chemistry Data from the 2024 McClean Lake Aquatic Vegetation Sampling Program

Table 4.7-2 Pond Lily Root Chemistry Data from the 2024 McClean Lake Aquatic Vegetation Sampling Program

Table 4.7-3 Pond Lily Shoot Chemistry Data from the 2024 McClean Lake Aquatic Vegetation Sampling Program

Table 4.7-4 Comparison of Mean Sediment Chemistry Data from the 2008 and 2024 Sampling

Table 4.7-5 Comparison of Mean Pond Lily Root Chemistry Data from 2008 and 2024 Sampling Programs

Table 4.7-6 Comparison of Mean Pond Lily Shoot Chemistry Data from 2008 and 2024 Sampling Programs

Table 5.2-1 Summary of Wildlife and Wildlife Habitat Surveys

Table 5.2-2 Ecosites Within the McClean Lake Operation Local Assessment Boundary

Table 5.2-3 Revegetation Activities at the Sue C Clean Waste Rock Pile at the McClean Lake Operation, 2022-2023

Table 5.2-4 Rare Plant Population Status Within the McClean Lake and Midwest Local Study Areas, June and August 2023

Table 5.2-5 2024 Vegetation Survey Transects and Plots per Ecosite Type and Areas of Specific Interests

Table 5.2-6 Vascular Plant, Bryophyte, Lichen and Fungi Species Detected During 2024 Terrestrial Vegetation Surveys

Table 5.2-7 Rare Species Detected During the 2024 Terrestrial Vegetation Surveys

Table 5.2-8 Non-native Plant Species Detected During the 2024 Terrestrial Vegetation Surveys

Table 5.2-9 Shoreline Survey Locations, Survey Dates, and Shoreline Length for Each Semi-Aquatic Furbearer Survey Area, August 2024

Table 5.2-10 Shoreline Survey Observations by Semi-Aquatic Furbearer Survey Area and Species, August 2024

Table 5.2-11 Relative Abundance of Small Mammals Captured for Population Surveys Across McClean Lake and Midwest LSAs, August 2024

Table 5.2-12 Relative Abundance of Small Mammals Captured in the Study Area by Species and Habitat Category, August 2024

Table 5.2-13 Number of Captures of Small Mammal Species per 100 Trap Nights at McClean Lake and Midwest Local Study Areas, 2024

Table 5.2-14 Metal and Radionuclide Concentrations in Gapper's Red-backed Voles Trapped at Exposure and Reference Areas, August 2024

Table 5.2-15 Recorded Bat Activity at McClean Lake Operation, 2023-2024

Table 5.3-1 Potential Rare Plants, Bryophytes and Lichens of the Regional Assessment Boundary and those Documented within the Local Assessment Boundary

Table 5.3-2 Rare Vascular Plants, Bryophyte and Lichen Sightings in the Local Assessment Boundary

Table 5.3-3 Wildlife Species that have been Observed Within the McClean Lake Area and Species that Potentially Occur in the Region

Table 6.2-1 Archaeological Cultures of Northern Saskatchewan

Table 6.2-2 Fur Trade Posts in the Regional Study Area

Table 6.3-1 Archaeological Resource Investigation Permits Issued for the Local Assessment Boundary

Table 6.3-2 Previously Recorded Heritage Resources in the Local Assessment Boundary

Table 6.4-1 Land Uses in the Vicinity of the McClean Lake Operation

Table 6.4-2 Value of Saskatchewan Fur Harvest 2004-2005 to 2020-2021

Table 6.4-3 Saskatchewan Trapper Licence Sales 2004-2005 to 2020-2021

Table 6.4-4 Northern Fur Conservation Area – N26 Wollaston Harvest and Cash Values 2004-2005 to 2019-2020
Table 6.4-5 Commercial Fishing Quotas, by Waterbody
Table 6.4-6 Commercial Fishing Licences for Wollaston Lake
Table 6.4-7 Wollaston Lake Commercial Fishing Data 2004 to 2024
Table 7.2-1 Current Waste Rock Inventory
Table 7.2-2 Tailings Discharged to JEB TMF in 2022-2024
Table 7.2-3 Summary of Waste Materials Generated and Shipped Off Site in 2022-2024
Table 7.2-4 JEB WTP Effluent Quality in 2022-2024
Table 7.2-5 Sue WTP Effluent Quality in 2022-2024
Table 7.2-6 Water Treatment Plant Discharge in 2022-2024
Table 7.2-7 Mass Loadings to S/V TEMS for 2022-2024
Table 7.2-8 Acute Lethality Toxicity Testing Results from the McClean Lake Operation, 2022-2024
Table 7.2-9 Sub-lethal Toxicity Testing Results on the JEB Treated Effluen from the McClean Lake Operation, 2022
Table 7.2-10 Sub-lethal Toxicity Testing Results on the JEB Treated Effluen from the McClean Lake Operation, 2023
Table 7.2-11 Sub-lethal Toxicity Testing Results on the JEB Treated Effluen from the McClean Lake Operation, 2024
Table 7.2-12 Hydrocarbon Soil Remediation Analytical Data

List of Figures

Figure 1.1-1 Project Location – Map of Saskatchewan

Figure 1.1-2 Location of McClean Lake Operation and Midwest Site

Figure 1.1-3 McClean Lake Operation Site

Figure 1.1-4 Midwest Site

Figure 1.3-1 Simplified JEB Site Water Balance

Figure 1.3-2 Simplified Sue Site Water Balance

Figure 1.5-1 Sustainable Development Framework

Figure 1.6-1 Diagram of Linkages Among Valued Ecosystem Components and Monitoring Endpoints.

Figure 1.6-2 Regional Study Area of the McClean Lake Operation

Figure 1.6-3 McClean Lake Operation Local Study Area, Midwest Project Local Study Area, and Local Assessment Boundary

Figure 2.2-1 McClean Lake Operation Groundwater Monitoring Sites

Figure 2.2-2 Sandstone Isopach

Figure 2.2-3 Conceptual Site Model of McClean Lake Operational Flows During the Operational Period

Figure 2.2-4 JEB Site Groundwater Monitoring Locations

Figure 2.2-5 Sue Site Groundwater Monitoring Locations

Figure 2.2-6 Moffat Domestic Landfill Groundwater Monitoring Locations

Figure 2.2-7 Sink Dam Groundwater Monitoring Locations

Figure 2.2-8 McClean Mining Site (SABRE) Groundwater Monitoring Locations

Figure 2.2-9 Jeb Area Hydraulic Head in Sandstone for Dewatered Pit

Figure 2.2-10 Jeb Site Hydraulic Head Cross Section A-A' - 2024

Figure 2.2-11 Water Levels in the Overburden, Athabasca Sandstone, and Basement units relative to baseline

Figure 2.2-12 Upward Groundwater Flow Trends in JEB Monitoring Wells

Figure 2.2-13 JEB Site Pre-Development Potentiometric and 2024 Hydraulic Head Contours Map for Basement

Figure 2.2-14 Pre-Development Potentiometric Map for JEB Site Sandstone

Figure 2.2-15 JEB Site Upper Sandstone Hydraulic Head Contours - 2024

Figure 2.2-16 JEB Site Lower Sandstone Hydraulic Head Contours - 2024

Figure 2.2-17 JEB Site Pre-Development Potentiometric and 2024 Hydraulic Head Contours Map for Overburden

Figure 2.2-18 Downward Groundwater Flow Trend in JEB Overburden Monitoring Wells with Daily Precipitation

Figure 2.2-19 Hydrograph for Multi-Level Monitoring Well 96-03 and 96-07A

Figure 2.2-20 Groundwater directional flow from Mill terrace and Ore pad towards Johannes and Pat Lakes

Figure 2.2-21 Sue Site Pre-Development Potentiometric Surface Map for Sandstone

Figure 2.2-22 Sue Site Hydraulic Head Cross Section B-B' - 2024

Figure 2.2-23 Downward Groundwater Flow Trend in Sue Monitoring Wells

Figure 2.2-24 Sue Site Basement Hydraulic Head Contours - 2024

Figure 2.2-25 Sue Site Lower Sandstone Hydraulic Head Contours - 2024

Figure 2.2-26 Sue Site Overburden Hydraulic Head Contours - 2024

Figure 2.2-27 Sink Dam Groundwater Levels

Figure 2.2-28 McClean Mining (former SABRE Test) Site Groundwater Levels

Figure 2.3-1 Hydrological Monitoring Stations at McClean Lake Operation

Figure 2.3-2 Maximum water level difference from SG08E to SG09E

Figure 2.3-3 Standard Precipitation Index (SPI) at McClean Lake Operation

Figure 2.3-4 Average Annual Water Elevation - top) Mallen Lake (SG01C) and bottom) Fox Lake (SG02E) 1995 to 2024

Figure 2.3-5 Average Annual Water Elevation - top) Pat Lake (SG03E) and bottom) Sue Lake (SG04E) 1995 to 2024

Figure 2.3-6 Average Annual Water Elevation - top) Johannes Lake (SG05E) and bottom) Sink Reservoir (SG06E) 1995 to 2024

Figure 2.3-7 Average Annual Water Elevation - top) Vulture Lake (SG07E) and bottom) McClean Lake (SG09E) 1995 to 2024

Figure 2.3-8 Average Annual Water Elevation - top) Candy Lake (SG10E) and bottom) Isis Lake (SG11E) 1995 to 2024

Figure 2.3-9 Average Annual Water Elevation - top) Osiris Lake (SG12E) and bottom) Tail Lake (SG13E) 1995 to 2024

Figure 2.3-10 Average Annual Water Elevation - top) Moffat Lake (SG14E) and bottom) Tut Lake (SG15E) 1995 to 2024

Figure 2.3-11 Average Annual Water Elevation - top) Esto Lake (SG16E) and bottom) Kewen Lake (SG17E) 1995 to 2024

Figure 2.3-12 Average Annual Water Elevation - top) Sils Lake (SG18E) and bottom) Indigo Lake (SG19C) 1995 to 2024

Figure 2.3-13 Average Annual Water Elevation - top) Bena Lake (SG20E) and bottom) Sharp Lake (SG21E) 1995 to 2024

Figure 2.3-14 Average Annual Water Elevation - top) Telephone Lake (SG22E) 1995 to 2024

Figure 3.1-1 Meteorological Stations within the McClean Lake Operation LSA

Figure 3.1-2 2016 ERA CALMET Wind Rose

Figure 3.1-3 Mean Daily Temperature at McClean Lake Compared to Collins Bay and Key Lake Climate Normals

Figure 3.1-4 Mean Monthly Total Precipitation at McClean Lake Compared to Collins Bay and Key Lake Climate Normals

Figure 3.1-5 Wind Rose at McClean Lake, 2000 to 2010

Figure 3.1-6 Wind Rose at McClean Lake, 2011 to 2015

Figure 3.1-7 Wind Rose for McClean Lake (2016 to 2021 and 2022 to 2024) Compared to Collins Bay (2022 to 2024)

Figure 3.2-1 High Volume Air Sampling Stations Within the McClean Lake Operation LSA

Figure 3.2-2 Measured 24-hour TSP Concentrations at the JEB TMF (HVJ1A), 2022 to 2024

Figure 3.2-3 Measured 24-hour TSP Concentrations at the Mill Site (HVJ2), 2022 to 2024

Figure 3.2-4 Measured 24-hour TSP Concentrations at the JEB Camp (HVJ3), 2022 to 2024

Figure 3.2-5 Measured 24-hour TSP Concentrations at the Sue C Pit (HVS1A), 2022 to 2024

Figure 3.2-6 Measured 24-hour TSP Concentrations at Vulture Lake (HVJ4), 2022 to 2024

Figure 3.2-7 Seasonal Average TSP Concentrations at the JEB TMF (HVJ1A), 2022 to 2024

Figure 3.2-8 Seasonal Average TSP Concentrations at the Mill Site (HVJ2), 2022 to 2024

Figure 3.2-9 Seasonal Average TSP Concentrations at the JEB Camp (HVJ3), 2022 to 2024

Figure 3.2-10 Seasonal Average TSP Concentrations at the Sue C Pit (HVS1A), 2022 to 2024

Figure 3.2-11 Seasonal Average TSP Concentrations at Vulture Lake (HVJ4), 2022 to 2024

Figure 3.2-12 Annual Geomean TSP Concentrations at the JEB Exposure Stations, 2000 to 2024

Figure 3.2-13 Annual Geomean TSP Concentrations at the JEB Camp, 2000 to 2024

Figure 3.2-14 Annual Geomean TSP Concentrations at the Sue C Pit, 2000 to 2024

Figure 3.2-15 Measured Annual Average Arsenic Concentrations, 2000 to 2024

Figure 3.2-16 Measured Annual Average Cadmium Concentrations, 2000 to 2024

Figure 3.2-17 Measured Annual Average Cobalt Concentrations, 2000 to 2024

Figure 3.2-18 Measured Annual Average Copper Concentrations, 2000 to 2024

Figure 3.2-19 Measured Annual Average Lead Concentrations, 2000 to 2024

Figure 3.2-20 Measured Annual Average Molybdenum Concentrations, 2000 to 2024

Figure 3.2-21 Measured Annual Average Nickel Concentrations, 2000 to 2024

Figure 3.2-22 Measured Annual Average Selenium Concentrations, 2000 to 2024

Figure 3.2-23 Measured Annual Average Uranium Concentrations, 2000 to 2024

Figure 3.2-24 Measured Annual Average Vanadium Concentrations, 2000 to 2024

Figure 3.2-25 Measured Annual Average Zinc Concentrations, 2000 to 2024

Figure 3.2-26 Measured Annual Average Lead-210 Concentrations, 2000 to 2024

Figure 3.2-27 Measured Annual Average Polonium-210 Concentrations, 2000 to 2024

Figure 3.2-28 Measured Annual Average Radium-226 Concentrations, 2000 to 2024

Figure 3.2-29 Measured Annual Average Thorium-230 Concentrations, 2000 to 2024

Figure 3.2-30 Special Projects Box Plots for Total Suspended Particulate (TSP) Concentrations from New and Old HVAS Units

Figure 3.2-31 Radon Monitoring Stations within the McClean Lake Operation LSA

Figure 3.2-32 Measured Annual Average Radon Concentrations at the JEB Exposure Stations, 2000 to 2024

Figure 3.2-33 Measured Annual Average Radon Concentrations at the McClean Mining Area and Sue Exposure Stations, 2000 to 2024

Figure 3.2-34 Annual Average pH from Acid Precipitation Monitoring at the McClean Lake Operation Meteorological Station, AR02, 2000 to 2024

Figure 3.2-35 Exhaust Stack Emissions and Sulphur Dioxide Stations Within the McClean Lake Operation LSA

Figure 3.2-36 Historical Ambient Annual Average SO_2 Concentrations, 2000 to 2024

Figure 3.2-37 Historical SO_2 Annual Average Emission Rates from the Acid Plant Stack, 2016 to 2024

Figure 4.2-1 The Location of Reference, Primary Exposure, and Secondary Exposure Waterbodies In 2022 To 2024

Figure 4.2-2 Sink and Vulture Treated Effluent Management System Schematic

Figure 4.3-1 Baseline Water Quality Sampling Areas for the McClean Lake Operation

Figure 4.3-2 Location of Surface Water Quality Monitoring Stations in 2022 to 2024

Figure 4.3-3 COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions

Figure 4.3-4 COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines

Figure 4.3-5 COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines

Figure 4.3-6 COPC Levels in the Reference Area Surface Water with Associated Guidelines

Figure 4.4-1 Baseline Sediment Sampling Areas for the McClean Lake Operation

Figure 4.4-2 Benthic Invertebrate and Sediment Sampling Areas

Figure 4.4-3 Mean and Standard Deviation COPC Levels in the Sediment

Figure 4.5-1 Variations in Indices of Benthic Community Composition for Lake Benthos Samples in Sink Reservoir

Figure 4.5-2 Variations in Indices of Benthic Community Composition for Lake Benthos Samples in Vulture Lake

Figure 4.5-3 Variations in Indices of Benthic Community Composition for Lake Benthos Samples in McClean Lake – East

Figure 4.5-4 Variations in Indices of Benthic Community Composition for Lake Benthos Samples in Kewen Lake

Figure 4.5-5 Correspondence Analysis Axis Scores for Lake Benthos Samples at the Four Exposure Lakes (Sink, Vulture, McClean East Basin, and Kewen) and the Reference Lake (McClean West Basin)

Figure 4.5-6 Correspondence Analysis Taxa Scores for Lake Benthos Samples

Figure 4.5-7 Scatterplots of Indices of Benthic Community Composition in Relation to Organic Carbon in Lake Sediments

Figure 4.5-8 Variations in Riverine Erosional Abundance, Richness, Simpson's Diversity, and Evenness in Collins Creek

Figure 4.5-9 Biplot of Riverine Erosional Benthic Invertebrate CA Axis Scores in Collins Creek

Figure 4.5-10 Box Plot and Mean Indices of Benthic Community Composition for Riverine Depositional Benthos Samples from Collins Creek Calculated at the Lowest Practical Level

Figure 4.5-11 Biplot of Riverine Depositional Benthic Invertebrate CA Axis Scores Calculated at the Lowest Practical Level

Figure 4.6-1 Baseline Fish Sampling Areas for the McClean Lake Operation

Figure 4.6-2 Location of Waterbodies Sampled for the Fish Chemistry Program

Figure 4.6-3 Catch per unit effort (CPUE) of Northern Pike for the Fish Chemistry Monitoring Program, 1998 to 2024

Figure 4.6-4 Catch per unit effort (CPUE) of White Sucker for the Fish Chemistry Monitoring Program, 1998 to 2024

Figure 4.6-5 Catch per unit effort (CPUE) of Lake Whitefish for the Fish Chemistry Monitoring Program, 1998 to 2024

Figure 4.6-6 Axes 1 And 2 Samples Scores from Principal Component Analysis (PCA) Carried Out on Fish Tissue Chemistry for Northern Pike (Top Panel) And White Sucker (Lower Panel) From Reference Lakes (Mallen, Henday, Konner), All Years, And Baseline Years, All Lakes

Figure 4.6-7 PCA Scores for Northern Pike Tissue Chemistry from Sink Reservoir

Figure 4.6-8 PCA scores for Northern Pike Tissue Chemistry from Vulture Lake

Figure 4.6-9 PCA Scores for Northern Pike Tissue Chemistry from McClean Lake - East Basin

Figure 4.6-10 PCA Scores for Northern Pike Tissue Chemistry from Kewen Lake

Figure 4.6-11 Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure 4.6-12 PCA Scores for White Sucker Tissue Chemistry from Sink Reservoir

Figure 4.6-13 PCA Scores for White Sucker Tissue Chemistry from Vulture Lake

Figure 4.6-14 PCA Scores for White Sucker Tissue Chemistry from McClean Lake – East Basin

Figure 4.6-15 PCA Scores for White Sucker Tissue Chemistry from Kewen Lake

Figure 4.6-16 Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure 4.6-17 Sampling Locations for the Fish Population Program

Figure 4.6-18 Probability Plots of Slimy Sculpin and Burbot in the Reference and Exposure Areas of Collins Creek, October 2022

Figure 4.6-19 Comparison of Burbot Length-Frequency Histograms Among Years (2008, 2013, 2016, and 2022) in the Reference (left panels) and Exposure (right panels) Areas of Collins Creek with Age Classes Estimated

Figure 4.6-20 Box Plot of Weight and Length for YOY Burbot Collected from the Reference and Exposure Areas of Collins Creek, October 2022

Figure 4.6-21 Box Plot of Weight and Length at age for Non-YOY Burbot Collected from the Reference and Exposure Areas of Collins Creek, October 2022

Figure 4.6-22 Box Plot of Weight and Length for 1+ Burbot Collected from the Reference and Exposure Areas of Collins Creek (October 2008, 2013, 2016, and 2022)

Figure 4.6-23 Variation in Percent Composition of YOY Burbot Collected from the Reference and Exposure Areas of Collins Creek (October 2008, 2013, 2016, and 2022)

Figure 4.6-24 Relationship Between Weight (g) and Length (cm) of YOY and non-YOY Burbot in the Reference and Exposure Areas of Collins Creek, 2022

Figure 4.6-25 Box Plot of Condition Factor for non-YOY Burbot collected from the Reference and Exposure Areas of Collins Creek, 2022

Figure 4.6-26 Probability Plots of Slimy Sculpin in the Reference and Exposure Areas of Collins Creek, October 2022

Figure 4.6-27 Histogram of Slimy Sculpin Length (mm) in the Reference and Exposure Areas of Collins Creek, 2022

Figure 4.6-28 Box Plot of Weight and Length for YOY Slimy Sculpin Collected from the Reference and Exposure Areas of Collins Creek, October 2022

Figure 4.6-29 Box Plot of Weight and Length at age for Non-YOY Slimy Sculpin Collected from the Reference and Exposure Areas of Collins Creek, October 2022

Figure 4.6-30 Box Plot of Body Weight and Total Length Among Years for YOY Slimy Sculpin Collected from the Reference and Exposure Areas of Collins Creek

Figure 4.6-31 Box Plot of Body Weight and Total Length Among Years for 1+ Slimy Sculpin Collected from the Reference and Exposure Areas of Collins Creek

Figure 4.6-32 Variation in Percent Composition of YOY Slimy Sculpin Collected from the Reference and Exposure Areas of Collins Creek (October 2008, 2013, 2016, and 2022)

Figure 4.6-33 Relationship Between Weight (g) and Length (mm) of YOY and non-YOY Slimy Sculpin in the Reference and Exposure Areas of Collins Creek, 2022

Figure 4.6-34 Box Plot of Condition Factor for non-YOY Slimy Sculpin collected from the Reference and Exposure Areas of Collins Creek, 2022

Figure 4.7-1 2024 Aquatic Survey Waterbodies

Figure 4.7-2 2024 Aquatic Vegetation Survey Locations

Figure 4.7-3 Locations of 2024 Aquatic Rare Plants Occurrences at the McClean Lake Operation Area.

Figure 4.7-4 2024 Aquatic Vegetation and Sediment Chemistry Locations

Figure 5.2-1 Ecosite Pattern Within the Local Assessment Boundary

Figure 5.2-2 Revegetated Area of Sue C CWRP

Figure 5.2-3 2023 Rare Plant Checks Surveyed Locations

Figure 5.2-4 2024 Terrestrial Vegetation Survey Locations

Figure 5.2-5 2024 Semi-Aquatic Furbearer Survey Transects

Figure 5.2-6 2024 Semi-Aquatic Furbearer Observations: Collins Creek Upstream

Figure 5.2-7 2024 Semi-Aquatic Furbearer Observations: Konner Lake

Figure 5.2-8 2024 Semi-Aquatic Furbearer Observations: South McMahon Lake, Lake C1 and Lake C2

Figure 5.2-9 2024 Semi-Aquatic Furbearer Observations: McClean Lake East and West Basins

Figure 5.2-10 2024 Semi-Aquatic Furbearer Observations: Candy Creek, Bena Lake and Caribou Lake

Figure 5.2-11 2024 Semi-Aquatic Furbearer Observations: Collins Creek Downstream and Kewen Lake

Figure 5.2-12 2024 Semi-Aquatic Furbearer Observations: Fox Lake

Figure 5.2-13 2024 Semi-Aquatic Furbearer Observations: Sink Reservoir and Vulture Lake

Figure 5.2-14 2024 Small Mammal Population Survey Locations

Figure 5.2-15 2024 Small Mammal Tissue Collection Locations

Figure 5.2-16 2024 Migratory Bird Nests Survey Area

Figure 5.2-17 2024 eDNA Survey Locations for Northern Leopard Frog

Figure 5.2-18 2024 Wildlife Camera Survey Locations

Figure 5.2-19 2023-2024 Bat Activity Survey Locations

Figure 5.2-20 2024 Supplementary Wildlife Observations

Figure 5.3-1 Locations of Provincially Tracked Rare Vascular Plant Species

Figure 5.3-2 Locations of Provincially Tracked Rare Bryophytes and Lichens Species

Figure 6.3-1 Known Heritage Sites Within the Local Assessment Boundary

Figure 6.3-2 Known Areas of Previous Heritage Assessments in the Vicinity of the McClean Lake Operation and Midwest Surface Lease Areas

Figure 6.4-1 Location of Spiritual Places within the Area of Interest

Figure 6.4-2 Location of Subsistence and Commercial Water Use within the Area of Interest

Figure 6.4-3 Location of Large Animal Kill Sites within the Area of Interest

Figure 6.4-4 Location of Other Animal Harvest Sites within the Area of Interest

Figure 6.4-5 Trapping Density within the Area of Interest

Figure 6.4-6 Location of Overnight Sites, Plant, And Earth Material Areas within the Area of Interest

Figure 7.2-1 Waste Management Facilities at JEB Site

Figure 7.2-2 Waste Management Facilities at Sue Site

List of Appendices

Appendix I.2-1	McClean Lake Operation History and Evolution of Environmental Assessment Evolution
Appendix I.2-2	CNSC and SMOE Licences, Approvals and Permits in Effect for McClean Lake Operation During 2022-2024
Appendix I.3	Summary of Discharges, Incidents and Exceedances at McClean Lake Operation – 2022-2024
Appendix I.6	Follow-up on CNSC and SMOE Comments on the 2022 EP TID Volume 1
Appendix II.1	Geology of McClean Lake Operation Area
Appendix II.2	Detailed Groundwater Data
Appendix II.3	Surface Hydrology of McClean Lake Operation Area
Appendix III.2	Detailed COPC Screening for Total Suspended Particulate (TSP) at the McClean Lake Operation
Appendix IV.3	Detailed Surface Water Chemistry Data
Appendix IV.4	Detailed Sediment Chemistry Data
Appendix IV.6	Detailed Fish Data
Appendix IV.7-1	University of Saskatchewan Selenium Trophic Transfer Research Publications
Appendix IV.7-2	Aquatic Vegetation Summary from 2016 EP TID Vol 1
Appendix IV.7-3	Detailed Aquatic Vegetation and Sediment Chemistry Data - 2024
Appendix IV.7-4	Water Quality Data Review at Sink Vulture Treated Effluent Management System Report
Appendix V.1	Vegetation and Soil Chemistry Monitoring from 2022 EP TID Volume 1
Appendix V.2	Wildlife and Wildlife Habitat - Pre-Development Baseline Studies from 2016 EP TID Volume 1
Appendix V.3	Wildlife and Wildlife Habitat - 2010 – 2018 Operational Studies from 2016 EP TID Volume 1 and 2022 EP TID Volume 1
Appendix V.4	Habitat Classification Within the Local Assessment Boundary (LAB)
Appendix V.5	Small Mammal Tissue Chemistry Data Tables, August 2024

Acronyms and Abbreviations

Term	Definition
AAQC	Ambient Air Quality Criteria
ACFN	Athabasca Chipewyan First Nation
AECB	Atomic Energy Control Board
AJES	Athabasca Joint Engagement And Environmental Subcommittee
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
ARU	Autonomous Recording Units
ASTt	Arctic Small Tool Tradition
AWG	Athabasca Working Group
B.P.	Before Present
BAC	Business Advisory Committee
BACI	Before-After-Control-Impact
CA	Correspondence Analysis
CABIN	Canadian Aquatic Biomonitoring Network
CAC	Criteria Air Contaminant
CBEMP	Community Based Environmental Monitoring Program
CEQG	Canadian Environmental Quality Guidelines
CES	Critycal Effect Sizes
CNSC	Canadian Nuclear Safety Comission
COPC	Constituent of Potential Concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPUE	Catch Per Unit Effort
CSA	Canadian Standards Association
CWRP	Clean Waste Rock Pile
CX	Ammonium Sulphate Crystallization
DBH	Diameter at Breast Height
DL	Detection Limit
DWS	Dewatering Well System
EA	Environmental Assesment
EAA	Environmental Assessment Act
EARMP	Eastern Athabasca Regional Monitoring Program
EC	Environment Canada
ECCC	Environment And Climate Change Canada
EcoRA	Ecological Risc Assessment
eDNA	Environmental DNA
EE TID	Existing Environment Technical Information Document

Term	Definition
EEM	Environmental Effects Monitoring
EIS	Environmrntal Impact Statements
EM DD	Environmental Monitoring Detailed Design
EMP	Environmental Monitoring Program
EP TID	Environmental Performance Technical Information Document
EPP	Environmental Protection Plan
ERA	Environmental Risk Assessment
ES	Effect Size
EvC	Evaluation Criteria
FEQG	Federal Environmental Quality Guidelines
GPS	Global Positioning System
HC	Health Canada
HCB	Heritage Conservation Branch
HRIA	Heritage Resource Impact Assessment
HVAS	High Volume Air Samplers
IEC	Independent Environmental Consultants
IEMP	Independent Environmental Monitoring Program
IMA	Impact Management Agreement
IOC	Investigation Of Casue
ITL	Inner Tolerance Limit
JIC	Joint Implementation Committee
LAB	Local Assessment Boundary
LEL	Lowest Effect Level
LOEC	Lowest-Observed-Effect Concentration
LOI	Loss-Of-Ignition
LPL	Lowest Practical Level
LSA	Local Study Area
MBR	Migratory Birds Regulations
MDMER	Metal And Diamond Mining Effluent Regulations
MED	Mining Equipment Development
MK	Mann-Kendall
NCEP	National Centre For Environmental Prediction
NE2	No-Effect Values
NOEC	No-Observed-Effect Concentration
NOx	Nitrogen Oxides
NPRI	National Pollutant Release Inventory
NR	Normal Range
NSEQCs	Northern Saskatchewan Environmental Quality Committees
NSERC	Natural Sciences and Engineering Research Council

Term	Definition
NWC	Northwest Company
PAGC	Prince Albert Grand Council
PCA	Principal Component Analysis
PDP	Preliminary Decommissioning Plan
PEL	Probably Effect Level
PM	Patrticulare Matter
PMP	Probable Maximum Precipitation
PNEC	Predicted Non-Effected Concentration
QA	Quality Assurance
QC	Quality Control
RDL	Reportable Detection Limit
RSA	Regional Study Area
S/V TEMS	Sink/Vulture Treated Effluent Management System
SAAQS	Saskatchewan Ambient Air Quality Standards
SABRE	Surface Access Borehole Resource Extraction
SAR	Species At Risk
SD	Standart Deviation
SDSP	Species Detection Survey Protocol
SEL	Severe Effect Level
SEQG	Saskatchewan Environmental Quality Guidelines
SKCDC	Saskatchewan Conservation Data Centre
SMOE	Saskatchewan Ministry Of Environment
SOCC	Species of Conservation Concern
SQV	Sediment Quality Value
SRC	Saskatchewan Research Council
SSN	Site Of Special Nature
SSWQO	Saskatchewan Surface Water Quality Objective
SUC	Sink Upper Compartment
SX	Solvent Extraction
TAP	Technical Advisory Pannel
TCL	Temporary Contaminated Landfill
TDS	Total Dissolved Solids
TFPW	Trend-Tree Pre-Whitening
TID	Technical Information Document
TLU	Traditional Land Use
TMF	Tailings Management Facility
TOC	Total Organic Carbon
TOVP	Tailings Optimization And Validation Program
TPP	Tailings Preparation Process

Term	Definition
TSP	Total Suspended Particulate
U.S. EPA	United States Environmental Protecting Agency
USask	University Of Saskatchewan
UTM	Universal Transverse Mercator
VC	Valued Component
VEC	Valued Ecosystem Component
VOC	Volatile Organic Compounds
WTP	Water Treatment Plant
YOY	Young-Of-Year
YTN CA	Ya'Thi Néné Collaboration Agreement

Executive Summary

Introduction

Orano Canada Inc. (Orano) is the majority owner and operator of the McClean Lake Operation, a uranium mine and mill located in northern Saskatchewan, Canada. The McClean Lake Operation has a long exploration, environmental assessment (EA), and licensing history. Exploration activities started in the late 1970s, EAs in the early 1990s, and the initiation of mining and mill operations in 1996 and 1999, respectively. Since the initial EA of the McClean Lake Operation, there have been substantial changes in environmental legislation, continued evolution in EA methodology, and advances in environmental effects science. As outlined in this document, to meet the challenges associated with this changing landscape, Orano has adopted a sustainable development framework, which incorporates continual improvement and adaptive management to prevent unreasonable risk to the environment. Within this framework, Valued Components (VCs) provide the underlying assessment basis for the McClean Lake Operation.

Volume 1 of the 2025 Environmental Performance Technical Information Document (EP TID) provides information on the operation's environmental performance in 2022-2024 in line with the provincial Environmental Performance Report Guideline. The 2025 EP TID Volume 1 focuses on the evaluation of operational effects against predicted effects associated with air dispersion and treated effluent discharge. The monitoring data is compared to a set of evaluation criteria which included comparison to quantitative EA impact predictions (where available), to reference and baseline conditions, and to available federal and provincial guidelines. Trend analysis is performed based on baseline and operational monitoring results.

In terms of spatial boundaries used in the EP TID, the upper Collins Creek and Moffatt Creek watersheds define the McClean Lake local study area (LSA). The Midwest Project LSA is defined by the Smith Creek and Nicholson Creek drainage basins. These two LSAs combine to form the local assessment boundary (LAB).

Physical Environment

Baseline studies determined that groundwater flow in the McClean Lake Operation LAB is characteristic of a shallow to intermediate flow according to the three components of the geology: glacial deposits, sandstone, and basement rock. As predicted, mine dewatering at the JEB and Sue sites has resulted in local changes to groundwater levels and flow patterns. At both sites, groundwater levels previously reduced by dewatering activities are recovering as the Sue pits re-flood and the tailings pond elevation increases in the JEB Tailings Management Facility (TMF). Groundwater quality monitoring indicates that hydrodynamic containment continues to be maintained preventing contaminant migration out of the open pits and JEB TMF. To date, groundwater chemistry has not been significantly influenced by mining activities and is generally consistent with baseline data. As intended, the influence of McClean Mining (former SABRE Test) activities on the aquifer is limited and a drawdown state generally occurs during drilling and mining, though some elevated COPC concentration were observed in the downgradient wells.

The McClean Lake Operation is located in the Collins Creek and Moffat Creek drainage basins which are both part of the larger Athabasca Basin. Hydrometric data collected during baseline and operational phases at lakes and streams throughout the McClean Lake Operation LSA show trends that generally reflect the climatic variability of the area. The water level elevation data collected throughout the operational period suggest that the expected dewatering impacts from mining activities were negligible. Impacts to the streamflow in Collins Creek by inputs to Sink Reservoir from the Sue and JEB WTPs and regular water withdrawals from Pat Lake were less than those predicted in the 1991 McClean and 1995 Midwest EAs.

No changes are recommended to groundwater monitoring. The following monitoring program adjustments are suggested for hydrology: (i) additional annual measurements to further validate the Collins Creek stage-discharge relationship and (ii) improve water level measurement methodology.

The following supplementary studies have been recommended to address identified data gaps and uncertainty in groundwater and hydrology results: (i) further investigation of poor performing monitoring wells; (ii) groundwater modelling of contaminant transport around the mill terrace area ; (iii) complete ecological risk assessment for McClean Mining; (iv) align next update of the stage-discharge relationship for Collins Creek with the ECCC guideline.

Climate and Air Quality

The McClean Lake Operation is located in the continental sub-arctic region of northern Saskatchewan, west of Wollaston Lake. The climate is characterized by short, cool summers with mean maximum temperatures of 22.5^{o}C in the warmest month and a frost-free period of less than 90 days. Snow cover lasts more than half the year. The on-site meteorological record is generally consistent with the long-term climatic record documented at the Key Lake weather station, and the 2022 to 2024 data recorded at the nearby Collins Bay weather station, both operated by Environment and Climate Change Canada (ECCC) and aligns with the original description of baseline conditions. Temperature and annual precipitation amounts recorded at site between 2022 and 2024 were comparable to regional and historical levels. Surface wind directions were predominantly from the west and west-northwest in the 2022-2024 reporting period, which is consistent with the 2016-2021 period, but differed from the 2000 to 2015 period when winds mostly blew from the northwest. The difference was attributed to the meteorological station moving locations in October 2014, where different geographical conditions or nearby infrastructure may have affected the historical wind distribution. The 2022 to 2024 wind data is consistent with Collins Bay observations for the same period, indicating that the current wind distribution data is accurate.

During operations, the annual geometric mean total suspended particulate (TSP) concentrations at exposure monitoring stations were well below annual Saskatchewan Ambient Air Quality Standards (SAAQS), with a few exceedances of the 24-hour SAAQS during the current period. Annual TSP concentrations were also below historical levels and the 2016 ERA predictions in all stations except for one station at JEB site, where the most recent ERA predictions was exceeded. The observed increased TSP levels were attributed to forest fire smoke. Concentrations of adsorbed metals and radionuclides in TSP were well within the applicable regulatory criteria and the 2016 ERA predictions, except for copper and molybdenum, which exceeded the ERA predictions, but stayed well below the guidelines. The radon monitoring program demonstrated that radon levels were elevated near sources of emissions, but the measured levels rapidly decreased to be

consistent with background levels within a short distance and that only a few monitoring stations measured values that exceeded the 2016 ERA predictions.

There were no exceedances of SAAQS hourly, 24-hour and annual SO_2 concentrations during the 2022 to 2024 period. Observed historical exceedances were largely due to inefficient conversion of SO_3 causing elevated SO_2 emissions from the start-up of the Sulphuric Acid Plant after an extended shut-down. However, it is noted that the current SO_2 monitoring location is no longer considered a compliance point for the SAAQS as per the Orano's 2019 Industrial Source Air Quality Environmental Protection Plan (EPP) submitted under Saskatchewan Environmental Code. Average hourly and 24-hour SO_2 concentrations recorded throughout the 2022 to 2024 period were lower than those recorded between 2016 and 2021. Maximum 24-hour and mean annual SO_2 concentrations recorded from 2022 to 2024 were also lower than those predicted in the 2016 ERA, while maximum hourly SO_2 concentrations were higher than the 2016 ERA prediction. Overall, the McClean Lake Operation have had limited effects on the local air quality, with concentrations of the TSPs, radon, and SO_2 being within the impact predictions of the 1991 McClean and 1995 Midwest EAs and consistent with the current ERA predictions.

No changes are recommended to the meteorological and air quality monitoring based on the environmental performance assessment. A supplementary study to investigate the cause of the observed increases in copper and molybdenum concentrations is recommended. Further validation of the monitoring program was implemented based on the 2025 ERA update as presented in 2025 EP TID Volume 2.

Aquatic Environment

Lakes and streams within the LSA are typical of the region with moderate productivity supporting a diversity of benthic invertebrates, phytoplankton, zooplankton, and fish species.

Surface water quality monitoring at primary exposure areas in the McClean Lake Operation LSA revealed stable or decreasing trends over time in Constituent of Potential Concern (COPC) concentrations. Decreasing trends in total Kjeldahl nitrogen, magnesium, and molybdenum concentrations were identified over the 2000 to 2024 period at all primary exposure locations assessed. No consistent increasing trends were identified across all primary exposure areas. The influence of treated effluent discharge on the primary exposure area has been less than predicted in the original EAs and remains lower than the most recent predictions. Throughout the current reporting period, COPC concentrations generally did not exceed the most recent ERA predicted levels. Where parameters exceeded recent predictions during some sampling events, the exceedances either 1) occurred for brief periods of time and were not consistent across all primary exposure areas, or 2) were due to the Detection Limit (DL) being higher than the prediction. Further, radionuclide levels were generally below or near to the Reportable Detection Limit (RDL). Most parameters were below available guidelines. Water quality monitoring conducted in the secondary exposure areas indicated that COPC concentrations were often below RDLs, generally within the range of concentrations measured in the reference areas, and/or below water quality guidelines for the protection of aquatic life. However, nitrate and most major ion concentrations showed increase in Bena Lake and Candy Lake. Notably, nitrate concentrations in Bena Lake exceeded the water quality guidelines, however concentrations appear to show a recent decrease from peak levels in 2021. These trends in Bena and Candy lakes were further reviewed as part of

the 2025 ERA update reported in the 2025 EP TID Volume 2. Overall, the current water quality monitoring data agrees with the original Joint Panel EAs and more recent ERAs that predicted limited effects downstream of the S/V TEMS.

Analysis of sediment chemistry data from baseline and operational monitoring periods collected in the McClean Lake Operation LSA indicates several analytes have accumulated in the surficial sediment layer above historical and reference values particularly within the S/V TEMS, which is in line with the EA predictions. Overall, the sediment quality data collected during the current reporting period agreed with the most recent predictions from the 2016 ERA and 2018 Selenium RA, generally falling within the mean and 95th percentile predictions.

The 1991 McClean and 1995 Midwest EAs predicted moderate to major impacts on the biological environment within the S/V TEMS (Sink Reservoir and Vulture Lake), implying impacts to benthic macroinvertebrate abundance and richness that would fall outside of the normal range (NR) of variation of baseline conditions. Subsequent EAs and ERAs, supported theses predictions, with negligible effects predicted to McClean Lake east basin and Collins Creek. The long-term benthic invertebrate community monitoring of lake depositional habitat has demonstrated that there was a reduction in both density and taxa richness in both Sink Reservoir and Vulture Lake from baseline to the operational period when compared to the west basin of McClean Lake. However, the observed density and richness values in 2024 fell within the NR of variation of values observed during baseline periods and/or in reference waterbodies. The observed variations in indices of benthic community composition in these two waterbodies, therefore, were relatively subtle, and in all cases, within the NR of variation. Finally, potential changes in benthic invertebrate community structure were noted.

Within McClean Lake east basin, density and richness were reduced from the baseline to the operational period when compared to McClean Lake west basin, but there were no differences over time and differences were within the NR. Some subtle differences in non-core variables were evident, suggesting some changes in benthic invertebrate community structure. However, the maintenance of the core characteristics of the McClean Lake east basin benthic invertebrate community and subtle differences in composition suggest negligible effects.

The EAs and subsequent ERAs predicted negligible effects on the benthic environment in Collins Creek, implying no change in benthic community abundance or richness outside of the NR of variation of baseline conditions. Within the current reporting period, depositional habitats within Collins Creek were surveyed using a semi-quantitative method as part of the Environmental Effects Monitoring (EEM) biological studies in 2022. The observed variations in composition of the depositional habitat were consistent with the predictions of the EAs, that effects would be negligible in Collins Creek.

Multivariate analysis of fish tissues indicated that chemistry of northern pike and white sucker were generally similar to the chemistry of fish collected from baseline periods or reference locations, with a few elevated concentrations of select COPCs observed mostly from fish collected from Sink Reservoir and Vulture Lake. Fish tissue selenium concentrations have been increasing over time in both Sink Reservoir and Vulture Lake. The actual as well as estimated mean northern pike ovary selenium concentrations exceeding the site-specific benchmark and the available selenium criteria at these waterbodies. These results indicate a potential impact on northern pike reproduction in the S/V TEMS, which is consistent with decreases of northern pike capture

in 2021 and 2024. The higher levels of contaminants measured in fish tissue samples from Sink Reservoir and Vulture Lake in 2024, relative to the reference values, reflect the influence of treated effluent. The 1991 McClean and 1995 Midwest EAs predicted potential incorporation of some heavy metals into Vulture Lake fish flesh and bone resulting in “moderate to major” effects limited to the lifetime of the operation. The results presented here are consistent with the anticipated effects reviewed by the Joint Panel.

Selenium concentrations in fish tissue from McClean Lake east basin, Collins Creek, and Kewen Lake remain similar to previous monitoring periods and well below available selenium criteria. In addition, the selenium concentrations were similar to the most recent predictions provided in the 2018 Selenium Assessment Report, which overall supported minor and negligible effects to the fish of McClean Lake and Collins Creek downstream of McClean Lake as a result of exposure to the McClean Lake Operation treated effluent.

The most recent sentinel fish population monitoring indicated that burbot and slimy sculpin in the exposure area showed species-specific and, in some cases, divergent responses in 2022. Burbot in the exposure area continued to be in good condition compared to reference area burbot with higher relative abundance of YOY and significantly higher growth and condition metrics in non-YOY fish. There were no differences in growth rate of YOY burbot in terms of both weight and length between the two areas. Burbot from the exposure area were about 22% heavier and had a condition factor about 21% higher than reference area fish. Burbot from the exposure area have always had equal or higher condition factor than fish from the reference area with a clearer divergence shown in 2022. Also, there was a significant difference in reproductive output, with YOY burbot comprising a greater proportion of the population in the exposure area. Interestingly, 2022 was the first EEM year that YOY burbot were collected from the reference area, no YOY were collected in previous EEM years.

In contrast to the burbot, slimy sculpin populations in the exposure area exhibited signs of reduced reproductive success but increased survival in 2022 suggesting either a recent shift or a continuation of improvements beginning prior to 2016. Slimy sculpin YOY was significantly lower in the exposure area relative to reference, suggesting potential effects on recruitment. However, YOY from the exposure area were generally longer than those from the reference area, indicating a shift in size structure consistent with enhanced growth and/or size-selective survival at the exposure area. Non-YOY slimy sculpin from the exposure area were lighter and shorter at age, than reference area fish, however multi-year analyses showed that several growth and condition metrics for both YOY and 1+ sculpin have undergone step-changes, with 2022 data generally indicating narrowing differences between reference and exposure areas. Condition factor of slimy sculpin in the exposure area, as for burbot, has historically been as high or higher than the reference. However, condition of exposure slimy sculpin has remained within the NR of the reference area fish across all EEM years.

As was found in all prior EEM years, the most recent data suggests that burbot continues to show strong growth and condition performance, now coupled with improved YOY abundance. In contrast, slimy sculpin, show signs of reduced YOY recruitment in the exposure area despite continued adequate growth and condition. These findings, supported by step-change testing suggest that while conditions for burbot may be improving, slimy sculpin populations could be experiencing subtle stressors affecting reproduction.

In addition to the routine monitoring, several supplementary studies have been implemented during the reporting period. The supplementary data facilitates better understanding of the operation's impact on aquatic environment and will be used for future ERAs and support for future mining operations.

The surface water monitoring program optimization is suggested as follows: (i) remove two of the four monitoring stations at S/V TEMS, (ii) align timelines for aquatic studies under the EMP and EEM, (iii) adjust large-bodied fish performance criteria. Additionally, sediment sampling in Bena and Candy Lakes is recommended to evaluate the potential deposition of surface water parameters identified during this current assessment. Further validation of the monitoring program was implemented based on the 2025 ERA update as presented in 2025 EP TID Volume 2.

Terrestrial Environment

The soils, landforms, vegetation, and wildlife within the LSA are typical of the regional Boreal Shield Ecozone. The ecosite classification for the entire LAB was completed between 2023-2025 using the most recent remote sensing data, available ground truthing data, and publicly available data. Ecosite phases dominated by coniferous species are most represented, including mature jack pine (*Pinus banksiana*) forests and mature black spruce (*Pinus mariana*) forests, interspersed with areas of open water and wetland habitat containing bogs, fens, and swamps. The ecosite data have been used to outline habitat suitability for caribou, moose, and vegetation species of conservation concern (SOCC) and identify the dominant habitat types. Areas classified as anthropogenically disturbed during the ecosite classification process represent about 1.5% of the LAB which includes anthropogenic impacts that are both related and unrelated to the McClean Lake Operation. The total developed areas within McClean Lake Operation and Midwest Joint Venture Surface Lease Areas represent 1.2% of the LAB, which falls within predictions of the previous EAs.

The main focus of the current McClean Lake Operation Environmental Monitoring Program (EMP) for the terrestrial environment is soil and vegetation chemistry monitoring which is now conducted on a six-year cycle. The most recent sampling occurred in 2021, with the next scheduled for 2027; therefore, no updates to the soil and vegetation chemistry data were made during the current reporting period.

Supplementary wildlife and vegetation studies were completed during the current reporting period. This included rare plant surveys, vegetation surveys, targeted surveys for a number of avian, amphibian and mammalian species, and small mammal chemistry sampling. The information collected was used to update the wildlife species list for the McClean Lake Operation. Thirteen federally listed SARA and/or COSEWIC ranked SAR were observed in the LAB, including barn swallow (*Hirundo rustica*), common nighthawk (*Chordeiles minor*), lesser yellowlegs (*Tringa flavipes*), olive-sided flycatcher (*Contopus cooperi*), rusty blackbird (*Euphagus carolinus)*, snowy owl (*Bubo scandiacus)*, barren-ground caribou (*Rangifer tarandus groenlandicus*), woodland caribou (*Rangifer tarandus caribou*), eastern red bat (*Lasiurus borealis)*, hoary bat (*Lasiurus cinereus)*, little brown myotis (*Myotis lucifugus)*, northern myotis (*Myotis septentrionalis)*, and silver-haired bat (*Lasionycteris noctivagans)*. No federally ranked plant species at risk was recorded in the area. The updated wildlife and vegetation data has been used to inform planning for future mining activities and the 2025 ERA update presented in the 2025 EP TID Volume 2.

No changes are recommended to terrestrial monitoring.

Culture

Indigenous occupation and use of northern Saskatchewan dates back approximately 8,000 years. A reliance on large game, numerous furbearers, fish, and waterfowl, as well as innumerable plant species, historically and currently provide for physical, social, and spiritual needs of residents. Traditional knowledge can provide relevant and reliable information on the ecological components of the existing environment and can assist in developing the criteria for determining adverse effects from commercial and industrial developments.

There are 34 precontact and historic archaeological sites that have been identified to date in the LAB, 18 of which occur in the McClean Lake Operation LSA. Heritage resources impact assessments completed in 1979, 2012, 2015 and 2024 on select portions of the LSA did not identify any heritage resources. There are currently no known paleontological, precontact, historic, or architecturally significant sites in the LSA. Given the Traditional Land Use (TLU) data made available through the Prince Albert Grand Council (PAGC), TLU activities in the LAB are largely focused on the larger lakes located at the periphery of the study area. Regional monitoring programs indicate that Orano's operations sustain the safety of local country foods and continued traditional land use within the LAB.

Waste and Substance

McClean Lake Operation waste streams include waste rock, tailings, treated effluent, domestic waste, industrial waste, chemically and radiological contaminated waste, hazardous waste, recycling materials, and sewage solids. All waste types are stored at the designated facilities and handled in line with the approved procedures. Three major wastes - waste rock, tailings, and treated effluent - are disposed on the site. Waste generation and the resulting potential environmental impact are carefully monitored and regularly reviewed through comprehensive assessments. The assessment outcomes are documented and submitted for regulatory review.

Other waste disposed of at the site include domestic, industrial, chemical, and radiological waste, and sewage. All hazardous waste, except for hydrocarbon contaminated soil, is shipped off site for disposal at designated facilities. Orano's initiative for sustainable waste management includes on-site bioremediation of hydrocarbon contaminated soil and collection of recyclable materials for donation to local communities or recycling at designated facilities.

Orano proactively reviews the risks associated with the waste management practices and takes every opportunity for waste management optimization. In case of a significant risk to human health or environment, proper mitigation measures are developed and implemented. Such an approach ensures that environmental impact from the on-site waste handling and disposal remains within the predictions made at the EA stage.

1 Introduction

1.1 Background

The McClean Lake Operation is a uranium mine and milling facility located approximately 15 km west of Wollaston Lake in northeastern Saskatchewan, Canada (Figure 1.1-1). It also includes the Midwest Project located about 15 km west of the McClean Lake Mill (Figure 1.1-2). Orano Canada Inc. (Orano) is the majority owner and operator of the McClean Lake Operation (77.5%) and Midwest Project (74.83%). Orano is a Canadian company with its head office located in Saskatoon, Saskatchewan and is a wholly owned subsidiary of Orano group, a France-based company active in all aspects of the nuclear fuel cycle. Denison Mines Incorporated is a joint venture partner for the McClean Lake Operation (22.5%) and Midwest Project (25.17%).

The McClean Lake Operation is based on Crown land owned by the Government of Saskatchewan. The Surface Lease Agreement between the Government of Saskatchewan and the joint venture partners was signed on April 10, 2002. The agreement term is thirty-three years.

The telephone number for the McClean Lake Operation is (306) 633-2177. The email address of the General Manager, McClean Lake Operation is yann.baradello@orano.group. The business address of Orano is 100-833 45th Street West, Saskatoon, SK, S7L 5X2.

Uranium mineralization was first discovered in the McClean Lake region in early 1979. Since that time, a large number of environmental baseline and monitoring studies have been conducted in the vicinity of the McClean Lake Operation (MacClaren and SRC, 1979; Minatco, 1991; COGEMA, 1995; Orano, 2022a). In 2003, Orano undertook the initiative to summarize the relevant environmental studies related to the McClean Lake Operation into the Existing Environment Technical Information Document (EE TID). The EE TID was subsequently updated as the McClean Lake Operation Environmental Performance Technical Information Document (EP TID) which is comprised of two volumes:

- Volume 1 - Environmental Performance Assessment, which focuses on assessing the McClean Lake Operation environmental performance based on the most recent monitoring and operational data. The EP TID Volume 1 also summarizes key environmental aspects of the McClean Lake Operation and Midwest Project areas as well as results of the supplementary studies and follow-up programs.
- Volume 2 - Environmental Risk Assessment (ERA), which presents an updated ERA based on the most recent environmental data, refined model inputs based on the new monitoring data, recent and anticipated operational performance, adjustments to the mine plan, scientific advancements in ERA methodology, and changes in the regulatory framework. Volume 2 aims:
    - to support current and future licensing applications and environmental assessments,
    - inform environmental protection and monitoring, and
    - identify opportunities for continual improvement and the need for additional mitigation measures, where required.

The EP TID is updated periodically in line with regulatory requirements. Updates to Volume 1 are guided by requirements specified in the provincial Approval to Operate; updates of the ERA in Volume 2 are subject to the Canadian Nuclear Safety Commission (CNSC) REGDOC 2.9.1 requirements and CSA 288.6 guidance. The previous editions of EP TID Volumes 1 and 2 were released in 2012 and 2016. In 2020, the CNSC and the Saskatchewan Ministry of Environment (SMOE) accepted Orano's proposal to re-align the McClean Lake Operation environmental monitoring and reporting requirements, which included deferral of the EP TID Volume 1 submission from 2021 to 2022 and the EP TID Volume 2 submission from 2021 to 2025 (Orano, 2020a; CNSC, 2020; SMOE, 2020). The approval conditions included the following requirements:

1. The environmental performance report including the applicable 2016-2021 environmental monitoring information as described in the most recent version of the Environmental Performance Reporting Guideline to be submitted to the SMOE no later than September 30, 2022 (SMOE, 2020).

2. "Adequacy review" for CSA N288.6 to be included in the Annual Report and will fully demonstrate that Orano: (1) updated risk assessment(s) for any individual contaminants of concern identified during the review process; (2) thoroughly documented the review process, findings and any follow-up actions; and that (3) there have been no major facility changes (CNSC, 2020).

3. Future EP TID Volume 2 ERA updates to be submitted to the CNSC in 2030 and in 2035, subject to change based on the review of the "adequacy review" in the Annual reports, review of the 2025 EP TID Volume 2 - ERA, and following the CNSC relicensing hearings in 2027 (CNSC, 2020).

The proposed alignment and above requirements have been addressed as follows:

- The previous EP TID update was limited only to revision of Volume 1, which was submitted for the regulatory review in 2022 (Orano, 2022a).

- The ERA adequacy reviews were included into the 2019 to 2024 Annual Reports (Orano, 2020b; Orano, 2021a; Orano, 2022b; Orano, 2023a; Orano, 2024a; Orano, 2025a).

- Submission of the ERA update presented in the 2025 EP TID Volume 2, will inform timelines for future ERA updates.

It is Orano's view that the EP TID supplies necessary information to facilitate future licence applications and Environmental Assessments (EAs) as well as fulfill the SMOE's requirement for an Environmental Performance Report in condition 7.5 of the PO24-012 Approval to Operate Pollutant Control Facilities. It is Orano's expectation that sections of this EP TID will continue to be updated periodically based on new operational performance data, or in conjunction with significant changes in anticipated activities which would warrant a re-evaluation of the potential environmental risks.

1.1.1 Site Layout

The current configuration of the major infrastructure comprising the McClean Lake Operation is illustrated in Figure 1.1-3. The site comprises of the following areas:

- the JEB area which includes the permanent camp (JEB camp), the McClean Lake Mill (previously referred to as the JEB Mill), the JEB Clean Waste Rock Pile (CWRP), the JEB Tailings Management Facility (TMF) and the JEB water treatment plant (WTP);
- the Sue mining area which includes the mined-out Sue C/A (which contains the contaminated landfill), Sue B, and Sue E pits, the Sue C CWRP, The Sue E CWRP, the Sue WTP, and the undeveloped Sue F Project (formerly known as the Caribou Project) deposit;
- the Sink/Vulture Treated Effluent Management System (S/V TEMS) which includes Sink Reservoir and its control structure, and Vulture Lake and the effluent diffuser system which discharges effluent into the east basin of McClean Lake; and
- McClean Mining site which served as a testing ground for development of the Surface Access Borehole Resource Extraction (SABRE) mining method in 2007-2021 and scheduled for mining in 2025.

An important environmental protection design feature of the site is the comprehensive water management strategy that has been implemented across operational areas. This water management strategy entails the capture and treatment of excess process water and site runoff from each of the operational areas, and the interception and diversion of surface runoff away from disturbed areas to minimize water treatment requirements. Infrastructure associated with the water management strategy includes water collection systems, two WTPs (the JEB and Sue WTPs), and a single treated effluent management system S/V TEMS to regulate treated effluent released to the receiving environment. The S/V TEMS is the final repository for wastewater generated at the operation. Wastewater inputs to the S/V TEMS currently consist of treated effluent from the JEB and Sue WTPs. The JEB dewatering well system (DWS), previously used to intercept and divert clean groundwater entering the JEB TMF, ceased operation in 2014 and its infrastructure has been decommissioned. As such, the JEB TMF hydraulic containment is provided exclusively by pumping water from the TMF base drain.

The Midwest Project site has been in care and maintenance status since 1989. Existing infrastructure includes a building that formerly served as a WTP, two settling ponds, Mink Arm Dam (with spillway), and the headframe from the test mine that operated during the 1980s (Figure 1.1-4). There is no liquid effluent discharged from the site, and the only source of air emissions are vehicles that travel to and from the site.

1.2 Environmental Assessment and Authorized Activities

The McClean Lake Operation has previously undergone several environmental assessments to assess the potential and expected effects to the environment from the initial development, additional projects, through to the post-decommissioning period. Table 1.2-1 provides an overview of the environmental assessment history for the McClean Lake Operation. Appendix I.2-1 details the McClean Lake Operation history along with the evolution of the environmental assessment and legislation since 1990s.

The following Environmental Impact Statements (EIS) have been completed and received federal and provincial environmental assessment approval:

- 1991 McClean Lake Project EIS (Minatco, 1991);
- 1995 Midwest Project EIS (COGEMA, 1995);
- 1995 Cigar Lake Project EIS (CLMC, 1995);

- 2001 Cigar Lake Waste Rock Disposal (COGEMA and CLMC, 2001);
- 2004 Sue E Project EIS (AREVA, 2004);
- 2009 Caribou (now Sue F) Project Screening EIS (AREVA, 2009); and
- 2011 Midwest Project EIS (AREVA, 2011).

In addition to EISs listed above, several federal and provincial screenings and determinations were completed to review proposed projects or changes to previously approved projects related to McClean Lake Operation (Table 1.2-1).

The 1991 and 1995 EISs were reviewed by a joint federal-provincial EA review panel (Joint Panel) appointed to study uranium mine developments in northern Saskatchewan. While the environmental assessments reviewed by the Joint Panel provide the broad context of the types of environmental interactions and effects that would occur with project development, the Joint Panel also recognized that changes in science and technology would occur over the life of the Project and acknowledged that it would be the responsibility of the province and the CNSC to evaluate the effects of such changes in science and technology in the context of their licensing responsibilities and the prevention of unreasonable risk to the environment. Table 1.2-1 presents a list of EISs reviewed by the federal and provincial governments under the Canadian Environmental Assessment Act and Saskatchewan Environmental Assessment Act (EAA) as applicable. Orano has no projects that were reviewed under the Impact Assessment Act, 2019.

The McClean Lake Operation is governed by approvals and permits issued by the SMOE and licences issued by the CNSC. In 1994, the Atomic Energy Control Board (AECB) (predecessor to the CNSC) issued COGEMA (predecessor to AREVA; now Orano) a Licence for the McClean Lake Operation. This Licence has since been subject to several renewals and amendments (Table 1.2-2). The McClean Lake Operation currently operates under operating licence, UML-MINEMILL-McClean.02/2027, renewed by the CNSC on July 1, 2017 for a 10-year term, expiring June 30, 2027. Table 1.2-2 provides cross-references to the EA processes in which the activities were considered, and under which the CNSC licence(s) or amendment(s) the activity was granted.

The first McClean Lake Approval to Operate Pollutant Control Facilities IO-112 (Approval to Operate) was issued on February 29, 1996 by Saskatchewan Environment and Resource Management (predecessor of SMOE). The Approval to Operate has been revised and amended to reflect the changes in operations and regulations. The Approval provides authorization to operate and specifies facility conditions for management of materials, waste, emissions, water and wastewater. The current Approval to Operate was issued by SMOE Environmental Protection Branch on January 31, 2024 and will expire on October 31, 2029.

Appendix I.2-2 lists licences, approvals and permits from CNSC and SMOE in effect during 2022-2024. As of 2024 the following activities are approved for the McClean Lake Operation:

- Operate the McClean Lake Mill and produce uranium concentrate up to 24 million pounds annually;
- Receive and process Cigar Lake mine ore slurry;
- Vertically expand the JEB TMF pit perimeter to 468 mASL;
- Import, possess, use, store, transfer, and dispose of nuclear substances and radiation devices;
- Package and transport nuclear substances;

- Operate the SABRE Project;
- Store waste rock;
- Dispose of tailings and operate the JEB TMF;
- Operate the JEB Dewatering and Water Management Systems and JEB WTP;
- Operate the Sue WTP;
- Operate the JEB Office/Mill and Camp Potable Water supply systems;
- Operate the S/V TEMS;
- Handle and store hazardous materials and dispose of hazardous wastes;
- Operate landfills for disposal of contaminated and industrial waste;
- Operate landfills and an incinerator for disposal of domestic waste;
- Conduct sewage treatment associated with the McClean Lake Operation;
- Conduct remediation of hydrocarbon contaminated soil;
- Operate air pollution monitoring and abatement equipment; and
- Manage care and maintenance activities at the Midwest Project site.

1.3 McClean Lake Operation History

The uranium mineralization in the McClean Lake region was initially discovered in 1979, and an initial proposal to develop the McClean Lake Project dates back to the early 1990s. Subsequent to regulatory approval, extraction of the uranium ore at the McClean Lake Operation commenced in 1996 and processing ore into a yellowcake product began in 1999.

1.3.1 1995-2021 Operational History

Table 1.3-1 provides timelines for key events that have occurred at the McClean Lake Operation since 1995 including

- the open pit mining of the JEB and Sue A, B, C, and E deposits, the operation of the McClean Lake Mill and JEB TMF, the JEB and Sue WTPs, and the S/V TEMS in 1995-2009;
- temporary cessation of the milling activities due to depletion of uranium ore sources in 2010-2011;
- resumption of the mill operations with processing of ore from the Cigar Lake Mine in 2014;
- upgrade of the mill from its previous back-end capacity of 13 Mlbs U_3O_8 to 24 Mlbs U_3O_8 equivalent to accommodate the Cigar Lake Mine production rates,
- the JEB TMF optimization and expansion starting from 2012;
- the SABRE Project (previously referred as the Mining Equipment Development (MED) Research program) starting from 2007;
- implementation of selenium mitigation measures to reduce selenium loadings to the S/V TEMS;

- temporary cessation of milling activities in response to the COVID-19 pandemic (2020 – 2021); and
- other activities related to the mill operation and maintenance.

Appendix I.2-1 provides a more detailed discussion of the McClean Lake Operation history.

1.3.2 2022-2024 Operational Performance

A summary of the mill operation data is included in Table 1.3-2. From 2022 to 2024, 156,503 tonnes of ore was processed, which resulted in production of about 50 million pounds U_3O_8. Additionally, 37,000 tonnes of ammonium sulphate (by product) were generated and shipped off site during the reporting period.

Table 1.3-1 provides an overview of the most significant process changes and facility modifications during the reporting period. During these three years the following most significant projects were undertaken:

- Upgrade of the JEB WTP with the integrated ferrous sulphate treatment system to enhance selenium removal from the mill effluent;
- Upgrades to Solvent Extraction (SX) Circuit (installation of anhydrous ammonia isolation valves to mitigate large releases of ammonia);
- JEB TMF Expansion (placement of liner to 452.5 mASL, installation of new sub-aqueous deposition lines at two new locations and removal of deposition lines installed in 2023);
- Replacement of the JEB WTP effluent discharge pipeline to Sink Reservoir;
- Ammonium Sulphate Crystallization (CX) Plant equipment upgrades;
- An interim gypsum mitigation strategy was implemented at JEB WTP;
- McClean Mining Pad expansion (formerly known as SABRE pad); and
- McClean Mining: four access holes drilled.

Annual water flow volumes for the JEB and Sue WTP are presented in Table 1.3-3. From 2022 to 2024, a total of 2,741,693 m^3 of contaminated water was metered as feed to the JEB WTP, while a total of 2,344,596 m^3 of treated effluent was metered as discharge to Sink Reservoir. Approximately 67,888 m^3 of treated effluent was recycled back to the JEB TMF from the JEB WTP during the reporting period. Comparing JEB WTP feed volumes with the JEB WTP discharge volumes (discharge to Sink Reservoir + recycle to JEB TMF) shows an overall discrepancy of approximately 12%. Some treated effluent is cycled back to the JEB wash bay, which accounts for most of this difference. Additionally, the various flow meters each have a range of error. For the Sue WTP, a total of 1,692,985 m^3 of treated mine water was metered as discharge to Sink Reservoir during the reporting period. Figures 1.3-1 and 1.3-2 show a simplified water balance for the JEB site and Sue sites, respectively.

Appendix I.3 provides a summary of discharges, exceedances, and other reportable environmental events, including causes and measures undertaken to prevent re-occurrences. None of the events resulted in an adverse effect to the environment.

Additionally, progressive decommissioning and reclamation efforts occurred at the McClean Lake Operation during the 2022-2024 reporting period including:

- removal and shredding of various buildings around site including trailer dormitories, former Sue Site mine offices, dry complexes, batch plant buildings, abandoned wash cars and office trailers, and various obsolete facilities at Moffat and Sue sites;
- completed hydroseeding on some portions of Sue C CWRP as part of progressive decommissioning initiatives (see Section 5 for further details).

1.3.3 Decommissioning Plan and Financial Assurance

The Joint Venture partnerships in place for the McClean Lake Operation and the Midwest Project are responsible to ensure that sufficient financial resources are available to complete the required decommissioning work in the event Orano Canada Inc. defaults on its requirements in this regard. The Preliminary Decommissioning Plan (PDP) and Financial Assurance outlines the combined decommissioning plan and financial assurance for both McClean Lake Operation and Midwest Project. This document is reviewed at least once every five years, in accordance with the provincial Mineral *Industry Environmental Protection Regulations*.

In 2025, Orano updated and submitted PDP Version 10 for regulatory review (Orano, 2025b). This revision was completed to incorporate updates to the JEB TMF closure strategy and its associated cost, as well as adjust the entire financial assurance to reflect current unit rates, labour and monitoring costs. This financial assurance value was increased from $102,098,000 to $122,527,000.

1.4 Environmental Effects Science Evolution

The understanding of environmental effects science has evolved significantly since the initial McClean Lake Operation EA. The scientific information associated with potential environmental effects comes from a variety of sources including the peer reviewed scientific literature and ecological risk assessment guidelines developed in support of environmental protection goals. Advances in air, water, and sediment quality guidelines and standards have been driven by new scientific information. Constituents of concern once thought to be relatively benign have been determined to be more interactive in the environment than previously thought. The federal and provincial environmental quality guidelines have continued to evolve to address a wider range of constituents of potential concern along with refinement of scientific understanding of their potential impact on ecosystems and human health.

Examples of the most prominent scientific advancements related to assessment of environmental effects from the McClean Lake Operation include:

- Sediment Benchmark Development: The influence of contaminants of potential concern in sediments and their influence on benthic invertebrates and benthic invertebrate communities has been extensively researched. Thompson et al. applied the screening level concentration approach to derive lowest effect level (LEL) and severe effect level (SEL) concentrations for a number of contaminants of potential concern in uranium mining and milling regions of Canada (Thompson et al., 2005). Liber et al. using laboratory spiked sediment toxicity tests, derived northern Saskatchewan sediment threshold values for uranium, molybdenum, nickel and arsenic based on amphipod and midge species responses (Liber et al., 2011). Finally, sediment quality values were derived for northern Saskatchewan based on co-occurring sediment chemistry and benthic invertebrate community metrics for reference and no-effects sites by Burnett-Seidel and Liber (Burnett-Seidel and Liber, 2013).

- Selenium Toxicity Assessment Framework: The environmental risks of selenium to aquatic ecosystems were first recognized in the 1980s by North American scientists and government agencies, following ecological damage observed at the Kesterson Reservoir in California. Since then, the understanding of the potential effects from exposure to selenium to cause environmental effects has significantly evolved (Chapman et al., 2010; DeForest et al., 2012; Palace and Gilron, 2025), which led to the introduction of regulatory benchmarks for selenium (USEPA, 2016; ECCC, 2022). The scientific knowledge and regulatory guidelines were used to develop site specific selenium benchmarks and exposure-based release limit for the McClean Lake Operation (Orano, 2018; Orano, 2019a).

- The scientific literature has also identified molybdenum exposure as a potential cause of molybdenosis in ungulates (BCMOE, 2021) which is addressed by using the wildlife-specific benchmarks in the current ERA update.

To incorporate the continued evolution of environmental effects science into the assessment of environment effects at the McClean Lake Operation, an adaptive management framework was developed as presented in the Section 1.5 below.

1.5 Sustainable Development Framework

Orano recognizes that continued economic and social development depend on a healthy environment and incorporates environmental protection considerations into company activities to ensure sustainable development. Orano is committed to continually improve approaches and technology to minimize the effects of its activities on the environment. Early in the life of the McClean Lake Operation, it was recognized that to advance new activities, it was necessary to adopt a flexible, iterative approach which embraces the sustainable development objectives of the EA process and provides opportunities to incorporate enhanced EA methodologies, and new environmental effects science. The approach also needed to support the identification of continuous improvement opportunities and the need for adaptive management, where required.

Orano's sustainable development strategy, first outlined in the Sue E EIS (AREVA, 2004) and shown on Figure 1.5-1, embraces a number of environmental principles: innovation in advanced environmental protection technologies, responsible management of the consumption of natural resources, and limiting and managing environmental risks and effects of waste emissions from project activities; As outlined in Figure 1.5-1, this sustainable development framework represents an integrated environmental protection approach encompassing three main processes: EA, continual improvement, and adaptive management. This framework aligns with the environmental protection framework outlined in the CNSC *REGDOC 2.9.1. Environmental Protection: Environmental Principles, Assessments and Protection Measures* and *CSA N288 Series of Standards for Environmental Management of Nuclear Facilities.*

Figure 1.5-1 shows that the EA process generates several important elements including a set of environmental effects predictions, compliance and environmental effects monitoring programs, a follow-up program to address uncertainties in the prediction of environmental effects, and the identification of contingency measures that could be implemented should non-conservative assumptions be identified in the original assessment framework. Each of these elements are integrated into the environmental management system for the development and operation of a project.

The environmental monitoring results are reviewed versus the most recent ERA predictions and applicable benchmarks in the EP TID Volume 1, which also includes results of the follow-up programs and supplementary studies. The updated environmental risk assessment (EP TID Volume 2) utilizes refined model inputs from environmental monitoring programs and most recent science advancements to facilitate the prediction of potential future environmental effects and their alignment with impacts predicted at the EA stage. Thus, the EP TID Volume 1 and 2 provide an appropriate forum to verify accuracy of EA predictions, identify opportunities to improve performance, assess risks, and remain proactive and adaptable in ways that reflect the increasing level of information available throughout operations. These documents also ensure monitoring and follow-up programs are appropriately focused, and that the results are documented, and communicated.

1.6 Current Environmental Performance Assessment

1.6.1 Objectives

The purpose of this document is to provide information on the operation's environmental performance from 2022-2024 in a clear and concise manner. The report content addresses requirements of the SMOE Environmental Performance Report Guideline (SMOE, 2013) as shown in Table 1.6-1 and applicable regulatory comments on the 2022 EP TID Volume 1 as shown in Appendix I.6.

The 2025 EP TID Volume 1 pursues the following objectives:

- provide a brief overview of baseline surveys performed at the pre-development stage;
- summarize predictions from relevant EISs listed in Section 1.2 and ERAs with a focus on comparisons to the 1991 McClean and Midwest 1995 EA predictions, the current ERA predictions presented in the 2016 EP TID Volume 2 (AREVA, 2016a) and the additional risk assessment completed for selenium in 2018 (Orano, 2018);
- summarize monitoring activities and supplementary studies performed during the operational period;
- discuss the monitoring results with focus on the 2022-2024 reporting period;
- present the outcome of the environmental data analysis including:
    - temporal and spatial comparisons of the monitoring results (where applicable),
    - comparison with the evaluation criteria,
    - review if the operation performs within the scope of the applicable EAs and ERAs; and
- identify areas for the Environmental Monitoring Program (EMP) adjustments or collection of additional data via supplementary studies.

The EP TID Volume 1 focuses on the evaluation of operational effects against predicted effects associated with air dispersion and treated effluent discharge. The following sub sections provide an overview of the assessment approach adopted for the McClean Lake Operation.

1.6.2 Assessment Approach

A variety of comparative frameworks are utilized to provide a comprehensive evaluation of the current status of key environmental components in the vicinity of the McClean Lake Operation. Primary comparisons are to quantitative evaluation criteria (including EA impact predictions (where available), to reference (baseline or background) conditions, and to available federal and provincial guidelines. Baseline and operational monitoring results are combined to evaluate possible trends. Each of these comparative frameworks is useful in assessing the status of the environment. A summary of the study objectives, methods, and results is provided for each monitoring aspect, in order for a reviewer to gain a good understanding of the potential effects of the McClean Lake Operation on the local environment and on potential effects in the future.

1.6.2.1 Baseline Studies

During the McClean Lake Operation pre-development phase, a variety of existing environmental information, both quantitative and qualitative, including interviews with local community leaders and public servants, were collected from the local area (Minatco, 1991). Much of this information comprises part of the initial site characterization (e.g., aquatic macrophytes, fish habitat maps, preliminary upland vegetation maps, climate and meteorology), including baseline inventories or indices summarizing species presence within the local area and region (e.g., indices of water and sediment quality, phytoplankton and zooplankton taxonomy, fish collections, soil profiles, plant and animal inventories). As the McClean Lake project development plans became more defined, baseline data collection programs adopted more formal study designs to provide quantitative information that served as the foundation of future monitoring. Within the local area, quantitative data were obtained using appropriate sampling procedures and equipment at locations anticipated to be exposed to operational emissions. Where possible, study designs also incorporated reference areas (control locations) that were anticipated to be outside the zone of influence of the project. Baseline data were also used to identify Valued Components (VCs – formerly known as Valued Components (VECs)) and to provide the foundation for the prediction and monitoring of potential effects from the McClean Lake Operation. The importance of incorporating traditional knowledge into baseline studies, project design and monitoring programs has been increasingly recognized (Iaccarino , 2003). With this acceptance, the incorporation of the human environment – heritage resources, socioeconomics, traditional knowledge - into environmental baseline studies has evolved and grown from previous EAs focused primarily on consultation with stakeholder groups.

The baseline data has been used to assess potential environmental effects from the McClean Lake Operation. Baseline information is fundamental to the study design of the various environmental monitoring components and provides background values to compare against measurements of environmental endpoints obtained during operations. This document presents background data relevant for analysis of the 2022-2024 environmental monitoring results. The background data relevant to other monitoring activities and surveys can be found in previous EP TIDs.

1.6.2.2 Valued Components

The identification of VCs formed a key part of the approach used during pre-development baseline and operational monitoring studies. The concept and identification of VCs has a long history in relation to the McClean Lake Operation, originally referring to VCs as VEC (Joint Panel, 1992; Minatco, 1991; COGEMA, 1995). Joint Panel (1992) defined a VEC as “an environmental attribute or component perceived as important for social, cultural, economic or ecological reasons, and identified through consultation with affected people and through

scientific opinion". CSA (2022) revised the terminology to VC and updated the definition as "a biological entity that can be exposed to contaminants or physical stressors and might be subject to associated effects". VCs support ecosystem structure and function while holding significant cultural, social, and economic values. Consultation with residents of northern Saskatchewan regarding traditional knowledge and land use was intrinsic to the identification of VCs. The VC list is periodically revised based on new environmental data and advice from local communities. The most recent review was completed based on the community feedback obtained in April 2025. The current McClean Lake Operation VC list includes:

- Aquatic Plants: pondweed
- Terrestrial Plants: Blueberry, Labrador tea, and Lichen
- Benthic Invertebrates: Chironomids
- Phytoplankton: Green Algae
- Zooplankton: Daphnids
- Predatory Fish: Northern Pike and Lake Trout
- Bottom-feeding Fish: White Sucker and Lake Whitefish
- Terrestrial Birds: Bald Eagle, Ptarmigan, Rusty Blackbird, Snowy Owl
- Aquatic Birds: Mallard, Merganser, and Scaup, Lesser Yellowlegs
- Terrestrial Mammals: Caribou (Woodland and Barren-ground), Snowshoe Hare, Moose, Wolf, Black Bear, Red Fox, Lynx, Masked Shrew, and Little Brown Myotis
- Aquatic Mammals: Muskrat, Beaver, and Mink
- Amphibia: Frogs
- Terrestrial Invertebrates: Terrestrial Invertebrates (e.g. earthworm, insects etc.)

The EP TID Volume 2 provides more information on the VCs selected for the 2025 ERA update. Section 6.4 summarizes the cultural, social, and economic value of some of the VCs including berries, Labrador tea, caribou, moose, muskrat, beaver, northern pike, and lake trout.

The VC framework facilitates the identification of ecological endpoints that form the basis for monitoring potential operational effects on the local environment. The interrelationships among environmental components, VCs, and monitoring endpoints are complex. A simplified schematic in Figure 1.6-1 illustrates the primary interactions between environmental components and VCs, and identifies many of the endpoints, which have been incorporated into the monitoring program. As illustrated, many aquatic environment VCs are assessed directly as part of the monitoring program, while many terrestrial animal VCs, which due to their relatively large home range and seasonal behaviour, are assessed indirectly through integrated ecological risk assessment. Monitoring the physical components of the environment (water, sediment, air, and soil quality) provides the foundation for both the monitoring program, and the integrated risk assessment. Together, these assessment frameworks form a comprehensive evaluation of current and predicted future health of human and non-human biota in the vicinity of the McClean Lake Operation.

1.6.2.3 Environmental Monitoring Program

The McClean Lake Operation environmental monitoring framework builds on the initial Operational EMP (COGEMA, 1998) established in conjunction with the McClean Lake Project – Approval to Operate (AECB-MFOL-170-0.5). The initial Operational EMP incorporated the recommendations of the Joint Federal-Provincial Environmental Assessment Review Panel, the changes to the project development plans, the comments of regulatory agencies, and environmental monitoring best practices, including the incorporation of baseline data and study design power analysis. Since then, the environmental monitoring requirements at the McClean Lake Operation have been captured in successive licensing documents.

The monitoring objectives and sampling design (including locations, frequencies, and parameters) are described in the Environmental Monitoring Detailed Design (EM DD). The environmental monitoring activities are designed to meet regulatory compliance requirements, verify impact predictions, inform the evaluation of potential risks, and reduce risk assessment uncertainties, through sampling and measuring a wide range of environmental monitoring components at the McClean Lake Operation. The design includes quality assurance (QA), quality control (QC) and recommended reporting aspects of environmental monitoring. The EM DD formalizes the various environmental monitoring study designs into a single document which undergoes periodic reviews to ensure the adequacy of the study design elements for each environmental monitoring component, to ensure objectives continue to be achieved, and to address any changes to environmental risk from the facility. The EM DD was updated in 2023 which means the monitoring requirements for the 2022 to 2024 reporting period are detailed in both the 2019 and 2023 EM DDs (Orano, 2019b; Orano, 2023b). The 2023 EM DD provides description of the current EMP; changes to the EMP are captured in the history of revisions section of that document (Orano, 2023b).

In 2008, the McClean Lake Operation EMP was updated with air (radon) and surface water quality monitoring requirements for the Midwest Project area. In 2020 the Midwest monitoring was removed from the EMP due to delays with the project development. Thus, no monitoring data were collected in the Midwest Project area in 2022-2024.

The focus of this TID is to evaluate the results of receiving environment monitoring to allow comparison to EA predictions. The remaining components captured in the EMP (i.e., compliance monitoring, inspections) are reported elsewhere (e.g., annual reports). Information on waste rock and tailings management is detailed and evaluated in the most recent McClean Lake Operation Waste Rock Management TID (Orano, 2021b) and Tailings Management TID (Orano, 2025c), respectively. Additionally, the review of the monitoring results provided opportunities for rationalization of the EMP adjustments. Recommendations for the EMP update are described in Sections 2 to 5.

1.6.2.4 Constituents of Potential Concern

Although a comprehensive suite of parameters was measured in all media assessed as part of the McClean Lake Operation EMP, data analyses focused on a select list of Constituents of Potential Concern (COPCs) identified as most relevant to the study area and objectives. The COPCs for this EP TID were media-specific and selected based on measured levels in the primary exposure area involving several consecutive steps with use of applicable evaluation criteria.

i. If a measured parameter had an available maximum mean predicted concentration in the 1991 McClean and 1995 Midwest EISs or the relevant environmental modelling (i.e., the 2016 ERA presented in the 2016 EP TID Volume 2 and groundwater modelling presented in the Tailings and Waste Rock Management TIDs), then it was selected as a COPC.

ii. Recent monitoring data (2022 to 2024) for all monitoring parameters were screened against laboratory detection limits (DLs) (used as the first evaluation criteria). If more than 90% of a parameter concentration was below the DL, it was considered heavily censored and was not selected as a COPC.

iii. Parameters considered un-censored (after Step 2) were compared to the applicable background (reference) or baseline data (used as the second evaluation criteria). If mean concentrations in at least one of the exposure monitoring locations were more than two reference standard deviations (SDs) above the reference mean, then they were selected as a COPC. Parameters with concentrations lower than the screening criteria were dropped from further assessment.

iv. Additional consideration was given to modifying factors such as total hardness and pH, which may affect whether a parameter exceeds available guidelines. These parameters were selected as COPCs regardless of steps above.

Details for each media's COPC selection process are provided in the applicable media sections.

1.6.3 Spatial Boundaries

1.6.3.1 Regional Study Area

The McClean Lake Operation is located in the Athabasca Plain Ecoregion of Northern Saskatchewan and locally referred to as the Athabasca Basin, approximately 350 km northeast of La Ronge near Wollaston Lake in the Boreal Shield Ecozone. The Athabasca Basin, including Wollaston Lake and Lake Athabasca, and the northern communities located within and along the periphery of the Basin were selected to define the Regional Study Area (RSA) of the McClean Lake Operation (Figure 1.6-2). Other uranium mines in the RSA include Rabbit Lake Operation, Key Lake Operation, McArthur River Mine, and Cigar Lake Mine . Proposed uranium mines in the RSA include the Midwest Project, Wheeler River Project, Rook I Project, and Patterson Lake South Project. A number of communities are present in the RSA including Wollaston Post, Uranium City, Camsell Portage, Stony Rapids, Hatchet Lake First Nation, Black Lake First Nation, and Fond du Lac First Nation. The Athabasca Basin covers an area of approximately 100,000 km^2.

The Athabasca Basin is composed of sandstone formations which vary in thickness up to about 200 m. The sandstone unconformably overlies older basement rock consisting of granite and gneiss (Precambrian Shield). The unconformity is represented by a regolith horizon, which is typically 20 m to 40 m thick, and hosts many known uranium deposits. The sandstone is overlain with up to 50 m of glacial deposits of silt and sand mixed with boulders and gravel.

The Athabasca Basin covers about one-third of the Saskatchewan Precambrian Shield. The climate is characterized by short cool summers and long cold winters. Dry sandy soils lead to a predominance of jack pine forests on the landscape, which are interspersed with black spruce and tamarack in poorly drained areas. White spruce, trembling aspen and poplar can be found adjacent to larger streams and lakes. Open fens, bogs, lakes,

streams, and wetlands comprise the remainder of the landscape. All of these habitats support a number of fish, bird, and mammal species. However, because of the relatively harsh nature of the environment, the richness and relative abundance of aquatic and terrestrial animals is moderate compared to more southern latitudes.

1.6.3.2 Local Study Areas and the Local Assessment Boundary

The upper Collins Creek and Moffatt Creek watersheds define the McClean Lake Local Study Area (LSA) (Figure 1.6-3). The Midwest Project LSA is defined by the Smith Creek and Nicholson Creek drainage basins. These two LSAs combine to form the McClean Lake Operation Local Assessment Boundary (LAB), which represents the area within which measurable changes to the environment resulting from all activities may be anticipated. All Orano activities occur within the McClean Lake Operation and Midwest Project Surface Lease areas, with the exception of some environmental monitoring activities (i.e., reference site and downstream monitoring) and the transportation of materials to and from the sites which extend beyond the lease boundaries and into the LAB and RSA.

1.6.4 Temporal Boundaries

The collection of data describing the existing environment was initiated in 1979. Two events (or milestones) in the development and operation of the project were used to separate pre-development baseline from monitoring data: I) initiation of treated water release (early 1996), and II) initiation of mill operations (June 1999).

1.6.4.1 Pre-development Baseline

The above milestones were used to define the temporal boundaries for the McClean Lake Operation. For each of the existing environmental components, pre-development baseline conditions are represented by data collected before 1996. In most cases, this includes information from 1979 through 1995. Specific sampling periods for each environmental component are provided in the discussion of pre-development baseline data for each component. There is an exception to the above definition of temporal boundaries. The exception relates to sediment and benthic invertebrate data collected in 1996. During initial development of the McClean Lake Operation, it was necessary to dewater the future mine area, and intercept surface runoff waters that contained elevated levels of suspended solids. In 1996, these waters were collected and treated prior to discharge to the environment. During this time, a sampling program was undertaken to collect additional aquatic baseline data for sediments and benthic invertebrates downstream of effluent release. For the purpose of this evaluation, it is assumed that the non-industrial nature of the effluent and the level of water treatment prior to release would have had a negligible influence on these environmental components. Subsequently, the data collected for sediments and benthic invertebrates in 1996 are considered representative of baseline conditions.

1.6.4.2 Operational Period

The operational period extends from the end of the pre-development phase, as outlined above, until the present, which equals to 29 years of operation. This submission of the EP TID presents monitoring data to the end of December 2024, with a focus on the data collected in 2022-2024. Environmental studies conducted during this period have collected monitoring data that may be compared with baseline conditions. Specific sampling periods for each environmental component are provided in the discussion of operations data for each component. Key aspects of the McClean Lake Operation during this period include mining of the JEB pit, the Sue C, A, E and B

pits, and the operation of the McClean Lake Mill and JEB TMF, the JEB and Sue WTPs, the S/V TEMS, and the general mine infrastructure (accommodations, offices, and site roads).

1.7 Supplementary Studies

In addition to the evaluation of the EMP results to EA predictions, this EP TID also captures the results of supplementary studies undertaken to fill data gaps and address uncertainty, some of which have been raised through comments or concerns during regulatory review of EAs. The following supplementary studies are introduced in this EP TID:

- 2021-2022 Plume Delineation in McClean Lake East Basin
- 2021-2023 Fox and Pat Lake Sediment Study
- 2022-2024 Collins Creek Bankfull Capacity Review
- 2024 S/V TEMS Water Quality Monitoring Optimization
- 2023 Habitat Classification
- 2023 Rare Plant Checks
- 2024 Vegetation Surveys
- 2023-2024 Sink Upper Compartment Investigation
- 2023-2024 University of Saskatchewan Collaborative Bat Research
- 2024 University of Saskatchewan Collaborative Large Mammal Research
- 2024 Bena Lake Study
- 2024 Aquatic Surveys at Candy Creek and Caribou Lake
- 2024 Semi-Aquatic Furbearers Surveys
- 2024 Leopard Frog eDNA Surveys
- 2024-2025 Wildlife Camera Surveys
- 2024 Migratory Bird Nest Survey
- 2024 Aquatic Vegetation and Sediment Sampling
- 2024 Small Mammal Surveys
- 2024 Heritage Resource Impact Assessment for McClean Mining Extension

The supplementary study objectives, methodology, and results (if available) are presented in Sections 2, 3, 4, and 5. Information about the supplementary studies completed before the reporting period can be found in the 2016 and 2022 EP TID (AREVA, 2016b; Orano, 2022a).

1.8 Report Organization

The EP TID is subdivided into eight major sections:

- Section 1 Introduction
- Section 2 Physical Environment
- Section 3 Climate and Air Quality
- Section 4 Aquatic Environment
- Section 5 Terrestrial Environment
- Section 6 Culture
- Section 7 Waste and Substance Data Analysis
- Section 8 Conclusions

Sections 2 to 5 summarize impact predictions, describe the study design methodology, and present results of various environmental studies at the McClean Lake Operation LSA. They also include recommendations for monitoring adjustments. Section 6 provides background information on socio-economic aspects of the RSA. An overview of the operation's waste and substance management systems is provided in Section 7. Finally, Section 8 summarizes conclusions and recommendations for the EMP update from the previous sections.

1.9 References

AREVA. (2004). *McClean Lake Operation Sue E Project Environmental Impact Statement.* AREVA Resources Canada Inc.

AREVA. (2009). *McClean Lake Operation Caribou Project Environmental Impact Statement.* AREVA Resources Canada Inc.

AREVA. (2011). *Midwest Project Environmental Impact Statement.* AREVA Resources Canada Inc.

AREVA. (2016a). *McClean Lake Operation Technical Information Document, Environmental Performance, Volume 2 of 2 - Environmental Risk Assessment. Version 3, Revision 0.* AREVA Resources Canada Inc.

AREVA. (2016b). *McClean Lake Operation. Technical Information Document Environmental Performance, Volume 1 of 2 - Environmental Monitoring. Version 3, Revision 0.* AREVA Resources Canada Inc.

BCMOE. (2021). *Molybdenum Water Quality Guidelines for the Protection of Freshwater Aquatic Life, Livestock, Wildlife and Irrigation. Water Quality Guideline Series, WQG-07. Prov. B.C., Victoria B.C.* B.C. Ministry of Environment and Climate Change Strategy.

Burnett-Seidel and Liber. (2013). *Derivation of no-effect and reference-level sediment quality values for application at Saskatchewan uranium operations. Environmental Monitoring and Assessment. 185(11): 9481-9494.* Burnett-Seidel, C., and K. Liber.

Chapman et al. (2010). *Ecological assessment of selenium in the aquatic environment: Summary of a SETAC Pellston Workshop. Pensacola FL (USA): Society of Environmental Toxicology and Chemistry (SETAC).* Chapman PM, Adams WJ, Brooks ML, Delos CG, Luoma SN, Maher WA, Ohlendorf HM, Presser TS, Shaw DP.

CLMC. (1995). *Cigar Lake Project Environmental Impact Statement.* Cigar Lake Mining Corporation.

CNSC. (2020). *Correspondence: Akhter to Laniece. Orano - McClean Lake - Environmental Performance Monitoring - Aligning Monitoring and Reporting Requirements - CNSC Acceptance. Email dated on August 12, 2020.* Canadian Nuclear Safety Commission .

COGEMA. (1995). *The Midwest Project Environmental Impact Statement.* COGEMA Resources Inc.

COGEMA. (1998). *McClean Lake Project Fish Habitat Compensation Baseline Monitoring Report and Enhancement Design Schedule. Prepared by Conor Pacific Environmental Technologies Inc. Saskatoon, Saskatchewan.* COGEMA Resources Inc.

COGEMA and CLMC. (2001). *Disposal of Cigar Lake Waste Rock Environmental Impact Statement, August 2001.* COGEMA Resources Inc. and Cigar Lake Mining Corporation.

CSA. (2022). *Standard N288.6:22 Environmental Risk Assessments at Nuclear Facilities and Uranium Mines and Mills. Reaffirmed in 2022.* Canadian Standards Association (CSA).

DeForest et al. (2012). *Species sensitivity distribution evaluation for selenium in fish eggs: Considerations for development of a Canadian tissue-based guideline. Integr. Environ. Assess. Manag. 8: 6-12. .* DeForest, D.K., Gilron, G., Armstrong, S.A., and E.L. Robertson.

ECCC. (2022). *Federal Environmental Quality Guidelines—Selenium. Canadian Environmental Protection Act 1999. .* Environment and Climate Change Canada .

Iaccarino . (2003). *Science and culture: Western science could learn a thing or two from the way science is done in other cultures. EMBO reports, 4(3), pp. 220-3.* Iaccarino M. .

Joint Panel. (1992). *Guidelines for the Preparation of Environmental Impact Statements and Government Information Requests for the Cigar Lake and McArthur River Projects. Joint Federal/Provincial Panel on Uranium Mining Developments in Northern Saskatchewan.* Joint Panel.

Liber et al. (2011). *Toxicity of uranium, molybdenum, nickel, and arsenic to Hyalella azteca and Chironomus dilutus in water-only and spiked-sediment toxicity tests. Ecotoxicology and Environmental Safety, 74: 1171-1179.* Liber, K., Doig, L.E., and S.L. White-Sobey.

MacClaren and SRC. (1979). *Environmental Baseline Studies for Wolly McClean Lake Project Area. Interim Report No. 1. Prepared for Canadian Occidental Petroleum Ltd. Saskatoon, Saskatchewan.* MacLaren Plansearch and Saskatchewan Research Council.

Minatco. (1991). *McClean Lake Project Environmental Impact Statement. Volume 1, Chapters 1-6. August 1991. 30706-1.* Minatco Ltd.

Orano. (2018). *McClean Lake Operation Selenium Review and Assessment Report. July 2018.* Orano Canada Inc.

Orano. (2019a). *Correspondence: Huffman to Akhter Subject: Orano Canada Inc. - McClean Lake - Selenium review and assessment report - CNSC review comments regarding Orano's response dated November 22, 2018 to CNSC's initial comments. Dated June 24,2029.* Orano Canada Inc.

Orano. (2019b). *McClean Lake Operation Environmental Monitoring Design Document, Version 3. March 2019. Saskatoon, Saskatchewan.* Orano Canada Inc.

Orano. (2020a). *Correspondence: Laniece to Akhter and Merkowsky. Subject: McClean Lake Operation – Environmental Performance Monitoring – Aligning Monitoring and Reporting Requirements.* Orano Canada Inc.

Orano. (2020b). *McClean Lake Operation 2019 Annual Report. March 2020.* Orano Canada Inc.

Orano. (2021a). *McClean Lake Operation 2020 Annual Report. March 2021.* Orano Canada Inc.

Orano. (2021b). *McClean Lake Operation Waste Rock Management Technical Information Document. November 2021. Saskatoon, Saskatchewan.* Orano Canada Inc.

Orano. (2022a). *McClean Lake Operation Technical Information Document 2022 Environmental Performance. Volume 1 of 1. Version 1 Revision 0.* Orano Canada Inc.

Orano. (2022b). *McClean Lake Operation 2021 Annual Report. March 2022.* Orano Canada Inc.

Orano. (2023a). *McClean Lake Operation 2022 Annual Report. March 2023.* Orano Canada Inc.

Orano. (2023b). *McClean Lake Operation Environmental Monitoring Design Document, Version 4. December 2023. Saskatoon, Saskatchewan.* Orano Canada Inc.

Orano. (2024a). *McClean Lake Operation 2023 Annual Report. March 2024.* Orano Canada Inc.

Orano. (2025a). *McClean Lake Operation 2024 Annual Report. March 2025.* Orano Canada Inc.

Orano. (2025b). *Correspondence: Braithwaite to Frantik & Akhter Subject: McClean Lake Operation - Preliminary Decommissioning Plan and Financial Assurance Version 10. Dated January 31, 2025.* Orano Canada Inc.

Orano. (2025c). *McClean Lake Operation Tailings Management Technical Information Document. September 2025. Saskatoon, Saskatchewan.* Orano Canada Inc.

Palace and Gilron. (2025). *Regulatory issues surrounding the management of selenium—introduction to a special series of papers, Integrated Environmental Assessment and Management, Volume 21, Issue 1, January 2025, Pages 35–38 .* Guy Gilron, Vince Palace.

SMOE. (2013). *Environmental Performance Report Guideline. EPB 453. September 2013.* Saskatchewan Ministry of Environment .

SMOE. (2020). *Correspondence: Moulding to Laniece. McClean Lake Operation – Amendment of Condition 7.5.1 of Approval to Operate PO17-186. Dated on August 19, 2020.* Saskatchewan Ministry of Environment .

Thompson et al. (2005). *Derivation and use of sediment quality guidelines for ecological risk assessment of metals and radionuclides released to the environment from uranium mining and milling activities in Canada. Environmental Monitoring and Assessment 110:71-85.* Thompson, P.A., Kurias, J., and S. Mihok.

USEPA. (2016). *Aquatic life ambient water quality criterion for selenium—freshwater 2016. United States Environmental Protection Agency, Office of Water Report EPA-822-R-16-006.(revised 2021).* United States Environmental Protection Agency.

2 Physical Environment

2.1 Introduction

Information on the physical environment surrounding the McClean Lake Operation and Midwest Project area has been obtained through numerous field exploration and development drilling programs, and through the completion of a number of hydrogeological and hydrological studies. The physical environment discussion is divided into the following subsections.

- Section 2.2 provides a description of the hydrogeology. This section presents data from of each site within the McClean Lake Operation in terms of impact predictions, groundwater flow and chemistry, and operational impacts. Groundwater quality data collected at the McClean Lake Operation prior to its development in 1996 is presented to describe baseline conditions in the RSA.
- Section 2.3 provides a description of the surface hydrology. This section focuses on presenting hydrological information from nearby surface waterbodies within the McClean Lake Operation area in order to assess potential impacts on the local surface water regime.

The available geological information is primarily based on exploration activities, existing mine sites, and known deposits and presented in Appendix II.1. Information about the regional and local surface watersheds and drainage boundaries is presented in Appendix II.3.

2.2 Hydrogeology

The following sections present hydrogeological information obtained at the McClean Lake Operation between 1995 and 2024 with a focus on potential effects of the mining and milling operations on groundwater flow and quality within the current reporting period (2022 to 2024). Information on predevelopment groundwater quality collected from the McClean Lake Operation prior to its development is detailed in the 1991 McClean EIS (Minatco 1991).

Groundwater monitoring requirements for the current reporting period are detailed in the 2019 and 2023 EM DD (Orano 2019, Orano 2023a) which includes measurement of hydraulic head values and collection of water samples at groundwater monitoring wells situated at the McClean Lake Operation LSA (Figure 2.2-1). The monitoring results are used to improve the future predictions of groundwater response to mining activities and long-term solute transport through periodic updates to modelling of the Collins Creek basin. The most recent modelling results are presented in 2011 Hydrogeology and Groundwater Modelling of the Collins Creek Basin TID (Groundwater TID; AREVA 2011a).

With the incorporation of the Midwest Project into the McClean Lake Operation Operating License and the submission of the Midwest Project EIS, Midwest baseline groundwater monitoring information is also referenced. Groundwater conditions at the Midwest Project have been detailed previously in the 2009 Midwest EE TID (AREVA 2009c), the 2011 Midwest EIS (AREVA 2011b), and in the Groundwater TID (AREVA 2011a).

2.2.1 Study Area

The LAB is based on the local surface drainage systems, namely the Collins Creek, Moffat Creek, Smith Creek, and Nicholson Creek drainage basins. The combination of the McClean Lake Operation LSA and the Midwest Project LSA form the LAB (Figure 1.6-3). To characterize the hydrogeology within the LAB, information has been obtained through intrusive investigation and hydraulic testing of the hydrostratigraphic units potentially affected by mining activities.

In 2022 to 2024, the main sites monitored to characterize the current state of hydrogeology within the McClean Lake Operation LSA included JEB site, Sue site, Moffat Domestic Landfill, Sink Dam and the McClean Mining Site (former McClean Underground Mine site) (Figure 2.2-1). An overview of the main features on each site and monitoring locations is detailed with Section 2.2.4 Study Design and Objectives.

The McClean Lake Operation also includes two sites with undeveloped deposits:

- Sue F (former Caribou) site situated approximately 2 km northwest of the Sue site, the 2009 Caribou EIS (AREVA 2009b) outlines proposed development of this site

- Midwest site situated approximately 15 km west of the JEB site, the 2011 Midwest EIS (AREVA 2011b) outlines proposed development of this site

With the deposits remaining undeveloped, groundwater monitoring at Sue F and Midwest was removed from the EMP in 2020 and no data were collected during the 2022 to 2024 period.

2.2.2 Hydrostratigraphic Units

In general, hydrostratigraphy within the LAB can be discussed in terms of three main hydrostratigraphic units: basement rock, sandstone, and Quaternary deposits or overburden (Table 2.2-1). These are discussed below.

Hydraulic conductivity data has generally been established through specific hydrogeological field programs to determine baseline values, or through observations during mining such as dewatering influences. Hydraulic conductivity data is not routinely collected through the EMP and there are no new observations for this reporting period (2022 to 2024). A comprehensive discussion of the current hydraulic conductivity dataset can be found in the 2011 Groundwater TID (AREVA 2011a).

2.2.2.1 Basement Rock

The basement rock includes a variety of crystalline rocks, such as granitoids, gneisses, and graphitic gneisses. The deep fresh basement rock has a low hydraulic conductivity and acts as a low permeable lower bound to the active groundwater flow system above, although some flow can occur as a result of fracture-enhanced hydraulic conductivity. Overlying the fresh basement rock is a layer of weathered basement rock called the regolith. This material varies in thickness from a few meters to approximately 50 m and, in general, has a much lower hydraulic conductivity than the sandstone above it. The hydraulic conductivity of the regolith is either equal to or slightly greater than the hydraulic conductivity of the basement.

The basement rock was hydraulically tested through packer and slug tests in monitoring locations throughout the LAB. Tests were performed mainly in the regolith and the upper 50 m of the basement rock. A summary of hydraulic testing results is provided in Table 2.2-2. Hydraulic conductivity values range from 2.5×10^{-10} m/s to 1.8×10^{-5} m/s, with a geometric mean of approximately 1×10^{-7} m/s. The average hydraulic conductivity of the basement rock, including the regolith, is an order of magnitude lower than the hydraulic conductivity of the overlying sandstone (Table 2.2-2).

While these values represent bulk hydraulic properties of the basement rock, locally elevated hydraulic conductivity can be associated with fault and shear zones. Faults with a northeast-southwest orientation have been identified as having an increased permeability along these structures and make act as preferential flow paths.

2.2.2.2 Athabasca Sandstone

The Athabasca Sandstone directly overlies the basement rock, and ranges in thickness from 90 m at the JEB site and 45-100 m at the Sue site to 165 m at the McClean Mining site and 200 m at the Midwest site (Figure 2.2-2). Hydraulic conductivity within this unit is highly variable due to complex structural geology and local alteration (Table 2.2-2).

The Athabasca sandstone unit has a low hydraulic conductivity matrix but is fractured on both local and regional scales. Fracture-enhanced hydraulic conductivity is observed, depending on fracture density, orientation, and hydraulic conductivity of the individual fractures and faults present. Conglomerate-enhanced hydraulic conductivity is also observed, mainly in the basal member of the sandstone unit. As a result, the overall hydraulic conductivity of the sandstone is significantly higher than the hydraulic conductivity of the matrix only. At the scale of a few meters, the sandstone unit likely acts as a fractured media for flow with hydraulic contrasts depending almost on a single fracture. At a larger scale, the fracture density and the connection between fractures appear to be high enough that the sandstone acts in a hydraulically similar manner as a porous media.

Assuming that the sandstone acts as porous medium does not mean that there is no contrast in the hydraulic properties of the rock mass. In particular, contrasts in hydraulic conductivity between the upper and lower part of the sandstone have been observed. When less permeable, due to a finer matrix and fewer open fractures, the upper part of the sandstone can act as an aquitard or semi-confining layer separating the more permeable overburden and the underlying more permeable lower sandstone. In contrast, when the sandstone is more permeable, the upper part of the sandstone can act as a drain separating the less permeable overburden and the underlying less permeable lower sandstone. In addition, both the upper and lower parts of the sandstone are affected by major faults that influence the distribution of hydraulic heads.

Laboratory determination of hydraulic conductivity of the sandstone matrix at the JEB site (MacLaren and SRC 1980; COGEMA 1997) indicates that unfractured sandstone has a hydraulic conductivity that ranges from 5×10^{-11} m/s to 1×10^{-7} m/s. In general, the hydraulic conductivity of the unfractured sandstone matrix is very low, on the order of 10^{-9} m/s, and as a result, flow in the sandstone is expected to occur mainly in conglomeratic-beds and in open fractures and faults.

Field response tests including packer tests, slug tests (or single-well response tests), and pumping tests have been conducted to determine the hydraulic conductivity of the sandstone. The dewatering of the JEB pit has also provided response data. Packer tests and slug tests provide information representative of only a small volume

of rock in the immediate vicinity of the borehole. A large variability in hydraulic conductivity values may be expected with these methods. The mean hydraulic conductivity of the sandstone unit calculated from both packer tests and slug tests is on the order of 10^{-6} to 10^{-7} m/s.

Pumping tests and responses to pit dewatering provide information that is more representative of a larger sandstone volume and allow determination of hydraulic conductivity on a larger scale. The overall hydraulic conductivity calculated from pumping tests is slightly higher than that of the single-well response tests and is generally on the order of 10^{-5} to 10^{-6} m/s and is considered a reasonable estimate of the average bulk hydraulic conductivity of the Athabasca sandstone unit within the LAB.

2.2.2.3 Quaternary (Overburden) Deposits

The Quaternary strata refer to the most recently placed geological layers which overlie the Athabasca sandstone (i.e., surficial deposits or overburden). The surficial deposits have a glacial origin and are typically heterogeneous, with hydraulic conductivity varying by several orders of magnitude from one location to another, depending on the clay content and the abundance of boulders and large cobbles. The surficial deposits show a high degree of hydraulic continuity with the surface water system. In general, the zones of muskeg adjacent to lakes and streams have a water table close to the surface and at a similar elevation as the surface waterbody. The fluctuations in shallow groundwater and lake water levels are also comparable.

Hydraulic conductivity values calculated from packer and slug tests carried out in the Quaternary strata range from 5.3×10^{-8} m/s to 1.2×10^{-4} m/s, with a mean of approximately 4×10^{-5} m/s for the LAB (Table 2.2-2). The Quaternary strata is often referred to as overburden throughout this document. However, Overburden deposits have been categorized into three types – with differing hydraulic conductivity values:

- fine deposits with a high clay and/or organic content; this material has a low hydraulic conductivity of approximately 10^{-8} m/s;
- medium sandy deposits, including some pebbles but also some clay; the hydraulic conductivity of these deposits is approximately 10^{-7} m/s; and
- coarser material, with boulders and cobbles in a sandy matrix; this material has a higher hydraulic conductivity ranging from 10^{-6} m/s to 10^{-5} m/s.

2.2.3 Regional Groundwater Flow

The groundwater regime in the LAB has been subdivided into two major components: one associated with the surficial deposits or overburden and the second associated with the bedrock layers of Athabasca sandstone and weathered basement (AREVA 2011a). Water levels in the two flow systems are affected by seasonal fluctuations in precipitation and surface water features. In general, water levels are highest in September/October following significant groundwater recharge from precipitation and snow melt that occurs between May and September. Conversely, water levels are near their lowest values in April, following a reduced period of recharge between October and April.

Groundwater flow within the overburden is expected to show a much stronger influence of surface water and topography, with local discharge to smaller surface waterbodies.

Several geological units influence deeper groundwater flow according to their thickness, orientation, and hydraulic properties in the LAB. Regionally, deep groundwater flow is from west to east toward Wollaston Lake, where the lake level is at an elevation of 396.4 mASL, approximately 50 m to 60 m lower than groundwater levels in the McClean Lake Operation and Midwest Project areas. However, a topography and groundwater divide, corresponding to the eastern side of the Collins Creek watershed, separates these sites from Wollaston Lake. As a result, the topography generates a radial convergent deep groundwater flow, with a discharge zone along Collins Creek, south of McClean Lake. This is illustrated by the hydraulic head distribution in the sandstone units that indicate westward flow from the Sue site, eastward flow from the Midwest site and southwest trending flow from the JEB site. In addition to topography, groundwater flow within the sandstone unit at these sites is influenced by changes in transmissivity, as a result of changes in both thickness and hydraulic conductivity of the sandstone.

To support an improved understanding of groundwater behaviour and mine-water interactions, a series of numerical groundwater models were developed over time and summarized below in Section 2.2.4 Impact Predictions.

2.2.4 Study Design and Objectives

Figure 2.2-3 provides the conceptual site model for groundwater flows at the McClean Lake Operation. Groundwater monitoring requirements includes measurement of hydraulic head values and collection of water samples at groundwater monitoring wells situated at the McClean Lake Operation LSA (Figure 2.2-1). The following sub sections provides an overview of the main features, monitoring objectives and monitoring locations specific to each site situated within the LSA.

2.2.4.1 JEB Site

The JEB site encompasses the JEB TMF, JEB CWRP, McClean Lake Mill, Shop, JEB ore pad, and Fuel Farm. Monitoring locations are shown in Figure 2.2-4. Table 2.2-3 provides an overview of wells used for groundwater monitoring during the reporting period. Wells within the JEB site are used to:

- monitor hydraulic containment of the JEB TMF,
- inform the regional and local groundwater flow modelling,
- provide an indication of hydrocarbon contamination, and
- provide an indication of potential influence from the various mill circuits, JEB CWRP, and the JEB ore pad.

The 95-series, 96 series, and MW series of wells were installed to monitor the JEB TMF (near, mid and far field), the JEB CWRP, and the JEB Shop area. The following is a summary of notable monitoring additions and replacements since the installation of the 95 series, 96 series, and MW series:

- A number of wells were installed on the mill terrace in 2001-2016 to monitor various potential sources of contamination within the mill and associated facilities. These include: 01-06, 01-07, 05-07, 14-01, 14-03, 14-04, 14-05 (which replaced 05-06), 16-07, and 16-08, all of which were formally added to the groundwater monitoring program in 2019. Monitoring wells 13-05 and 14-02 were also installed on the

mill terrace during this time but 14-02 have since been decommissioned and 13-05 have been used for water levels only since 2017 (see following points below).

- A few additional wells were installed in vicinity of the mill terrace:
    - Monitoring well 16-01 was installed to replace 14-02 for the purpose of the ore pad monitoring in 2016. 14-02 was decommissioned because it was in the way of the construction of the Probable Maximum Precipitation (PMP) pond on the Mill Terrace.
    - Monitoring well 16-02 was installed for the purpose of increased monitoring downstream of the JEB ore pad.
    - Monitoring well 16-03 was installed as a replacement for water quality monitoring well 13-05 which previously replaced 95-13. The locations of 16-03 and 95-12 are primarily for leak detection of hydrocarbons from the JEB fuel farm and JEB shop area, as well as to monitor downstream for potential sources on the mill terrace.
- In 2007, three monitoring wells were installed on the JEB CWRP (07-08, 07-09, and 07-10). These wells were added to the EMP in March 2019 and are sampled every second year.
- In 2018, monitoring well 18-01D was installed to replace 95-01D, which had consistently been dry since installation.
- In the summer of 2019 monitoring well 19-01 was installed to monitor impact of a breach in the Yellowcake Precipitation circuit concrete.
- In the fall of 2021, monitoring wells 21-01, 21-02, 21-03, 21-04, and 21-05 were installed on and downstream of the mill terrace for future monitoring to better define groundwater flow in the vicinity of the mill terrace and provide a more comprehensive grid of wells to better delineate potential leak detection. Except for 21-03, these wells were added to the EM DD. 21-03 does not produce enough water for sampling, so it is not recommended for future monitoring.
- The inner (TW02, TW04, TW06, and TW07) and outer (TW01, TW03, TW05, and TW08) trend monitoring wells were within the footprint of JEB TMF Optimization/Expansion construction activities and the majority could not be maintained in their original configurations. TW04, TW06, and TW07 were modified into vibrating wire piezometers in 2013 and TW02 was transformed as a vibrating wire piezometer in 2019. TW01, TW03, and TW05 were decommissioned in 2018-2019. Thus, TW08 is the only monitoring well of TW series which was used to validate the JEB TMF hydraulic containment for the entire monitoring period. In 2019 TW08 was complemented with the 95 B series of wells which surround the JEB TMF (i.e., 95-01B, 95-02B, 95-03B, 95-04B, and 95-05B) to monitor and validate the TMF hydraulic containment (Orano 2019).
- In 2023, biennial water quality sampling was introduced at wells 96-05B, 96-06B, 96-07A and MW18 during the 2023 EMP update, with the first sampling scheduled for 2025.

2.2.4.2 Sue Site

The Sue Site encompasses the Sue B pit, Sue C/A pit, Sue C CWRP, Sue E pit, and the Sue E CWRP. Table 2.2-4 provides an overview of wells used for groundwater monitoring during the reporting period. Wells within the Sue site are used to:

- inform the regional and the local groundwater flow modeling,
- inform water balance for pit level equilibrium, and
- monitor for potential influence from the flooded mining pits, CWRPs, and the ore pad.

Figure 2.2-5 presents the locations and overview of the Sue site monitoring wells. The “97 Series” of wells were installed in 1997 to monitor the Sue C open pit and Sue C CWRP. In 2005, additional monitoring wells were installed in the lower sandstone and overburden in the vicinity of the Sue E pit including 05-01A/B, 05-02A/B, 05-03, 05-04, and 05-05A/B. These wells were installed to obtain pre-mining water level and groundwater quality information as well as to monitor parameters during mining of the Sue E pit . In 2007, monitoring wells 07-11, 07-12, and 07-13 were installed in the Sue C CWRP and monitoring wells 07-14 and 07-15 were installed in the Sue E CWRP. In 2014 14-06 was installed to replace 97-03C, but it has been dry since installation and is scheduled for decommissioning.

2.2.4.3 Moffat Domestic Landfill

The Moffat Domestic Landfill site is located approximately 2 km northwest of the Sue site within the Moffat Lake groundwater recharge area. The groundwater sampling was designed to monitor a potential release of contaminants to groundwater and transportation to the Moffat Lake. There are currently three groundwater monitoring wells being monitored in the vicinity of the Moffat Domestic Landfill (97-19, 04-01, and 04-02) (Table 2.2-5 and Figure 2.2-6). 04-01 and 04-02 were installed in 2004 to replace two previous wells, 97-20 and 97-21, respectively.

2.2.4.4 Sink Dam

Three monitoring wells were installed in the dam between the Sink Reservoir and Vulture Lake (i.e., S/V TEMS) to monitor flow through the Sink Reservoir Dam (Figure 2.2-7, Table 2.2-6). The water level measurements were taken bi-monthly. Water quality is not monitored at this location.

2.2.4.5 McClean Mining Site (former SABRE Test Site)

The McClean Mining site, (formerly the McClean Underground Mine site), located between McClean Lake and Candy Lake, is approximately 2.5 km west of the Sue site (Figure 2.2-8). Investigation of this site began in 1979 with an initial site reconnaissance and subsequently three major drilling campaigns, testing, and piezometer installations in 1980 and 1981 (Minatco 1991). Currently, a portion of the McClean mining site was developed as part of the SABRE test mining area (previously referred to as the MED program). In 2022, the site was cleared of equipment used during the 2021 mining test, and a 20-hole diamond drilling program on the mining pad was completed to confirm the resource estimate of Pod #1 (Orano 2023b). In 2023, McClean Mining site remained

in care and maintenance for the entire year (Orano 2024a). In 2024, a pad extension was completed, and four pilot holes were completed and an additional four were started which is scheduled for completion in early 2025 (Orano, 2025a).

Table 2.2-7 lists the monitoring wells in the McClean Mining sites. There currently seven monitoring wells in the that surround the mining pad, three were installed in lower sandstone at the mining depth, and four were installed in the overburden. The McClean Mining groundwater monitoring objectives include the following:

- hydraulic head monitoring establishes baseline water levels, determines the operational influences on the local water table, monitors water table recovery, and ensures the project operates in a under-pressured condition to create a net inflow into the cavity during active mining.

- groundwater chemistry monitoring confirms the absence of contaminant transport to the aquifer and overburden layers from drilling and mining activities.

In 2022 and 2023, one sample was collected from wells 13-01, 13-03, and 13-04. Two samples were collected from these wells in 2024. Wells 13-02, MED05-01, MED05-02, and MED05-03 and were sampled semi-annually over the reporting period. The monitoring results for the SABRE test mining program is the focus of discussion in this results section.

2.2.5 Impact Predictions

The 1991 McClean EIS (Minatco 1991) and 1995 Midwest EIS (COGEMA 1995b) provided initial hydrogeological predictions to characterize the expected influence of mine dewatering activities on the hydraulic head in the LAB. The predictions were based primarily on estimates of groundwater flow from lakes towards the JEB and Sue pits. In addition, impacts on lake levels were predicted from the cone of depression associated with the McClean Mining (former McClean Underground Mine) site (Minatco 1991). Initial contaminant transport predictions were also presented in the 1991 McClean and 1995 Midwest EIS documents for the post decommissioning period and these predictions are validated in the Tailings and Waste Rock TIDs.

Groundwater flow and contaminant transport predictions at the McClean Lake Operation have been revisited through a number of subsequent assessments that incorporate operational monitoring data. The assessments include the 2004 Sue E EIS (COGEMA 2004b), the 2009 Caribou EIS (AREVA 2009b), the 2011 Midwest EIS (AREVA 2011b), the 2020 Tailings Management TID (Orano 2020a), and the 2021 Waste Rock Management TID (Orano 2021). The Groundwater TID (COGEMA 2004a; AREVA 2011a) establishes the regional groundwater model for the Collins Creek basin and provides the basis for the localized submodels used in the subsequent EIS and TID assessments. In addition, a groundwater flow and solute transport report was prepared to support the JEB TMF Expansion project (Golder 2019).

The impact predictions in terms of pit dewatering, and groundwater quality are summarized in the following sections. It was not possible to compare individual monitoring well groundwater levels to the impact predictions because the predictions focused on general impacts during periods of peak pit dewatering and overall pit inflow rates, rather than providing well-specific groundwater level forecasts.

2.2.5.1 Dewatering of JEB Pit

During the development of the JEB pit, initial dewatering was planned to occur over a period of 21 months. The S/V TEMS was used to impound dewatering well water and control releases to ensure that total flows in Collins Creek would not be increased by more than 30% (COGEMA 1995e).

Initial predictions indicated that surface water elevations in Fox and Pat lakes would be slightly decreased by dewatering activities at JEB pit due to their proximity. The predicted water level decrease in Fox Lake was 0.05 m, while the decrease in Pat Lake elevation was predicted to be no more than 0.014 m (Minatco 1991). In contrast, Tail, Isis, Osiris, and Johannes lakes were predicted to experience little impact due to longer groundwater flow paths to the open pit (Minatco 1991).

Maintaining the JEB pit in a dewatered state was expected to have a limited influence on the water levels of Fox, Johannes, Pat, and Wallace lakes during the period of operations. Any influence on these lakes was expected to be hard to distinguish from natural lake level variability (COGEMA 1995e).

The 2011 Groundwater TID (AREVA 2011a) assessed the actual influence of JEB dewatering on nearby lakes. The TID analysis was generally consistent with the original assessment. Data collected during the early period of mining showed that the Isis and Osiris lakes experienced some decline in water levels in response to the dewatering of the JEB pit, but these levels recovered as dewatering rates were reduced. The other lakes in the JEB area did not exhibit a strong response to pit dewatering.

2.2.5.2 Dewatering of Sue Pits

It was predicted that Sue and Sils lakes would experience considerable drawdown or be completely dewatered from mining operations in the Sue area (Minatco 1991; COGEMA 1995b). The anticipated effects were attributed to their small, isolated drainage areas and close proximity to the Sue pits.

Post-mining water elevation data for Sue and Sils lakes is included in the 2011 Groundwater TID (AREVA 2011a). The data show that Sue Lake water levels were not significantly affected by mining activities, while Sils Lake does show some influence from the mining of the Sue E pit.

2.2.5.3 Groundwater Quality

The EIS, Tailings TID and Waste Rock TID assessments consider future contaminant transport through groundwater from sources on site such as waste rock and tailings and the resulting potential concentrations in receiving water bodies. As part of the analysis, baseline groundwater quality data was compared to operational monitoring data to identify spatial and temporal trends in groundwater quality. The results will allow for the identification of post decommissioning contaminant transport from the waste rock and tailings and validate predictions of groundwater flow paths from sources to receptors. The documents did not focus on long-term groundwater quality predictions but rather used the mass flux through groundwater as an input to long-term surface water quality predictions.

2.2.6 Operational Monitoring

This section discusses the groundwater monitoring program for the following sites: JEB site, Sue site, Moffat domestic landfill, the Sink Dam, and the McClean Mining (former SABRE test) site. Groundwater monitoring was performed as outlined in the 2019 and 2023 EM DDs (Orano, 2019, Orano 2023a) for the 2022 to 2024 reporting period. Methods and data analysis for both groundwater level and quality are first described, followed by results and findings for each of the sites.

2.2.6.1 Sampling Methods

Groundwater quality and hydraulic head monitoring methods and frequency are outlined in the EM DD (Orano 2023a), and a brief summary is provided below.

Water level is measured either manually using a dropline or using pressure transducers. Prior to collecting water samples, the well is purged. Purging is conducted to remove three pipe volumes or until the well is dry. After each purge, temperature, pH, and conductivity are measured; a sample is collected only after two consecutive conductivity readings are within 10% of each other. If the well is purged dry, the sample is collected after the well recharges.

Sampling containers are rinsed three times with sample water prior to sample collection. For areas with high iron content, inline filters are used in the field. All other samples are filtered at the site laboratory after sample collection. Samples are kept cool and out of direct sunlight. Samples are filtered and preserved as necessary and kept refrigerated until they are sent offsite for analysis.

The EM DD also outlines the QA/QC program for groundwater monitoring, which includes collection of duplicate samples, field blanks, sampler blanks, field spike samples, and trip blanks.

2.2.6.2 Data Analysis

Approaches to interpretation of groundwater level and groundwater quality data are described below. Both groundwater level and groundwater quality interpretations include consideration of the material the well is screened in (e.g., waste rock vs. basement rock vs. sandstone) as well as spatial location.

Initial Screening

Prior to conducting detailed data analysis, groundwater data was screened for completeness and to identify potentially erroneous data, duplicate entries, omissions and potential outliers. Performance criteria for groundwater level measurements is provided in Table 2.2-8 and for groundwater quality in Table 2.2-9. Performance criteria defined by Orano targets completion of 95% of planned water quality samples. Actual sample numbers were compared to planned sample numbers in each table for both all planned samples, as well as planned samples excluding problematic wells. A groundwater well was considered problematic when the monitoring wells had persistent issues such that water level measurements and/or water quality samples could not be collected (e.g., well is consistently dry). Specific details on problematic wells are described under the Monitoring Performance section (Section 2.2.6.3). Water quality QA/QC sampling frequency is also assessed in

Table 2.2.9; Orano also targets collection of field duplicates and field blanks samples equal to 10% of total samples.

Additionally, the QA/QC process for groundwater elevation data incorporated a comparison with well screen elevations, assessment of sampling remarks, and statistical evaluation using rolling Z-scores to identify outliers. Data flagged as being below well screens, collected under unsuitable conditions (e.g., frozen or dry wells), or identified as statistical outliers were carefully examined and excluded only if confirmed to be unreliable.

Evaluation Criteria

Groundwater evaluation criteria (EvC) have been proposed to identify potential impacts to the environment as per Annex B of Canadian Standards Association (CSA) N288.7:23. The following sub sections below summarizes the EvC for groundwater level and groundwater quality.

Groundwater Level

Groundwater level EvCs includes the following:

- EvC 1: Comparison to Pre-mining levels: If the current groundwater level is within two standard deviations of the pre-mining groundwater level, the groundwater level is deemed unimpacted. If it is outside of this range, it is advanced to EvCs 2 and 3.
    - It should be noted that while pre-mining groundwater levels serve as an initial screening tool, observed deviations from these baseline conditions do not inherently indicate operational impacts. Changes may simply reflect the natural variability of the groundwater table, rather than being attributable to site activities.

- EvC 2: Check for Artesian Conditions: If the groundwater well displays flowing artesian conditions, it is flagged for further investigation. Regardless of the outcome of EvC 2, water level is also screened against EvC 3.

- EvC 3: Check for directional trends: If the groundwater level does not display a significant increasing or decreasing trend, it is deemed unchanged. If a significant increasing or decreasing trend is identified, the well is flagged for further investigation. A significant trend is defined as change greater than ±0.5 m/year across the reporting period (2022 to 2024).

If a groundwater monitoring location is flagged as having a potential impact based on the above criteria internal reviews will be conducted by Orano to assess if (1) the conditions in the flagged well pose an environmental risk, and (2) if the cause of the conditions or trend are understood.

Groundwater Quality

Groundwater quality EvCs includes the following:

- EvC 1: Comparison to Detection Limits - all measured parameters were first screened against laboratory DLs. If less than 90% of a parameter's concentration for all monitoring locations at a given site were below the DL during the reporting period (2022 to 2024), then it was retained for further evaluation under EvC 2.

- EvC 2: Comparison to Reference dataset (Baseline and Background): Any result from the reporting period of a given parameter that is greater than 2 standard deviations above baseline (historical mean of baseline values) or background results (mean value) OR if baseline or background results are greater than 80% of the most conservative Saskatchewan Environmental Quality Guidelines (SEQG) Tier 1 for groundwater quality, (as shown in Table 2.2-10) the results should be considered in EvC 3. Since there is no reference data for wells situated in waste rock, groundwater data from the waste rock wells were compared to the highest value from other lithologies at the given site.

- EvC 3: Statistical Trend Assessment: Data will be analyzed using statistical methods (Mann-Kendall analysis) to identify increasing trends. Any data with a statistically significant change in trend will be identified. Data with a trend that indicates a potential negative impact to receptors (e.g., increasing concentration or decreasing pH) will continue to be evaluated by EvC 4.

- EvC 4: Comparison to Guidelines: Any data which exceeds EvCs 1 and 2 and satisfies EvC 3 will be evaluated against the SEQG where available. COPCs whose mean concentration exceed 80% of the value of the SEQG will be further investigated.

EvCs 1 and 2 were applied for COPC selection, while EvCs 3 and 4 were used for detailed data analysis for selected COPCs as described below.

Table 2.2-10 provides a comparison of mean background and baseline data to SEQG guidelines. Highlighted in this table are parameters for which the background and/or baseline data at the McClean Lake Operation site exceeds SEQG values.

COPC Selection

Although a full suite of parameters has been assessed, COPCs were identified through the screening process described in Section 1.6.2.4 with use of EvCs 1 and 2 described above. The COPC screening was implemented for each site (JEB, Sue, Moffat Domestic Landfill, and McClean Mining) separately. The screening results are shown in Tables 2.2-11 to 2.2-14. The COPCs specifically addressed for each site in this report are:

COPCs	JEB	Sue	Moffat	McClean Mining
General Chemistry, Major Ions, and Field Parameters				
Total Alkalinity (as CaCO3)	Yes	No	Yes	Yes
Bicarbonate (as HCO3)	Yes	No	Yes	Yes
Ammonia (as N)	Yes			
Nitrate	Yes	Yes	Yes	No
Nitrate + Nitrite (as N)	Yes	Yes	Yes	No
Fluoride	Yes	Yes	No	Yes

Chloride	Yes			
Sulphate	Yes			
Calcium	Yes			
Magnesium	Yes			
Potassium	Yes			
Sodium	Yes			
Sum of ions	Yes			
Hardness, Total	Yes			
Total Dissolved solids (TDS)	Yes			
Total suspended solids	Yes			
pH, Field	Yes			
Specific Conductivity, Field	Yes			
Metals and Trace Elements				
Aluminum, Dissolved	Yes	Yes	No	Yes
Arsenic, Dissolved	Yes			
Barium, Dissolved	Yes			
Beryllium, Dissolved	No[2]	Yes	No	No
Boron, Dissolved	Yes	Yes	Yes	Yes
Cadmium, Dissolved	Yes			
Chromium, Dissolved	Yes			
Cobalt, Dissolved	Yes			
Copper, Dissolved	Yes			
Iron, Dissolved	Yes			
Lead, Dissolved	Yes			
Manganese, Dissolved	Yes	Yes	No	Yes
Molybdenum, Dissolved	Yes			
Nickel, Dissolved	Yes			
Selenium, Dissolved	Yes			
Silver, Dissolved	Yes			
Strontium, Dissolved	Yes			
Tin, Dissolved	No	No	No	Yes
Titanium, Dissolved	Yes	Yes	No	Yes
Uranium, Dissolved	Yes			
Vanadium, Dissolved	Yes			
Zinc, Dissolved	Yes			
Radionuclides				
Lead-210, Dissolved	Yes			
Polonium-210, Dissolved	Yes			
Radium-226, Dissolved	Yes			
Thorium-230, Dissolved	Yes			

Orange shading indicates parameters historically considered as COPC.

Detailed Data Analysis

Groundwater Level

The data analysis methodology used for groundwater levels is similar to the approaches used in the 2022 EP TID and also align with CSA guidelines (N288.7:23). The approach focuses on ensuring the consistency and completeness of the groundwater data.

Groundwater elevation time series plots were created for each monitoring well and for each monitoring area to visually compare the data to other nearby monitoring wells as well as to identify trends. These groundwater elevation time series plots are supplemented by statistical analyses to meet data interpretation requirements in the CSA guidelines (CSA 288.7:23, Clause 9.2). The statistical methods include:

- **Rolling Z-Score Analysis**: This method is used to detect outliers in groundwater elevation datasets by identifying abrupt changes or anomalies relative to the short-term variability of the data. This approach calculates deviations from the local mean within a defined rolling window, making it effective for spotting unusual values that could indicate data errors, measurement inconsistencies, or sudden environmental shifts.

- **Mann-Kendall Analysis**: This analysis can identify significant trends over time, whether increasing, decreasing, or stable. This is used to support and quantify visual trends in the groundwater elevation plots. By detecting long-term trends, the analysis provides insights into possible changes occurring in the groundwater system.

Groundwater head contour maps and cross-section diagrams are also used to investigate groundwater level data and to satisfy the CSA recommendations (Clause 9.2.2). Groundwater level measurements have undergone a review to ensure groundwater elevation surveys are carried out consistently at approximately the same time each year to satisfy recommendations in the CSA guidelines (Clause 7.7.2.6).

Groundwater Quality

The groundwater quality analysis included herein builds on that conducted in the 2022 EP TID, with additional methods and approaches selected to address regulator comments and enhance interpretation. As with groundwater level, monitoring locations were grouped based on site (JEB, Sue, Moffat Domestic Landfill, and McClean Mining) as well as the material the well is screened in (unconsolidated waste rock, overburden, upper sandstone, lower sandstone, and basement). For the JEB and Sue sites, monitoring locations are further separated into sub-groups based on their spatial location and monitoring purpose.

Groundwater quality monitoring is frequently compared to reference datasets to investigate changes in quality after mining activities commenced. Two reference datasets are used for groundwater quality interpretation: baseline and background data. Baseline data was collected from monitoring wells during the period before mine impacts are expected. Background data refers to monitoring wells that are located in areas expected to be unimpacted by mining activities. Orano has identified background wells and baseline data (location and time period of baseline monitoring); this information is summarized in the Groundwater TID (AREVA 2011a). Summary statistics for data from background wells throughout the McClean Lake Operation site are provided in Table 2.2-15 and major ion chemistry is shown on a piper plot in Figure II.2-5-1 (key statistics) and II.2-5-2 (all background data). It is noted that there are no background locations screened in basement rock. Baseline summary statistics are provided for each site and are included each site's subsection.

For interpretation, a combination of visual/graphical and statistical methods have been used, each of which is summarized below:

- **Piper Plots:** These plots show the major ion chemistry of groundwater and group samples into water-type classifications. These plots have been used to identify differences in major ion chemistry between monitoring locations at a site group or sub-group as well as to applicable baseline and background data.

- **Statistical Summary Tables and Box & Whisker Plots:** Sample count, minimum, maximum, and standard deviation for each location for the period of 2022-2024 as well as pre-2022 was tabulated. Box & Whisker Plots were also used to visualize summary statistics for the most recent ten years of data and compare to reference data.

- **Time Series Graphs:** Times series graphs have been generated for all parameters identified as COPCs. Mean values for applicable baseline and background datasets are also shown on the graph as are minimum method detection limits, and the SEQG (which references the AB Tier 1 Groundwater Quality guidelines) if one exists for the parameter. Where a calculation is required for the SEQG (e.g., guidelines that vary by hardness or pH), the value shown is representative of typical conditions, but may not apply to each series. Visual inspection of the data and comparison to relevant reference data and guidelines is used to compliment the statistical trend analysis (described below).

- **Statistical Trend Analysis:** The groundwater quality time series is accompanied by statistical analyses, which are referenced in Section 9.2 of CSA N288.7:23, which in turn references United States Environmental Protection Agency (U.S. EPA) QA/G-9S. The Mann-Kendall (MK) Analysis, or a derivation of this method, has been used. This analysis can identify significant trends over time, defining whether the trend is increasing, decreasing, or stable. Data from 2011-2024 was considered, and MK was performed if there were four or more distinct results (the practical minimum). Furthermore, if more than 40% of the results were at or below the detection limit, no MK analysis was performed for that parameter at the given location. The following were then applied:
    - Outliers were identified using the Tukey method. Values outside the upper and lower fence were excluded from the trend analysis.
    - Autocorrelation was tested using a Ljung-Box test. If autocorrelation was suspected, trend-free pre-whitening (TFPW) MK test was also performed. If no autocorrelation was suspected, only standard MK was performed.
    - For locations sampled twice per year for a minimum of four years, a Seasonal MK test (two seasons, SMK2) was performed. For this test, samples were divided into two “halves” or “seasons” of the year (January to July and August to December). For locations sampled quarterly, a Seasonal MK test (four seasons, SMK4) was performed with results divided into quarters. If there was more than one sample in a given “season” the data points in that “season” were averaged, and the average value used.

  A parameter at a given location could therefore have up to three trend analyses performed: standard MK, trend-free pre-whitening MK, and Seasonal MK. If a statistically significant trend was detected in any of the tests performed, the trend was noted as either increasing or decreasing and the Sen’s Slope was reported for Standard and TFPW MK tests. It is important to note that the trend analysis was performed on data from 2011-2024. Visual checks of the time series data were also performed to check for recent changes in data over the reporting period.

In addition to the approaches described above, interpretation of water quality results in groundwater also included review in context of the Groundwater Conceptual Model (Figure 2.2-3), groundwater flow direction, and the stated purpose of the monitoring location (e.g., hydrocarbon results for fuel areas).

2.2.6.3 Results

A discussion of results for each site is provided below, with most detailed plots and tables provided as appendices. Appendices include:

- Appendix II.2-1: Groundwater Level Statistics
- Appendix II.2-2: Groundwater Evaluation Criteria
- Appendix II.2-3: Groundwater Level Trend Analysis
- Appendix II.2-4: Groundwater Quality Box & Whisker Plots
- Appendix II.2-5: Groundwater Quality Piper Plots
- Appendix II.2-6: Groundwater Quality Statistical Summaries
- Appendix II.2-7: Detailed Groundwater Quality Data
- Appendix II.2-8: Groundwater Quality Time Series Graphs
- Appendix II.2-9: Groundwater Quality Trend Analysis

Monitoring Performance

As discussed previously, groundwater monitoring conducted during the reporting period (2022 to 2024) was performed in accordance with 2019 EM DD (for 2022 to 2023) and 2023 EM DD (for 2024). In 2024, Orano defined performance criteria for all aspects of the monitoring program to ensure a complete dataset was collected to achieve EMP objectives and comply with the CSA N288.4 standard (CSA 2025). A target of 95% completion was set for planned groundwater level measurements and water quality sampling.

Orano's staff attempted to collect data at all monitoring wells as per the monitoring requirements and target performance criteria, but it was not always possible to collect a representative sample or measure the water level due to various potential issues such as insufficient water volume (dry well) or recharge, or were frozen, or otherwise non-functional for natural reasons. Below target sampling could also be associated with well damage, disturbance, or equipment malfunction. These wells were flagged as poor performing wells which are defined as monitoring wells that had persistent issues such that water level measurements and/or water quality samples could not be collected.

Actual measurements and sampling completed were compared to planned targets and presented in Table 2.2-8 (water level) and Table 2.2-9 (water quality). This comparison was completed for all monitoring locations, both including and excluding poor performing wells. The comparison showed that the water quality sampling target was achieved, if poor performing wells are excluded. Water quality QA/QC sampling frequency is also assessed in Table 2.2-9; Orano targets collection of field duplicates and field blanks samples equal to 10% of total samples, and the comparison indicates that this goal was met. The water level measurement target was not achieved.

Specific details on poor performing wells for each site and the most prominent issues which affected continuity of the monitoring data for the current reporting period are described in the sub sections below.

JEB Site

Wells 95-06, 96-05B, 96-06B, 96-07A, 96-08, 95-08, 95-09, 07-08, 07-09, 07-10, MW11, MW12 and MW18 were not sampled for groundwater quality in 2024, as they are scheduled for biennial monitoring (as per 2023 EM DD), which will occur in 2025.

Poor performing wells for JEB Site are identified in Table 2.2-3 and the following list provides an overview of the most prominent issues at each of these which affected continuity of the monitoring data during the reporting period:

- 95-03A had extremely slow recharge throughout the monitoring period. No groundwater quality samples were collected.
- 95-04D was damaged or blocked throughout the reporting period. No groundwater quality sampling or water level data was obtained.
- 95-05C, 95-05A, and 96-07A have become artesian.
    - Water quality results are still available for these locations.
- 95-08 is a deep well that is frequently frozen over the colder months. No groundwater level data was obtained in February, April, and December 2022, as well as in February, April, and October 2023.
    - Water quality results are available for 2022 and 2023.
- 95-09 was buried under snow from December 2022 to April 2023. No groundwater level data was obtained for the period.
- 95-12 was dry in October 2024, so no groundwater quality sampling or water level data was obtained Q4 of 2024.
- 95-15 was decommissioned in 2021 and was removed from the EMP in 2023.
- 96-03C, 96-03B, and 96-03A have become artesian.
    - Water quality samples are available for 96-03C (four samples over reporting period), 96-03B (one sample), but not 96-03A
- 96-05B was frozen in April of 2023 and one water level measurement was missed. No other water level measurements were missed between 2022 and 2024. No groundwater quality sampling was completed.
    - Biennial water quality sampling at this well was introduced only during the 2023 EMP update with the first sampling scheduled for 2025.
- 96-06B has a high water elevation and freezes over the colder months. No groundwater level data was obtained from January to May 2022 and December 2022 to May 2023.
    - Biennial water quality sampling at this well was introduced only during the 2023 EMP update, with the first sampling scheduled for 2025.
- 96-07A has been artesian and frozen during the colder months. Water levels have not been obtained since 2022.
    - Biennial water quality sampling at this well was introduced only during the 2023 EMP update, with the first sampling scheduled for 2025.

- 96-07B is blocked and was slated to be removed from the EMP. No groundwater level or quality data was obtained in 2022 to 2023.
- MW18 is a shallow well with high water elevation which frequently freezes in the winter and is dry in the summer. No groundwater level data was obtained from January to September 2022 and March to July 2023.
    - Biennial water quality sampling at this well was introduced only during the 2023 EMP update, with the first sampling scheduled for 2025.

Sue Site

Wells 07-13, 07-12, 97-15, 97-09, 97-10, and 97-11 were not sampled for groundwater quality in 2024 but will be sampled in 2025 as per the 2023 EM DD.

Poor performing wells for Sue Site are identified in Table 2.2-4 and the following list provides an overview of the most prominent events which affected monitoring during the reporting period:

- 97-01C, 97-05C, 97-12, 97-14, 97-16, 05-02B, and 05-05B were often dry or frozen and never produced enough water for groundwater quality sampling during the reporting period.
- 97-01B was broken and buried under snow during the winter months. No groundwater level data was obtained in February, April, and December 2022 as well as February and April 2023.
- 97-08B is a shallow well and frequently frozen. No groundwater level data was obtained in February and April 2022, February and April 2023, and February 2024. Only one groundwater quality sample was collected in 2023 (instead of the planned two samples).
- 97-18 was buried under snow in February 2022 and 2024 so it was not possible to collect water level data.
- 05-01B is frequent dry and often doesn't not have enough water for groundwater quality sampling. Sampling was completed only twice from 2022 to 2024. One groundwater level reading was missed in 2022, and two in 2023, due to the well being dry.
- 14-06 was dry since installation. The well is scheduled for decommissioning.

Moffat Domestic Landfill

No erroneous data or data gaps were identified at the Moffat Domestic Landfill monitoring wells (97-19, 04-01, and 04-02) during the reporting period. All scheduled groundwater level measurements and groundwater quality samples were collected as required. As such, the dataset for this period is considered complete and representative of site conditions.

Sink Dam

No erroneous data or data gaps were identified at the Sink Dam monitoring wells (95-15, 95-16, and 95-17) during the reporting period. All scheduled groundwater level measurements were collected as required. As such, the dataset for this period is considered complete and representative of site conditions.

McClean Mining Site

No erroneous data or data gaps were identified at the McClean Mining monitoring wells. Sue 03-03 well was reported to be broken in 2021 which did not allow for groundwater sampling or water levels. Sue 03-03 was removed from the EMP in 2023.

JEB Site

Dewatering Operations

Monitoring observations associated with the dewatering of the pit over the operational period are discussed as follows. Full time pit dewatering at the JEB site began in March 1996. A series of perimeter dewatering wells and an in-pit sump were used to dewater the JEB pit during mining. Maximum pumping during mining operations reached approximately 12,000 m^3/day with the pit dewatered to about 360 mASL. Reflooding of the JEB pit began in 1999. While operating the JEB pit as a TMF, pond water levels have increased over time corresponding to tailings placement. Figure 2.2-9 shows the location of the JEB TMF and dewatering wells, and the hydraulic head in the sandstone for the fully dewatered JEB pit condition. Currently, the observed hydraulic head distribution indicates significant recovery of groundwater levels as the JEB TMF pond level has increased from 447.998 mASL in Q1 2024 to approximately 449.305 mASL as of Q4 2024 (Figure 2.2-10).

To prevent the migration of COPCs from the tailings, the JEB TMF is designed and operated to maintain hydraulic containment. The containment strategy has evolved over time as the water level has risen in the TMF. Historically, containment was achieved by pumping from the base drain as well as the perimeter dewatering wells. Groundwater flows to the JEB TMF pond and/or base drain were pumped to the mill for use in the process or to the JEB WTP for treatment before discharge to S/V TEMS. The dewatering wells were rendered ineffective once the JEB TMF pond level rose above the overburden/sandstone contact. The dewatering wells were shut down in 2014 and their decommissioning was initiated in 2017 following a decommissioning plan approval by SMOE (PC17-031 – April 24, 2017; Orano 2018) and the CNSC (CNSC 2017). As shown on Figure 2.2-9 the majority of dewatering wells have been decommissioned. Hydraulic containment is presently maintained by pumping from the base drain raise well and pond reclaim systems. The 2025 Tailings Management TID (Orano 2025b) fully discusses the hydraulic containment of the JEB TMF and associated infrastructure changes over time.

Groundwater Flow

Detailed groundwater level statistics and results of the Mann-Kendall trend analysis for monitoring wells in the JEB area can be found in Appendix II.2-1 and Appendix II.2-3. A summary of the groundwater level evaluation results is presented in Appendix II.2-2.

Groundwater flow in the JEB area has been influenced by previous operational activities associated with dewatering of the JEB Pit and by current operations of the TMF. Prior to the commencement of mining operations, groundwater flow within the Athabasca sandstone unit was generally directed to the southwest, broadly following the regional topographic gradient. Flow within the overburden was primarily towards the west, with Fox Lake likely acting as a local discharge area. Groundwater level data obtained prior to mining of the JEB pit and during the operation of the TMF are presented in Table 2.2-16. It should be noted that several 96-series

monitoring wells in the JEB area have current hydraulic heads above initial recorded values. This is because dewatering of the TMF began in March 1996 and the first readings were taken later that year. Therefore, the water table defined as “initial” for these wells was already affected by dewatering activities and therefore not true static pre-mining baselines.

Dewatering of the JEB Pit, which began in 1996, resulted in decreased water levels in the overburden, Athabasca sandstone, and basement units relative to baseline conditions (Figure 2.2-11). Peak dewatering rates between 1996 and 2002 led to a maximum drawdown of approximately 40 m in sandstone monitoring wells near the pit. The area of drawdown extended up to 400–500 m from the pit crest, beyond which the observed change in hydraulic head was negligible. Throughout the period of peak dewatering, the piezometric surface in the overburden had lowered but remained largely controlled by surface topography, while the water table in the sandstone was significantly lowered.

In 1999 the JEB open pit was converted into the JEB TMF and water management transitioned from simple dewatering to the hydraulic containment of the placed tailings. Since 1999 the pond water level of the JEB TMF has gradually risen to maintain a water cover over the tailings. Programs to expand the TMF capacity began in 2013 (optimization stage 1) and continued in 2018 (optimization stage 2). After completing optimization stage 1 the TMF pond level moved above the sandstone/overburden contact and since then has been higher than the natural groundwater elevation. In 2019 the first stage of the TMF expansion program was conducted allowing the pond level to move higher again. Each increase in the TMF pond level leads to a corresponding adjustment in the head differentials required between the containment monitoring location (CM05) and Fox Lake to maintain hydraulic containment. Over time this adjustment allows ongoing recovery in groundwater levels around the TMF.

The relationship between pit dewatering and subsequent hydraulic containment of the JEB TMF can be seen by plotting a hydrograph of groundwater monitoring data collected from the area such as the multi-level monitoring wells 95-01A, 95-01B, and 95-01C. Figure 2.2-11 shows a decrease in groundwater levels during initial mining of the JEB pit and then a staged recovery that corresponds to gradual re-flooding of the JEB TMF as tailings are deposited and the tailings pond level rises. Groundwater hydrographs for these and a number of other monitoring wells are routinely presented in the McClean Lake Operation Quarterly and Annual Environmental Reports and are not repeated herein.

Dewatering of the JEB Pit and the resulting of drawdown of groundwater levels in the sandstone led to local reversals in hydraulic gradients, changing some areas of naturally downward groundwater flow to upward flow. Recovering groundwater levels reached the upper sandstone in 2020 as a result of the first stage of the TMF expansion project, restoring flow gradients to their natural downward direction. Figure 2.2-12 shows the upward flow gradient between 1995 and 2020, and its subsequent return to the natural flow gradient for monitoring wells pairs 95-02A/95-02C (basement/upper sandstone) and 96-09A/96-09B (lower sandstone/upper sandstone).

Flow directions in the sandstone and basement units have changed in response to the changes in TMF dewatering rates and increases in the JEB TMF Pond level. Pre-development groundwater level measurements indicated natural groundwater flow in the basement rock generally trended north to south (Figure 2.2-13) while flow in the sandstone followed a south-westerly direction consistent with the regional topography (Figure 2.2-14). Until 2022, mapping of the hydraulic head distribution in both upper and lower sandstone units (Figures 2.2-15 and 2.2-16) indicated that JEB TMF operations drew groundwater radially toward the TMF base drain, although a residual regional gradient to the southwest remained. The 2023 increase in the JEB TMF pond

elevation has resulted in the pond level exceeding the groundwater elevation of several surrounding near-field wells, and the regional hydraulic head contours no longer indicate a convergence of groundwater flow towards the JEB TMF. However, the hydraulic containment of the JEB TMF continues to be achieved by maintaining the base drain water elevation at least 1 m below the Fox Lake water elevation (Golder 2021).

Pre-development groundwater level measurements in the overburden indicated natural groundwater generally trended to the west (Figure 2.2-17) with a natural lateral hydraulic gradient estimated at approximately 0.01 m/m. The direction of groundwater flow is influenced by the presence of a drumlin east of the pit and differences in recharge. The flow direction can be attributed to the relative elevation of the drumlin landform located east of the pit together with a potentially higher rate of groundwater recharge. Consequently, Fox Lake likely acts as a local discharge zone for groundwater flow in the overburden. Results from the groundwater modelling in 2016 indicated the presence of a groundwater divide along the mill terrace. As a result, structures located on the east side of the mill terrace would form flow paths for contaminants to be transported to Johannes Lake, while contaminants originating from the fuel farm or slurry receiving on the west side of the terrace would be transported to Pat Lake (Orano 2020b).

Similar to the sandstone and basement units, water levels in the overburden no longer display radial flow towards the TMF. Instead, groundwater flow in the overburden is showing a renewed trend to the west, consistent with pre-development conditions. During the 2022–2024 reporting period, ten overburden monitoring wells (01-07, 05-07, 14-05, 16-03, 16-07, 16-08, 21-02, 21-05, MW11, and MW12) located along the southern and eastern boundaries of the JEB Mill Terrace and the JEB CWRP recorded annual declines in groundwater levels ranging from -0.52 to -0.91 m (Appendix II.2-2) These declines can be attributed to below average precipitation observed during this period, rather than ongoing pumping of the JEB TMF (Figure 2.2-18).

Three wells screened in the basement (95-03A, 95-04A, 95-05A) and two wells in the lower Sandstone (95-05B, TW08) have shown annual increases in groundwater levels over the reporting period (0.53 to 1.37 m in the basement; 0.59 to 0.73 m in the lower Sandstone). These increasing trends are consistent with the reduction of pumping activities at the TMF and the resulting rise in TMF pond level. Monitoring well 95-05B has been observed to be artesian and exhibits a significant increasing trend in groundwater level, indicating a need for continued observation (Appendix II.2-2).

Four additional monitoring wells; 96-03A (Lower Sandstone), 96-03B (Upper Sandstone), 96-03C (Overburden), and 96-07A (Lower Sandstone) were identified for ongoing review (Appendix II.2-2) due to artesian conditions (Figure 2.2-19). These wells should be secured with a well cap or downhole packer to prevent possible flowing artesian conditions. Continued monitoring of these locations is recommended due to there location between the TMF and Fox Lake.

Groundwater Quality

Data Overview

A summary of baseline groundwater chemistry for the JEB site is provided in Table 2.2-17; detailed pre-development groundwater chemistry was presented in the 2011 Groundwater TID (AREVA 2011a). Piper plots summarizing JEB Baseline and McClean Lake Operation Background data and showing all JEB baseline data are provided in Figures II.2-5-3 and II.2-5-4. Samples from both baseline and background locations are Calcium/Magnesium Bicarbonate Type waters. Mean values for field pH in JEB baseline were 7.2 for the

overburden, 7.3 for the upper sandstone, 6.5 for the lower sandstone, and 7.2 for basement wells (Table 2.2-17).

Results for groundwater chemistry are grouped by (i) geologic unit the well is screened in and (ii) spatially based on the groupings and sub-groupings in Table 2.2-3. Detailed results are shown in the following appendix tables and figures: box plots for comparing JEB operational monitoring data to baseline are shown in Figure II.2-4-1 to II.2-4-294. Statistical summaries for all JEB wells comparing data from the reporting period to previous data (pre-2022) is provided in Tables II.2-6-1 to II.2-6-73. Time series graphs for COPCs for the JEB wells are provided in Figures II.2-8-1 to II.2-8-120. Results from statistical trend analysis for JEB are provided in Tables II.2-9-1 to II.2-9-73. Results for the different areas of the JEB site are discussed below.

Mill Terrace

Mill terrace monitoring has occurred since 1996 with the purpose of monitoring various potential sources of contamination within the mill and associated facilities. All monitoring in the mill terrace occurs the overburden, which has 14 wells installed (95-12, 01-06, 01-07, 05-07, 14-03, 14-04, 14-05, 16-03, 16-07, 16-08, 19-01, 21-01, 21-02, and 21-05) (see Figure 2.2-4 and Table 2.2-3). All of these locations were monitored semi-annually during the reporting period.

As noted in the groundwater flow section, groundwater flow in the mill terrace area is expected to be towards Johannes Lake on the east side of the Terrace (including the areas around SX Circuit, Yellowcake Precipitation Circuit, Sulphuric Acid Plant, CX Plant, and Sludge Farm) and towards Pat Lake on the west side of the Terrace (including the areas around the Fuel Farm and Slurry Receiving) (Orano 2020b) (Figure 2.2-20). Based on this, discussion of monitoring results in the mill terrace area is grouped by groundwater flow direction as:

- Towards Johannes Lake: 01-06, 01-07, 05-07, 14-04, 14-05, 16-07, 16-08, 21-01, 21-02, and 21-05
- Towards Pat Lake: 95-12, 16-03, 14-03, 19-01

Prior to 2024, four incidents have occurred where concrete floor slabs were breached, potentially releasing fluids to the ground under the buildings, including two in the CX Plant, one in the Yellowcake Precipitation Circuit, and one in the Sulphuric Acid Plant. The concrete was repaired immediately after discovery in each of these incidents; they were reported immediately, investigated, and follow up reports were completed. Follow up actions included the installation of monitoring wells downgradient of potential sources of contamination for the long-term monitoring of groundwater. In response to the Sulphuric Acid Plant incident, increased monitoring was implemented in two wells: one near and one downgradient of the Sulphuric Acid Plant berm (14-05 and 16-08) until the end of 2020. Additionally, groundwater well 21-02 was installed further downstream of the Sulphuric Acid Plant and SX Circuit in 2021. Routine monitoring continued during the 2024 monitoring program. In February 2024, a breach occurred to the concrete floor slab in the Yellowcake Precipitation Circuit; the spilled solution was pumped back into the Yellowcake Precipitation Circuit and the remaining contaminated soil was removed by vacuum truck (Orano 2025a).

Mean results for each location over the 2022 to 2024 reporting period are shown in Table 2.2-18 with colour coding to indicate parameters with statistically significant trends. While results for all COPCs are listed in Table 2.2-18, only select parameters will be discussed below, based on the monitoring purpose of the location and

potential impacts from mining activities. The focus of discussion is on changing trends in water quality and will include discussions of:

- **Field pH and Total Alkalinity:** Field pH is a key indicator in the groundwater monitoring around the Mill Terrace due to the presence of the Sulphuric Acid Plant and floor breaches in this plant; low and/or decreasing trends in field pH and alkalinity may indicate influences from plant processes.

- **Indicators of impacts from mill reagents:** Piper plots were used to assess the major ion chemistry. Furthermore, parameters sulphate, nitrate, ammonia, chloride, dissolved barium, and sodium were assessed as they are all potential indicators of impact from mill processes. Sulphate is used in a number of processes in the Mill Terrace area, including the use of sulphuric acid and ferric sulphate in the tailings preparation process (TPP) (Orano, 2025b). Elevated nitrogen species may result from breaches in the CX Plant floor, as ammonium is used in this facility. Barium chloride, sodium carbonate, and sodium hydroxide are all used as a reagents in the mill.

- **Select metals:** Aluminum, cadmium, cobalt, copper, iron, nickel, manganese, uranium and zinc were also assessed as they were either above 80% of the SEQG at multiple wells or included due to changes or variability between wells. Dissolved strontium was also included; there is no SEQG value for strontium, but there are increasing trends at some locations.

Based on the monitoring results groundwater flowing to Johannes Lake can be characterized as follows:

- Field pH and Total Alkalinity:
    - Field pH for most wells in the area reporting to Johannes Lake fall within the range observed in the JEB baseline overburden wells (i.e. pH 6.3 to 8.1), aside from 14-05 (mean for the reporting period of 6.0, also had a decreasing trend for alkalinity) and 16-08 (mean for reporting period of 5.2) (Table 2.2-18). 16-08 also has low alkalinity, with concentrations below the detection limit (1 mg/L as $CaCO_3$) since 2019 (Figure II.2-8-58). Field pH for all wells in the Mill Terrace area is shown in Figure II.2-4-59. Additionally, decreasing trends in field pH were noted for 14-04, 16-07, and 21-05; both 14-04 and 16-07 have a decreasing trend for total alkalinity as well.

- Potential indicators from mill reagents:
    - Major ion chemistry is shown for the mill terrace as piper plots in Figure II.2-5-5. Water in the overburden is expected to have bicarbonate as the dominant anion (based on baseline and background monitoring (Figure II.2-5-3), but wells 14-05, 16-08, and to a lesser extent 14-04 and 21-02, are dominated by sulphate in the anion space.
    - Sulphate concentrations decreased markedly in 16-08, from around 3,000 mg/L in 2017-2020, to 170 mg/L in 2024 (Figure II.2-8-58, Table II.2-6-67) - indicating improving water quality at this well. On the other hand, sulphate concentrations in 14-05 increased over the reporting period, from 150 mg/L in 2022 to 660 mg/L in 2024 (Figure II.2-8-58, Table II.2-6-61). The remaining wells expected to report to Johannes Lake had sulphate concentrations below 80% of the SEQG during the monitoring period.
    - Note that 14-05 has a decreasing trend for sulphate over the period of 2011-2024 but results over the reporting period (2022-2024) have consistently increased (Figure II.2-8-58 and Tables II.2-6-61 and II.2-9-14). This well highlights a limitation in trend analysis methods like Mann-Kendall,

which summarize monotonic trends over the entire period, potentially masking non-linear behaviour or reversals that occur within the period investigated. Visual checks and professional judgement are still required to assess if a subset of the data deviates from the longer period trend.

- 16-08 had the highest ammonia and nitrate concentrations of all JEB Mill Terrace Wells (Figures II.2-4-45 and II.2-4-46), although concentrations have generally decreased from 2022 onwards (for nitrate) and from 2020 onwards (for ammonia) (Figure II.2-8-58). Other wells with elevated nitrate include 05-07, 14-04, 14-05, 21-02, and to a lesser extent 01-06 and 14-05. Of these wells, increasing trends were identified for 05-07 and 14-04 (Table 2.2-18). Aside from 16-08, ammonia concentrations in this area were similar to the baseline mean (Figure II.2-4-45). The SEQG value for ammonia is pH and temperature dependent (value increases at lower pH and temperature); since well 16-08 had a mean field pH of 5.2 and temperature of 6.4ºC over the reporting period, it remains below the SEQG for ammonia, despite a mean concentration of 160 mg/L. Ammonia concentrations at 16-08 have decreased from ~600 mg/L as N in 2020 to <100 mg/L as N in 2024 (Table II.2-6-67).
- Only 14-05 had an increasing trend for chloride, and concentrations for all wells in this grouping (those reporting to Johannes lake) were well below the SEQG value of 100 mg/L (Table 2.2-18).
- Increasing trends in sodium and dissolved barium were identified for 05-07 and 14-04, although the concentrations are well below the SEQG value of 200 mg/L for sodium and 2.0 mg/L for barium (Table 2.2-18). Well 16-08 had the highest sodium concentrations, but displays a decreasing trend, with concentrations decreasing from >100 mg/L in 2018 to <50 mg/L in 2024.

- Metals: Several trends in dissolved metals concentrations were noted:
  - Dissolved aluminum concentrations exceeded SEQG values at two wells in this grouping (i.e. 16-08 and 21-02), although increasing trends were not identified for any well (Table 2.2-18).
  - Dissolved cadmium concentrations were above the SEQG at 14-04, 16-08, 21-01, and 21-02 (Figure II.2-8-62); baseline concentrations for the JEB site also exceed SEQG (Tables 2.2-10 and 2.2-18). Only 21-01 had dissolved cadmium concentrations above two standard deviations of baseline mean. In terms of trends, dissolved cadmium concentrations at well 16-08 have decreased since 2020 and have increased of late in well 14-05, although concentrations at 14-05 remain within baseline and background concentrations (Table 2.2-18).
  - Dissolved copper at 14-04 and 14-05 was above the SEQG. 14-04 had an increasing trend for the period of 2011 to 2024 while 14-05 had no trend (Table 2.2-18). Dissolved copper concentrations at 14-04 did decrease from 2022 to 2024 (from ~0.1 to ~0.06 mg/L).
  - Dissolved manganese exceeded the SEQG at a number of wells (Table 2.2-18 and Figure II.2-8-57). No increasing trends were identified.
  - Dissolved strontium trended to display similar trends to sulphate, including decreasing in 16-08, increasing in 14-05 (recent data only) and 01-07 (Figure II.2-8-60).
  - Dissolved cobalt and nickel concentrations remained higher in 16-08 than both 14-05 and 21-02 (Figure II.2-4-62), although nickel concentrations in 16-08 and 14-05 converged in more recent data (Figure II.2-8-59).
  - Dissolved uranium concentrations were also elevated at 05-07 but have been decreasing since 2016, although no statistically significant trend for uranium was identified for this location over the 2011-2024 period (Figure II.2-8-64 and Table II.2-9-11). The increase and decrease in concentrations at this well occurred within the time frame being assessed for trend analysis, and the MK analysis detects monotonic trends (consistently increasing or decreasing trends), so no

trend was identified for this well. Despite the decreasing trend, the mean concentration dissolved uranium at 05-07 over the reporting period is approximately three times the SEQG.

Wells on the west side of the groundwater divide which capture groundwater flowing towards Pat Lake from the mill terrace can be characterized as follows:

- Field pH and Total Alkalinity:
    - Field pH values fell within the range observed in the JEB baseline for overburden (i.e. pH 6.3 to 8.1) aside from 19-01 (mean for reporting period of 5.9) (Table 2.2-18). The only well in this area with a decreasing pH trend was 16-03; the other three wells had no trend in pH. No trend was identified for alkalinity in any of the four wells.

- Potential indicators from mill reagents:
    - Wells 14-03 and 19-01 both had increasing sulphate concentrations, but concentrations are relatively low (means of 21 and 23 mg/L, respectively, compared to the SEQG guideline of 130 mg/L).
    - Nitrate and ammonia concentrations either had no trend or were decreasing at 95-12, 19-01, and 16-03, while concentrations had an increasing trend at 14-03, although concentrations are below the SEQG at 14-03. While there was no statistically significant trend at 19-01, nitrate (and nitrate + nitrite) concentrations are above the SEQG, and concentrations have increased from ~10 mg/L in 2020 to almost 20 mg/L in 2024 (Table 2.2-18 and Figure II.2-8-98).
    - The highest chloride concentrations were measured at 16-03 (reporting period mean of 20 mg/L at 16-03) which is significantly below the SEQG of 100 mg/L and no trend was noted. Only 14-03 had an increasing trend however, the mean concentration for the reporting period was 4.8 mg/L which is well also below the SEQG (Table 2.2-18).
    - Barium and sodium concentrations were identified as having an increasing trend at 14-03, although concentrations are below SEQG values (Table 2.2-18).

- Metals:
    - Dissolved manganese concentrations were above the SEQG at all wells reporting to Pat Lake except well 14-03, however no increasing trends were noted (Figure II.2-4-98).
    - At 16-03, dissolved aluminum was above the SEQG but did not show an increasing trend. At this location, a single measurement in 2024 was abnormally high and skewing the mean for the reporting period (Figure II.2-8-98 and Table 2.2-18). The second sample collected in 2024 had typical concentrations.
    - Dissolved copper, nickel, and zinc were above the SEQG at 19-01 (Figure II.2-8-99). Dissolved nickel and zinc concentrations increased between 2019 (start of monitoring at this location) and 2022, but concentrations have decreased since 2022. Dissolved copper at 19-01 increased sharply in 2022 but does not show a continuous increasing trend.
    - Dissolved uranium concentrations was slightly elevated above the SEQG at 19-01 (mean of 11 µg/l compared to SEQG of 10 µg/L) however concentrations have been relatively stable since monitoring began at this location in 2019 (Figure II.2-8-104) with no trends observed.

In summary, changes in groundwater quality and some exceedances in SEQG were observed within the mill terrace monitoring wells potentially as a result of the 2024 floor breaches from the Sulphuric Acid Plant, CX Plant and Yellowcake Precipitation circuit. Some increasing trends with limited and localized effects were noted, but no overarching trend for the whole area was observed.

Ore Pad Monitoring Wells

Results in the Ore Pad Area (95-10, 14-01, 16-01, 16-02, MW07A, 21-04), which is situated between the JEB TMF and Mill Terrace, are discussed as a single group. Monitoring in this area occurs exclusively in the overburden, and during the reporting period occurred semi-annually. Mean results for each location over the reporting period are shown in Table 2.2-18 along with colouring to indicate parameters with statistically significant trends. While results for all COPCs are listed in Table 2.2-18, only select parameters will be discussed below, based on the monitoring purpose of the location and potential impacts from mining activities. These parameters include:

- **Major Ion Chemistry and Field pH:** Major ion chemistry and field pH are useful indicators of changing conditions in groundwater.
- **Hydrocarbons:** Wells 95-12 and 16-03 were specifically installed to monitor for leaks from the fuel and shop areas.

Based on the monitoring results, the groundwater quality at the ore pad wells were characterized as follows:

- Major Ion Chemistry and Field pH:
    - Major ion chemistry is shown for the ore pad as a piper plot in Figure II.2-5-6. Ore Pad wells are consistent with background and baseline data aside from 14-01, which has sulphate as the dominant anion (as opposed to bicarbonate). In this area, well 95-10 had a decreasing trend in field pH, although values in the most recent data are still within the baseline range (Tables 2.2-17 and 2.2-18 and Figure II.2-8-50). 16-01 was also identified as having a decreasing pH trend, but this may be influenced in part by a single measurement of 6.0 in 2024, which is lower than other data from the reporting period (typically ~7.3).
    - At well 95-10, chloride concentrations increased sharply in 2024 compared to previous results. Although concentrations are still relatively low (peak concentration <3.0 mg/L), this should continue to be monitored.
    - Sulphate concentrations at 14-01 are increasing with results in 2023 and 2024 >150 mg/L. Nitrate concentrations at 14-01 have consistently exceeded the SEQG or 80% of this value since monitoring began at this location. A more detailed discussion of water quality at 14-01 is included below.

- Hydrocarbons: Monitoring wells 95-12 and 16-03 were installed to monitor for leaks of hydrocarbons from the fuel and shop areas. Hydrocarbon analysis consisted of benzene, ethylbenzene, F1 hydrocarbons (C6-C10), F2 hydrocarbons (C10-C16), F3 hydrocarbons (C16-C34), F4 hydrocarbons (C34-C50), toluene, xylene, xylene m and p, and xylene o. All results for these parameters were below detection in the reporting period for both locations. Hydrocarbon analysis was also conducted at 21-01 in 2024, which is located near ammonia and kerosene storage; all results were below detection.

- Well 14-01: At well 14-01, several parameters had increasing trends including dissolved selenium and uranium. Dissolved selenium concentrations have surpassed SEQG, while two results for uranium were greater than 80% of the guideline value. Major cations, sulphate, field specific conductivity, TDS, and sum of ions also increased at 14-01, indicating increasing impacts of water with elevated dissolved constituents. The major ion chemistry at 14-01 is distinctly different than other overburden wells in the ore pad area as shown in the piper plot (Figure II.2-5-6). 14-01 has the highest dissolved arsenic concentrations of all mill terrace and ore pad wells, although concentrations were below the SEQG. Furthermore, 14-01 had the steepest rate of sulphate increase (Sen's Slope of ~10 mg/L per year); given the above, this well should continue to be monitored.

JEB TMF

Monitoring around the JEB TMF occurs in the following sub-areas (Table 2.2-3):

- Adjacent to the TMF in the Lower Sandstone (Containment Indicator Wells),
- Adjacent to the TMF in the Overburden, Upper Sandstone, and Basement (Nearfield Wells),
- In the Overburden and Upper and Lower Sandstone (Midfield Wells), and
- At a distance in the Overburden and Upper and Lower Sandstone (Farfield Wells).

A summary of mean groundwater concentrations during the 2022 to 2024 period with colour coding showing trend analysis results is provided in Table 2.2-19. Parameters that exceed 80% of the SEQG are also highlighted in this table, regardless of their evaluation criteria. Detailed results of the evaluation criteria screening and trend analysis are provided in Appendix II.2-9.

While monitoring in the TMF area is grouped by proximity to the TMF, the following paragraphs also examine wells grouped based on direction of groundwater flow from the TMF with the purpose of identifying directional differences/trends in water quality. As noted in the Groundwater Flow section, groundwater flow in the sandstone units was towards the TMF after the start of dewatering of the JEB pit in 1996 to the start of reflooding in 1999. Even after the start of reflooding, the TMF remained a hydraulic sink.; As of 2022, due to reduced pumping rates from the TMF base drain, the water level in the TMF reached a level such that pre-mining gradients (generally from the northeast to the southwest) were restored although hydraulic containment is maintained through continued pumping from the base drain which maintains a localized gradient towards to the TMF.

As monitoring of groundwater around the TMF is conducted to ensure hydraulic containment of the TMF is maintained, discussion of the groundwater quality in this report is focused on COPCs anticipated to exhibit the most significant changes if hydraulic containment is compromised. This includes:

- **Sulphate:** the mean sulphate concentrations in TMF pond water was 3,567 mg/L in 2024 (Orano, 2025a), and mean baseline sulphate concentrations at the JEB site (Table 2.2-17) and background data for McClean Lake Operation (Table 2.2-15) for overburden and upper and lower sandstone were <5.0 mg/L. Sulphate is not typically impacted by sorption processes and is expected to travel conservatively unless a saturation limit is reached. Even if some mineral precipitation were occurring (e.g., gypsum), sulphate concentrations would still be expected to increase.

- **Chloride:** the mean chloride concentration in TMF pond water was 164 mg/L in 2024 (Orano, 2025a), compared to <2.5 mg/L in background and JEB baseline data (Tables 2.2-15 and 2.2-17). Like sulphate, chloride is expected to travel conservatively in this setting, and mineral saturation is not expected at the range of concentrations in the TMF.

- **Specific conductivity:** this field measurement can indicate increasing dissolved constituents and is therefore also a useful indicator. Specific conductivity in TMF Pond water had a mean of 5,790 µS/cm in 2024 (Orano, 2025a). JEB baseline (Table 2.2-17) and McClean Lake Operation background (Table 2.2-15) had means <70 µS/cm.

Additional parameters selected for discussion in the following section are:

- **Field pH and Major Ion Chemistry:** field pH and major ion chemistry are useful indicators of overall water quality in an area, and changes may indicate changing conditions in groundwater.
- **Metals:** dissolved metals which exceed SEQGs in multiple wells are discussed. This includes aluminum, arsenic, iron, and manganese.
- **Radionuclides:** a brief discussion on dissolved uranium and radionuclides is included.

Based on the monitoring results, groundwater quality of the other JEB TMF monitoring wells can be characterized as follows:

- Sulphate, Chloride and Specific conductivity: Concentrations for these parameters remain well below the SEQG in TMF monitoring wells, with mean concentrations ≤20 mg/L for sulphate, ≤6 mg/L for chloride, and ≤190 µS/cm for specific conductivity (Table 2.2-19). In context, these values were also significantly low relative to 2024 TMF pond water data (Orano 2025a), suggesting that TMF water has not migrated to these locations and hydraulic containment is being maintained.

- Field pH and Major Ion Chemistry:
    - Field pH across TMF monitoring wells was typically circum-neutral (6.5 to 7.5), although a number of wells had mean pH values for the reporting period below 6.5 including overburden wells: MW20, 96-03C, 96-02C and lower sandstone wells: 96-09A , 96-02A , 95-09, TW08, 95-02B, and 95-03B (Table 2.2-19).

    - Major ion chemistry in TMF monitoring wells (Figures II.2-5-7 to II.2-5-9) is largely similar to background and baseline monitoring (Figure II.2-5-3) with the exceptions of 95-05D (Nearfield, overburden) and 96-03C (Midfield, overburden), which have calcium as the major cation as opposed to a mixed cation signature. Note that TDS in nearfield and midfield overburden wells was typically <100 mg/L, so small changes in concentration can result in changes to the major ion proportions. 95-05 and 96-03 wells are both situated to the west/northwest of the JEB TMF. 96-09B (midfield, upper sandstone) had one anomalous point in 2024 due to a large increase in number of major ions including sulphate, calcium, chloride, nitrate, potassium, sodium, magnesium. This single measurement will need to be confirmed by 2025 results, as it is atypical compared to historical monitoring at this location. Alkalinity and bicarbonate at 96-09B did not show a major change from 2022/2023 to 2024.

- Metals:
    - Aluminum: Reporting period mean concentrations for dissolved aluminum exceeded the SEQG in overburden wells 96-03C and 18-01D and upper sandstone well 96-01B. For all three locations, one elevated result was likely skewing the mean. While dissolved aluminum should continue to be monitored, no trends were identified, either spatially or with time.

    - Arsenic:
      Lower Sandstone Wells: Dissolved arsenic concentrations in lower sandstone wells have been relatively stable. Notably, wells 96-04 and 95-06 (both lower sandstone, located northeast of the TMF) had dissolved arsenic concentrations above the mean baseline concentration (but within two standard deviations of the mean). Concentrations of dissolved arsenic at these two locations have been relatively stable across the monitoring period. The highest dissolved arsenic concentrations around the TMF occurred in the lower sandstone at wells 95-01B and 95-04B. 95-01B is located upgradient of the TMF to the north/northeast, while 95-04B is located to the southwest. Mean concentrations during the reporting period for both wells were above the SEQG (values of 29 and 7.7 µg/L for 95-01B and 95-04B, respectively, compared to the SEQG of 5.0 µg/L), and both displayed increasing trends over the period of 2011 to 2024, with slopes of 0.14 and 0.02 µg/L/year (Tables II.2-9-29 and II.2-9-32). Arsenic concentrations at 95-01B increased between 2004 and 2016 but have been relatively stable from 2016 onwards at ~30 µg/L (Figure II.2-8-107). Increases at 95-04B were gradual; since 2000, dissolved arsenic concentrations increased from ~ 6.0 to 8.0 µg/L. All locations highlighted above are not expected to have been impacted by the TMF due to their location and groundwater flow directions, and rather likely highlight the variability, and relatively elevated arsenic concentrations in the lower sandstone in this area.

      Upper Sandstone Wells: Wells 96-03B (mean for reporting period of 6.3 µg/L) and 95-05C (mean for reporting period of 10 µg/L) also had mean dissolved arsenic concentrations above the SEQG; 96-03C is located to the south of the TMF, and 95-05C to the west/northwest. Concentrations at 96-03B have been relatively stable for the full monitoring period of this well, which started in 2005. Dissolved arsenic concentrations at 95-05C increased between 2005 to 2015 and have remained relatively stable since then. Another upper sandstone well, 96-02B had an increasing trend in dissolved arsenic and the mean concentration for the reporting period is >80% of the SEQG; the rate of increase is low (Sen's slope of 0.1 µg/L per year [Table II.2-9-50]). Overall, dissolved arsenic concentrations in the upper sandstone around the JEB TMF are relatively stable.

      Basement Wells: Dissolved arsenic concentrations in overburden and basement wells were all <1.0 µg/L aside from 95-05A (basement). At 95-05A, dissolved arsenic was both greater than two standard deviations above the mean and displayed an increasing trend (mean for reporting period of 2.5 µg/L, and Sen's Slope of 0.04 µg/L/year [Table II.2-9-71]).

    - Iron and Manganese: Several locations in the vicinity of the TMF had dissolved iron and manganese concentrations above the SEQG. Note that both iron and manganese in baseline and JEB background data are elevated above SEQG in certain units. As with arsenic, this includes wells located in the Farfield and to the northeast (upgradient) of the TMF. The highest mean dissolved iron concentration for the reporting period was at 95-05C, with a value of 3.7 mg/L (compared to the SEQG of 0.3 mg/L). A number of other upper and lower sandstone monitoring

wells had mean concentrations above SEQG, including upper sandstone wells 96-02B, 96-03B, 95-04C, and 95-05C, and lower sandstone wells 95-01B, 95-04B, 95-05B, 95-08, and 96-04. Basement wells 95-02A and 95-05A also had mean dissolved iron above SEQG (Table 2.2-19). The highest mean iron concentration in the overburden was 0.27 mg/L (96-03C). 95-08, near Pat Lake, has had increasing dissolved iron concentrations since 2008 (Figure II.2-8-115). Concentrations are still within the range of results for this well. This location is characterized by elevated chloride concentrations relative to other lower sandstone wells and may be influenced by a different water type. As with iron, dissolved manganese exceeded the SEQG of 0.020 mg/L in many monitoring wells. The highest mean reporting period result was 1.6 mg/L at 95-04C (Upper Sandstone).

- Dissolved Uranium and Radionuclides: Dissolved uranium concentrations across JEB TMF monitoring wells were below 80% of the SEQG of 10 µg/L, and no increasing trends were identified (Table 2.2-19). 95-05A (basement) had elevated dissolved uranium relative to other locations around the TMF between 2010 and 2020, but concentrations decreased from 2020 onwards, and recent results are consistent with other basement monitoring wells and the baseline mean. 95-02C (upper sandstone) had increasing lead-210 concentrations, and concentrations that now exceed two standard deviations from the mean baseline value. Concentrations are still below the SEQG.

TW08, which is a TMF containment indicator well located on the eastern side of the TMF in the lower sandstone, is the near field well with the most distinct water chemistry and had several increasing trends indicating an increase of impacted water (e.g., TDS, specific conductivity, sulphate, nitrate). Field pH at this well has been slowly decreasing (ranging from 6.0 to 6.4 over the reporting period), but alkalinity and bicarbonate are increasing, suggesting that there is still neutralization capacity in this area. The nitrate concentrations and positioning of this well may indicate that water quality at this location is being influenced by the waste rock pile.

In summary, the JEB TMF continues to maintain hydraulic containment, with no overarching trends or spatial patterns identified in the whole area.

JEB Clean Waste Rock Pile, Waste Rock Area, and Industrial Landfill Monitoring

Water quality monitoring occurs in the JEB CWRP (07-08, 07-09, and 07-10, all completed in unconsolidated waste rock), the waste rock area (MW11 and MW12 in overburden, and 96-08 in the lower sandstone), and in the Industrial Landfill area (MW16, completed in overburden). 95-15 (overburden, Industrial Landfill Area) was destroyed and has been replaced by MW16. MW16 is scheduled to be monitored annual, but only one result is available at this time, so no trend analysis could be conducted on this well. A summary table showing mean values for the reporting period along with colour coding showing trend analysis results is provided in Tabel 2.2-20. Detailed results of the evaluation criteria screening and trend analysis is provided in Appendix II.2-9. A piper plot for wells in this area is shown in Figure II.2-5-10. Examination of water quality in this area focused on:

- **Major ion chemistry and Field pH:** Field pH and major ion chemistry are useful indicators of overall water quality in an area, and changes may indicate changing conditions in groundwater. Major ions such as bicarbonate and calcium are higher in wells in waste rock than typical JEB site wells, so changes in these concentrations may indicate influences from waste rock.
- **Nitrate:** Nitrate concentrations are elevated in monitoring wells in waste rock compared to other JEB site wells. Increases in nitrate may indicate influence from waste rock runoff.

- **Metals:** Dissolved aluminum was included as multiple locations exceeded the SEQG value. Dissolved uranium was also included to examine concentrations in waste rock.

Based on the monitoring results, groundwater quality monitoring wells in this area can be characterized as follows:

- Major Ion Chemistry and Field pH:
    - Major ion chemistry was largely similar to background and baseline monitoring, although the unconsolidated waste rock had a higher proportion of calcium in the major cations compared to overburden (MW11 and MW12) and lower sandstone (96-08) monitoring in the waste rock area (Figures II.2-5-10 and II.2-4-9). 96-08 had increasing trends noted in some of the major ions (Table 2.2-20).
    - Field pH in the unconsolidated waste rock was typically around 6.0 (Figure II.2-4-17). MW11 had similar pH, whereas MW12, was closer to pH 7.0. In the lower sandstone, well 96-08 had a mean pH of 5.8 for the reporting period. Well MW16 had a single measurement of 6.4.
- Nitrate:
    - Nitrate concentrations in the JEB CWRP wells was expectedly higher than other JEB monitoring locations (Figure II.2-4-4) however trends were either stable or decreasing in the three CWRP wells.
    - At MW11, within the overburden, nitrate concentrations showed a decreasing trend since 2019 and remained below SEQG of 13 mg/L, with a mean value of 2.0 mg/L during the 2022 to 2024 period.
    - 96-08 (lower sandstone) has an increasing trend in nitrate and is now exceeding the SEQG (Tables 2.2-20 and II.2-9-5). The rate of increase at 96-08 is ~1.0 mg/L, and the reporting period mean was 14 mg/L.
- Metals
    - Dissolved aluminum was above the SEQG value for MW11 and MW16 (single result) (both overburden). As with other locations at the JEB site, MW11 has a single result that is higher than typical; if this value is removed, the reporting period average falls below 80% of the SEQG value.
    - Results dissolved uranium in the waste rock wells were 0.3, <0.1, and 1.6 µg/L for 07-08, 07-09, and 07-10 (Table 2.2-20). Results for overburden and lower sandstone wells in this area were typically below detection of 0.1 µg/L.

In summary, monitoring in and around the JEB CWRP and landfill yielded largely stable results across COPCs, with the exception of lower sandstone well 96-08 which had increasing trends in some COPCs.

Sue Site

Dewatering Operations

Initial dewatering of the Sue area began in 1997 during the mining of the Sue C pit and continued until 2002. Groundwater was then allowed to flood the Sue C pit until June 2004, when pumping was resumed in preparation for mining of the Sue A pit. Water was pumped from the Sue C/A pit until October 2009, after which it was allowed to flood naturally until 2011. Seasonal pumping, typically between June and October, has been conducted since 2011. In 2024, the pit water was drawn down between July and October. The purpose of the seasonal pumping is to partially dewater the Sue C/A pit to maintain hydraulic containment of the Sue mining area, and to keep water levels below the bottom of the contaminated waste landfill in Sue C so that additional waste can be placed in this location.

Mining of Sue E commenced in September 2005 and was completed March 2008. Dewatering in the Sue E pit began in the second half of 2006 and ended in 2008.Special waste from the Sue B pit was placed in the Sue E pit once mining was completed after which a till cap was placed over the waste to provide separation between the waste rock and the pit lake waters to improve the long term quality of Sue E pit lake. Mining of Sue B began in June 2007 and was completed in November 2008. Dewatering of the Sue B pit was initiated in early 2008 and the pit has been re-flooding naturally since December 2008, after which a layer of clean waste rock was placed on the bottom. Since then, water has been pumped out of the Sue B pit intermittently either directly into the Sue WTP (2011 to 2012) or into Sue C (2013 to 2021) (Orano 2021). No water has been pumped from the Sue B pit since 2021 as the water level remained below the full supply eleavation, with hydraulic head measurements in the area responding accordingly.

Groundwater Flow

Detailed groundwater level statistics and results of the Mann-Kendall trend analysis for monitoring wells in the JEB area can be found in Appendix II.2-1 and Appendix II.2-3. A summary of the groundwater level evaluation results is presented in Appendix II.2-2.

Sue area mining activities were initially predicted to result in partial or complete dewatering of the Sue and Sils Lakes (COGEMA 1995b). As discussed in Section 2.3 (Hydrology), observation and monitoring data indicated that water levels in Sils Lake decreased between 2005 and 2007 due to mining activities but have since recovered and limited water level elevation changes have been observed at Sue Lake since 2003. Despite dewatering the sandstone unit beneath Sue Lake during Sue C pit operations, the lake's surface water level remained generally unchanged. Similarly, dewatering of the Sue E pit did not appear to significantly influence the surface water level in Sils Lake, despite the water table in both the overburden and the sandstone layers being significantly dewatered.

This suggests that the both the Sue Lake and Sils Lake, became "perched" with respect to the water table in the underlying formations. These observations at Sue and Sils Lakes, are similar to what was observed at Fox and Pat Lakes during mining of the JEB open pit which suggests that most lakes in the study area exhibit a limited hydraulic connection with the underlying sandstone aquifer during the time frame that the pits were developed.

Figure 2.2-21 shows a groundwater elevation contour map for the sandstone aquifer under pre-mining conditions. Pre-mining groundwater flow in the Sue area was directed to the west towards McClean Lake and Collins Creek. The horizontal hydraulic gradient is much greater immediately west of the Sue C pit, as compared to the area further to the west between Candy Lake and McClean Lake. This decrease in the horizontal hydraulic gradient is believed to be the result of variation in the transmissivity of the sandstone in this area, which in turn is due to variations in the sandstone thickness. The thickness of the sandstone unit ranges approximately from 45 to 100 m in the Sue area and increases to 180 m near McClean Lake (COGEMA 2004a).

In the Sue E pit area, a southwest groundwater flow component is also apparent towards Telephone Lake. The difference in flow patterns is due to the locations of the pits. A drumlin is present to the northeast of the Sue pits, which results in a localized mounding of groundwater and a groundwater divide (AREVA 2011a). The Sue C/A and B pits are located closer to this groundwater divide than the Sue E Pit. The current potentiometric head cross-section in the Sue pits is presented on Figure 2.2-22.

As a result of dewatering at the Sue C/A and Sue E Pits, water levels in monitoring wells installed in the sandstone and basement units decreased by more than 40 m during the dewatering period and have since largely recovered during pit flooding, particularly in wells adjacent to Sue E. Decreases in overburden wells were not as large and in general have not fully recovered in wells adjacent to Sue C/A due to ongoing seasonal pumping (Figure 2.2-23). Figure 2.2-24 presents the current hydraulic head in the basement rock at the Sue site. Figure 2.2-25 shows the current hydraulic head within the lower sandstone at the Sue site. Generally, groundwater flow near the Sue open pits no longer flows in a westerly direction; rather, groundwater flow occurs in a radial pattern towards the Sue C/A pits.

Currently, the water table lies within the sandstone in the vicinity of the Sue pits and not the overburden. The position of the water table is due to drawdown from lowered pit water levels (Figure 2.2-26). Mining activities in the Sue pits have ceased along with most dewatering activities except for occasional pumping from Sue B on an as needed basis and seasonal pumping from Sue C/A. The hydraulic head observations indicate that decreases in all sandstone and basement monitoring wells located near the Sue pits remain, due to dewatering, compared to pre-development conditions although some locations are approaching pre-development conditions (Table 2.2-21).

Three monitoring wells (05-03, 05-05A, and 97-10) located within the Sue E Pit area and are screened within the Upper Sandstone unit. All flagged wells exhibited annual declines in groundwater levels, ranging from -0.55 m to -0.68 m over the reporting period (Appendix II.2-3). The observed decreases align with annual changes in the Sue E Pit water level, which has shown an average annual decline of 0.410 m/year. This decreasing trend in groundwater levels is interpreted as a recovery from temporarily elevated water levels recorded at the Sue E Pit at the beginning of 2020, which were attributed to above-average snowmelt and precipitation during that period.

Groundwater Quality

Data Overview

A summary of monitoring locations in the Sue area is listed in Table 2.2-4, and a summary of baseline statistics in Table 2.2-22. Baseline data (specific to Sue Site) and background major ion chemistry is shown in Figure II.2-5-11 (all baseline data is shown in Figure II.2-5-12). Similar to the JEB Site and background monitoring, baseline

water quality is mostly calcium/magnesium bicarbonate type, but some locations (SUE03-03, MED05-01, -02, and -03) in the lower sandstone are calcium chloride type. Those wells with the calcium chloride type are located in the vicinity of the McClean Mining area, to the west of the Sue Site.

Table 2.2-23 summarizes the mean concentrations for the 2022 to 2024 period at each location and trend analysis for 2011 o 2024. Detailed results are shown in the following appendix tables and figures: box plots summarizing Sue operational monitoring data compared to baseline and background data are shown in Figure II.2-4-376 to II.2-4-504. Statistical summaries for all Sue wells comparing data from the reporting period to previous data (pre-2022) is provided in Tables II.2-6-74 to II.2-6-106. Time series graphs are provided in Figures II.2-8-121 to II.2-8-208. Statistical trend analysis results are provided in Tables II.2-9-74 to II.2-9-107. Results for the different areas of the Sue site are discussed below.

Sue C/A and Sue B Pits Nearfield wells

Groundwater quality monitoring around the Sue C/A and Sue B Pits during the reporting period occurred in the lower sandstone (97-01B, 97-02B, 97-03B, 97-05B, 97-06B, 97-07B), and basement (97-01A, 97-02A, 97-03A, 97-05A, 97-07A; Figure 2.2-5). Monitoring in the overburden and upper sandstone could not be completed due to wells being dry, frozen, or otherwise unable to be sampled (see Monitoring Performance section), aside from well 97-18, which is located on the west side of the Sue B Pit, between this pit and the Ore Transfer Pad in the overburden/upper sandstone.

Groundwater flow direction in the basement and lower sandstone is generally towards the Sue C/A Pit (Figure 2.2-3). Water level in the Sue B Pit in 2024 was higher than the Sue C/A, resulting in a gradient towards the Sue C/A Pit. Gradients around the Sue ore transfer pad, overburden stockpile, Sue E pit, and both Sue C and E CWRPs are all towards the Sue C/A Pit, with the possible exception of the northern extent of the Sue C CWRP, which could have a more westerly flow direction.

Discussion of water quality in the following paragraphs focuses on parameters related to either potential influences from the Sue C CWRP (e.g., nitrate) or dissolved metals (e.g., iron, manganese, arsenic, cobalt, and nickel), and radionuclides with increasing trends in concentrations.

- Major Ions, Field pH, and Alkalinity:
    - Major ion chemistry around the Sue C/A and B Pits is shown in Figure II.2-5-13. Consistent with baseline and background data, the water has a mixed cation signature. On the other hand, there is a range in the anion make up from dominantly bicarbonate to dominantly sulphate, and one location (97-05A, completed in the basement unit) with chloride as the dominant anion. Monitoring location 97-01 had a decreasing proportion of bicarbonate in the lower sandstone compared to the basement, with the lower sandstone having a higher proportion of sulphate. 97-18 (overburden) and 97-03A (basement) also had higher proportions of sulphate than other wells in this area, with mean values during the reporting period of 9.4 and 24 mg/L, respectively however, these values were below the SEQG of 130 mg/L. (Figure II.2-4-383, Table 2.2-23).

    - Field pH trends were stable across most monitoring locations, aside from 97-18, which has a decreasing trend (ranging from 5.3 to 5.0 over the reporting period (Figure II.2-8-138 and Table II.2-9-94). Alkalinity at 97-18 is also below the mean values for background and baseline data and

was <5.0 mg/L as $CaCO_3$ over the reporting period (Figure II.2-4-376). Field pH is often below 6.0 around the Sue C/A and B Pits, with only well 97-05A above the SEQG (6.5 pH units) for all results in the reporting period. The 2024 sample from 97-07A has significantly lower field pH than typical for this location; this value is thought to be anomalous as the laboratory pH is consistent with previous data.

- Nitrate: Some wells were noted to have elevated nitrate concentrations relative to baseline and background (Figure II.2-4-379) and showed increasing trends (Table 2.2-23). The highest concentration was noted in 97-01B (lower sandstone) with a mean of 17 mg/L for the reporting period. Although above the SEQG, the trend remained stable. Well 97-07B which is located between the ore transfer pad and the Sue C/A Pit also had a mean concentrations equal to SEQG of 13 mg/L during the reporting period and also has an increasing trend over the 2011 to 2024 period.

- Metals:
    - Iron: Dissolved iron concentrations were notably higher at 97-05A (basement well on west side of Sue C/A Pit) than all other basement wells and display an increasing trend (Figure II.2-4-403 and Table II.2-9-88). With a mean concentration of 19 mg/L for the reporting period, this location has the highest dissolved iron in groundwater monitoring at the McClean Lake Operation site. This location also has high concentrations of chloride (Figure II.2-4-382). Dissolved iron was also increasing in 97-02B (lower sandstone well on the east side of the Sue C/A Pit), although this well has lower concentrations than 97-05A.

    - Manganese: Dissolved manganese was highest at 97-03A (basement, mean of 4.8 mg/L). It also exceed the SEQG at this location and several other locations in this area (Table 2.2-23).

    - Arsenic: There is a range of dissolved arsenic in the lower sandstone wells of this area, but all recent concentrations are within two standard deviations of the mean baseline concentration, below the SEQG, and concentrations have been relatively stable in recent data. Dissolved arsenic was highest in 97-07B and 97-06B, both on the west side of the Sue C/A Pit and near the contaminated landfill and was lowest in 97-03B on the east side of the Sue C/A Pit (Table 2.2-23). In monitoring wells completed in the basement unit, dissolved arsenic concentrations were near the baseline mean, except for 97-07A. Dissolved arsenic in 97-07A has decreased from concentrations approaching 8 µg/L around 2000 to concentrations less than 4 µg/L during the reporting period. Concentrations at this location have been relatively stable since 2015.

    - Cobalt: Dissolved cobalt was elevated in 97-02B (on the east side of the Sue C/A Pit) relative to other lower sandstone wells in this area and baseline and background means but is within two standard deviations of the background mean (Figure II.2-4-401). This well also had elevated dissolved iron and manganese relative to other lower sandstone wells in the area. While dissolved cobalt concentrations at 97-02B were relatively stable over the 2022 to 2024 reporting period (mean of 0.003 mg/L), there is an overall increasing trend in this parameter at this location over the 2011 to 2024 operational period (Table II.2-9-84). Basement well 97-03A also had elevated dissolved cobalt, higher than both 97-02B and all other monitoring in the Sue C/A and B area (reporting period mean of 0.0079 mg/L) and displays an increasing trend (Table II.2-9-85).

- Nickel: Dissolved nickel concentrations increased at some locations (97-01B, 97-07B, 97-18); concentrations at all three wells measured above the SEQG, with mean concentrations of 0.011, 0.012, and 0.0093 mg/L for 97-01B, 97-07B, and 97-18 respectively (Table 2.2-23). These three wells are all between the Sue B and Sue C/A Pits; and are therefore expected to report to the Sue C/A Pit (Figure 2.2-3). No increasing trends were noted in basement wells in this area for dissolved nickel.

- Aluminium: At 97-18, dissolved aluminum was elevated (reporting period mean of 0.11 mg/L) relative to lower sandstone wells around the Sue C/A and B Pits, shows an increasing trend, and was also above the SEQG (SEQG for aluminum is variable if pH<6.5). 97-01B also has higher dissolved aluminum (reporting period mean of 0.01 mg/L) than other lower sandstone wells, although concentrations are less than 97-18 and have been relatively stable since monitoring began in this location. Dissolved arsenic, cobalt, and manganese have previously been elevated in 97-18 between 2020 and 2022, but have been near the baseline mean for Sue overburden during the reporting period.

- Radionuclides:
  - The most recent result for polonium-210 at 97-05B is elevated relative to previous results (but still below SEQG and the Sue Pit baseline mean for lower sandstone); results from 2025 should be monitored to determine if this is the start of a trend, or an anomalous result. Increasing trends in polonium-210 were noted for 97-01A and 97-05A (both basement wells); concentrations at these locations are below the SEQG.

  - Radium-226 concentrations at 97-01B are elevated relative to other lower sandstone wells in the area but are below the SEQG. While concentrations have been relatively stable at this location since ~2016, result from 2024 are slightly higher than other recent data, and continued sampling is required to monitor for potential trends. Elevated radium-226 at well 97-01B is consistent with the concept that it is influenced by the CWRP, as concentrations in the waste rock are greater than those in the lower sandstone around Sue C/A and B. An increasing trend for radium-226 was identified for 97-05A (basement); concentrations at this location are lower than those in 97-01B. The radium-226 concentrations in 97-05A are now similar to the concentrations in 97-05B in the lower sandstone.

  - Mean lead-210 concentrations for the 2022 to 2024 period was above SEQG for wells 97-05B (lower sandstone), 97-01A and 97-07A (basement). No directional trends were noted for lead-210 in this area.

Sue C/A and B Pits Farfield Wells.

Three monitoring wells are situated in the lower sandstone at a greater distance from the Sue C/A Pit than the wells described above. These wells are farfield wells 97-09, east of the Sue C/A Pit, 97-10, located between the Sue C/A and E Pits, and 97-11 west of the Sue C/A Pit. Results from these wells was typically similar to, or lower than, baseline and/or background means for lower sandstone, with some exceptions. Lead-210 was always above the SEQG in 97-10 over the reporting period. It was also above the mean background concentration, but below the mean baseline concentration (which is above the SEQG). Nitrate concentrations at 97-10 and 97-11

are elevated relative to mean baseline and background values at reporting period mean concentrations of 2.2 and 2.1 mg/L, respectively.

In summary, monitoring around the Sue C/A and B pits yielded largely stable groundwater quality results with a few notable exceptions limited to isolated wells.

Sue E Pit

Groundwater quality monitoring around the Sue E Pit during the monitoring period occurred in the Lower Sandstone at wells 05-03, to the west of the Sue E Pit, 05-04 to the south, and 05-05 to the east. Groundwater flow in the lower sandstone around the Sue E Pit is to the north/northeast, towards the Sue C/A Pit.

- Major Ions, Field pH, and Alkalinity:
    - A number of major ions are increasing in one or more wells in this area. Chloride and sulphate concentrations are increasing in 05-03 and 05-05A, while nitrate is increasing in all three wells. While concentrations for these parameters are all below SEQG guidelines, nitrate at 05-05A is nearing 80% of the guideline value (11 mg/L) with a reporting period mean of 8.3 mg/L. 05-03 and 05-05A plot in different areas of the piper plot (Figure II.2-5-14) due to higher proportions of sulphate and chloride relative to bicarbonate; the cation signature is consistent across all three wells and is mixed. The rate of increase in sulphate concentrations has decreased at 05-05A; the slope for 2011-2024 was 0.6 mg/L per year (05-05A). The mean sulphate concentration for the reporting period at 05-05A was 7.7 mg/L, compared to the lowest SEQG of 130 mg/L.

    - Field pH in all three wells is below the SEQG of 6.5, and wells 05-04 and 05-05A have decreasing trends. Alkalinity and bicarbonate are relatively low (<30 mg/L as $CaCO_3$) in all three wells, which is similar to the mean baseline result for lower sandstone at the Sue Site. Well 05-05A has the lowest alkalinity and has had results <10 mg/L as $CaCO_3$ since 2020. The combination of decreasing pH and low alkalinity should continue to be monitored at 05-05A (Figure II.2-4-419).

- Metals:
    - Arsenic: Dissolved arsenic concentrations in these wells has in the past been near or above the SEQG for arsenic of 5.0 µg/L, but recent data is consistently below 80% of the guideline (Figure II.2-8-171). Furthermore, two of the three wells show decreasing trends (05-03 and 05-05A), whereas no trend was identified for 05-04 (Table 2.2-23).

    - Cobalt: Dissolved cobalt is highest across lower sandstone monitoring at the Sue site at 05-03 (Figure II.2-8-174). Concentrations were relatively stable prior to 2020, but recent concentrations are elevated relative to data pre-2020. Dissolved iron, manganese, and nickel have similar trends. No statistically significant increasing trend was noted for cobalt or iron, as concentrations in the reporting period were flagged as outliers. Continued monitoring should be conducted to determine if these elevated concentrations are indeed a trend. Dissolved manganese and nickel were identified as having increasing trends. Dissolved strontium was also increasing at 05-03. A single result for dissolved copper at 05-03 in 2024 was notably higher than previous data and was above 80% of the SEQG; monitoring in 2025 should confirm if this was an anomalous result or the start of an increasing trend.

- Radionuclides: No increasing trends in radionuclides were identified in this area, but well 05-04 typically has concentrations that exceed the SEQG for lead-210 (Table 2.2-23). Furthermore, concentrations in the reporting period are higher than most previous results (Table II.2-6-100). Polonium-210 results from 05-04 during the reporting period were higher than pre-2022 results (Table II.2-6-100), although concentrations are still below the SEQG.

Sue C CWRP and Waste Rock Area

Monitoring in waste rock in the Sue C CWRP area occurs in 07-11, 07-12, and 07-13. Monitoring also occurs around the CWRP in the overburden at 97-15 and 97-08B and in the lower sandstone in 97-08A. A piper plot for waste rock and waste rock area samples for both Sue C and Sue E CWRPs is shown in Figure II.2-5-15. Monitoring wells 07-11, 07-12, and 07-13 in waste rock have higher proportions of sulphate than the monitoring wells around the pile.

A number of parameters were elevated in the waste rock wells and also tended to be elevated in overburden well 97-08B, although to a lesser extent. Well nest 97-08 is located southwest of the CWRP. While elevated concentrations were noted in the overburden well in this nest (97-08B), the lower sandstone well (97-08A) tended to have lower concentrations. Some parameters of note are described below.

- Field pH and Major Ions: Alkalinity in the CWRP monitoring wells was below detection, and field pH is < 5.0 (Figures II.2-4-505 and II.2-4-521). Field pH was lowest at 07-12, on the north end of the CWRP; this location has the lowest pH across the Sue site with a mean value of 3.7 for the reporting period. Trends in field pH around the Sue C CWRP were relatively stable, aside from 97-08A which had a decreasing trend. This well is located in the lower sandstone between the CWRP and the Sue B Pit and is the well in the area with the highest mean pH for the reporting period. Chloride, calcium, magnesium concentrations in 97-08A (lower sandstone) have an increasing trend, nearly reaching concentrations in the waste rock wells and 97-08B. This potentially indicates the increasing influence of waste rock water in the lower sandstone south of the CWRP, and the increasing trend began around 2008, was steepest between 2008 and 2017, and has been relatively stable since 2017. Fluoride concentrations were higher in waste rock wells than other monitoring in this area and interestingly have been stable in both 97-08A and 97-08B, despite increases in other parameters noted to be elevated in the waste rock wells.

- Metals:
    - Aluminum: Dissolved aluminum tended to be higher in wells situated in waste rock, and overburden wells 97-08B and 97-15, both of which had reporting period means above the SEQG (Table 2.2-23). Dissolved aluminum concentrations in 97-08A sharply increased in 2017 and display an increasing trend and also above the SEQG (Figure II.2-8-145). Concentrations at 97-08A are now similar to 97-15, which has had relatively stable concentrations over its monitoring history (Table 2.2-23).

    - Antimony and Arsenic: Dissolved antimony increased in the most recent sample (2023) from both 07-13 and 07-11; all previous samples from these wells were at the detection limit. Monitoring in 2025 should continue to assess this change. Note that antimony is not considered a COPC at the Sue Site. Dissolved arsenic also increased in the same sample, to concentrations notably higher than previous results and concentrations at well 07-12 (Figure II.2-8-163).

- Cadmium and Copper: Dissolved cadmium was above the SEQG in all locations in this area, as are the mean background and baseline values. Dissolved copper was also higher in wells 07-11 and 07-12 than non-waste rock wells in this area; concentrations of this parameter in the waste rock wells have been variably over time (Figure II.2-8-166). Dissolved copper concentrations in 97-15, 97-08A, and 97-08B remained relatively stable (Figures II.2-8-150 and II.2-8-158). Dissolved nickel concentrations are also elevated in the waste rock wells relative to other monitoring locations nearby.

- Iron: Unlike other monitoring locations across the Sue Site, dissolved iron is typically relatively low in waste rock wells and nearby monitoring. This may be due to the presence of elevated nitrate controlling local redox conditions above the iron reduction step and allowing iron to precipitate as (oxy)hydroxides. Dissolved manganese directly contradicts this as it is elevated in waste rock wells and also 97-08B at concentrations roughly two orders of magnitude above the SEQG (Table 2.2-23).

- Radionuclides: Lead-210 was highest in 97-08A in this area; this well also had higher concentrations than other lower sandstone wells around the Sue B and C/A Pits, with a reporting period mean concentration of 0.42 bq/L compared to the SEQG of 0.2 bq/L (Table 2.2-23).

Sue E CWRP and Waste Rock Area

Monitoring in waste rock in the Sue E CWRP area occurs in 07-14 and 07-15. Monitoring also occurs around the CWRP in the overburden at 05-01B and in the lower sandstone in 05-01A and 05-02A.

- Major Ion Chemistry and Field pH: Major ion chemistry around the Sue E CWRP is compared to that around the Sue C CWRP in Figure II.2-5-15. Compared to waste rock monitoring in the Sue C CWRP, sulphate concentrations in Sue E CWRP were low. Magnesium concentrations in the Sue E waste were also somewhat lower than Sue C. Other major ions were similar. Mean values for pH were below the SEQG of 6.5 for all monitoring wells in this area, with mean values between 4.8 and 6.1 (Figure II.2-4-564).

- Metals: As with the Sue C CWRP, dissolved aluminum concentrations in waste rock wells 07-14 and 07-15 have increased (Figure II.2-8-193). Concentrations in 05-01B, 05-01A, and 05-02A have all been relatively stable or showing decreasing trends. Other parameters with concentrations notably higher in the waste rock than surrounding wells include dissolved beryllium, cadmium, cobalt, manganese, nickel, radium-226, and strontium. Dissolved lead, aluminum, and zinc were higher in 05-01B (overburden) than 05-01A and 05-02A (lower sandstone). On the other hand, lead-210 was higher in the lower sandstone well than the overburden well. Nitrate, dissolved nickel, and strontium concentrations in 05-02A decreased between 2017 and 2022 and remained at these lower concentrations after 2022 (Figures II.2-8-178, II.2-8-179, and II.2-8-180). This decreasing trend at 05-02A is attributed to a decreasing influence from the CWRP at this location. Dissolved uranium at 05-01A decreased between 2011 and 2021; recent concentrations are similar to the mean baseline for lower sandstone at the Sue Site. Concentrations in these three wells were typically relatively stable, with some increasing trends noted for major ions, but no increasing trends identified for dissolved metals or radionuclides.

Moffat Domestic Landfill

Groundwater Flow

Water levels have been collected in 97-19, 04-01, and 04-02 as part of the EMP, and the results for pre-mining and current operations are shown in Table 2.2-24. There has been no significant change in water levels over time as there are no influences near Moffat.

Groundwater Quality

A summary of monitoring locations in the Moffat Landfill area is listed in Table 2.2-5; all monitoring in this area occurs in the overburden. No specific baseline data is available for the Moffat area, and so the Sue Site Baseline data is used. Table 2.2-25 summarizes the monitoring results for the reporting period and trend analysis. Detailed results are shown in the following appendix tables and figures: box plots summarizing operational monitoring data compared to baseline and background data are shown in Figure II.2-4-295 to II.2-4-334. Statistical summaries for all Moffat wells comparing data from the reporting period to previous data (pre-2022) is provided in Tables II.2-6-107 to II.2-6-109. Time series graphs are provided in Figures II.2-8-209 to II.2-8-216.Statistical trend analysis results are provided in Tables II.2-9-108 to II.2-9-110. Results are discussed below.

Major ion chemistry is shown in Figure II.2-5-16. Similar to baseline, background, and most data from the JEB and Sue Sites, water quality in the Moffat Landfill area is calcium/magnesium bicarbonate type.

Most parameters in 97-19 and 04-01 displayed relatively stable or decreasing trends, while 04-02 had a number of parameters with increasing trends (Table 2.2-25). Dissolved nickel at 04-01 reached SEQG levels in 2017-2019, decreased in 2021, increased to near SEQG levels again in 2022, followed by a decrease in 2023 and 2024. Given past variability, this parameter at 04-01 should continue to be monitored (Figure II.2-8-211).

Many parameters, including most major ions, increased at 04-02, and display an increasing trend (Table 2.2-25). Dissolved uranium has been increasing since approximately 2009, and since 2016 concentrations have periodically been above the SEQG (Figure II.2-8-216). Nitrate concentrations at 04-02 were elevated between 2017 and 2022; but have, for the most part, decreased in the recent monitoring data and are now similar to the other wells in this area (Figure II.2-8-210). In 2013, Orano submitted a report with discussion of Moffat Landfill monitoring wells water chemistry trends to SMOE, which attributed the increase in uranium concentration to the increased bicarbonate, likely derived from the decay of organic matter in the landfill. (AREVA 2013). The increase in uranium concentrations is not predicted to increase concentrations in Moffat Lake above the SSWQO or SEQG (AREVA 2013).

Sink Dam

Groundwater Flow

Figure 2.2-27 shows water level variations in the wells, Sink Reservoir, and Vulture Lake. In general, the groundwater water levels in Sink Dam reflect the downward flow from the Sink Reservoir to Vulture Lake. The groundwater levels correlate with the Sink Reservoir water levels. The multi-year observations show the same pattern in the groundwater level variations at all three wells, which reflects uniform hydraulic conditions within

the dam body. Thus, use of three wells for monitoring of such a small structure seems to be excessive and the effort can be safely reduced to monitoring of a single well (i.e., 95-18) in the future.

McClean Mining (former SABRE Test) Site

Groundwater Flow

Water levels have been collected as part of the EMP, and the results for pre-mining and current operations are shown in Figure 2.2-28. During periods where mining does not occur, water elevations are generally stable in the overburden (13 series) and bedrock (MED series) with some seasonal fluctuation. Some drawdown and subsequent recovery are observed during sampling periods. The hydraulic head monitoring demonstrates that drawdown generally occurs during periods of drilling and mining, limiting the contaminant transport.

Groundwater Quality

Monitoring locations, frequencies, and monitoring issues at the McClean Mining site are listed in Table 2.2-7. A summary of baseline groundwater chemistry for the McClean Mining site is provided in Table 2.2-26. Mean values for the reporting period (2022-2024) along with findings from trend analysis are provided in Table 2.2-27. A piper plot summarizing McClean Mining baseline and McClean Lake Operation background data is shown in Figure II.2-5-17 and all McClean Mining baseline data is shown in Figure II.2-5-18. McClean Mining baseline data is from lower sandstone wells only and is distinctly different than background and most other baseline monitoring at the McClean LSA in that the dominant anion is chloride, resulting in a calcium chloride water type, with a mixed cation signature. A piper plot for the McClean Mining wells during the monitoring period are shown in Figure II.2-5-19. Detailed results are shown in the following appendix tables and figures: box plots summarizing operational monitoring data compared to baseline and background data are shown in Figure II.2-4-335 to II.2-4-375. Statistical summaries comparing data from the reporting period to previous data (pre-2022) is provided in Tables II.2-6-110 to II.2-6-116. Time series graphs are provided in Figures II.2-8-217 to II.2-8-232. Statistical trend analysis results are provided in Tables II.2-9-111 to II.2-9-117. Results are discussed below.

Monitoring wells 13-02 and 13-03 (both overburden wells) are installed downgradient of the mining pad, while 13-01 and 13-04 (also overburden wells) are installed upgradient of the mining pad.

Dissolved arsenic concentrations were higher in 13-02 and 13-03 than 13-01 and 13-04. Concentrations in both 13-02 and 13-03 were higher than the SEQG; the mean values for the reporting period were approximately four times higher than the guideline at 13-02 and approximately eight times higher at 13-03 (Table 2.2-27 and Figures II.2-4-352 and II.2-8-227). Dissolved arsenic trends were relatively stable in the overburden (Figure II.2-8-227). Dissolved uranium concentrations were also higher in the downgradient wells than the upgradient wells (Figure II.2-4-369). Concentrations in both 13-02 and 13-03 were periodically above either the SEQG or 80% of the guideline (Table 2.2-27 and Figure II.2-8-232). One sample collected from 13-03 in 2024 had elevated radionuclides relative to previous monitoring at this location and the SEQG (Figure II.2-8-232). A subsequent sample in 2024 was lower and consistent with previous results.

Dissolved nickel concentrations in 13-03 were elevated relative to the other overburden monitoring wells, and above the SEQG in 2024 (Figure II.2-8-227). As with the radionuclides, the sample collected in August 2024 had a higher result than typical, but the subsequent sample (from October 2024) was similar to previous results.

Dissolved titanium and vanadium concentrations were also higher at 13-03 than other overburden locations (Figures II.2-8-225 and II.2-8-227).

Monitoring in the lower sandstone occurs downgradient of the ore pad at MED 05-02 (near 13-02) and MED 05-03 (near 13-03). Upgradient monitoring in the lower sandstone occurs at MED 05-01 (near 13-01). Dissolved arsenic concentrations at MED05-02 were elevated and roughly two times the SEQG of 5.0 µg/L, but concentrations show a slight decreasing trend (Tables 2.2-27 and II.2-9-116). Dissolved uranium is also higher at MED05-02 than other Lower Sandstone wells at the McClean Mining site, but concentrations are below the SEQG. Dissolved Lead-210, polonium-210 and radium-226 are all higher in MED05-02 than other Lower Sandstone wells at the McClean Mining site; concentrations of all three radionuclides were higher than any other recent monitoring data at McClean Lake Operation and were also above SEQG (Table 2.2-27). As MED 05-02 is directly downgradient of the mineralized zone of the McClean deposit, the elevated concentrations are expected.

2.2.7 Monitoring Adjustments and Supplementary Studies Recommendations

No adjustments to the current groundwater monitoring program is proposed, however it is recommended that the poor performing wells identified in the monitoring performance section should be further investigated. Orano has already initiated an action plan to address these issues, with initial investigations scheduled to commence in 2025.

Given the elevated concentrations of a number of parameters at wells 16-08 and 14-05 (overburden, mill terrace) and due to the elevated and increasing dissolved uranium concentrations at 19-01, it is recommended that groundwater modelling of contaminant transport around the mill terrace area should be completed in order to determine whether additional monitoring is needed for the area.

Additional groundwater monitoring is recommended around the McClean Mining site to support future mining activities at Pod 1 West and Pod 2. This should include the installation of new monitoring wells, as well as the rehabilitation of selected historical wells (MU08-24, MU08-26, MU08-28, MU08-29, and 08-08), to provide improved coverage and facilitate the monitoring of potential groundwater flow paths toward Candy Lake. Orano will complete an ecological risk assessment (EcoRA) for the McClean Mining operations to inform additional monitoring.

For monitoring locations where groundwater level monitoring frequency was decreased from bi-monthly to annual during most recent EMP update, it is recommended that future annual measurements be taken at approximately the same time of year as a previous bi-monthly sampling events to maintain consistency with previous data in accordance with CSA Standard N288.7:23 guidelines (Clause 7.7.2.6). Maintaining this consistency will improve future comparisons with historical datasets by minimizing the effects of seasonal variability, supporting more accurate assessment of long-term groundwater quality and water level trends

2.2.8 Supplementary Studies

As outlined in Section 1.7, various supplementary studies were completed at the McClean Lake Operation in addition to routine EMP monitoring. The following supplementary studies were completed for groundwater before the current EP TID reporting period:

- JEB TMF Groundwater Flow and Solute Transport Report – 2019
- McClean Mill Terrace Detailed Groundwater Flow Modelling – 2020
- Additional Data Collection for Groundwater TID Update – 2016-2021

More detailed information about the above supplementary studies is provided in the 2022 EP TID Volume 1 (Orano 2022). The following sections outline supplementary groundwater studies implemented for the operation in 2022-2024.

2.2.8.1 2023 Background Groundwater Sampling Campaign

As part of an update to the Groundwater TID, groundwater sampling was conducted in 2023 in the JEB and Sue sites. The aim of this campaign was to establish groundwater locations which provide background data that can be sampled once every five years to accompany updates to the Groundwater TID. The background groundwater data were used in comparison with pre-mining baseline data to identify any natural changes to groundwater in locations that are unaffected by mining. For the current reporting period, the 2023 background data was added to the reference dataset used to evaluate any changes to the groundwater within the McClean Lake Operations Study area (Section 2.2.6). The 2023 background data will be included into the next iteration of the Groundwater TID which is scheduled to be submitted for regulatory review in 2026.

2.2.8.2 2024 Additional Groundwater Sampling for Bena Lake Study

Increasing nitrate+nitrite concentrations were observed in Bena Lake, which exceeded the nitrate SEQG for the protection of aquatic life in 2016-2022. It was suspected that the groundwater flow from the Sue E waste rock pile (Sue E CWRP) was the likely source for the elevated nitrate+nitrite levels. Orano implemented an action plan to assess the potential long-term impacts of elevated nitrate+nitrite levels on Bena Lake (Orano 2024b). To support this assessment, additional groundwater sampling were conducted to inform groundwater modeling and facilitate the EcoRA for Bena Lake (Orano 2024b).

Groundwater quality samples and water level measurements were collected from five wells. Three wells located between Sue E CWRP and Bena Lake (i.e. wells 05-01A, 05-01B and 05-02A) were sampled in spring, summer and fall of 2024, while 2 wells located within the Sue E CWRP itself (i.e. 07-14 and 07-15) were sampled in summer 2024 (Figure 2.2-14). The groundwater samples were analyzed in the laboratory for a suite of parameters, including analysis for nitrites to determine if the measured nitrate+nitrite data is primarily nitrate. The sampling results showed that nitrites were non-detectable, which suggests that nitrates were the main contributor to the nitrate+nitrite concentrations in groundwater. Furthermore, an increasing nitrate trend was observed only in well 05-01A while, the remaining wells either showed no trend or a decreasing trend. The additional groundwater data have been incorporated into the dataset used for the current environmental performance assessment of the Sue E CWRP area (Section 2.2.6.3 Results). The groundwater modelling outcome is presented in the 2025 EP TID Volume 2 (Orano 2025c).

2.3 Hydrology

Hydrology is monitored at 25 locations with varying measurement frequency (daily to semi-annual) for three different variables:

- Lake water levels (21 locations), monitored by manual staff gauging and level loggers,
- Effluent discharge volumes from JEB and SUE WTP and volume of fresh water withdrawn from Pat Lake, and
- Flows at Collins Creek (downstream of McClean Lake), outlet of Vulture Lake and outlet of Sink Reservoir, estimated by rating curves.

The following sections describe the study design and objectives (Section 2.3.1), predictions of potential impacts published in previous studies (Section 2.3.2), methods for data monitoring (Section 2.3.3.1) and evaluation criteria (Section 2.3.3.2), results of the analysis (Section 2.3.3.3) and recommendations (Section 2.3.4).

2.3.1 Study Design and Objectives

Hydrological surveys were performed during the mine's predevelopment phase between 1979 and 1995. The 2016 EP TID (AREVA 2016b) provides a detailed overview of the performed surveys and how their results were used to characterize potentially impacted water bodies, streams and lakes and assess potential impacts of the McClean Lake Operation on the local surface water regime. It was determined that changes in stream flow and lake level conditions could result from activity associated with site development and mining operations. Dewatering activities during the mining of the JEB and Sue ore bodies and operation of the JEB TMF could potentially result in local drawdown of lakes close to the open pits and TMF, and influence flow rates in several nearby streams, including Collins Creek. Conversely, treated effluent releases via Sink Reservoir and Vulture Lake augment downstream flow rates and can potentially influence lake levels.

In 1995, a lake elevation and stream flow monitoring program were implemented which has continued over the period of construction and operations. The purpose of the hydrological monitoring program is to track the potential influences of the mining and milling operations on the surface water hydrology in the LAB. To meet this objective, Collins Creek discharge and/or stage have been monitored almost continuously during the open-water season, and discharge has been measured regularly during the ice-covered season. In addition, surface water elevation monitoring has been conducted at waterbodies potentially affected by treated effluent discharge, surface water withdrawal, and open pit dewatering, and at two reference waterbodies unaffected by site operations. Figure 2.3-1 outlines the waterbodies and streams sampled in the McClean Lake Operation LSA for the hydrological monitoring program.

To assess the status of hydrology in the LAB, the updated dataset is compared to impact predictions made during the 1991, 1995, 2004, 2009 EA (Minatco 1991; COGEMA 1995a-e, COGEMA 2004b, AREVA 2009a) and to impact predictions made in previous EISs. In addition, annual trends of water levels are assessed, are compared to regional trends in the area, and are reviewed in consideration of site operations during the current monitoring period (2022 to 2024).

2.3.2 Impact Predictions

The 1991, 1995, and 2009 EAs provided hydrological predictions to characterize the expected influence of mine dewatering activities on lake levels in the LSA. The predictions were based primarily on estimates of groundwater flow from lakes towards the JEB and Sue pits. In addition, impacts on lake levels were predicted from the cone of depression associated with the McClean Mining deposit (not yet developed). A further prediction was that the

volume of streamflow in Collins Creek downstream of McClean Lake would be increased from the release of treated effluent into Sink Reservoir.

These predictions form the basis of comparison with newly collected monitoring data.

JEB Pit Dewatering

During the development of the JEB pit, initial dewatering was planned to occur over a period of 21 months. The S/V TEMS was used to impound dewatering well water and control releases to ensure that flows in Collins Creek would not be increased by more than 30%. (COGEMA 1995b).

It was initially predicted that surface water elevations in Fox and Pat lakes would be slightly decreased by dewatering activities at JEB pit due to their proximity. The predicted water level decrease in Fox Lake was up to 0.05 m, while the decrease in Pat Lake elevation was predicted to be up to 0.014 m (Minatco 1991). In contrast, Tail, Isis, Osiris, and Johannes lakes were predicted to experience little impact due to the longer flow paths to the open pit (Minatco 1991). Maintaining the JEB pit in the dewatered state was also expected to have a limited influence on the water levels of Fox, Johannes, Pat, and Wallace lakes during the period of operations. Any influence on these lakes was expected to be hard to distinguish from natural lake level variability (COGEMA 1995b).

As noted in the 2009 Caribou and 2011 Midwest EISs, only limited water level changes were observed at Fox Lake during mining of the JEB pit (AREVA 2009b). These limited changes were attributed to the fact that the JEB pit and Fox Lake do not form a single aquifer unit, rather they are separated by an unsaturated zone (AREVA 2009b).

Sue Pits Dewatering

Sue and Sils lakes were predicted to experience considerable drawdown or be completely dewatered from mining operations in the Sue area (Minatco 1991; COGEMA 1995b). These anticipated effects were attributed to their small, isolated drainage areas and proximity to the Sue pits (COGEMA 1995b). However, as noted in subsequent EISs (AREVA 2009b and 2011b), water levels in Sue and Sils lakes only saw minor fluctuations in water levels during mining of the Sue Pits and did not decrease considerably, as was predicted in the 1991 McClean and 1995 Midwest EISs.

As only limited water level elevation changes have been observed at Fox, Sue and Sils lakes since pit dewatering, it is suggested that most lakes in the study area exhibit a limited hydraulic connection with the underlaying sandstone aquifer (AREVA 2009b and 2011a).

Other Dewatering Activities

The 2009 Caribou EIS predicted that water levels in Candy and Bena lakes would decrease by roughly 0.8 m and 0.4 m respectively, during the Caribou Pit dewatering; however, this project has not yet proceeded to licensing (AREVA 2009b).

Treated Effluent and Dewatering

During the operational period, flows of treated water from the JEB and Sue WTPs, as well as from pit-perimeter dewatering wells have been released into Sink Reservoir. The quantity of treated effluent released into the Collins Creek watershed was predicted to be between 0.17 m^3/s and 0.23 m^3/s (Minatco 1991). In 1995, due to dewatering of the JEB pit, it was predicted that there would be a minor decrease in flow in Fox and Pat creeks (COGEMA 1995b). In addition, due to the decreased flow in Fox and Pat creeks, there would be a maximum of 1% reduction of streamflow in Collins Creek below McClean Lake. This was expected to be offset by the increase in streamflow in Collins Creek from water treatment facility releases (COGEMA 1995b).

Midwest Project

The 2011 Midwest EIS predicted the extent of the cone of depression given the open pit mining method proposed for the project (AREVA 2011b). Given the observations recorded at the JEB and Sue sites during initial dewatering of the pits, it was suggested that most lakes in the study area exhibit a limited hydraulic connection with the underlying sandstone aquifer during the time frame that the pits are developed. Thus, a similar trend was expected in the Midwest area. Three lakes were predicted to be impacted the most by pit dewatering at the Midwest Site: South McMahon Lake, Too Small Lake, and Shallow Lake. The maximum impact was predicted for Too Small Lake where the lake was predicted to be fully drained after 4 years of pit dewatering (AREVA 2011b). For Shallow Lake and South McMahon Lake, the predicted drawdowns ranged from approximately 0.60 m to 1.60 m (AREVA 2011b). The Midwest project has not been developed and as such, no operational hydrological monitoring data will be presented in this report.

2.3.3 Operational Monitoring

2.3.3.1 Methods

Surface Water Elevations

Lake and stream level elevations are monitored in the McClean Lake Operation vicinity and in Collins Creek below McClean Lake to determine whether increasing or decreasing trends exist, to assess whether any changes fall within the range predicted by modeling and baseline studies, and to determine if a change results from a physical change or falls within the natural range of hydrologic variability. Water levels are monitored at 21 locations during the operational period using staff gauges. The locations of surface water elevation gauging sites within the McClean Lake Operation LSA are shown in Figure 2.3-1 and universal transverse mercator (UTM) coordinates are provided in Table 2.3-1.

Several changes to the monitoring program have been made since the 2022 EP TID. In 2024, changes to the environmental monitoring program were implemented (Orano 2023a). In this update, monitoring ceased in 5 lakes: Johannes Lake (SG05E), Tail Lake (SG13E), Esto Lake (SG16E), Sharpe Lake (SG21E), and Telephone Lake (SG22E). In addition, the measurement frequency was changed from monthly to weekly at the Sink Reservoir (CM03 and SG06E), except for the three following days when one of the daily triggers was met. Daily trigger criteria include:

(i) Sink Reservoir elevation is being actively managed or

(ii) Rainfall in the past 24-hours is greater than 25 mm.

Between 2022-2023, leveloggers were installed in three monitoring stations: Mallen Lake (SG01C), Kewen Lake (SG17E), and Indigo Lake (SG19C) to provide continuous records for the open water period.

Baseline water level monitoring was carried out on an occasional basis in 1989, 1993, and 1994. Beginning in 1995, the McClean Lake Operation personnel began collecting data monthly during the open water period. At that time, most of the staff gauge benchmarks were surveyed to a geodetic elevation datum, with lake levels reported in mASL. Staff gauges were re-surveyed each spring to a local datum so that datasets are comparable from year to year. Due to possible surveying and benchmark errors and benchmark displacement, lake level elevations should be interpreted with caution.

Mallen and Indigo lakes are reference lakes in the McClean Lake Operation LSA whose records may be used to estimate natural variation in lake storage over time. Natural variation in lake elevation occurs as a function of lake water balance. Waterbodies with little or no surface water and groundwater inflow or outflow generally exhibit water level changes mainly in response to climatic factors. Both Mallen and Indigo lakes receive water from areas upstream.

Stream Discharge Monitoring

Sink/Vulture Treated Effluent Management System

Flow rates from the S/V TEMS are monitored at two locations. Outflow from the Sink Reservoir is measured at monitoring location CM03 using a v-notch weir that was constructed in 1999, and from which flow rate estimates can be made based on the water level according to Equation 1. Flows are also estimated downstream at the outlet of Vulture Lake through a rectangular sharp-crested weir (CM04), prior to entering the discharge pipeline to McClean Lake, by Equation 2.

$$Q = 4.1176\ h^{2.5} \quad \text{(Equation 1)}$$

$$Q = 2.82 * h^{1.5} + 0.212 * h^{2.5}/P^{5} \quad \text{(Equation 2)}$$

Where, Q is the discharge, and h is the water depth above the weir invert sill in m, and P is the vertical distance between the weir crest and the channel bed.

Collins Creek

According to COGEMA (1995d), daily discharge data from Collins Creek (below McClean Lake), collected during the periods of August 4 to October 13, 1989; June 5 to October 1, 1993; and June 2 to October 16, 1994, were compared with corresponding time series data from the Thyme Hill River station. In total, 329 data points were analyzed. The following equation was obtained to describe the relationship between flows at the two stations, and can be used to extend the Collins Creek record:

$$Y = 0.3\ x^{0.73},\ r^2 = 0.85 \quad \text{(Equation 3), 1979 - 1994}$$

where y is the station to be extended (Collins Creek), and x is the station record to be used for the extension (Thyme Hill River).

Equation 3 was used to generate daily flows for Collins Creek over a 16-year period (1979 - 1994) that characterizes the baseline hydrology.

Over the operations period, flow data have been estimated at Collins Creek near the outlet of McClean Lake at Station SG08E by manually collecting daily stage observations during the open water season. Stage data are converted to discharge values using a well-developed stage-discharge rating curve for the stream flow monitoring cross section. In winter, streamflow is metered at SG08E once every three weeks. During spring break up, additional streamflow metering is performed to provide data on high flows.

During the operational period at the Collins Creek streamflow monitoring station (SG08E), four well-developed stage-discharge relationships have been used to calculate discharge for the open water season. The first relationship (Equation 4) was used to calculate discharge values from 1979 to 2000, the second relationship (Equation 5) was used to calculate discharge values from 2001 to 2013, the third relationship (Equation 6) was used to calculate discharge values from 2014 to 2023, and the fourth relationship (Equation 7) was used to calculate discharge values for 2024. Daily stage elevations are converted to discharge using the following equations (4 to 7):

$Q = 24.29\ h_0^{1.956}$, $r^2 = 0.96$ (Equation 4), 1997 – 2000 (Orano, 2022)

$Q = 27.48\ h_0^{2.12}$, $r^2 = 0.96$ (Equation 5), 2001 – 2013 (Orano, 2022)

$Q = 24.78\ h_0^{1.88}$, $r^2 = 0.99$ (Equation 6), 2014 – 2023 (Orano, 2022)

$Q = 24.33\ h_0^{1.86}$, $r^2 = 0.99$ (Equation 7), 2024 (Orano 2023c)

Where, Q is the discharge at Collins Creek, and h_0 is the stage elevation minus the elevation of the gauge height at zero flow. Changes in channel morphology or flow velocity can produce shifts in the relationship between stage and discharge at a gauging station and as such, these relationships should evolve over time (Phillips and Eaton 2009). For this reason, four curves were used to calculate discharge throughout the operational monitoring period.

Orano applied to increase the Collins Creek bankfull capacity based on the updated of the rating curve (Equation 7). On April 17, 2024, the MOE approved the application in which the bankfull capacity was increased from 4.52 m^3/s to 5.60 m^3/s (Section 2.3.5 Supplementary Studies).

2.3.3.2 Evaluation Criteria

The data analysis period included 2022 – 2024. Separate EvC were applied to lake water level data and flow data, which are described in the following sub sections.

Water Elevations

At lake stations, water elevation was evaluated to identify potential effects of dewatering activities and effluent discharge on local hydrology. EvCs included:

- **EvC 1 – Changes in local hydrology**: Changes in the exposure lake water levels shall align with changes in the reference lakes (Mallen and Indigo) water levels.

- **EvC 2 – Comparison to EIS Predictions**: If EvC 1 identifies deviations from the local hydrology trends, those changes shall stay within available EIS predictions.

- **EvC 3 – Surface water rights license conditions (for Pat Lake only):** The annual volume of water withdrawn shall stay within the allocated quantity in surface water rights license (i.e. 1,000 cubic decameters).

Monthly measurements were also compared to historical maximum and minimum levels. Deviations outside this range were interpreted in the context of meteorological records (e.g., droughts, high precipitation).

Stream Flows

The evaluation criteria at each station are aligned with the objectives of the Environmental Monitoring Plan and designed to meet regulatory requirements (CSA N288.4). The evaluation criteria include:

- **EvC 1 – Collins Creek's bankfull capacity (i.e. 5.6 m^3/s).** The effluent discharge shall not exceed an amount which would cause the Collins Creek flow to exceed the creek's bankfull capacity (i.e. 5.6 m^3/s).

- **EvC 2 – Effluent Discharge condition:** The treated effluent portion of S/V TEMS discharge shall be equal or less than 1 part treated effluent to 5 parts Collins Creek Flow (i.e. 1/6 of measured Collins Creek flow) downstream of McClean Lake.

- **EvC 3 – Changes in local hydrology**: The Collins creek flow shall align with changes in the local hydrology.

Nonparametric statistical tests (Mann-Whitney for homogeneity and Mann-Kendall for trends) were used to compare post-development naturalized Collins Creek streamflow, which can provide insight about changes in local hydrology not driven by the mine activities. Post-development naturalized streamflow were calculated for Collins Creek by adding dewatered flows in Pat Lake back into the creek and subtracting effluent discharges from the water treatment plants. This provided flows from Collins Creek with effects of mine operations removed that can be compared against flows collected in the baseline period.

Because streamflow values were derived from rating curves, the associated uncertainty was quantified to account for potential error propagation, consistent with CSA N288.4:25 requirements. This uncertainty was addressed in compliance assessments for effluent discharge. The BaRatinAGE v 3.1.1 software (Le Coz et al. 2014) was used to estimate the predictive uncertainty of the rating curve.

2.3.3.3 Results

Monitoring Performance

In 2024, Orano defined performance criteria for all aspects of the monitoring program to ensure a complete dataset was collected to achieve EMP objectives and comply with the CSA N288.4 standard (CSA 2025). A target of 95% completion was set for surface water hydrology measurements. The data availability in terms of the performance criterion is shown in Table 2.3-2. All data collected has been measured at more than 95% of the programmed frequency for all types of data – surface water elevation, volumes and flow rates.

When the flow rate in Collins Creek is near or above bankfull capacity, the discharge from Sink Reservoir is halted to avoid exacerbating flood conditions downstream. The reservoir discharge was closed throughout May and June 2022, in August 2022, throughout the months of June and July 2023, and in June 2024.

In 2024, the daily trigger criterion related to Sink Reservoir measurement frequency was met five times, one time in May, three times in June and one time in July. In four of these occasions, daily measurements were not carried out on the day following the trigger day, constituting a data gap:

- Rainfall Trigger (May 31, 2024) – 30.3 mm | Gaps in SG06 (surface water elevation) and CM03 (flow)
- Rainfall Trigger (June 5, 2024) – 35.4 mm | Gaps in SG06 (surface water elevation) and CM03 (flow)
- Rainfall Trigger (July 26, 2024) – 25.4 mm | Gaps in SG06 (surface water elevation) and CM03 (flow)
- Sink Reservoir Actively Managed (June 30, 2024) | Gaps in SG06 (surface water elevation)

Data gaps were also identified in the Collins Creek (below McClean Lake) station (SG08E) dataset. Fewer than three gaps per month in the water level time series were observed in the following months: June and August 2022, September 2023, June–July 2024, and September 2024. Only one simultaneous stage-discharge measurement was performed in the open water season in 2022, and no simultaneous measurements were performed in 2023 and 2024. Currently, the EMP does not define a minimum frequency for simultaneous stage-discharge measurements.

The data quality of the surface water elevation stations was assessed by comparing neighboring stations; upstream water bodies should have higher water levels compared to downstream water bodies. This analysis identified that station SG09E located at McClean Lake has lower recorded elevations compared to station SG08E, in Collins Creek below McClean Lake, in many years. To some extent, this condition is driven by the natural uncertainty of the benchmarks' orthometric elevations. However, higher differences are likely caused by moving benchmarks or the need to perform more frequent levelling of the staff gauges. A comparison across groups of nearby lakes also indicated non-converging patterns in the water level time series in some lakes, which were likely due to moving benchmarks that were not surveyed on an annual basis. Monitoring adjustments are proposed in section 2.3.4 to address this root cause for errors.

Flow rates measured by weirs at the outlet of Sink and Vulture reservoirs (CM03 and CM04) were compared to the theoretical rating curve of the weirs The high quality of the measurements was verified by confirming that the calculated flow rates, derived from the theoretical equations based on water levels, closely matched the flow rates records from CM03 and CM04.

The manual discharge measurement carried out in Collins Creek station (SG08E) in 2022 is within 5% of the value predicted by the rating curve, thus no shift should be considered and the gauge performs according to standards (ECCC 2016). All rating curves were inspected based on the manual discharge measurements and their precision and accuracy were assessed in terms of the residuals (Table 2.3-3). Manual flow measurements were compared to flows calculated using the rating curves established between 1997 and 2023. Results indicate that calculated flows based on these rating curves exhibit a systematic bias (-16% to 11%, depending on the period, see Table 2.3-2), so long-term analysis involving the data from this period should be carried out with caution.

Available simultaneous stage and discharge measurements in Collins Creek were used to assess the uncertainty associated with the rating curve models that convert water levels into streamflow. Table 2.3-7 presents the mean and standard deviation of the residuals, which represent the differences between the measured discharges and those calculated from the rating curves. The total uncertainty of the rating curves, at the 95% confidence interval, can be approximated as the mean plus or minus two standard deviations of the residuals—assuming a normal distribution.

However, a portion of this total uncertainty is attributable to measurement errors inherent in the discharge measurements themselves. For example, current meter measurements have an associated error of approximately ±14% at the 95% confidence level (2 standard deviations), as reported by Le Coz et al. (2014). Therefore, the remaining portion of total uncertainty - that is not explained by measurement error - can be considered the epistemic uncertainty (associated with limitations in the rating curve models). For Collins Creek, this epistemic uncertainty ranged from –28% to +21% during the period from 1997 to 2024, for which records are available. The following considerations are made:

- Higher absolute residuals were observed for low flows, which uncertainty may be larger than quantified above.

- The data from 1979 – 1994 is synthetic and based on a regression with another gauge calibrated with measured data from June to October. Uncertainty quantification is challenging in this case, especially for November – May data, when more uncertainty is expected because these months were not used for calibration.

Water Elevations

Water Elevations EvC 1 – Changes in Local Hydrology

Mean annual, extreme maximum, and extreme minimum lake level elevations are shown in Table 2.3-1 for the period of 1995 to 2024.

In 2022 to 2024, most of the lakes' water levels followed the patterns exhibited by the control lakes (Mallen and Indigo). In 2022, only Vulture Lake had an increase in the average water level while all lakes, including the reference lake, had a decrease in their levels compared to the previous year. The same comparison was carried out for 2023 and 2024, which indicated an opposite trend to the reference lakes in Esto, Tut, Sink, Pat and Fox lakes in 2023 (reference lakes registered a decrease); and in Sils, Tut and Pat Lakes and Sink Reservoir in 2024 (reference lakes registered an increase). Sink reservoir, Vulture and Pat lakes are more strongly influenced by the mine operation due to the effluent discharge (e.g., Sink Reservoir discharge is stopped for weir repairs or during floods) and water withdrawn, which explains the deviation to the reference lakes. For instance, in 2023 the water abstraction from Pat Lake was 30% lower compared to the previous year, which might explain the deviation from the reference lakes behaviour. However, no specific reason was found for Sils, Tut, Fox and Esto lakes – these lakes are further discussed in the following section.

Water Elevations EvC 2 – Comparison to EIS Predictions

In Fox Lake, the predicted water level decrease was up to 0.05 m, while the decrease in Pat Lake was predicted to be up to 0.014 m (Minatco 1991). Based on monitoring data collected at these locations between 2004 and 2024, there was a slight increase in water level elevations (aside from the recent dry years, 2021-2023) which is also visible in the two reference lakes for the same period. Although dewatering activities did result in short-term declines in water levels during active dewatering in the early operational period, the observed increases over the subsequent years suggest that these effects were limited in duration, and recovery of water levels has occurred.

The 1991 EIS (Minatco 1991) also predicted that:

- McClean Lake water level could increase by 0.015 m due to the effluent discharge, which is within the natural variability of the lake water level (standard deviation of average water level of 0.07 cm); and
- Candy Lake could be completely drained with the mine dewatering, however, a positive trend in the water levels has been observed in the average water levels since 2004.

Sue Lake and Sils Lake would experience significant drawdown, or even complete dewatering, as a result of mining operations in the Sue area (Minatco 1991; COGEMA 1995b). However, since 2004, the average annual water level in Sue Lake has varied only slightly (within 46 cm), while Sils Lake has shown somewhat greater variability (within 86 cm). Importantly, neither lake has been completely dewatered. Bathymetric surveys conducted in 2004 indicate that both lakes are relatively shallow, with maximum depths of approximately 2.5 m. Therefore, even the maximum observed annual water level fluctuations correspond to approximately one third of the lakes' total depth. This means that the combined effects of mine dewatering and drought have impacted only a limited portion of each lake's total water volume, and neither has approached full dewatering as previously predicted.

EIS predictions did not anticipate significant impacts on Esto and Tut lakes; however, average annual water levels in 2023 (both lakes) and in 2024 (Tut Lake) deviated from those observed in the reference lakes. This deviation may be due to the use of benchmarks that are not surveyed annually, or to the shallow nature of these lakes, which makes them more sensitive to local climatic effects. Since the water level in these lakes increased while the water levels of the other lakes decreased in 2023, it is unlikely that these deviations are related to the open pits dewatering.

Eight out of the 22 monitored water bodies have recorded their minimum surface water elevation in the 2022-2024 monitoring period, including Mallen, Johannes, Moffat, Tut, Esto, Kewen, Indigo and Sharp lakes. The low water levels are due to three years with below average precipitation. Furthermore, 2023 was exceptionally dry (see the Standard Precipitation Index in Figure 2.3-3, calculated based on site climate data extended with Daymet (Thornton et al, 2022). The maximum recorded water levels have not been exceeded in the 2022-2024 monitoring period; most of the peak water levels were recorded in 2021.

The average annual water surface elevations are shown in Figures 2.3-4 to 2.3-14. Long-term changes in surface water elevations since 2004 were evaluated using the Mann-Kendall test. The test indicated that:

- Positive trends were identified in the lakes McClean, Candy, and Bena, and
- Negative trends were observed in Vulture, Tail, Moffat, Tut, Esto, and Kewen.
- No trends were found in the reference lakes, Mallen and Indigo, and in the remaining lakes with water surface elevation measurements.

The negative trends in these five lakes can be explained by the drier conditions in recent years, which resulted in the lowest values recorded in their time series. The water level in Vulture Lake is regulated to some extent by weir operation and treated effluent discharge, which in 2022-2024 was approximately 76% of the 2011-2021 average water level.

Tail Lake exhibits the lowest variability in the pool, with a standard deviation of 4 cm in average annual surface elevation. It is likely that this trend could be related to uncertainty in the vertical elevation measurements based on benchmarks.

For Bena and Candy lakes, which have shown a positive trend since 2004, a similar trend is also captured by monitoring wells 05-01A, 05-02A, and 97-11 which were installed in the overburden close to these lakes. The current increase in water levels at Bena and Candy lakes likely reflects a recovery following previous declines caused by dewatering of Sue C from 1997 to 2002 and again from 2004 to 2011. The surface water elevation in McClean Lake also displayed a positive trend, similar to the summer streamflow in Collins Creek (see Stream Discharge Monitoring and discussion within).

Water Level EvC 3 – Surface Water Rights License Conditions

The annual withdrawal from Pat Lake between 2011 and 2024 ranged from 58,663 m^3 to 730,698 m^3 (Table 2.3-4), therefore within the allocated volume of 1,000 cubic decametres / 1 Mm^3, stipulated by the water rights license.

Stream Flows

Collins Creek

Stream Flow EvC 1 – Collin's Creek Bankfull Capacity

The discharge from Sink Reservoir, as measured at station CM03, was compared to streamflow in Collins Creek measured at station SG08E to verify compliance regarding EvC 1. Streamflow at Colins creek was mostly in compliance during the reporting period on June 8, 2024, where Sink Reservoir discharged at 0.06 m^3/s while the streamflow in Collins Creek was above its bankfull capacity (5.6 m^3/s). Discharge from Sink Reservoir ceased the following day.

Stream Flow EvC 2 – Effluent Discharge Conditions

Based on the effluent flow rates and Collins Creek streamflow records, the effluent discharge for the monitored period was within limit defined in the McClean Lake Operation EMP, i.e., one part water treatment plant effluent flow to five parts Collins Creek flow as measured (1:5 ratio).

Considering the uncertainty associated with the rating curve used to estimate Collins Creek streamflow, it is possible that regulatory thresholds were accidentally exceeded in 2022 – 2024. Periods where high flows could have exceeded bankfull capacity occurred in early June 2024, which coincided with the freshet period. In contrast, instances when treated effluent releases may have been above the allowable maximum 1:5 ratio typically occurred from July to August 2023, when streamflows ranged from approximately 0.8 to 1.1 m^3/s. Due to the inherent uncertainty in the streamflow estimates, these exceedances cannot be confirmed with absolute certainty but are inferred to be possible based on available data.

Stream Flow EvC 3 – Changes in Local Hydrology

Table 2.3-9 provides a record of monthly and annual mean flows for Collins Creek at monitoring location SG08E. The mean annual flow during the baseline period (1979 to 1994) was 1.457 m^3/s while the mean annual flow during the operations period (1997 to 2024) was 1.788 m^3/s. From 2022 to 2024, the mean annual flow at Collins Creek was 1.640 m^3/s (Table 2.3-5). Hence, the average streamflow during operations has been higher than the average streamflow during the baseline period, and that includes the last period of records (2022 – 2024).

Trend analysis of the naturalized average monthly flow data revealed statistically significant increases in mean monthly flows from January to April. However, these represent a step change rather than a gradual upward trend over time, corresponding to a shift between two distinct periods: prior to and after 1997, which marks the start of mine operations. The Mann-Whitney test was applied separately to the time series of average streamflow of each month for December and January-April. The results support the presence of two distinct data populations within each monthly time series.

At the annual scale, statistical tests indicate that stream flows during the period of mine operation are significantly higher than during the baseline (pre-mining) period. In contrast, similar tests applied to annual precipitation data showed no evidence of a shift or change in population over time. Therefore, precipitation is unlikely to explain the observed change in Collins Creek streamflow since mine operations began.

Post-development Naturalized Collins Creek Streamflow

Water inputs to the Collins Creek basin are directly measured and were subtracted from the streamflow data to estimate streamflow unaffected by mine operations. It is therefore likely that the observed shift results from higher

uncertainty in the baseline data (1979–1994), particularly for the months of November to May, for which no data were available to support the model used to generate the synthetic records.

To assess seasonal trends during the mine operation period, data from 1997-2024 were analyzed. A statistically significant year over year increasing trend was identified in streamflow for May through July; however, no such trend was observed in the precipitation data for the same period. To further investigate external influences, streamflow records from the Waterfound River below Theriau Lake gauging station were analyzed. The Mann-Kendall test found no significant trends in monthly streamflow at this reference location.

Since the analysis relied on naturalized streamflow data for Collins Creek, the detected trends may be due to unexplained external factors or could be artifacts introduced by sample variability. Continue monitoring the streamflow is important to evaluate if these trends will persist in the future.

The average increase in streamflow to Collins Creek due to dewatering and WTP inputs was:

- 0.128 m^3/s and ranged from 0.05 to 0.22 m^3/s in 2001-2011 (AREVA 2016a); these values were calculated by summing the annual inputs from the JEB and Sue WTPs and subtracting the annual withdrawals from Pat Lake.
- 0.045 m^3/s and ranged from 0.038 to 0.064 m^3/s in 2011-2021 (Table 2.3-4).
- 0.024 m^3/s and ranged from 0.017 to 0.036 m^3/s in 2022-2024 (Table 2.3-4).

The lower values in the 2022 to 2024 are explained by a larger intake in Pat Lake and at the same time a lower discharge by the WTPs. The increase in streamflow to Collins Creek for all mentioned periods was lower than the rate predicted by Minatco (1991) of 0.17 to 0.23 m^3/s. As such, the quantity of treated effluent released into Collins Creek watershed during operations is within the original 1991 McClean EIS predictions.

Sink/Vulture Treated Effluent Management System

Stream Flow EvC 3 – Changes in Local Hydrology

Discharge measurements at CM03 are provided in Table 2.3-5. Annual mean flows were relatively uniform up until 2005 with the exception of 2002, when flows in June, July, and August were less than half of the annual mean value for the previous three years. This decreased flow rate in 2002 could potentially be attributed to site water management activities.

Mean annual flows from 2006 through to 2015 are on average one third less than the flows observed prior to 2006. This decrease in flow rate from the reservoir is attributed to site activities. Notably, there was no discharge from the Sue WTP during 2010 and only a very small volume of discharge in 2011 (AREVA 2011c and 2012). The annual mean flows recorded in 2013 and 2014 are the lowest on record as the dewatering wells were shut down in early 2014. The average annual discharge in 2000-2024 was 0.101 m^3/s and the average annual discharge in 2022-2024 was 0.084 m^3/s.

Table 2.3-6 provides the monthly and annual mean flows for monitoring location CM04 for the period 1997-2024. Similar to CM03, the 2011-2015 TID period showed an overall decrease in annual flow rates, with 2013 and

2014 being the lowest on record. The average annual discharge in 1997-2024 was 0.147 m^3/s and the average annual discharge in 2022-2024 was 0.099 m^3/s.

2.3.4 Monitoring Adjustments and Supplementary Studies Recommendations

The following monitoring adjustments are recommended to improve the hydrology monitoring and evaluation:

- Include a minimum of 3 simultaneous measurements of stage and discharge in the Collins Creek (station SG08E) during open-water season per year in the EMP. These measurements will be important to assess the validity of the rating curve and ensure compliance with Environment and Climate Change Canada (ECCC) (2016).
- Adopt use of Trimble Global Positioning System (GPS) equipment (accurate to 1 cm or less) as a new method of obtaining lake water reference elevation data. This is to reduce two sources of erroneous data arising from shifting benchmarks that occurs year to year and any incorrect level circuit surveys conducted of the benchmarks.

The following action is recommended as a supplementary study:

- Align the next update of the rating curve at Collins Creek (station SG08E) with guidelines provided by ECCC (2016), following a request from CNSC and SMOE (CNSC 2023, SMOE 2024).

2.3.5 Supplementary Studies

As outlined in Section 1.7, various supplementary studies were completed during the current reporting period in addition to routine EMP monitoring. The following section outlines supplementary surface hydrology studies conducted in 2022-2024.

2.3.5.1 2022-2024 Collins Creek Bankfull Capacity Review.

Collins Creek bankfull capacity is defined as the maximum flow rate (m^3/s) at which Sink Reservoir may discharge effluent into Collins creek downstream of McClean Lake (i.e. at SG08E, Figure 2.3-1). It was initially established as 4.52 m^3/s in 1997. The purpose of establishing the bankfull capacity is to ensure that discharge from Sink Reservoir does not contribute to flooding in Collins Creek which could result in alteration of fisheries habitat. A flood condition exists when the Collins Creek stream flow exceeds it's bankfull capacity flow. To prevent this impact, Orano controls discharge flow rates from the S/V TEMS to ensure that they do not cause or augment flooding conditions at Collins Creek.

In 2021, Orano saw extreme flooding in Collins Creek during spring freshet which resulted in the review of the 1997 bankfull capacity as per SMOE recommendations. The most recent review was completed in 2022-2023 using the methodology detailed by Harrelson et al., 1994. A field elevation survey to determine the bankfull height of the east bank of Collins Creek (near SG08E) was completed in the spring of 2023, followed by an update of the Collins Creek stage-discharge curve equation. The new bankfull capacity was determined to be 5.60 m^3/s. The review was documented in the 2023 Application to Increase Collins Creek Bankfull Capacity (Orano 2023c) and accepted by the regulators in 2024 (CNSC 2024, SMOE 2024). The next review of the Collins Creek bankfull capacity and stage-discharge curve will be performed following the *Hydrometric Manual –Data Computations Stage-Discharge Model Development and Maintenance* (ECCC 2016) in 2028.

2.4 Overall Summary and Conclusions

2.4.1 Hydrogeology

Groundwater monitoring programs at the McClean Lake Operation have collected data to monitor hydraulic containment of the JEB TMF and the Sue Pits, to contribute to the regional and local (JEB/Sue) groundwater flow models, and to provide an indication of potential influence from other potential sources such as the CWRPs, ore pads, landfills, and fuel farm. In 2025, Orano developed groundwater evaluation criteria in accordance with CSA N288.7:23 standard and applied it to assess the state of groundwater for the McClean Lake Operation.

The key observations with respect to groundwater flow are summarized below:

- **JEB:**

    - In the sandstone, groundwater flow has been affected by the dewatering of the JEB pit during mining and its subsequent operation as a TMF. To prevent the migration of COPCs from the tailings, the TMF is designed and operated to maintain hydraulic containment and groundwater flows towards the JEB pit. Currently, containment is maintained by pumping from the base drain and pond reclaim systems. In 2023, the JEB TMF pond elevation increased above the groundwater elevation of several surrounding near-field wells, and as a consequence local hydraulic head contours no longer indicate a convergence of groundwater flow towards the JEB TMF. However, the hydraulic containment of the JEB TMF continues to be achieved by maintaining the base drain water elevation at least 1 m below the Fox Lake water elevation.

    - The relative elevation of the drumlin landform located east of the pit, together with a possible higher rate of groundwater recharge, likely results in the local east-west direction of groundwater flow in the overburden. Consequently, Fox Lake likely acts as a local discharge zone for groundwater flow in the overburden. During the reporting period, some declines in overburden groundwater levels were observed, attributed to below-average precipitation. A 2020 model of the mill terrace area reconfirmed that for structures located on the east side of the mill terrace, any contaminants would be transported to Johannes Lake, while those from the fuel farm or slurry receiving area on the west side would be transported to Pat Lake.

    - Drawdown in the sandstone after JEB pit dewatering, led to local reversals of hydraulic gradients changing local areas of downward groundwater flow to upward flow. However, as a result of the first stage of the TMF expansion program, the pond level was allowed to increase above the upper sandstone, and monitoring now shows a return toward natural pre-mining gradients which is expected as TMF pond levels increase.

- **Sue:**

    - As a result of pit dewatering at the Sue site during active mining, water levels in monitoring wells installed in the overburden, sandstone, and basement units generally decreased. Some water levels in monitoring wells located within the immediate vicinity of the pits decreasing by more than 40 m. Water levels in all wells at the Sue site have shown significant recovery post-mining, following pit flooding.

- Groundwater flow near the Sue open pits currently occurs in a radial pattern drawn in toward the Sue C/A pit, reflecting the influence of seasonal pumping to maintain hydraulic containment of the Sue area The pre mining condition was a westward flow of groundwater which is expected to reestablish when hydraulic containment is no longer needed.

- **Sink Dam:** The groundwater water levels in Sink Dam reflect the downward flow from the Sink Reservoir to Vulture Lake. Multi-year measurements show uniform hydraulic conditions within the dam, indicating stable groundwater flow patterns.

- **Moffat Domestic Landfill:** The water levels around the Moffat Domestic Landfill have not changed significantly from pre-mining levels. This area remains outside the influence of Sue pit operations, and observed variations in the water table are attributed to natural fluctuations, with no evidence of operational impacts.

- **McClean Mining (former SABRE Test) Site:** The influence of McClean Mining activities on the aquifer is limited and a drawdown state generally occurs during drilling and mining, as intended, limiting the contaminant transport.

The key observations with respect to groundwater quality are summarized below:

- **JEB:** Groundwater quality monitoring at the JEB site is used to monitor potential impacts from a number of activities including those on the mill terrace (e.g., Sulphuric Acid Plant, fuel farm, etc.), around the TMF, and in and around the clean waste rock pile. Indicative constituents for each of these areas were examined to assess potential impacts on groundwater; some key findings are highlighted below.

  - <u>McClean Lake Mill Terrace:</u>

    - Changes in groundwater quality were observed within the mill terrace monitoring wells potentially as a result of the 2024 floor breaches from the Sulphuric Acid Plant, CX Plant and Yellowcake Precipitation Circuit. Increasing trends and some exceedances in SEQG in a few COPCs with limited and localized effects were noted, but no overarching trend for the whole area was observed. It is recommended that groundwater modelling for the mill terrace should be completed in order to determine whether additional monitoring is needed for the area.

  - <u>JEB Ore Pad:</u>

    - Most wells around the JEB ore pad areas had groundwater quality consistent with background and baseline conditions except for well 14-01. Well 14-01 chemistry was distinctly different and had several parameters with increasing trends although concentrations were mostly below the SEQG. Monitoring in this area will be continued to assess if trends persist.

  - <u>JEB TMF:</u>

- Sulphate, chloride, and specific conductivity, all of which are elevated in the JEB TMF tailings pore water and pond water, are low in JEB TMF monitoring locations which indicates that hydraulic containment of the TMF has been maintained. Also, major ion chemistry for monitoring wells around the JEB TMF were largely similar to background and baseline data.

- Some monitoring wells around the TMF showed increasing trends and a few exceedances above SEQG for a few parameters (e.g. aluminum, arsenic, iron and manganese), particularly those finished in the sandstone units which are likely attributable to the groundwater recovery in the area interacting with residual mineralization proximal to the original JEB deposit, but no overarching trends or spatial patterns were identified. Monitoring around the TMF, especially to the southwest of the TMF in the direction of groundwater flow, will be continued to assess potential changes in water quality due to the increase in pond elevation in the TMF.

- TW08, which is a TMF containment indicator well located on the eastern side of the TMF installed into the lower sandstone, had the most distinct water chemistry with some increasing trends (e.g., TDS, specific conductivity, sulphate, nitrate). Field pH at this well has been slowly decreasing (ranging from 6.0 to 6.4 over the reporting period), but alkalinity and bicarbonate are increasing, suggesting that there is still neutralization capacity in this area.

  - <u>JEB Clean Waste Rock Pile, Waste Rock Area, and Industrial Landfill Monitoring:</u>

    - Monitoring wells situated in waste rock are characterized by elevated nitrate (among other parameters) compared to other water quality at the JEB site. Concentrations of dissolved arsenic and radium-226 were similar to nearby monitoring wells, and while dissolved uranium was higher than nearby monitoring wells it was still lower than 80% of the SEQG.

- **Sue:** Groundwater monitoring results around the Sue pits and waste rock areas were often in the range of baseline results, with some exceptions described below.

  - <u>Sue C/A and B Pits</u>**:**

    - Monitoring locations on the northern extent of the Sue C/A and B Pits potentially show some influence from the Sue C CWRP, particularly 97-18 (overburden), 97-01B and 97-07B (both lower sandstone), and 97-07A (basement), as indicated by elevated nitrate concentrations.

    - Various dissolved metals/radionuclides (e.g., aluminum, cadmium, iron, manganese, nickel, lead-210) were elevated at certain locations relative to SEQG, but overall directional trends were not identified. The Sue area remains hydraulic contained as groundwater flow continues towards the Sue C/A pits.

  - <u>Sue E Pit:</u>

- Despite previous measurements above the SEQG for arsenic, concentrations in all three wells in the Sue E Pit area are now below 80% of the guideline.

- Dissolved cobalt was highest across lower sandstone monitoring at the Sue site at 05-03. Concentrations were relatively stable prior to 2020, but recent concentrations are elevated relative to data pre-2020. Dissolved iron, manganese, and nickel have similar trends at this location. No statistically significant increasing trend was noted for cobalt or iron, as concentrations in the reporting period were flagged as outliers and therefore not included into the trend analysis. Continued monitoring will be conducted to determine if these elevated concentrations are indeed a trend.

- Well 05-04 typically has concentrations that exceed the SEQG for lead-210 and concentrations in the reporting period are higher than most previous results. Polonium-210 results from 05-04 during the reporting period were higher than the previous three results, although concentrations are still below the SEQG.

o Sue Clean Waste Rock Areas:

- Concentrations of some dissolved metals (e.g., dissolved aluminum, cobalt, cadmium) were elevated relative to SEQG in one or more monitoring wells in or around the Sue C and E CWRPs. Some major ions (e.g., chloride, calcium) have increasing trends in monitoring locations downgradient of the Sue C CWRP.

- **Moffat Domestic Landfill:** Groundwater quality monitoring occurs at three locations in the overburden around the Moffat Domestic Landfill. Two of the three wells, 04-01 and 97-19, tended to have stable or decreasing trends, while the third, 04-02 tended to have increasing trends. In 2013, Orano submitted a report with discussion of Moffat Landfill monitoring wells water chemistry trends to SMOE, which attributed the increase in uranium concentration to the increased bicarbonate, likely derived from the decay of organic matter in the landfill (AREVA 2013). The increase in uranium concentrations is not predicted to increase concentrations in Moffat Lake above the SEQG (AREVA 2013).

- **McClean Mining (former SABRE Test) Site:** Dissolved arsenic concentrations in overburden monitoring wells were higher in 13-02 and 13-03 (downgradient to the mining pad) than 13-01 and 13-04 (upgradient of the mining pad). Concentrations in both 13-02 and 13-03 were higher than the SEQG; the mean values for the reporting period were approximately four times higher than the guideline at 13-02 and approximately eight times higher at 13-04. Dissolved uranium concentrations were also higher in the downgradient wells than the upgradient wells. Dissolved arsenic concentrations in the lower sandstone monitoring wells were also elevated above SEQG in one well (MED05-02) but show a slight decreasing trend. This location (MED05-02) also has elevated dissolved lead-210, polonium-210 and radium-226 relative to other monitoring locations at the McClean Lake Operation and SEQG; however, concentrations of are relatively stable. As MED 05-02 is directly downgradient of the mineralized zone of the McClean deposit, the elevated concentrations are expected. Additional groundwater monitoring is recommended around the McClean Mining site to support future mining activities. Orano will complete an EcoRA for the McClean mining to inform the additional monitoring required.

No adjustments to the current routine groundwater monitoring were recommended, however considerations for additional investigations and modelling are discussed in Section 2.2.7.

2.4.2 Hydrology

Recent hydrological monitoring data (2022–2024) indicate that most lake level variations are primarily influenced by climate variability, particularly below-average precipitation observed over the last three years. The majority of water level changes in the monitored lakes track closely with patterns at control (reference) lakes, and there is no evidence of significant impacts from mining activities. Notably, several lakes reached minimum levels during this period, reflecting the extended dry conditions, while maximum levels remain consistent with those previously recorded.

Predicted operational impacts, such as drawdown from pit dewatering and treated effluent discharge, have remained within or below the ranges forecasted in prior environmental assessments. Water withdrawals from Pat Lake continue to operate within licensed limits.

For streamflow, Collins Creek has maintained flows consistent with and above historical baseline. Streamflow in Collins Creek during the operational period is statistically higher than in the baseline period, a pattern likely attributable to operational discharges and data uncertainties in earlier baseline models. The increase in total streamflow by the effluent discharge remains below initial environmental predictions.

Data quality and monitoring performance targets have been met for both lake elevation and streamflow records, although some minor gaps and uncertainties remain - primarily due to gauges' benchmarks and rating curve. As a result, it is recommended to continue routine monitoring of lake levels and streamflow at key locations, with periodic review and update of rating curves according to best practices (ECCC, 2016). In addition, it is recommended to adopt use of GPS equipment as a new method of obtaining lake water reference elevation data. Current patterns do not support the need for additional monitoring stations. Ongoing climate and hydrological variability highlight the importance of sustaining the monitoring program to promptly identify any future operational impacts or long-term trends.

2.5 References

AREVA (AREVA Resources Canada Inc.). 2009a. McClean Lake Operation Status of the Environment Report Assessment Period 2006-2008. Prepared by AREVA Resources Canada Inc. in association with Canada North Environmental Services, SENES Consultants Ltd., and Kilgour & Associates Ltd.

AREVA (AREVA Resources Canada Inc.). 2009b. McClean Lake Operation Caribou Project Environmental Impact Statement.

AREVA (AREVA Resources Canada Inc.). 2009c. Midwest Project Existing Environment Technical Information Document.

AREVA (AREVA Resources Canada Inc.). 2011a. McClean Lake Operation. Technical Information Document Hydrogeology and Groundwater Modelling for the Collins Creek Basin.

AREVA (AREVA Resources Canada Inc.). 2011b. Midwest Project Environmental Impact Statement.

AREVA (AREVA Resources Canada Inc.). 2011c. McClean Lake Operation 2010 Annual Report. March 2011. Saskatoon, Saskatchewan.

AREVA (AREVA Resources Canada Inc.). 2012. McClean Lake Operation 2011 Annual Report. March 2012. Saskatoon, Saskatchewan.

AREVA (AREVA Resources Canada Inc.). 2013. McClean Lake Operation – Moffat Landfill Monitoring Wells Water Chemistry Trends, July 2013. Saskatoon, Saskatchewan.

AREVA (AREVA Resources Canada Inc.). 2016a. McClean Lake Operation 2015 Annual Report. March 2016. Saskatoon, Saskatchewan.

AREVA (AREVA Resources Canada Inc.). 2016b. McClean Lake Operation. Technical Information Document Environmental Performance. Volume 1.

CNSC (Canadian Nuclear Safety Commission). 2017. Correspondence: Akhter to Laniece. Orano - McClean Lake – Notification/Application to Decommission JEB TMF Infrastructure. Dated May 15, 2017.

CNSC (Canadian Nuclear Safety Commission). 2023. Correspondence: Akhter to Mitchell. Subject: RE: McClean Lake Operation - Orano Application to Increase Collins Creek Bankfull Capacity Dated December 13, 2023.

CNSC (Canadian Nuclear Safety Commission). 2024. Correspondence: Akhter to Mitchell. Subject: RE: McClean Lake Operation - Orano Application to Increase Collins Creek Bankfull Capacity - CNSC Acceptance Dated January 30, 2024.

COGEMA (COGEMA Resources Inc.). 1995a. Application for Approval to Operate JEB Mine and Associated Facilities. March 1995.

COGEMA (COGEMA Resources Inc.). 1995b. The Midwest Project Environmental Impact Statement, August 1995.

COGEMA (COGEMA Resources Inc.). 1995c. Midwest Environmental Impact Statement. Supporting Document 2 – Hydrogeological Studies & Waste Management and Characterization, August 1995.

COGEMA (COGEMA Resources Inc.). 1995d. The Midwest Project. Environmental Impact Statement. Supporting Documents 3 and 6. August 1995.

COGEMA (COGEMA Resources Inc.). 1995e. McClean Project. JEB Pit Dewatering Well Drilling. 95-CM-99-01, October 1995.

COGEMA (COGEMA Resources Inc.). 1997. McClean Lake Project. JEB Tailings Management Facility. Volume 2, Appendix A1 Quaternary Geology, JEB Open Pit Mine.

COGEMA (COGEMA Resources Inc.). 2004a. McClean Lake Operation. Technical Information Document Hydrogeology and Groundwater Modelling for the Collins Creek Basin. Version 1.0. March 2004.

COGEMA (COGEMA Resources Inc.). 2004b. McClean Lake Operation – Sue E Project Environmental Impact Statement. November 2004.

CSA (Canadian Standards Association). 2023. Groundwater protection and monitoring programs for nuclear facilities and uranium mines and mills. CSA N288.7:23.

CSA (Canadian Standards Association). 2025. Environmental monitoring programs at nuclear facilities and uranium mines and mills. CSA N288.4:25.

ECCC (Environment and Climate Change Canada). 2016. Hydrometric Manual – Data Computations: Stage-Discharge Model Development and Maintenance, SOP-NA049-01-2016. Water Survey of Canada, National Hydrological Services, Meteorological Services of Canada, Ottawa.

Golder (Golder Associates Ltd.). 2019. Groundwater Flow and Solute Transport Report. JEB TMF Expansion Stage 2 Project. October 2019. Saskatoon, Saskatchewan.

Golder (Golder Associates Ltd.). 2021. Assessment of JEB TMF Hydraulic Containment and Monitoring. November 2021.

Harrelson, C.; Rawlins, C.L.; Potyondy, J.P. 1994. Stream channel reference sites: an illustrated guide to field technique. Gen Tech. Rep. RM-245. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.

MacLaren Consultants and Saskatchewan Research Council (SRC). 1980. Environmental Baseline Studies for Project Wolly McClean Lake Area. Prepared for Canadian Occidental Petroleum Ltd. Interim Report No. 2.

Minatco (Minatco Limited.). 1991. The McClean Lake Project Environmental Impact Statement, Supporting Document III, IV and V, August 1991.

Orano (Orano Canada Inc.). 2018. McClean Lake Operation 2017 Annual Report. March 2018. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2019. McClean Lake Operation Environmental Monitoring Design Document, Version 3. March 2019. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2020a. McClean Lake Operation Tailings Management Technical Information Document. May 2020. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2020b. Groundwater Flow Model for the Mill Terrace. August 2020. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2021. McClean Lake Operation Waste Rock Management Technical Information Document. November 2021. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2022. McClean Lake Operation Technical Information Document 2022 Environmental Performance. Volume 1 of 1. Version 1 Revision 0. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2023a. McClean Lake Operation Environmental Monitoring Design Document Version 4. December 2023. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2023b. McClean Lake Operation 2022 Annual Report. March 2023. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2023c. McClean Lake Operation Application to Increase Collins Creek Bankfull Capacity. November 2023. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2024a. McClean Lake Operation 2023 Annual Report. March 2024. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2024b. McClean Lake Operation - 2022 Environmental Performance Technical Information Document – Response to SMOE Comments. Prepared by Orano Canada Inc. April 2024.

Orano (Orano Canada Inc.). 2025a. McClean Lake Operation 2024 Annual Report. March 2025. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2025b. Tailings Management Technical Information Document. Saskatoon, Saskatchewan. December 2025.

Orano (Orano Canada Inc.). 2025c. Environmental Performance Technical Information Document Volume 2 of 2 – Environmental Risk Assessment. Version 1, Revision 0. December 2025. Saskatoon, Saskatchewan.

Phillips, J.C. and B.C. Eaton. 2009. Detecting the timing of morphological changes using stage-discharge regressions: A case study at Fishtrap Creek, British Columbia, Canada. Canadian Water Resources Journal 34(3): 285-300.

Ramaekers, P, G. Yeo and C. Jefferson. 2001. Preliminary Overview of Regional Stratigraphy in the late Paleoproterozoic Athabasca Basin, Saskatchewan and Alberta. In Summary of Investigations 2001, Volume 2, Saskatchewan Geological Survey, Sask. Energy Mines, Misc. Rep.2001-4.2, p 240-250.

Sibald, T.I. 1983. Geology of the Crystalline Basement, NEA/AEA ATHABASCA Test Area. In: Cameron, E.M. (ed.), Uranium Exploration in Athabasca Basin, Saskatchewan.

SMOE (Saskatchewan Ministry of Environment). 2024. Correspondence: Moulding to Mitchell. McClean Lake Operation - Orano Application to Increase Collins Creek Bankfull Capacity - SMOE Acceptance Dated April 17, 2024.

Thornton, M.M., R. Shrestha, Y. Wei, P.E. Thornton, and S-C. Kao. 2022. Daymet: Daily Surface Weather Data on a 1-km Grid for North America, Version 4 R1. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2129

3 Climate and Air Quality

The following section summarizes the regional and local data that characterize the climatic parameters which could influence the McClean Lake Operation, as well as air quality data collected locally to assess the effects of the McClean Lake Operation on environmental conditions in the region.

3.1 Climatology and Meteorology

3.1.1 Study Design and Objectives

Meteorological mechanisms govern the dispersion, transformation, and eventual removal of pollutants from the atmosphere. Key meteorological variables such as wind direction, wind speed, atmospheric stability, and mixing heights are needed to characterize the dispersion meteorology of the region. The quantity of precipitation affects the rate at which pollutants such as fugitive dust, are released to the atmosphere. Ambient temperature plays a lesser role, affecting the initial dispersion of pollutants due to thermal rise.

This section provides an overview of the fundamental elements of climate and meteorology in the McClean Lake Operation region, including temperature, precipitation, wind speed, and wind direction. Information on the evaporation and evapotranspiration, atmospheric stability, and mixing heights in the area can be found in the 2016 McClean Lake Technical Information Document Volume 1 Environmental Performance (AREVA 2016a). A summary of the meteorological data for the period 2022 to 2024 from the McClean Lake Operation is provided below and compared with historical observations (2000 to 2021) and long-term climate norms (1991 to 2020) from the Environment and Climate Change Canada (ECCC) station at Key Lake. Currently, climate norms for the ECCC Collins Bay station located at Cameco's Rabbit Lake facility (Figure 3.1-1) do not exist for the 1991 to 2020 period; however, a comparison to meteorological data measured at Collins Bay for the current reporting period (2022 to 2024) is provided.

3.1.2 Impact Predictions

Meteorological monitoring for the McClean Lake Operation is intended to provide data to improve the operation's air dispersion modelling and not to assess potential impacts on local meteorological conditions. Consequently, no impact predictions are available for meteorological parameters. The air dispersion model for the 2016 McClean Lake Technical Information Document Volume 2 Environmental Risk Assessment (AREVA 2016b) was initialized using a one-year CALMET meteorological dataset. The CALMET dataset was developed for the year 2008 using three-dimensional non-hydrostatic mesoscale model (NMM) analysis data available from the US National Centre for Environmental Prediction (NCEP). The NMM analysis data was supplemented with surface wind observations from the former on-site Moffat Lake meteorological station (Figure 3.1-1) as well as the Collins Bay and Key Lake stations operated by Cameco and ECCC. The 2008 CALMET wind rose is presented in Figure 3.1-2 and illustrates that winds most frequently blow from the northwest followed by the south, and that the average wind speed is 2.7 m/s.

Precipitation data from the Cameco Collins Bay station was also used as input to CALMET and substituted with ECCC data from Collins Bay and Key Lake, as required.

Studies that pre-date the operation, including the 1991 McClean Lake EIS (Minatco 1991) and 1995 EIS (COGEMA 1995), developed air dispersion meteorological datasets using observations from nearby Collins Bay, while the 2009 Caribou EIS (AREVA 2009) and the 2011 Midwest EIS (AREVA 2011) utilized data collected at the on-site Moffat Lake station that was supplemented with data from other regional stations, including Collins Bay and Key Lake.

3.1.3 Methods

3.1.3.1 Sampling Methods

The local meteorology near the McClean Lake Operation is characterized by the surface meteorological dataset collected from the McClean Lake Operation on-site station (Figure 3.1-1). The location of the meteorological station moved in October 2014 from the Moffat Lake location to the JEB site, southeast of the McClean Lake Mill. These two locations are approximately 6.4 km apart, with no major relief features between them. An evaluation of six months of data from both stations indicated that differences in temperature and precipitation between the two sites are negligible (AREVA 2017). Additionally, the site's weather data is routinely compared to data from ECCC's Collins Bay weather station to ensure its reliability. The comparison indicates that data collected since the station's relocation is accurate, representative of the area and suggests that the station's current location is suitable and meets environmental monitoring and safety requirements.

The JEB station collects hourly measurements of temperature, wind speed, wind direction, precipitation, relative humidity, station pressure, and solar radiation. Regional data includes climate normals data collected by an ECCC weather station at Key Lake for the period of 1991 to 2020, and data collected by an ECCC weather station at Collins Bay for the reporting period (2022 to 2024).

3.1.3.2 Data Analysis

Summary statistics for temperature, wind speed, wind direction, and precipitation for the reporting period 2022 to 2024 have been generated using the on-site meteorological dataset and compared to historical observations from 2000 to 2021. Data are also compared to available regional observations, including the Key Lake climate norms (1991 to 2020) and ECCC Collins Bay data for the reporting period (2022 to 2024). Specifically, the following evaluation criteria (EvCs) were applied for the on-site climate data analysis:

- EvC 1: Comparison to historical data – data were compared to historical on-site data and 30-year climate norms to identify changes in climate parameters over time. Changes are identified and discussed in the detailed analysis section.

- EvC 2: Comparison to regional data – data were compared to observations collected from regional climate stations. Differences are identified and discussed in the detailed analysis section.

- EvC 3: Comparison to the most recent ERA air dispersion model inputs – wind data were evaluated to ensure that values were consistent with the 2008 CALMET wind rose developed in the most recent ERA (Figure 3.1-2).

3.1.4 Results

3.1.4.1 Monitoring Performance

The data record for the 2022 to 2024 period contained some data gaps due to extended instrumentation malfunctions at the JEB weather station. These equipment issues resulted in inaccurate precipitation records from June 8 to October 31, 2023, and March 1 to July 20, 2024, during which precipitation data from ECCC's Collin's Bay weather station was substituted. Wind direction data was also not recorded from March 27 to June 8, 2023, which accounted for approximately 20% of the 2023 wind direction dataset. While there were also missing records for wind speed and solar radiation during the current reporting period, they accounted for less than 2% of the total dataset and were therefore considered insignificant. All issues with the weather station equipment were resolved by Campbell Scientific in 2024.

In 2024, Orano specified performance criteria for all aspects of the monitoring program to ensure a complete dataset was collected to achieve EMP objectives and comply with the Canadian Standards Association (CSA) N288.4 standard (CSA 2025). The target set for the on-site weather station is 90% completion on an annual basis for each measured parameter. Due to the instrumentation issues noted above, wind direction measurements did not meet this target in 2023. Wind direction measurements met the target in 2022 and 2024, and all other meteorological parameters met the completeness targets in 2022, 2023, and 2024.

3.1.4.2 Temperature

Temperature data have been summarized for the historic period of 2000 to 2021 (Table 3.1-1) and the reporting period of 2022 to 2024 (Table 3.1-2) from data collected by the McClean Lake on-site meteorological station. The 2022 to 2024 data are compared to data measured by an ECCC weather station at Collins Bay over the same period (Table 3.1-3) and long-term Canadian climate normals (1991 to 2020) for Key Lake provided by ECCC (Table 3.1-4), which are used to characterize climate and weather conditions in the region (ECCC 2025b).

As shown in Table 3.1-2, mean daily temperatures at the McClean Lake Operation are below 0°C from November through to April. Between 2022 and 2024, the mean daily maximum temperature at the McClean Lake site ranged from a high of 23.1°C in July to a low of -17.6°C in January, with an extreme maximum temperature of 33.4°C being recorded in July 2024. Between 2022 and 2024, the mean daily minimum temperature at the McClean Lake site was lowest in February (-28.6°C) and highest in July (10.6°C), with an extreme as low as -41.5°C in February 2022. Over the same period at the ECCC Collins Bay station (Table 3.1-3), the highest mean daily maximum temperature (22.0°C) was recorded in July, and the lowest mean daily maximum temperature was recorded in January (-17.3°C), with an extreme of 30.7°C recorded in June 2023. The mean daily minimum temperature recorded at Collins Bay ranged between -30.2°C in February and 9.1°C in July, with an extreme minimum temperature of -43.5°C recorded in February 2022. Climate normals for the ECCC station at Key Lake for the years 1991 to 2020 (Table 3.1-4) show that the highest mean daily maximum temperature (22.5°C) was recorded in July and the lowest mean daily minimum temperature was recorded in January (-16.4°C), with an extreme temperature of 36.0°C recorded in August 1991. The mean daily minimum temperature recorded at Key Lake in the 30-year period ranges between -27.7°C in January and 9.8°C in July, with an extreme temperature of -52.5°C recorded in January 2004.

Overall, differences in mean daily minimum/maximum temperatures, mean daily temperatures, and extreme temperatures are small between the regional stations and the historical data record. The average annual temperature observed at the McClean Lake Operation from 2022 to 2024 (-2.1°C) was similar to the annual average at Collins Bay over the same period (-2.8ºC) as well as the Key Lake climate normal (1991 to 2020) of -2.4°C. Temperatures recorded at the McClean Lake site between 2022 and 2024 were comparable to those recorded between 2000 and 2021; however, most months were slightly warmer during the current reporting period compared to the historical record. This is evident in Figure 3.1-3, which shows the mean daily temperature by month for the McClean Lake meteorological station (both the 2000 to 2021 and 2022 to 2024 periods), the Collins Bay ECCC station (2022 to 2024), and the ECCC Key Lake climate normals (1991 to 2020). The exception is February and March, where the mean daily temperature for the reporting period is less than the historical on-site record and the climate normals.

3.1.4.3 Precipitation

Total precipitation data from the McClean Lake meteorological station for the historic period of 2000 to 2021 and the reporting period 2022 to 2024 are presented in Tables 3.1-5 and 3.1-6, respectively.

Due to a malfunction in the precipitation gauge in 2023 and 2024, data from June 8 to October 31, 2023, and March 1 to July 20, 2024, is from the nearby ECCC station at Collins Bay. The 2022 to 2024 precipitation values are compared to data collected at Collins Bay over the same period (Table 3.1-7) and long-term Canadian climate normals (1991-2020) for Key Lake provided by ECCC (Table 3.1-8).

Annual mean precipitation rates at the McClean Lake Operation between 2022 and 2024 were comparable to the regional stations and the historical data record. As shown in Table 3.1-6, the average annual precipitation measured at the McClean Lake station between 2022 and 2024 was 419.6 mm. Approximately 59% of the total annual precipitation occurred during the months of May through October. The highest mean-monthly rainfall was in June (62.6 mm) and the greatest rainfall in a 24-hour period was recorded in June 2024 (35.4 mm). Over the same period at the ECCC Collins Bay station (Table 3.1-7), the average annual precipitation measured was 394.5 mm, which is within 6% of the McClean Lake station total. The highest monthly rainfall occurred in July (64.9 mm), and the greatest 24-hour rainfall event (37.1 mm) occurred in June 2024, also consistent with the McClean Lake station. Table 3.1-6 summarizes the 30-year precipitation norms for the Key Lake station for the 1991 to 2020 period (ECCC 2025b). Mean annual precipitation at Key Lake is 471.4 mm, which is within 12% of the McClean Lake station total, and approximately 72% of the total annual precipitation (342.9 mm) fell between the months of June to September. The highest mean monthly rainfall was in July 1998 (72.0 mm).

As described above, mean annual precipitation rates recorded at the McClean Lake station between 2022 and 2024 were similar to Collins Bay for the same period as well as the historical record and climate normals. However, a comparison of mean monthly precipitation rates for the current reporting period in Figure 3.1-4 shows larger differences compared to the on-site historical record and the climate norms in some months. For example, precipitation amounts for the reporting period were noticeably higher in February compared to the historical on-site record, while August through October showed lower precipitation for the 2022 to 2024 period. Compared to the climate norms, precipitation amounts at McClean Lake for the current reporting period were noticeably lower for the months of July through October, likely owed to regional differences in precipitation between McClean Lake and Key Lake.

3.1.4.4 Surface Winds

Wind direction is reported as the direction from which the wind blows and is based on surface (10 m) observations. In general terms, if the wind does not blow toward a receptor (human or environmental) there will be no air quality impact. However, the wind does blow in all directions with certain directions occurring more frequently than others. These are known as the prevailing wind directions. Ambient concentrations of COPCs typically decrease with increasing wind speed because of dilution. When wind speed is high there is typically good dispersion, while with low wind speeds, local, ground-level air quality concentrations can be higher due to poor dispersion. Higher wind speeds can also induce greater mechanical turbulence due to flows in and around obstacles (e.g., buildings).

The annual frequency distribution of surface winds at the McClean Lake site are illustrated in the form of wind rose diagrams showing wind direction frequency and wind speed by direction. Wind rose plots for the historical period 2000 to 2015 are presented in Figure 3.1-5 (2000 to 2010) and Figure 3.1-6 (2011 to 2015). Figure 3.1-7 includes data from the McClean Lake station for both the 2016 to 2021 and 2022 to 2024 periods, as well as data from the ECCC Collins Bay station for the period from 2022 to 2024 for comparison.

As shown in Figure 3.1-7, the prevailing annual wind directions for all datasets were from the west (W), occurring 11.4% of the time at McClean Lake in 2016 to 2021, 9.8% of the time at McClean Lake in 2022 to 2024, and 12.2% of the time at Collins Bay in 2022 to 2024. The average wind speeds in this direction at McClean Lake were 2.7 m/s (2016 to 2021) and 2.9 m/s (2022 to 2024), and at Collins Bay it was 2.7 m/s. Calm wind conditions (wind speed less than 0.5 m/s) were observed 1.9% of the time at McClean Lake in the 2016 to 2021 period and 1.1% of the time in the 2022 to 2024 period. It is noted that the instrument at Collins Bay has a threshold of 0.83 m/s, therefore, the percentage of time that winds are below 0.5 m/s is zero. The historical record (Figures 3.1-5 and 3.1-6) are similar to the ERA wind rose shown in Figure 3.1-2 – all datasets show prevailing wind directions from the northwest (NW). The shift in dominant wind direction from NW to W between the historical and current data period is likely owed to the change in the meteorological station location. In 2019, Independent Environmental Consultants (IEC) evaluated the JEB location of the McClean Lake meteorological station and found that the wind data between the McClean Lake station and Collins Bay were similar, indicating that the site dataset is accurate, and that Collins Bay could be considered a suitable substitute for missing wind data. This is consistent with the comparison shown in Figure 3.1-7 for the current reporting period. Additionally, IEC found no evidence to suggest that local topographical features or trees were impacting the wind data and determined that the siting of the JEB meteorological station was suitable and did not need to be modified (IEC 2019).

3.1.5 Monitoring Adjustments Recommendations

No adjustments to the climate and meteorology monitoring are recommended.

3.2 Air Quality

Air quality monitoring at the McClean Lake Operation consists of the following monitoring programs discussed in the subsections below:

- airborne dust monitoring with High Volume Air Samplers (HVAS)

- (Section 3.2.1);
- ambient radon (track-etch) monitoring (Section 3.2.2);
- pH measurements in precipitation (Section 3.2.3).
- ambient sulphur dioxide monitoring (Section 3.2.4); and
- exhaust stack monitoring (Section 3.2.5).

3.2.1 Total Suspended Particulate Matter

3.2.1.1 Pre-development Baseline

Pre-development baseline air quality monitoring in the McClean Lake LSA included total suspended particulate (TSP) sampling at two sites, Candy Lake and Moffat Lake, completed periodically between 1979 and 1982. The annual geometric mean TSP levels at Moffat Lake were similar between the years, measuring 9.22 µg/m^3 in 1981 and 9.15 µg/m³ in 1982. At Candy Lake, a low geometric mean TSP value of 6.88 µg/m^3 was measured in 1979 and a higher geometric mean of 29.42 µg/m^3 was measured in 1980. The baseline TSP values obtained from both stations during the four years were below the annual TSP standard of 60 µg/m³ (geometric mean) as outlined in the Saskatchewan Ambient Air Quality Standards (SAAQS) (GS 2022). Baseline TSP monitoring at Cigar Lake between 1988 and 2003 recorded a baseline geometric mean TSP level of 8.8 µg/m^3 (Cameco 2004).

Based on data collected during baseline monitoring, the background annual TSP level was estimated to be in the range of 10 µg/m³ to 20 µg/m³ (Minatco 1991).

3.2.1.2 Study Design and Objectives

The McClean Lake Operation is a source of atmospheric emissions of TSP and adsorbed radioactive and non-radioactive COPCs. Orano operates a comprehensive air quality monitoring program to measure ambient levels of atmospheric TSP and its adsorbed COPCs at five sampling locations (Table 3.2-1 and Figure 3.2-1). The general objectives of the TSP sampling program are to collect data that can be used to verify compliance with applicable ambient air quality standards or criteria, assess risks to the environment, verify air quality model predictions, and inform/improve the ERA model.

The program is designed to collect one 24-hour TSP sample per week at each of the five monitoring stations, and to analyze composite samples from each station on a quarterly basis for adsorbed COPCs. The samplers are maintained and operated such that at least 24 valid samples are collected from each location during a consecutive six-month period per the SMOE Approval to Operate PO24-012.

3.2.1.3 Impact Predictions

In the 1991 McClean EIS (Minatco 1991), the maximum long-term TSP concentration was predicted to be between 40 µg/m^3 and 50 µg/m^3 near the Sue B pit. Dust concentrations were predicted to rapidly fall off with distance from the pit, with values predicted to fall below 20 µg/m^3 beyond the McClean Lake property boundary. Background TSP for the project area was estimated to be approximately 10 µg/m^3. The impact of TSP on local air quality was predicted to be minor (Minatco 1991).

The 2004 Sue E EIS did not include predictions for TSP concentrations (AREVA 2004). The 2009 Caribou EIS mentioned that predicted concentrations of TSP would remain below the federal and provincial air quality standards from that time and would decrease rapidly away from the active working areas, including the McClean Lake Mill and Sulphuric Acid plant, and the Sue Site (AREVA 2009).

In support of the 2016 ERA, TSP from the McClean Lake Operation was modelled for the current reporting period (2022 to 2024) and for future operations, decommissioning, and post decommissioning activities (AREVA 2016b). For the 2022 to 2024 period, modelled activities included JEB TMF optimization and expansion construction, and milling of Cigar Lake slurry (Phase 1), Midwest ore, and stockpiled Sue B ore. During the assessment period, the principal sources of particulate were related to on-site roads (82%), followed by the mill calciner stack (12%) (AREVA 2016b).

Total TSP concentrations (i.e., including background) predicted in the 2016 ERA for the 2022 to 2024 period are included in Table 3.2-2. The assessment predicted that the annual average TSP concentrations for the 2022 to 2024 operational period would be 13.3 µg/m^3 for the McClean Lake Operation area and 19.5 µg/m^3 at the JEB Camp (AREVA 2016b). These predictions are lower than those predicted in the 1991 McClean EIS (Minatco 1991) and are within the range of baseline values collected between 1979 and 1982. The 2016 ERA also predicted total metal and radionuclide concentrations in TSP for the current reporting period (2022 to 2024) (Table 3.2-2). Most of the concentrations predicted for the McClean Lake Operation area and JEB Camp were below the applicable ambient air quality criteria (AAQC) applied in the assessment. The exceptions were arsenic, nickel, and uranium; however, these results were attributed to conservative background concentrations which already exceed the AAQC. Radionuclide values ranged from 0.00062 Bq/m^3 for Radium-226/Thorium-230 to 0.012 Bq/m^3 for Lead-210/Polonium-210, while metals ranged from 0.005 µg/m³ for selenium to 0.55 µg/m³ for zinc (AREVA 2016b).

3.2.1.4 Operational Monitoring

Sampling Methods

The particulate air sampling program was initiated in February 1997, with five HVAS installed at various locations around the McClean Lake Operation to monitor TSP and adsorbed metals and radionuclides (Figure 3.2-1). In July 2020, station HVJ1 was relocated from approximately 100 m north of the JEB TMF to approximately 150 m south of the JEB TMF and now renamed as HVJ1A. Station HVJ2 is located approximately 300 m east-southeast of the McClean Lake Mill, downwind of the mill based on prevailing wind direction. Station HVJ3 is located approximately 100 m south of the permanent camp. Station HVJ4 is located at the south end of Vulture Lake away from mining and milling activities and acts as a reference station. Justification for the reference station location was discussed during the review of the 2022 EP TID (Orano 2023a). Station HVS1 is located approximately 300 m east of Sue C/A pit (Orano 2021). As a result of power issues, station HVS1 was relocated in November 2021 to approximately 350 m north of its' original location (Orano 2022) and now renamed as HVS1A (Figure 3.2-1). The HVAS operate once per week for 24 hours. Weekly samples are then compiled into quarterly composites for analysis of metals and radionuclides. The locations and frequency of TSP monitoring is adequate to meet the requirements of the EMP.

Data Analysis

Initial Screening

HVAS data were initially screened to identify potentially erroneous data and data gaps prior to data analyses. This included screening for duplicate data, errors or omissions, and investigating potential anomalous values or extreme outliers. Any identified outliers were screened against the entire dataset for that constituent to ascertain whether the value appeared erroneous. No data were removed from the analysis unless they were confirmed to be erroneous.

Evaluation Criteria

The following EvCs were applied to the HVAS data analysis:

- EvC 1: Comparison to detection limits (DLs) – all measured parameters were first screened against laboratory DLs to identify which constituents are below measurable thresholds. If less than 90% of a parameter's concentration for all monitoring locations were below the DL during the reporting period (2022 to 2024), then it was retained for further evaluation.

- EvC 2: Comparison to reference dataset – the measured concentrations from exposure stations were compared to the applicable background (reference station data) and baseline data to identify differences from baseline or background concentrations. If mean concentrations in at least one of the exposure monitoring locations were more than two standard deviations (SDs) above the reference mean, then it was carried forward for further evaluation.

- EvC 3: Comparison to historical data – data from the current reporting period were compared to historical data (2000 to 2021) to identify increases or decreases in concentrations over time. Changes are identified and discussed in the results section.

- EvC 4: Comparison between seasons – current data were compared between the summer and winter seasons to identify differences in seasonal concentrations. Summer is defined as May to October inclusive, when the mean monthly temperature is above zero (see Table 3.1-2). Differences are identified and discussed in the results section.

- EvC 5: Comparison to the EIS and most recent ERA predictions – data were evaluated to ensure that values remained within the most recent impact predictions presented in Section 3.2.1.3.

- EvC 6: Comparison to ambient air quality standards or criteria – data were compared to the SAAQS (GS 2022) for TSP and the Ontario AAQC (OMECP 2022) for the metal constituents. Exceedances are identified and discussed in the results section.

EvCs 1 and 2 were applied for COPC selection, while EvCs 3 to 6 were used for detailed data analysis for selected COPCs.

COPC Selection

Although a full suite of parameters has been analyzed for metals and radionuclides in TSP, COPCs were identified through the screening methodology described in Section 1.6.2.4 and shown in Tables 3.2-3 and Appendix III.2. EvCs 1 and 2 listed above were applied as part of the COPC screening process. Additionally, any parameter with a predicted concentration in the 2016 ERA was included as a COPC in the current EP TID. The following table lists the COPCs specifically addressed in this report:

COPCs
Metals Constituents in TSP
Arsenic
Cadmium
Cobalt
Copper
Lead
Molybdenum
Nickel
Selenium
Uranium
Vanadium
Zinc
Radionuclides in TSP
Lead-210
Polonium-210
Radium-226
Thorium-230

Detailed Data Analysis

HVAS data collected throughout the 2022 to 2024 period were analyzed and presented in Tables 3.2-4 to 3.2-6 and Figures 3.2-3 to 3.2-29. To be consistent with annual reporting, measurements that were below the DL were set equal to the DL value. As requested by the CNSC (CNSC 2017) and as prescribed in Schedule 2 of the SMOE Approval to Operate PO24-012, annual TSP values are presented as geometric means. Data were compared spatially between reference and exposure areas, temporally to historical sampling periods (i.e., 2000 to 2021), seasonally, to predictions made in previous EIS and in the 2016 ERA, and to applicable standards or criteria.

Results

Monitoring Performance

Weekly TSP monitoring was conducted consistently throughout the 2022 to 2024 reporting period; however, some data gaps were identified. In 2023 and 2024, the following weekly samples were missed:

- in February 2023, one weekly sampling was missed at all five monitoring locations,

- in June 2023, one weekly sample was missed at HVJ2, and
- in August 2024, one weekly sample was missed at HVJ3.

Instances where a negative TSP concentration was recorded or samples with suspect results were considered erroneous data. Negative samples were noted in April 2023 for one weekly measurement at HVJ1A and in December 2023 for one weekly measurement at HVJ1A, HVJ3, HVJ4, and HVS1A. In June 2024, one weekly measurement at HVJ4 was removed since no mass was recorded and in September 2024, one weekly measurement at HVJ3 was removed since the reported flow was too low (less than 1 m^3).

No station recorded more than 2 missed weekly samples in any calendar year, accounting for approximately 2% to 4% of a station's annual dataset. The SMOE Approval to Operate PO24-012 requires that at least 24 valid HVAS samples must be collected at each station over a consecutive six-month period, and this requirement was achieved during the reporting period.

In 2024, Orano specified performance criteria for all aspects of the monitoring program to ensure a complete dataset was collected to achieve EMP objectives and comply with the CSA N288.4 standard (CSA 2025). An annual target completion of 95% was set for TSP monitoring (i.e., a target of 247 TSP samples per year and 19 adsorbed metals samples per year). Orano met its target completion for TSP and adsorbed metals samples for each year. For TSP, the number of samples collected in 2022, 2023, and 2024 was 260, 254, and 259, respectively. For metals, 20 samples were collected each year.

Operational Data

A statistical summary of the TSP data collected in the period from 2022 to 2024 is summarized in Table 3.2-4. In this table, the geometric mean for the entire 2022 to 2024 period and the maximum annual geometric mean within this period are compared to the geometric mean of TSP concentrations from 2000 to 2021. The arithmetic average for the 2022 to 2024 period is also presented and compared to the predicted annual average concentrations from the 2016 ERA (AREVA 2016b). Figure 3.2-2 to Figure 3.2-6 present the 24-hour TSP concentrations for each sample at each station over the 2022 to 2024 period. Figure 3.2-7 to Figure 3.2-11 show the TSP results from the summer period (May to September) compared to the winter period (October to April) from 2022 to 2024. Generally, TSP concentrations are higher during the summer months, due to drier conditions and the absence of snow cover. Values are expected to increase during snow free periods due to the increased presence of dust.

The data summarized in Table 3.2-4 show that the annual geometric mean and annual arithmetic mean TSP levels recorded at all four exposure stations during the 2022 to 2024 period were higher than those recorded at the Vulture Lake reference station. TSP levels measured between 2022 and 2024 were highest at the JEB TMF (HVJ1A) station (Table 3.2-4), with the highest concentrations being measured in the summer of 2023 (Figure 3.2-7). Increases at HVJ1A in 2023 are attributed to increased smoke from forest fires in the surrounding area (Orano 2024a). The annual arithmetic mean for HVJ1A during the 2022 and 2024 period is higher than the prediction in the 2016 ERA for the McClean Lake Operation area (AREVA 2016b). The increase is likely associated with the forest fire smoke in 2023. There were five exceedances of the 24-hour SAAQS for TSP of 100 µg/m^3 at HVJ1A in the 2022 to 2024 period (out of 153 valid samples), four of which occurred in 2023 and one in 2022.

Arithmetic and geometric mean TSP concentrations at the mill area (HVJ2) and Sue C Pit (HVS1A) were similar and were below the levels predicted to occur for the McClean Lake Operation area in the 2016 ERA (Table 3.2-4). There was one measured exceedance of the 24-hour TSP SAAQS at HVJ2 during the 2022 to 2024 period (out of 154 valid samples), and no exceedances at HVS1A (out of 154 valid samples). The arithmetic and geometric mean TSP concentrations for 2022 to 2024 at the JEB Camp (HVJ3) were similar to HVJ2 and HVS1A and less than the concentration predicted at the JEB Camp in the 2016 ERA (Table 3.2-4). There were three exceedances of the 24-hour TSP SAAQS at HVJ3 in the 2022 to 2024 period (out of 152 valid samples), two of which occurred in 2023 and one in 2022. The annual geometric means from 2000 to 2024 are shown for the JEB Exposure Stations (HVJ1A and HVJ2) in Figure 3.2-12, the JEB Camp (HVJ3) in Figure 3.2-13, and the Sue C Pit (HVS1A) in Figure 3.2-14. Each are shown with the results from the reference station (HVJ4), the associated prediction of annual arithmetic mean from the 2016 ERA, and the SAAQS of 60 µg/m^3. During the 2022 to 2024 period, annual geometric mean TSP concentrations at each station were within the range of historical on-site measurements and were below the annual SAAQS of 60 µg/m³. The annual geometric means for the current reporting period (ranging between 4.3 to 10.9 µg/m^3 per Table 3.2-4) were also within the range of pre-development baseline levels discussed in section 3.2.1.1 (ranging from 6.9 to 29.4 µg/m^3).

Besides monitoring TSP at each of the HVAS stations, filter samples are also analyzed for both radioactive and non-radioactive COPCs. Table 3.2-5 provides a statistical summary of the metal and radionuclide concentrations from all samples collected between 2022 and 2024 and includes available Ontario AAQC (OMECP 2022). It is noted that neither Saskatchewan nor federal regulators have developed similar criteria to date. Table 3.2-6 provides a summary of the average metal and radionuclide concentrations in TSP compared to those from 2000 to 2021 and to 2016 ERA predictions for the 2022 to 2024 period, as shown in Table 3.2-2. For each exposure station, figures are provided showing the annual average concentrations of the metals (Figure 3.2-15 to Figure 3.2-25) and the radionuclides (Figure 3.2-26 to Figure 3.2-29) from 2000 to 2024. The concentration data from the reference station at Vulture Lake are included in each plot to show how the concentrations at the exposure stations compared to the reference station. In most cases, the average metal and radionuclide concentrations measured at Vulture Lake station were lower than those measured at the exposure stations.

Majority of the metal and radionuclide samples were above the laboratory detection limit. The exceptions were thorium-230 and radium-226, which had several non-detectable samples at HVS1A and HVJ4. Most of the metals and radionuclides had annual average concentrations in 2022 to 2024 that were consistent with or lower than those from the 2000 to 2021 period. These COPCs include arsenic, cadmium, cobalt, lead, nickel, selenium, uranium, vanadium, zinc, lead-210, polonium-210, radium-226, and thorium-230. It is noted that the annual concentrations of copper and molybdenum showed sharp increases at all stations during the 2022 to 2024 period compared to historical data. For molybdenum, the concentrations reached in 2024 at all stations were the highest measured since 2000 (Figure 3.2-20). For copper, the concentrations were the highest measured since 2003 when there was a steep decline in copper concentrations that remained consistent until around 2022 (Figure 3.2-18). This increase in copper concentrations is likely owed to interference from the HVAS brush style motors which are known to cause filter contamination (King and Toma 1975), but further investigation is needed to identify actual cause of increasing trends. The metal concentrations measured at each station were all below the AAQC throughout the 2022 to 2024 period. Except for copper, all values at each station were also below the 2016 ERA predictions throughout the reporting period.

3.2.1.5 Supplementary Studies

New HVAS samplers were purchased in 2023 and tested alongside all five existing units from July to September to identify any impacts to the results. In 2024, the new and existing units were also operated side-by-side at HVJ1A, HVJ3, and HVJ4 from April to June. Statistics for the side-by-side monitoring data are compared in Table 3.2-7, while Figure 3.2-30 compares the side-by-side results graphically in box and whisker plots. As shown in Table 3.2-7, the absolute differences in the mean and median concentrations at HVJ1A, HVJ3, and HVJ4 were small, ranging from 0.3 to 5.5 µg/m³. At HVJ2 and HVS1A, the differences were larger, however, the sample size for these datasets was limited to 13 compared to 25 or 26 samples at the other HVAS stations. Figure 3.2-30 also illustrates how the interquartile ranges are similar at the stations, the exception being HVJ2. Overall, the study showed consistency between the monitors at most locations and no impacts to results were identified.

3.2.2 Radon

3.2.2.1 Pre-development Baseline

The collection of radon data has been an important component of the ambient air quality program at the McClean Lake Operation since 1988. Baseline data were collected using track-etch cups at 16 stations within the LSA from 1988 to 1990. Exposure stations were located around McClean Lake and the JEB and Sue ore bodies, while the reference station was located south of Dwarf Lake.

Annual average radon concentrations measured in the McClean Lake Operation LSA during the baseline period ranged from a low of 8.6 Bq/m³ at the McClean Lake exposure station in 1988 to 72.2 Bq/m³ at the far-field reference station in 1990 (Table 3.2-8). In general, most stations showed stable and low average concentrations during the pre-development period and were generally consistent with the expected background levels of 15 to 25 Bq/m³ typical of northern Saskatchewan (CNSC 2024). The 1990 average baseline radon level of 72.2 Bq/m³ measured at the far field reference site as well as the mean level of 48.8 Bq/m³ measured at the JEB exposure stations are considered atypical. By contrast, the baseline radon concentrations measured at the McClean Lake exposure stations and the Sue exposure stations in 1990 were consistent with the levels measured in the earlier years.

3.2.2.2 Study Design and Objectives

The McClean Lake Operation is a potential source of atmospheric emissions of radon gas. Orano operates a comprehensive air quality monitoring program to measure ambient levels of radon in the McClean Lake Operation LSA (Table 3.2-1 and Figure 3.2-31). The general objectives of the radon sampling program are to collect data that can be used to assess risks to the environment, verify air quality model predictions, and inform/improve the ERA model.

The program is designed to collect two samples per year at each of the monitoring locations (i.e., 6-month exposures). Three locations (TE-J1, TE-S2, and TE-C1) are selected per deployment for duplicate sampling (i.e., six samples per year) for QA/QC purposes. During the current reporting period, radon monitoring was completed in accordance with the 2019 EM DD (for 2022 to 2023) and the 2023 EM DD (for 2024). Five radon stations (TE-J5, TE-J8, TE-M5A, TE-S5, and TE- S7) were removed from the EMP during the 2023 EM DD update. In 2022 and 2023 there were 24 radon monitoring stations, while in 2024, there were 19 radon monitoring stations.

3.2.2.3 Impact Predictions

Radon-222 gas is a natural decay product of the uranium-238 series and thus is naturally present in the atmosphere. For convenience, it is referred to below simply as radon. The long-term and short-term radon concentration attributed to development of the McClean Lake Operation was predicted to be negligible. The background concentration for radon is between 15 and 25 Bq/m^3 typical of northern Saskatchewan (CNSC 2024). The project was expected to contribute, at maximum, an additional 15 to 20 Bq/m^3 to radon concentrations on the project site. Considering this two-fold increase in normal background concentrations and the fact that background concentrations were measured as high as 60 Bq/m^3 in a 1990 sampling program which included the cities of Saskatoon, Regina, and Prince Albert, the project was not expected to have a significant impact on air quality with respect to radon concentrations (Minatco 1991).

The 2004 Sue E EIS predicted incremental radon concentrations of 0.115 Bq/m^3 for the 2010 to 2045 timeframe in the McClean Lake Operation area airshed (AREVA 2004) and the 2009 Caribou EIS predicted incremental radon concentrations of 0.295 Bq/m^3 in the McClean Lake Operation area airshed for a period of maximum atmospheric emissions. For the Midwest Project area, the maximum incremental radon concentrations were predicted to be in the order of 0.60 Bq/m^3 at Points North Landing located within 5 km of the Project area (AREVA 2011).

In support of the 2016 ERA, radon from the McClean Lake Operation was modelled for the current reporting period (2022 to 2024) and for future operations scenarios, decommissioning, and post decommissioning activities (AREVA 2016b). For the 2022 to 2024 period, modelled activities included JEB TMF optimization and expansion construction, and milling of Cigar Lake slurry (Phase 1), Midwest ore, and stockpiled Sue B ore. The main contributors to radon emissions during this period were activities at the McClean Lake Mill (58%) and emissions from stockpiled ore near the mill (33%) (AREVA 2016b). Incremental radon concentrations predicted in the 2016 ERA were 0.196 Bq/m^3 in the McClean Lake Operation area and 4.99 Bq/m^3 at the JEB Camp, which equates to total annual concentrations of 23 Bq/m^3 for the McLean Lake Operation area and 26 Bq/m^3 at the JEB Camp. These predictions are consistent with the baseline data collected from the McClean Lake baseline radon monitoring program. Total concentrations (i.e., including background) predicted in the 2016 ERA for the Operational Period 2 scenario (2022 to 2030) for radon are included in Table 3.2-2.

3.2.2.4 Operational Monitoring

Sampling Methods

Passive radon monitoring started in 1994 and occurs throughout the year at various locations surrounding the operation using track-etch cups that are changed out semi-annually (Table 3.2-1 and Figure 3.2-31). Based on past air dispersion modelling assessments, exposure stations were established around McClean Lake, the JEB site, and the Sue site, while the reference station was located near Mallen Lake, north of the JEB facilities (Figure 3.2-31). Originally, five stations (i.e., 1 through 5) in each of the exposure areas were installed at the same location as the baseline stations. In 2006, the McClean Lake Exposure station TE-M7, south of Bena Lake, was destroyed by mining activities and was replaced by TE-S9, while TE-S4 southwest of Sue E, was replaced by TE-S8 (AREVA 2007). In 2022 and 2023, there were 24 sampling stations. In 2024, TE-J5, TE-J8, TE-M5A, TE-S5, and TE-S7 were removed from the program following the 2023 EM DD update, with 19 stations remaining.

From 1994 to September of 2003, the exposure periods for samples occurred over three-month intervals (January to March, April to June, July to September, and October to December) until September 2003 when exposure periods became semi-annual (Orano 2019a). In 2020, the CNSC and SMOE approved a 12-month deployment of the track etch cups due to reduced personnel on site during the COVID-19 pandemic. The cups were deployed from December 2019 to December 2020 (Orano 2021). In 2021, the semi-annual deployment was reinstated with cups being deployed from December 2020 to June 2021 and from June 2021 to December 2021 (Orano 2022). This December to June and June to December schedule continued through the duration of 2022, 2023, and 2024. Starting in 2023, the cups were deployed in stainless steel mesh bags in order to reduce the number of samples that are destroyed or removed by wildlife.

Data analysis

Initial Screening

Radon data were initially screened to identify potentially erroneous data and data gaps prior to data analyses. This included screening for duplicate data, errors or omissions, and investigating potential anomalous values or outliers. Any identified outliers were screened against the entire dataset for that constituent to ascertain whether the value appeared erroneous. No data were removed from the analysis unless they were confirmed to be erroneous.

Evaluation Criteria

The following EvCs were applied to the radon data analysis:

- EvC 1: Comparison to detection limits – radon data were compared to detection limits to identify which locations are below measurable thresholds. The comparison is discussed in the results section.

- EvC 2: Comparison to reference levels – data from exposure stations were compared to the reference station data and background conditions in northern Saskatchewan to identify differences from baseline or background concentrations. Differences are identified and discussed in the results section.

- EvC 3: Comparison to historical data – data were compared to historical data to identify increases or decreases in concentrations over time. Changes are identified and discussed in the results section.

- EvC 4: Spatial comparison of data – data were compared spatially to identify differences and spatial trends in the data. Differences and trends identified and discussed in the results section.

- EvC 5: Comparison to the most recent EIS and ERA predictions – data were evaluated to ensure that values remained within the most recent predictions presented in section 3.2.2.3.

Detailed Data Analysis

Radon data collected throughout the 2022 to 2024 period were analyzed and presented in Table 3.2-9 and Figures 3.2-32 and 3.2-33. To be consistent with annual reporting, measurements that were below the DL were

set equal to the DL value. As requested by the CNSC (CNSC 2017) and as prescribed in Schedule 2 of the SMOE Approval to Operate PO24-012, annual radon values are presented as geometric means. Additionally, the annual geometric mean calculation for radon values calculated at the Sue exposure stations does not include TE-S2 as per the CNSC methodology (CNSC 2017). Data were compared spatially between reference and exposure areas, temporally to previous sampling periods (i.e., 2000 to 2021), to predictions made in the 2016 ERA, and to established background conditions at the McClean Lake site and northern Saskatchewan generally.

Results

Monitoring Performance

In 2022, there were no cups that went missing in the field during the first semi-annual deployment; however, one cup was not reported, as the lab reported that it was not received. In the second semi-annual deployment of 2022, ten cups were destroyed in the field, and one cup was not reported, as the lab reported that it was not received (Orano 2023b). No cups were destroyed or removed by wildlife in 2023, an improvement attributed to deployment of the detectors in stainless steel mesh bags (Orano 2024a). This method of deployment continued to be effective in 2024, and no cups were destroyed again (Orano 2025a). In December 2024, anomalously elevated radon levels were detected in the Mallen Lake reference station (TE-C1) which was attributed to sample contamination and removed from the dataset.

Performance criteria were also specified for radon monitoring with an annual target of 95% sample collection per year. The destroyed cups in 2022 resulted in a completion percentage of 78%; however, with the improvements to the program implemented in 2023 the completion percentage was 100% in both 2023 and 2024.

Operational Data

A statistical summary of the radon concentrations collected from 2022 to 2024 is provided in Table 3.2-9 along with a comparison to the average geometric mean from 2000 to 2021 for each station. The annual average radon concentrations from 2000 to 2024 are plotted in Figure 3.2-32 for the JEB exposure stations, and Figure 3.2-33 for the McClean mining area and Sue exposure stations. Each of these plots includes data from the reference station (TE-C1) and the predicted radon concentration for the McClean Lake Operation area from the 2016 ERA.

During the 2022 to 2024 period, spatial comparisons of the average annual geometric mean radon concentrations (Table 3.2-9) at the JEB exposure sites (17.2 Bq/m^3) and the McClean Lake and Sue exposure sites (17.8 Bq/m^3) show radon levels in these areas are similar. It should be noted that the average annual geometric mean calculation for the Sue exposure stations does not include TE-S2 as per the CNSC methodology (CNSC 2017). The annual geometric mean concentration at the Mallen Lake reference station (TE-C1) was 20.6 Bq/m^3, which is slightly higher than the exposure areas. The radon concentration predicted for the McClean Lake Operation area in the 2016 ERA (23.0 Bq/m^3) was similar to the measured values. The values measured in 2022 to 2024 were also similar to those measured historically from 2000 to 2021 at the JEB exposure sites (15.9 Bq/m^3) and the McClean Lake and Sue exposure sites (17.8 Bq/m^3, excluding TE-S2 as noted above). The annual geometric mean at the Mallen Lake reference site was lower during the historical period at 12.6 Bq/m^3. See also Figures 3.2-32 and 3.2-33, which show the annual average radon concentrations for the period 2000 to 2024 for the JEB exposure stations and for the McClean Lake/Sue exposure stations.

Average radon values measured at TE-J5 in the JEB exposure area during the 2022 to 2024 period were higher than those recorded at other stations in the JEB area and were higher than the values predicted in the 2016 ERA (AREVA 2016b) for the McClean Lake Operation area. At the McClean Lake and Sue exposure stations, the average measured values at TE-M8, TE-S2, and TE-S9 were higher than levels recorded at the other stations in this area during the 2022 to 2024 period and also higher than the values predicted in the 2016 ERA (AREVA 2016b) for the McClean Lake Operation area. Environmental factors such as temperature, humidity, and moisture can all have an impact on ambient radon levels, owing to differences in the measurements across the stations.

Throughout the 2022 to 2024 monitoring period, the highest radon value was recorded at station TE-S2 in 2023 (358.0 Bq/m^3) and the geometric mean radon concentration over the 2022 to 2024 period at this location was 218.2 µg/m³. This is similar to the historical period 2000 to 2021, which had an average geometric mean of 200.2 Bq/m^3. Station TE-S2 is located less than 200 m from the Sue ore stockpile. The remaining stations within the McClean Lake Mining and Sue Exposure areas exhibited annual radon concentrations that were generally comparable to concentrations measured at the JEB exposure stations.

Radon data over the 2000 to 2024 period indicate that, with isolated exceptions, radon levels remain low and comparable to expected background levels of 15 to 25 Bq/m³ for northern Saskatchewan, measurements at the reference station, and the 2016 ERA predictions. However, a slight increase in radon concentrations from 2015 to 2024 is occurring throughout the operation in all exposure areas. Measured concentrations for the most part remain within the 2016 ERA predicted level of 23 Bq/m^3 for the McClean Lake Operation area while geometric mean values of 17.2 Bq/m³ for the JEB exposure stations and 17.8 Bq/m³ for the McClean Mining Area and Sue exposure station were within the maximum potential contribution of 15 Bq/m^3 to 20 Bq/m^3 from the McClean Lake site that was predicted in the EIS (Minatco 1991).

3.2.3 Acid Precipitation Monitoring

3.2.3.1 Pre-development Baseline

Pre-development baseline monitoring of acid in precipitation was not completed for the McClean Lake Operation.

3.2.3.2 Study Design and Objectives

Acid precipitation monitoring began at the site in 2005 and provides insight into the changes to the environment caused by acidic compounds produced, and released, as a result of anthropogenic activities, including air emissions associated with the McClean Lake Operation (Orano 2022). Precipitation samples are collected and analyzed monthly at the McClean Lake Operation weather station located southeast of the McClean Lake Mill (Orano 2023b). The objective of the program is to collect data that can be used to assess risks to the environment and inform the ERA.

3.2.3.3 Impact Predictions

Impact predictions of acid in precipitation were not completed for the McClean Lake Operation.

3.2.3.4 Operational Monitoring

Sampling Methods

Acid precipitation monitoring is completed on a monthly basis by measuring the pH in precipitation (both rain and snow) collected at the weather station located southeast of the McClean Lake Mill (AR02; Figure 3.2-1). During the months where only snowfall occurred, snow samples were collected and melted for analysis.

Data Analysis

Acid precipitation data collected throughout the 2022 to 2024 period were analyzed and presented in Table 3.2-10 and compared to historical data for the 2000 to 2021 period in Figure 3.2-34. There are no criteria or predictions for comparison to the acid precipitation monitoring data. The following evaluation criterion is used:

- EvC 1: Comparison to historical data – monthly measured pH values are compiled and compared on a temporal basis to assist with identifying any trends. Identified trends are discussed in the results section.

Results

Monitoring Performance

pH values in precipitation were monitored in each month from 2022 to 2024, except for September 2023 when no sample was collected due to insufficient rainfall during the month (Orano 2024a). Performance criteria specified for acid precipitation monitoring is to collect at least five out of six samples on a semi-annual basis, and this target was achieved in each year of the current reporting period (2022 to 2024).

Operational Data

A summary of the acid precipitation monitoring results from 2022 to 2024 is provided in Table 3.2-10. pH values measured in the precipitation collected at the site during this period ranged from a low of 4.63 in October of 2023 to a high of 7.70 in March of 2022. As shown in Figure 3.2-34, average annual pH values for the 2022 to 2024 period were within the range of historical averages at the site since the year 2000 (4.58 to 6.70).

3.2.4 Sulphur Dioxide

3.2.4.1 Pre-development Baseline

Pre-development baseline monitoring of ambient SO_2 was not completed for the McClean Lake Operation.

3.2.4.2 Study Design and Objectives

Ambient SO_2 concentrations are measured on a continuous basis at a monitoring station located approximately 200 m downwind (east-southeast) of the McClean Lake Mill, based on the prevailing wind direction (JM02; Table

3.2-1 and Figure 3.2-35). The general objectives of the ambient SO_2 sampling program are to collect data that can be used to verify compliance with applicable ambient air quality standards or criteria, assess risks to the environment, verify air quality model predictions, and inform future ERA updates.

The program is designed to measure continuous levels of ambient SO_2 concentrations, with self-calibration every 24-hours. It collects a sample every five minutes and calculates and reports an hourly average to the EQuIS database. Hourly and calculated 24-hour and annual average concentrations are compared to the SAAQS. Ideally the monitor would collect 8,760 hours of data per year.

3.2.4.3 Impact Predictions

In the 1991 EIS, the maximum long-term concentration of SO_2 was predicted to be between 2 and 3 µg/m^3, or 6.6% to 10% of the annual limit of 30 µg/m^3 from that time (Minatco 1991). Beyond the property boundary, SO_2 concentrations were predicted to be less than 1 µg/m^3. Overall, the long-term impact of SO_2 on local air quality was predicted to be minor (Minatco 1991).

The 2004 Sue E, 2009 Caribou, and 2011 Midwest EISs predicted that the highest concentrations of SO_2 would occur at the active working areas, including the McClean Lake Mill and Sulphuric Acid Plant, and the Sue site where vehicle emissions play a dominant role (AREVA 2004, 2009, and 2011). Otherwise, the concentrations were predicted to decrease rapidly further away from these areas; similar to the predictions presented in the 1991 McClean EIS. All three EISs predicted the mean annual concentration of SO_2 to be 1.22 µg/m^3, the mean 1-hour concentration to be 134 µg/m^3, and the mean 24-hour concentration to be 12.7 µg/m^3 at the JEB Camp (AREVA 2004, 2009, and 2011).

In support of the 2016 ERA, SO_2 from the McClean Lake Operation was modelled for the current reporting period (2022 to 2024) and for future operations, decommissioning, and post decommissioning activities (AREVA 2016b). During the 2022 to 2024 phase of operations, the main source of SO_2 emissions was the Sulphuric Acid Plant stack (93%). For this period, average annual concentrations of SO_2 in the 2016 ERA were predicted to be 0.1 µg/m^3 (0.038 ppb) for the McClean Lake Operation area, 1.2 µg/m^3 (0.458 ppb) at JEB Camp, and 2.5 µg/m³ (0.954 ppb) at JM02 (AREVA 2016b). These values were well below the annual SAAQS of 8 ppb. SO_2 concentrations predicted in the 2016 ERA for the 2022 to 2024 EP TID period are included in Table 3.2-2.

The 1-hour and 24-hour predicted concentrations for SO_2 in the McClean Lake Operation area were based on the maximum operating scenario, which included the construction of an expanded TMF, mill operations, and an expanded powerhouse. These activities were assumed to occur in the year 2025 in the air quality assessment (AREVA 2016b). For this scenario, predicted values were well below the SAAQS of 172 ppb (1-hour) and 48 ppb (24-hour) (Table 3.2-2). One-hour and 24-hour concentrations predicted for the McClean Lake Operation area were 5.2 µg/m^3 (1.92 ppb) and 1.5 µg/m^3 (0.573 ppb), respectively. At JEB Camp, 1-hour and 24-hour concentrations were predicted to be 74.6 µg/m³ (28.5 ppb) and 17.0 µg/m³ (6.49 ppb), respectively, while at JM02, the concentrations were 91.0 µg/m³ (34.7 ppb) and 53.0 µg/m³ (20.2 ppb). It is noted that the predicted concentrations at JM02 were interpreted from the contour plots presented in the air quality assessment (AREVA 2016b). The 2016 ERA predicted concentrations across a grid of receptors (for use in developing contour plots) and at discrete points representing pathways receptors (i.e., human and ecological exposures). The monitoring location at JM02 was not represented by one of the discrete receptor points that were included in the results tables in the 2016 ERA and so, the contour plots were used to estimate the concentrations at the specific point where the monitor is located.

3.2.4.4 Operational Data

Sampling Methods

To monitor ambient SO_2, a continuous monitoring system was installed approximately 200 m downwind (east-southeast) of the McClean Lake Mill, based on prevailing wind direction (JM02; Figure 3.2-35). The monitoring system initially consisted of a Thermo Fisher Scientific Model 43i Fluorescent SO_2 Analyser, and a data acquisition system in a temperature-controlled shelter. During the July 2021 shutdown, a new analyzer (Thermo Fisher SO_2 Analyzer iQ Series 43) was installed after the previous analyzer failed on July 11, 2021. The new analyzer became operational on July 24, 2021. This monitoring location is not considered a compliance point for SAAQS for SO_2 as per the 2019 Environmental Protection Plan (EPP) submitted under the Saskatchewan Environmental Code (Orano 2019b). Orano continues to monitor ambient SO_2 levels at this location, however, exceedances are no longer be considered immediate reportable events that require notification to the SMOE within 30 days.

Data Analysis

Ambient SO_2 was measured on an hourly basis and calculated into 24-hour and annual averages for analysis (Tables 3.2-11 and 3.2-12 and Figure 3.2-36). In developing these data, negative readings from the continuous SO_2 analyzer were converted to zeros for computational purposes. As requested by the CNSC (CNSC 2017) and as prescribed in Schedule 2 of the SMOE Approval to Operate PO24-012, SO_2 concentrations are presented as annual arithmetic mean values in Tables 3.2-11 and 3.2-12. Data were compared temporally to historical sampling periods (i.e., 2000 to 2021), to predictions made in previous EISs and in the 2016 ERA, and to applicable standards or criteria. The following EvCs were applied to the SO_2 data analysis:

- EvC 1: Comparison to historical data – data from current reporting period were compared to historical data (2000 to 2021) to identify increases or decreases in concentrations over time. Changes are identified and discussed in the results section.

- EvC 2: Comparison to the EIS and most recent ERA predictions – data were evaluated to ensure that values remained within the most recent model predictions at JM02 presented in Section 3.2.4.3.

- EvC 3: Comparison to ambient air quality standards or criteria – data were compared to the SAAQS (GS 2022). Exceedances are identified and discussed in the results section.

Results

Monitoring Performance

SO_2 concentrations were consistently monitored throughout the 2022 to 2024 period; however, there was one occurrence on September 14, 2023, in which eight hours of data was not recorded due to a power outage (Orano 2024a). The Sulphuric Acid Plant was shut down during this time and so, it is unlikely that ambient SO_2 concentrations were elevated. Orano specified a target completion performance criterion of 85% for the ambient SO_2 monitor (i.e., at least 7,446 hours). The target collection efficiency for the ambient SO_2 monitor was met in each year, with collection efficiencies of 99.8% in 2022, 99.7% in 2023, and 99.6% in 2024.

Operational Data

Summary data over the 2000 to 2024 period are provided in Tables 3.2-11 and 3.2-12 for hourly and 24-hour ambient SO_2 data, respectively. Annual average data are presented in both tables under the heading “arithmetic mean.” As noted above, 2016 ERA predictions at JM02 shown in the tables were interpreted from contour plots for the air quality assessment (AREVA 2016b).

As shown in Table 3.2-11, from 2000 to 2024, there were 114 hours (0.51% of the time) where measured SO_2 concentrations exceeded the 1-hour SO_2 SAAQS of 172 ppb (equivalent to 450 µg/m^3). There were no exceedances of the 1-hour SO_2 SAAQS during the current reporting period (2022 to 2024). Average and maximum hourly SO_2 concentrations recorded throughout the 2022 to 2024 period were lower than those recorded between 2016 and 2021. However, the maximum 1-hour ambient SO_2 concentrations recorded from 2022 to 2024 were approximately 3 to 4 times higher than the maximum 1-hour concentration predicted in the 2016 ERA (AREVA 2016b).

Twenty-four-hour average ambient SO_2 data over the period of 2000 to 2024, summarized in Table 3.2-12, show that there were 24 days (1.85% of the time) when measured SO_2 concentrations exceeded the 24-hour SO_2 SAAQS of 48 ppb (equivalent to 125 µg/m^3). There were no exceedances of the 24-hour SAAQS during the current reporting period (2022 to 2024). Mean 24-hour concentrations recorded throughout the 2022 to 2024 period were lower than those recorded between 2016 and 2021, while the maximum 24-hour concentrations recorded between 2022 and 2024 were similar to those recorded in 2020 and 2021, and less than those recorded in 2016 to 2019. The maximum 24-hour ambient SO_2 concentrations recorded in each year from 2022 to 2024 were lower than the maximum 24-hour SO_2 concentration predicted in the 2016 ERA (AREVA 2016b).

The annual averages calculated from 24-hour SO_2 concentrations are presented in Figure 3.2-36 for the period 2000 to 2004. Over the entire period, the lowest annual average 24-hour SO_2 concentration was recorded in 2004 (0.4 ppb), and the highest in 2017 (14.9 ppb). Concentrations exceeded the annual SAAQS of 8 ppb in 2017 only, which is likely due to periods of elevated concentrations on September 11 and 27 that were attributed to a restriction in the gas path and/or a fouled catalyst in the converter (Orano 2018). During the current reporting period (2022 to 2024), the minimum and maximum annual average 24-hour SO_2 concentrations were 0.5 ppb (2022) and 0.9 ppb (2024), which were comparable to the 2016 ERA prediction of 0.95 ppb.

3.2.5 Stack Emissions

3.2.5.1 Pre-development Baseline

Pre-development baseline is not applicable to the stack testing program.

3.2.5.2 Study Design and Objectives

Stack testing is completed each year as outlined in the SMOE Approval to Operate PO24-012 at four stacks: the ammonium sulfate crystallization plant stack (SE02), the ore receiving and grinding stack (SE03), the yellowcake calcining stack (SE04), and the yellowcake packaging stack (SE05). In addition, daily emissions of SO_2 from the Sulphuric Acid Plant stack (SE01) are calculated based on sulphur consumption and monthly average conversion efficiency (Orano 2023b). The general objectives of the stack testing program are to collect data that

can be used to assess risks to the environment, inform the inputs to the air dispersion model, demonstrate compliance with release limits and objectives, and confirm the effectiveness of control systems.

Stack testing of the crystallization stack (SE02), the grinding stack (SE03), the yellowcake stack (SE04), and packaging stack (SE-05) is to be completed on a semi-annual basis. Stack testing of the incinerator (SE07) is to be completed once every five years.

3.2.5.3 Impact Predictions

Emissions from the Sulphuric Acid Plant, calciner, crystallizer, and packaging stacks within the mill were estimated using representative source testing results from 2015 and 2016 in the air quality assessment for the 2016 ERA. In this assessment, emissions were scaled based on U_3O_8 production relative to the maximum operations scenario (AREVA 2016b). For SO_2 emissions from the Sulphuric Acid Plant, the upper range of engineering estimates were used. The current reporting period, 2022 to 2024, is represented by Operational Period 2 (2022 to 2030) in the 2016 ERA. During this period, the main source of SO_2 was the Sulphuric Acid Plant stack (93%) (AREVA 2016b).

The maximum SO_2 emission rate used in the 2016 ERA air dispersion model for the Sulphuric Acid Plant is 12,444 g/h (Table 3.2-13). For other point sources modelled in the 2016 ERA, stack emission rates estimated for Operational Period 2 (2022 to 2030) are included in Table 3.2-14.

3.2.5.4 Operational Monitoring

Sampling Methods

Emission rates for various parameters are measured at the Sulphuric Acid Plant (SE01), the ammonium sulphate crystallization plant (SE02), the yellowcake calcining (SE04) and yellowcake packaging (SE05) areas, and the camp incinerator (SE07) (Table 3.2-1 and Figure 3.2-35). Sampling at stacks SE02, SE04, and SE05 is completed on a semi-annual basis, while sampling at SE07 is performed once every five years. Sampling was not completed at SE03 since the grinding circuit did not operate within the current reporting period. Stack emissions from SE01 are estimated on a daily basis. The Sulphuric Acid Plant is the primary source of SO_2 on the site which is exhausted into the atmosphere through a single stack (AREVA 2016b). Daily stack emissions are calculated based on daily sulphur consumption and a monthly average conversion efficiency (Orano 2023b). In addition to the Sulphuric Acid Plant, the calciner and packaging stacks within the mill are also sources of SO_2 emissions (AREVA 2016b), which are measured during stack testing.

The Saskatchewan Research Council (SRC) were contracted to perform semi-annual stack testing at SE02, SE04, and SE05 according to reference method EPS 1/RM/8 as specified in Table 5.0 of the SMOE Approval to Operate PO24-012. The camp incinerator stack was sampled by SRC in April 2024.

Data Analysis

Monthly average emission rates of SO_2 and average annual emission rates were summarized and compared to data for the previous EP TID period (2016 to 2021). Historically, Orano reported SO_2 emissions calculated based on SO_2 concentrations measured with the in-stack analyzer and a calculated volume of gas released from the

stack (AREVA 2017). Upon analysis of the data in Q4 2016, Orano determined that this method of calculating the total mass of SO_2 released appeared to underreport, thus daily stack emissions are now calculated using daily sulphur consumption and conversion efficiency results (AREVA 2017). This method of calculation results in greater calculated daily SO_2 emissions than the previous method used, which means that the data presented for 2016 and onwards shows a significant increase compared to values reported in previous years. As a result, the historical period is restricted to 2016 to 2021.

Other stack emission rates are calculated by SRC in the stack testing reports provided to Orano. The stack testing results for the reporting period (2022 to 2024) are compared to data for the previous EP TID period as well as the 2016 ERA emission rates. The following EvCs were applied for to the stack emissions data analysis:

- EvC 1: Comparison to historical data – data were compared to available historical data (2016 to 2021) to identify increases or decreases in emissions over time. Changes are identified and discussed in the results section.

- EvC 2: Comparison to the most recent ERA predictions – data were evaluated to ensure that values remained within the most recent predictions presented in section 3.2.5.3.

Results

Monitoring Performance

The Sulphuric Acid Plant operated intermittently throughout the 2022 to 2024 reporting period. The plant operated for 339 days in 2022 (Orano 2023b), 338 days in 2023 (Orano 2024a), and 366 days in 2024 (Orano 2025a). Shutdowns coincided with the mill shutdowns. Per the Approval to Operate, emissions calculations for the Sulphuric Acid Plant stack SE01 are only required when the acid plant is in operation. Daily emissions were calculated for each day of operation.

The grinding circuit did not operate during the 2022 to 2024 period and so the grinding circuit stack (SE03) was not included in any of the stack testing programs. As such, the semi-annual testing program focused on three stacks: SE02, SE04 and SE05. Semi-annual testing was completed on these stacks in each 2022, 2023 and 2024 and so there is no missing data. In terms of collection efficiency, Orano has established a target completion of 100% for stack sampling data (i.e., no semi-annual programs are to be missed) and the target performance objective of 100% completeness was achieved. Stack testing of SE07 was completed in 2024, also meeting the performance objective.

Operational Data

Monthly stack emission rates of SO_2 from the Sulphuric Acid Plant stack (SE01) for the 2022 to 2024 period are presented in Table 3.2-13. Monthly emission rates of SO_2 monitored at SE01 range from 0 g/h in September 2024 (since the plant was not operating) to 41,525 g/h in September 2023. In both 2022 and 2024, there was one month (August and March, respectively) when the monthly average SO_2 emission rate was above the ERA estimate of 12,440 g/h. In 2023, the average monthly SO_2 emission rate was above the ERA emission estimate from July to November, inclusive. Compared to the previous EP TID period of 2016 to 2021, emissions for the

2022 to 2024 period were higher, with 2023 having the highest average annual emission rate (12,211 g/h) over the 2016 to 2024 period (Figure 3.2-37).

Stack testing for SO_2 was also conducted by SRC for the calcining stack (SE04) in 2022, 2023, and 2024. The measured SO_2 emission rates for the 2022 to 2024 period are presented in Table 3.2-14. Measured SO_2 values at SE04 ranged from 0.028 kg/h in April 2023 to 0.62 kg/h in April 2024. There were no SO_2 tests completed at the packaging stack (SE05) in the 2022 to 2024 period. Emission rates of SO_2 from SE04 during the period of 2022 to 2024 were below historical levels. Compared to the 2016 ERA emission rate for SO_2, the 2022, 2023, and 2024 stack tests for SE04 were all lower.

Table 3.2-14 also presents the stack emissions of TSP from 2022 to 2024. In each year, the emission rates of TSP from the ammonia sulphate crystallizer (SE02) and yellowcake calcining (SE04) stacks were comparable to historical levels and lower than the emission rate used in the 2016 ERA air model. Conversely, the measured emission rates for the packaging stack (SE05) were higher than the 2016 ERA rate for three out of six tests completed in the 2022 to 2024 period but overall comparable to historical levels. For the incinerator stack (SE07), the TSP emission rate was also higher than the 2016 ERA rate; however, only one test was completed for this stack over the 2022 to 2024 period. Compared to the test completed during the previous EP TID period (2016 to 2021), the 2024 test for the incinerator had a lower TSP emission rate.

The stack testing results for metals (uranium, arsenic, nickel, and copper) and radionuclides (radium-226, lead-210, and thorium-230) completed by SRC from 2022 to 2024 are presented in Table 3.2-14. Analysis of trace metals and radionuclides is completed for one of the two semi-annual programs in each year for stacks SE04 and SE05. Three test runs are completed during each campaign and the test results presented in Table 3.2-14 represent the averages of the three tests. Results of the tests varied between the sampling campaigns, which is expected since different operating conditions occurred throughout the monitoring period. Many test results for metals at SE04 were higher than the emission rates in the 2016 ERA, while the SE05 test results were below the 2016 ERA emission rates. For both SE04 and SE05, results were generally higher than the previous EP TID period (2016 to 2021), which can reflect differences in operating conditions and ore grades in the mill.

3.2.6 NPRI Reporting

As required by the Canadian Environmental Protection Act, Orano completed and submitted a National Pollutant Release Inventory (NPRI) report for the McClean Lake Operation for each of the years in the current reporting period. A summary of the reportable releases to air for the 2022 to 2024 period is provided in Table 3.2-15. Several of the reportable substances are included in the monitoring programs described in the preceding sections, including TSP, metals adsorbed in TSP, and SO_2. Other reportable substances to air include nitrogen oxides (NOx), fine particulate matter (PM_{10} and $PM_{2.5}$), total volatile organic compounds (VOC), ammonia (NH_3), and total dioxins and furans (D&F).

Regarding the Criteria Air Contaminants (CACs), particulate matter, SO_2, and VOC releases to air increased from 2022 to 2023 and decreased from 2023 to 2024, while NOx releases decreased from 2022 to 2023 and increased from 2023 to 2024. Ammonia increased each year. Changes are due to normal fluctuations in production. Releases of metals similarly fluctuated from year to year but generally remained in a similar range.

3.2.7 Halocarbon Reporting

The Government of Canada (GC 2003) identifies the purpose of halocarbon monitoring as *"…to reduce and prevent emissions of ozone-depleting substances and of their halocarbon alternatives to the environment.*" The McClean Lake Operation is subject to the requirements within the *Federal Halocarbon Regulations, 2003*. Components that are monitored for compliance with the regulations at the McClean Lake Operation include motorized vehicles and heavy equipment that have air conditioning systems that contain halocarbons, as well as the refrigeration systems and air conditioning systems at the camp and other mine infrastructure. Only certified personnel were involved in the installation, service, leak testing, or charge of a refrigeration or air conditioning system containing halocarbons. No halocarbon releases greater than 10 kg occurred at the McClean Lake Operation in 2022, 2023 or 2024 (Orano 2023b, 2024a, and 2025a).

3.2.8 Monitoring Adjustments and Supplementary Studies Recommendations

As discussed in section 3.2.1.4, molybdenum and copper concentrations were noticeably higher during the 2022 to 2024 period compared to historical measurements likely to be caused by interference from the HVAS brush style motors, which are known to cause filter contamination. It is recommended that a supplementary study to investigate this trend and determine the cause of the elevated concentrations be considered. In the meantime, the exhaust ducting of the HVAS units could be extended in order to direct the exhausts further away from the HVAS units.

In 2025 EP TID Volume 2, the air dispersion modelling results were used to evaluate the current air quality monitoring programs. Based on the evaluation, additional monitoring adjustments and supplementary studies were recommended for TSP, radon, and stack emissions (Orano 2025b).

3.3 Overall Summary and Conclusions

Meteorological monitoring completed at the on-site station and at the Collins Bay weather station operated by ECCC provides a comprehensive summary of pertinent meteorological information for the McClean Lake Operation on an hourly and daily basis. Temperature data recorded at the McClean Lake site between 2022 and 2024 were comparable to data recorded at the Collins Bay weather station for the same period and to the on-site historical record (2000 to 2021) and 30-year Canadian climate norms (1991 to 2020) for ECCC's Key Lake weather station. Annual precipitation recorded at the site between 2022 and 2024 were also comparable to regional and historical levels; however, on a monthly basis, precipitation tended to be lower than the historical period and climate norms from August to October and higher in February. Surface wind directions in the 2022 to 2024 period were consistent with the 2016 to 2021 period but differed from the 2000 to 2015 period, with wind directions predominately coming from the NW instead of W and WNW. The difference was attributed to the meteorological station moving locations in October 2014, where different geographical conditions or nearby infrastructure may have affected the historical wind distribution. The 2022 to 2024 wind data is consistent with Collins Bay station observations for the same period, indicating that the current wind distribution data is accurate.

Ongoing monitoring of meteorological conditions is essential for temporal climate trend analysis, for future air dispersion modelling, and needs of the site's health and safety programs. In 2019, IEC determined that the siting and location of the on-site station was adequate to provide accurate wind direction and speed data (IEC 2019).

Based on this study and the findings described above, it is recommended that this station continue to operate in the current location, and no changes are proposed.

The ambient air quality monitoring program at the McClean Lake Operation includes monitoring of radon at 19 locations (as of 2024), 24-hour weekly measurements of TSP at five locations, continuous ambient SO_2 monitoring at one location, acid precipitation monitoring near the weather station, and stack emissions sampling. Annual geometric mean TSP concentrations were well within the SAAQS of 60 µg/m^3. The TSP concentrations exceeded the 24-hour SAAQS of 100 µg/m³ 9 times at the exposure stations during the period of 2022 to 2024 due to regional forest fire smoke. Except for HVJ1A, annual TSP concentrations were below historical levels and predictions made in the 2016 ERA. The increase over historical levels and the ERA prediction observed at HVJ1A is likely associated with the forest fire smoke. Concentrations of adsorbed COPCs (metals and radionuclides) were also well within the applicable criteria as well as the 2016 ERA predictions. The exception was copper which exceeded the 2016 ERA prediction possibly due to contamination from the HVAS brush style motors. Copper was also elevated compared to historical levels as was molybdenum.

The radon monitoring program demonstrated that levels may be elevated near sources of emissions, but most measured levels were consistent with background concentrations and within the previous EIS and 2016 ERA predictions. Only four exposure stations (TE-J5, TE-M8, TE-S2, and TE-S9) had annual arithmetic average concentrations that exceeded the 2016 ERA predictions. Consistent with the previous EP TID period (2016 to 2021), the highest radon levels measured throughout the 2022 to 2024 monitoring period were at TE-S2 near the Sue site. The spatial breadth of the monitoring program has demonstrated that this is localized, and background levels are achieved within a few kilometers of the source.

Monthly precipitation samples were collected near the on-site meteorological station and analyzed for acid precipitation. The pH levels ranged from 4.63 to 7.70 and annual averages for 2022 to 2024 were consistent with the historical record. It is recommended that the acid deposition monitoring program continue to operate in the current location, and no changes are proposed.

From 2022 to 2024, hourly ambient concentrations of SO_2 were measured at JM02. No exceedances of the hourly, 24-hour or annual SAAQS were recorded during the reporting period; however, this monitoring location is no longer considered a compliance point for the SAAQS per the 2019 EPP submitted under the Saskatchewan Environmental Code (Orano 2019b). Average hourly and 24-hour SO_2 concentrations recorded throughout the 2022 to 2024 period were lower than those recorded between 2016 and 2021. Maximum 24-hour and mean annual SO_2 concentrations recorded from 2022 to 2024 were also lower than those predicted in the 2016 ERA, while maximum hourly SO_2 concentrations were higher than the 2016 ERA prediction. It is recommended that this program continue as it provides useful information regarding demonstrating compliance with the ambient standards and can also be used to inform/improve the air dispersion model for the ERA. Orano will continue to monitor ambient SO_2 levels at this location, but exceedances are not considered immediate reportable events.

Emission rates of COPCs monitored as part of the stack sampling program at the McClean Lake Operation varied between 2022 and 2024, which is expected since operating conditions and ore grades in the mill fluctuate. Calculated monthly average stack emission rates of SO_2 from the Sulphuric Acid Plant (SE01) were higher in 2022 to 2024 compared to the previous EP TID period (2016 to 2021) and exceeded the maximum 2016 ERA emission rate of 12.24 kg/h once in 2022 and 2024 and five times in 2023. Stack test results for TSP showed higher emission rates than the 2016 ERA for the packaging (SE05) and incinerator (SE07) stacks but lower emission rates for the crystallization (SE02) and calcining (SE04) stacks. Stack emissions of metals and

radionuclides (uranium, arsenic, nickel, copper, radium-226, thorium-230, and lead-210) from SE04 were generally higher than those used in the 2016 ERA, while emissions from SE05 were lower than the 2016 ERA; a finding consistent with the previous EP TID (Orano 2024b). Compared to the previous EP TID period (2016 to 2021), trace element results for SE04 and SE05 were typically higher.

Based on the analysis of HVAS data for the 2022 and 2024 reporting period, a supplementary study to investigate the cause of the observed increases in molybdenum and copper concentrations is recommended. Based on the air dispersion modelling results in 2025 EP TID Volume 2, changes to the HVAS, radon, and stack emissions monitoring programs and supplementary studies are recommended.

3.4 References

AREVA (AREVA Resources Canada Inc.). 2004. McClean Lake Operation Sue E Project Environmental Impact Statement. November and 2005 Addendum.

AREVA (AREVA Resources Canada Inc.). 2007. McClean Lake Operation 2006 Annual Report. March 2007. Saskatoon, Saskatchewan.

AREVA (AREVA Resources Canada Inc.). 2009. McClean Lake Operation Caribou Project Environmental Impact Statement.

AREVA (AREVA Resources Canada Inc.). 2011. Final Midwest Project Environmental Impact Statement. September 2011. Saskatoon, Saskatchewan.

AREVA (AREVA Resources Canada Inc.). 2016a. McClean Lake Operation Technical Information Document Environmental Performance, Volume 1 of 2 – Environmental Risk Assessment. Saskatoon, Saskatchewan.

AREVA (AREVA Resources Canada Inc.). 2016b. McClean Lake Operation Technical Information Document Environmental Performance, Volume 2 of 2 – Environmental Risk Assessment. Saskatoon, Saskatchewan.

AREVA (AREVA Resources Canada Inc.). 2017. McClean Lake – Environmental Performance Technical Information Document (EP TID), Volume 1 Environmental Monitoring – Responses to CNSC Staff Comments. March 2017. Saskatoon, Saskatchewan.

Cameco (Cameco Corporation). 2004. Cigar Lake Project Construction, Operation and Decommissioning Environment Assessment Study Report. January 2004.

CNSC (Canadian Nuclear Safety Commission). 2017. Request for data and/or information for the CNSC's annual regulatory oversight report. Letter dated February 20, 2017.

CNSC (Canadian Nuclear Safety Commission). 2024. Regulatory Oversight Report for Uranium Mines and Mills in Canada: 2021. Accessed on 8 October 2025 at: https://www.cnsc-ccsn.gc.ca/eng/resources/publications/reports/regulatory-oversight-reports/umm-report-2021/.

COGEMA (Cogema Resources Inc.). 1995. Midwest Project Environmental Impact Statement. Main Document. August 1995. Saskatoon, Saskatchewan.

CSA (Canadian Standards Association). 2025. Environmental monitoring programs at nuclear facilities and uranium mines and mills. CSA N288.4:25.

ECCC (Environment and Climate Change Canada). 2025a. Historical Data, Ottawa, Canada. Website: https://climate.weather.gc.ca/historical_data/search_historic_data_e.html.

ECCC (Environment and Climate Change Canada). 2025b. Canadian Climate Normals, Ottawa, Canada. Website: https://climate.weather.gc.ca/climate_normals/index_e.html.

GC (Government of Canada). 2003. Protecting the ozone layer: national initiatives. Website: Ozone Layer Protection.

GS (Government of Saskatchewan). 2012. Saskatchewan Air Quality Modelling Guideline. Website: Publications Centre (saskatchewan.ca).

GS (Government of Saskatchewan). 2022. Saskatchewan environmental quality guidelines for air quality. Website: Publications Centre (saskatchewan.ca).

IEC (Independent Environmental Consultants). 2019. McClean Lake Wind Data Analysis, January 2016 to July 2019.

King, R.B. and J. Toma 1975. Copper Emissions from a High Volume Air Sampler. NASA Lewis Research Center. March 1975. NASA-TM-X-71693.

Minatco (Minatco Ltd). 1991. McClean Lake Project Environmental Impact Statement. Volume 1, Chapters 1-6. August 1991. 30706-1.

OMECP (Ontario Ministry of the Environment, Conservation and Parks). 2022. Ontario's Ambient Air Quality Criteria. Website: Ontario's Ambient Air Quality Criteria.

Orano (Orano Canada Inc.). 2018. McClean Lake Operation 2017 Annual Report. March 2018. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2019a. McClean Lake Operation Environmental Monitoring Design Document Version 3. March 2019. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2019b. McClean Lake Operation Environmental Protection Plan Version 1. September 2019. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2021. McClean Lake Operation 2020 Annual Report. March 2021. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2022. McClean Lake Operation 2021 Annual Report. March 2022. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2023a. Correspondence: Seary to Akhter. Subject: 2022 McClean Lake Operation Environmental Performance – Technical Information Document – Responses to CNSC Staff Comments Dated May 23, 2023.

Orano (Orano Canada Inc.). 2023b. McClean Lake Operation 2022 Annual Report. March 2023. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2024a. McClean Lake Operation 2023 Annual Report. March 2024. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2024b.Technical Information Document 2022 Environmental Performance Volume 1 of 1 Revision 1. September 2024. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2025a. McClean Lake Operation 2024 Annual Report. March 2025. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc.). 2025b. Environmental Performance Technical Information Document Volume 2 of 2 – Environmental Risk Assessment. Version 1, Revision 0. December 2025. Saskatoon, Saskatchewan.

4 Aquatic Environment

4.1 Introduction

A significant volume of data has been collected within the aquatic environment of the McClean Lake Operation LSA (Figure 1.6-3). Initial baseline investigations between 1979 and 1990 were conducted in support of the 1991 McClean EIS (Minatco 1991). Subsequently, additional baseline data were collected between 1993 and 1995 in support of a formalized study design (COGEMA 1995). Within the LAB, additional baseline data has been collected in support of the Midwest Project, dating back to 1978. In 2003, a comprehensive monitoring program was conducted to evaluate water quality, sediment quality, and key components of the aquatic environment within the Midwest LSA to supplement historical data and provide updated data in preparation of future development of the Midwest uranium deposit. A detailed description of the baseline data can be found in the Midwest Project EE TID (AREVA 2008). Data in both the 1991 McClean and 1995 Midwest EISs were used to model potential impacts to the aquatic environment because of the mining and milling operations outlined and provide a foundation for the comparison of predicted effects with current operational monitoring data within the LSA. Modeling was further completed as part of the 2011 Midwest EIS to predict effects from the combined Midwest Project, current activities, and future activities at the McClean Lake Operation (AREVA 2011a).

The 1991 McClean EIS (Minatco 1991) concluded that discharge of treated effluent to Sink Reservoir would have a moderate to major impact on water quality in the S/V TEMS during the operating life of the Project. The impact on water quality in McClean Lake and downstream was assessed to be minor to moderate during the operating life of the Project. In the 1995 Midwest EIS (COGEMA 1995), the discharge of treated effluent to Sink Reservoir was determined to result in a moderate to major impact on water quality within the S/V TEMS during the operating life of the Project. The overall impact on water quality in McClean Lake and Collins Creek was assessed to be minor to moderate during the operating life of the Project. The overall impact of the sediments on surface water quality was assessed to be moderate in the short term and minor in the long-term. In 1999, the assessment outcome was used to develop an EMP, which included monitoring of surface water, benthos communities, and fish chemistry. A formal quantitative baseline study design based on the Before-After-Control-Impact (BACI) framework was adopted for the EMP implementation. The BACI design allows for a comparison of reference and exposure areas over time and can be used to assess whether there are effects on the aquatic environment related to the mining and milling activities.

Since its inception, the routine EMP has been complemented with other monitoring programs such as the Environmental Effects Monitoring (EEM) program and supplementary studies, which provides a comprehensive environmental monitoring framework. The EEM program came into effect June 6, 2002, and is a requirement for metal mining operations in Canada, regulated under the *Metal and Diamond Mining Effluent Regulations* (MDMER). The objective of the EEM program is to assess whether fish, fish habitat, and fisheries resources are being affected by mine effluent (EC 2012). Phase 1 and Phase 2 monitoring were completed in 2005 and 2008, respectively. Due to differences between effluent-exposed and reference fish populations and benthic invertebrate communities in these two phases, Phase 3 included an Investigation of Cause (IOC) study in 2010 (AREVA 2011b). Subsequent to the submission of the Interim Interpretative IOC Report (AREVA 2011b), the operation was advised by Environment Canada (EC) and the Technical Advisory Panel (TAP) to return to periodic monitoring (AREVA 2013). Phases 4, 5, 6, and 7 EEM were completed in 2013, 2016, 2019, and 2022 respectively (AREVA 2014, AREVA 2017a, Orano 2020, CanNorth and Kilgour 2023). Additionally, sublethal

and acute toxicity testing of the mine effluent has been implemented in accordance with requirements stipulated in the MDMER.

A number of supplementary studies were implemented for characterization of various aquatic ecosystem components and refining the ERA predictions of the mining and milling impact on the aquatic environment. Supplementary studies provide the opportunity to develop issue-specific, time-limited investigations to address emerging issues, refine monitoring activities and enhance environmental risk assessment processes. Such supplementary studies serve to enhance our understanding of interactions between the operation and the environment and support the continued refinement of the characterization of potential risks.

This section provides an overview of the EMP and EEM results in Sections 4.3 to 4.6. Results of supplementary studies completed during the reporting period are presented in Section 4.7. Detailed information on pre-development (baseline) studies and supplementary studies completed before 2022 can be found in the 2016 EP TID and 2022 EP TID (AREVA 2016a, Orano 2022).

4.2 Study Area

One of the most important components of site characterization is a description of the reference and exposure areas where the biological monitoring studies will be conducted. Exposure and reference areas within the McClean Lake LSA were identified based on the initial BACI design, using the information presented in the 1991 (Minatco 1991), 1995 (COGEMA 1995), 2004 (COGEMA 2004), 2009 (AREVA 2009a), and 2011 (AREVA 2011a) EISs. Baseline data were used to model potential impacts from the McClean Lake Operation. Potential impacts were classified based on the source of exposure: 1) the release of treated effluent, and/or 2) atmospheric emissions, and groundwater dewatering.

The primary exposure area is situated entirely within the Collins Creek drainage, and includes the area that directly receives treated effluent, including the S/V TEMS, McClean Lake east basin, Collins Creek (downstream from the operation), and Kewen Lake (Figure 4.2-1). Secondary exposure areas within the LSA are located within the Collins Creek and Moffat Creek drainages (Figure 4.2-1). These near-field locations are not associated with treated effluent release from the milling operation; rather, they can be potentially affected by changes in the groundwater regime (see Section 2.2) or by atmospheric emissions associated with the mining and milling operations (see Section 3.2). Monitoring of secondary exposure areas also provides confirmation for the absence of groundwater contaminant transport at these near-field locations (see Section 2.2). Reference areas within the LSA are in the Collins Creek, Umpherville River, and Smith Creek drainages, and are considered areas not influenced by any of the operation's mining or milling activities.

Midwest Project activities, such as exploration, dewatering, and/or test mining, were undertaken in or near Mink Arm of South McMahon Lake from 1968 to 1989 (AREVA 2011a). Since 1989, mining activities were limited to exploration only. There were no monitoring activities completed in Midwest Project area as the site was in care and maintenance.

The S/V TEMS is the single common facility for the controlled release of treated effluent generated at the operation. The S/V TEMS consists of Sink Reservoir, Vulture Lake, and all control structures, measurement structures, and connecting pipelines from Sink Reservoir to the east basin of McClean Lake. A schematic of the S/V TEMS is illustrated in Figure 4.2-2. From the JEB site, a single pipeline transports effluent from the JEB

WTP to a discharge point at the north end of Sink Reservoir. Similarly, a single pipeline transports water from the Sue WTP to the discharge point on the east side of Sink Reservoir. A compacted earth dam defines the reservoir containment area. Water is discharged from Sink Reservoir to Vulture Lake via a buried pipeline. Similarly, water from Vulture Lake is discharged into the east basin of McClean Lake via a buried pipeline, which terminates in an effluent diffuser to enhance mixing.

The S/V TEMS provides a means of storing effluent as required to minimize effects to the receiving environment, while allowing water treatment to proceed on demand. The operational objectives are to minimize water quality and flow regime fluctuations and minimize the augmentation of streambed erosion in Collins Creek, downstream of McClean Lake east basin.

4.3 Surface Water Quality

4.3.1 Pre-development Baseline

A substantial quantity of pre-development water quality data is available for the McClean Lake Operation. Baseline water quality monitoring programs provided both a broad spatial context and relatively consistent parameter list and analytical methodologies throughout the baseline period. An index of sampling dates, parameters, and water sampling locations is provided in Appendix IV.3, Table IV.3-1. Table 4.3-1 and Figure 4.3-1 summarize the areas sampled during the baseline surveys as well as the year and season sampled.

During the initial collection of baseline water quality data in 1979 and 1980, the sampling program was restricted to areas in the vicinity of the McClean uranium deposits (Collins Creek watershed south of Torwalt Lake) and a reference area established at Mallen Lake. When the JEB ore zone was discovered in 1982, baseline data was also collected from additional lakes and streams in this area. In 1988 and 1989, the focus shifted to areas potentially to be influenced by the development of the McClean Lake Operation mine site infrastructure. At that time, waterbodies sampled were situated in proximity to the McClean, JEB, and Sue ore zones. In 1990, waterbodies east and southeast of the JEB ore zone were sampled to provide additional baseline water quality characterization.

In 1993, 1994, and 1995, additional baseline water quality data were collected to support future comparisons to the data from the operational phase of the McClean Lake Operation. Water chemistry and limnology was characterized in the primary and secondary exposure areas, which had been established based on their potential for effects from activities associated with the McClean Lake Operation. Appropriate reference areas were also sampled. Areas sampled during the baseline program completed in 1993 and 1994 are provided in Figure 4.3-1 and Table 4.3-1. Because these baseline study areas are the most consistent with operational monitoring locations, this report focuses on the baseline data collected from 1993 and 1995. However, data collected prior to 1993 are presented and some discussion is provided. In addition, where possible, comparisons were made to current Saskatchewan Environmental Quality Guidelines (SEQGs) for freshwater aquatic life (GS 2025) and the Canadian Environmental Quality Guidelines (CEQGs) for the protection of freshwater aquatic life (CCME 2025) or the Federal Environmental Quality Guidelines (FEQGs) for freshwater aquatic life (GC 2024).

In general, the baseline water quality of the lakes and streams within the LSA was typical of Precambrian Shield lakes. Levels of major ions, metals, and radionuclides were low, measuring at or near reportable detection limits (RDLs). Extensive temporal and spatial coverage during baseline surveys provided water chemistry information

for comparisons with current monitoring programs. A summary of baseline (1993 to 1995) physical property, major ion, nutrient, and radionuclide data is provided in Tables 4.3-2 to 4.3-6. Mean concentrations of copper and lead exceeded available guidelines in at least one exposure lake during the baseline period. Mean copper concentrations ranged between 0.001 mg/L to 0.007 mg/L, exceeding the CEQG of 0.002 mg/L in Collins Creek and Osiris Lake (Table 4.3-5). Notably, levels remained at or below the SEQG of 0.007 mg/L in all baseline sampling areas. Mean lead concentrations exceeded the SEQG and CEQG of 0.001 mg/L in all baseline sampling areas (Table 4.3-5). A more detailed description of baseline water quality is provided in AREVA (2016a).

4.3.2 Study Design and Objectives

Water quality monitoring is a requirement of the EMP for the McClean Lake Operation. The purpose of the program is to assess whether mining and milling operations are influencing water quality in the LSA. Treated effluent is discharged into the S/V TEMS and released through a diffuser into the east basin of McClean Lake. There it enters Collins Creek, flows through Kewen Lake, and eventually to Collins Bay of Wollaston Lake (Figure 4.3-2). Because treated effluent is released to the east basin of McClean Lake, the upstream west basin is designated as a reference area. Additional reference sites are located at Mallen Lake, upstream locations of Collins Creek, and Henday Lake (Figure 4.3-2). In the secondary exposure areas, water quality sampling is conducted near the JEB and Sue site areas (Figure 4.3-2).

With the establishment of a formal water quality program in 1995, water quality station codes were adopted within the primary exposure, secondary exposure, and reference areas. Sampling coordinates for each station are provided in Table 4.3-7. Several changes with respect to sampling locations have been implemented since the inception of the operational water quality monitoring program. In 1999, Tail Lake, Isis Lake, and Osiris Lake were removed from the monitoring program and Sue Lake, Sils Lake, Candy Lake, and Bena Lake were added. The latter were added to the program because of their proximity to the Sue mining area. They are monitored for the potential effects of atmospheric deposition of dust and dewatering activities from the Sue site development. An additional reference location at Henday Lake was added in 1999 because this lake is isolated from both treated effluent release and potential atmospheric exposure. An amendment was made in 2000 to reinstate Osiris Lake in the program; however, it was removed again in 2016. The last time it was sampled was in 2014.

Milling at the McClean Lake Mill began in June 1999 and operated until April 2010 when the mill entered a period of care and maintenance while the facility waited for the arrival of ore for processing. The mill resumed operations in 2014. The mill feed is currently Cigar Lake ore slurry. In conjunction with the mill restart, tailings are once again being placed into the JEB TMF. There has been no conventional mining at the McClean Lake Operation since 2008.

A comprehensive water quality monitoring program was also in place for the Midwest Project, which is located adjacent to the McClean Lake Operation LSA. Semi-annual monitoring of water quality was done in South McMahon Lake from 1992 until 1997, and in 1998, the sampling station was relocated to Mink Arm. Beginning in 2008, this station (WQ31E, (formerly M1)) was added to the McClean Lake Operation EMP but was later removed from the program in 2020. The last time it was sampled was in 2019. A detailed description of the Midwest Project water quality monitoring program can be found in the Midwest Project EE TID (AREVA 2008), and the detailed data are presented in the 2022 EP TID.

4.3.3 Impact Predictions

Results from the 1991 and 1995 EAs included predictions for selected water quality parameters in the downstream environment as the result of treated effluent discharge from mine and mill operation during the operational phase. Overall, impact on water quality was predicted to be minor to moderate over the operating life of the Project in McClean Lake and Collins Creek. Predictions were further completed as part of the 2011 Midwest Project EA, which included the assessment of the Midwest Project activities combined with current and future activities at the McClean Lake Operation. The predictions were based on expected flows from the mining and milling operation, as well as from expected performance of effluent treatment. These expectations, along with data characterizing the surface water flow in the area, were used within a probabilistic modelling framework to generate water quality predictions at selected sites downstream from the effluent discharge point within the Collins Creek drainage basin. The Sue E Project EA (COGEMA 2004) incorporated more advanced ERA methodologies that were subsequently applied in both the Caribou Project (AREVA 2009a) and Midwest Project (AREVA 2011a) EAs. These ERAs have since been updated; most recently as part of Volume 2 of the 2016 EP TID (AREVA 2016b) and the 2018 Selenium Review and Assessment Report (Orano 2018). Data from the current EP TID monitoring period were assessed against the most recent 2016 and 2018 ERA predictions.

Effluent quality was defined by a combination of treatability studies and full-scale industry WTP performance experience. Compliance requirements, where available, provided an upper bound of treated effluent quality used in the modelling exercise. Similarly, baseline surface water monitoring results were used to define parameter distributions for background water quality. Operational flow and water quality expectations, combined with information for the receiving environment flow regime, were combined in a surface water dispersion-modelling framework to predict maximum mean and 95th percentile concentrations for parameters of concern at selected locations downstream of the treated effluent release. Maximum annual mean and 95th percentile concentrations predicted for the 2022 to 2024 reporting period for select parameters at Sink Reservoir outlet (CM03), Vulture Lake outlet (CM04), McClean Lake outlet (WQ12E), and Kewen Lake (WQ14E) are presented in Table 4.3-8.

Additionally, in 2018, a Selenium Review and Assessment Report (Orano 2018) was completed to meet one of the objectives of the operation's Selenium Adaptive Management Plan (AREVA 2017b). After a period of non-operation while the mill was in care and maintenance (2010 to 2014), selenium outputs rose once processing of Cigar Lake ore commenced. Selenium concentrations in Cigar Lake ores present a more significant challenge than in ores previously processed at the mill. The selenium risk assessment was revised, based on improvements made at the operation and the resulting revised 2018 selenium forecast. There was a substantial reduction in the anticipated residual selenium risks associated with the milling of Cigar Lake ore at the McClean Lake Mill compared to the risks presented in 2016. Selenium predictions in Sink Reservoir, Vulture Lake, McClean Lake, and Kewen Lake were calculated for each year from 2022 to 2024 (Table 4.3-8). The exceedances of the maximum annual mean water concentrations for the 2018 Revised Selenium Forecast were limited to the S/V TEMS. No prolonged exceedances were predicted in McClean Lake east basin, Collins Creek, and Kewen Lake surface waters.

While treated effluent discharge was identified as the primary influence on water quality at the McClean Lake site, atmospheric emissions and groundwater dewatering and potential groundwater contaminant transport from mining and milling operations were also identified as potential influences on surface water quality. Monitoring of water quality in the McClean Lake Operation secondary exposure areas was established to evaluate these potential influences.

4.3.4 Operational Monitoring

4.3.4.1 Sampling Methods

Surface water samples, during the operational monitoring phase, were collected from the surface or at depth intervals depending on the sampling location. In shallow locations, surface water grab samples were collected. Samples collected from deep lakes with the potential to chemically stratify were collected from the surface, mid-depth, and bottom using either a Van Dorn or a Kemmerer sampler. Discrete samples have more recently been collected using a spool of tubing with a weighted end that is lowered to the desired sampling depth. Prior to collecting the sample, a peristaltic pump is used to purge (rinse) water from the line/ tubing using water from the sample collection depth and then the sample is collected at the discrete depth. A timer is used in the field to ensure the tubing has been adequately purged before sampling. To ensure that the sample is collected from the correct depth, the boat is anchored in place, and the end of the tubing is sufficiently weighted to hold tubing upright through the water column. Depth is labelled in meters on the tubing so the tubing can be lowered to the desired sample depth. The change in methodology was implemented because it is faster and less labour-intensive than using the Kemmerer sampler and similar to the Kemmerer, this methodology is effective at collecting a representative sample from a discrete depth. Deep lakes including Mallen Lake (WQ01C), Pat Lake (WQ05E), Johannes Lake (WQ08E), and Kewen Lake (WQ14E) were sampled at three discrete depths. All water quality samples were submitted to the Saskatchewan Research Council (SRC) Environmental Analytical Laboratory in Saskatoon for chemical analysis.

4.3.4.2 Data Analysis

Initial Screening

Water chemistry data were initially screened to identify potentially erroneous data and data gaps prior to data analyses. This included screening for duplicate data, errors or omissions, and investigating potential anomalous values or extreme outliers. Any identified outliers were screened against the entire dataset for that constituent to ascertain whether the value appeared erroneous. No data were removed from the analysis unless they were confirmed to be erroneous. All data that included top, middle, and bottom sample results were averaged together per sampling event at a given station.

Evaluation Criteria

The primary method used to assess the status of the water quality in the McClean Lake Operation LSA was to compare the data to predictions made during the 1991 and 1995 Joint Panel Environmental Assessments (EAs; Joint Panel 1993 and 1997) and the most recent ERAs (2016 and 2018) (Section 4.3.3). Secondary to that objective was assessing long-term trends in the water quality data for which impact predictions were calculated, and assessing the water quality of secondary exposure areas in relation to reference and baseline data. The overall water quality monitoring design is primarily a control-impact design. Because of consistency with the baseline study design, comparisons can also be made to pre-operational data.

The following EvCs were applied for surface water data analysis:

- EvC 1: RDL – all measured parameters were first screened against laboratory RDLs. If less than 90% of a parameter's concentration were below the RDL during the reporting period, then it was retained for further evaluation under EvC 2.
- EvC 2: Upper Reference Range – data retained from EvC 1 was compared to recent reference data. If mean concentrations in at least one of the exposure monitoring locations were more than two reference standard deviations above the reference mean, then it was carried forward for evaluation under EvC 3.
- EvC 3: Comparison to most recent ERA predictions – data retained from EvCs 1 and 2, were evaluated to ensure that concentrations remained within the most recent ERA predictions listed in Table 4.3-8. Note the most recent ERA predictions were utilized as a more conservative prediction for comparison as opposed to the original 1991 and 1995 EIS predictions.
- EvC 4: Comparison to applicable guidelines – data retained from EvCs 1 and 2, were also evaluated to ensure that concentrations remained within applicable regulatory guidelines detailed on Table 4.3-9.
- EvC 5: Confirmed temporal trends – data retained from EvCs 1 and 2 was also analysed to identify changes in trends over time using appropriate statistical methods. Data with statistically significant change in trend were identified and discussed further in the detailed analysis section.

EvCs 1 and 2 were applied for COPC selection, while EvCs 3, 4 and 5 were used for detailed data analysis for selected COPCs as described below.

COPC Selection

Although a full suite of parameters has been assessed, COPCs were identified through the screening process described in Section 1.6.2.4 and shown in Tables 4.3-10, IV.3-2 and IV.3-3. EvCs 1 and 2 listed above was applied as part of the COPC screening process. The following table outlines water quality COPCs specifically addressed in this report:

COPCs
Nutrients
Ammonia (as N)
Carbon, Inorganic
Carbon, Organic
Carbon, Organic dissolved
Carbon, Total
Nitrate (as N)
Nitrogen, Total
Nitrogen, Total Kjeldahl
Phosphorus
General Chemistry and Major Ions
Alkalinity (as $CaCO_3$)
Bicarbonate (as HCO_3)
Calcium
Chloride
Dissolved Oxygen (Field)
Hardness, Total
Magnesium
pH, Laboratory
Potassium
Sodium

COPCs
Specific Conductivity
Specific Conductivity (Field)
Sulphate
Sum of Ions
Total Dissolved Solids (TDS)
Metals and Trace Elements
Aluminum
Arsenic
Barium
Boron
Cadmium
Chromium
Cobalt
Fluoride
Mercury
Molybdenum
Nickel
Selenium
Silver
Strontium
Thallium
Titanium
Uranium
Radionuclides
Lead-210
Polonium-210
Radium-226

Detailed Data Analysis

Primary Exposure Areas

Although discussion of changes in water quality in this report will focus primarily on the current EP TID period (2022 to 2024), comprehensive water quality data dating back to 1996 are presented to provide a long-term perspective on the evolution of water quality since the start-up of the McClean Lake Operation. Water quality data in the primary exposure areas were evaluated using two approaches: 1) measured parameter concentrations were compared, where possible, to available most recent ERA predictions and guidelines for the protection of aquatic life (GS 2025; CCME 2025; GC 2024) and 2) trends over time were assessed for all COPCs. Data have been evaluated with various time periods associated with operational changes as shown in Table 4.3-11. Data were previously screened spatially against reference (control) areas as part of identifying COPCs.

Using graphs, COPC concentrations were visually compared to the most recent predicted maximum annual mean, the maximum annual 95th percentile, and a selected water quality guideline for each COPC at six locations progressively downstream from the effluent release point: Sink Reservoir outlet (CM03), Vulture Lake outlet (CM04), McClean Lake east basin (WQ11E), McClean Lake outlet (WQ12E), Collins Creek Downstream (WQ13E), and Kewen Lake (WQ14E; Figure 4.3-2). Graphs of COPC concentrations or levels were plotted using the R statistical software (R Core Team 2024) including packages Lubridate (Grolemund and Wickham 2011) and Plotrix (Lemon 2006). All available data points were plotted; data less than the RDL were set at the RDL and are identified in the figure. In addition, where possible, comparisons were made to current SEQGs for

freshwater aquatic life (GS 2025) and the CEQGs for the protection of freshwater aquatic life (CCME 2025) or the FEQGs for freshwater aquatic life (GC 2024), as well as B.C. surface water guidelines where relevant (BC WQG 2023). Guidelines preferentially selected for inclusion in graphs and tables are described in Table 4.3-9.

Impact predictions presented in the 2016 and 2018 ERAs (Table 4.3-8) were used as comparative benchmarks for evaluating the surface water quality associated with primary exposure areas located downstream of the treated effluent release. Predictions from the model presented in the 2016 and 2018 ERA were calculated here for the current EP TID period. For guidelines that are dependent on other physical parameters (i.e., pH, temperature, and hardness), the values used for computing guidelines were those obtained in the field concomitantly to the collection of the water samples. For ammonia (as N), sulphate, aluminum, cadmium, cobalt, and nickel, the calculated guidelines widely fluctuated between samples; thus, the average guideline over the entire period was shown to clarify the figure and facilitate its interpretation.

Long-term temporal trends in COPC concentrations were evaluated to determine if parameter concentrations in the receiving environment have changed over the time periods evaluated as per Table 4.3-11. Trend analyses were performed if <40% of values were below the RDL.

Trend analyses were performed using the R statistical software (R Core Team 2024) including packages Lubridate (Grolemund and Wickham 2011) to manage sample date and time information, Seastests (Ollech 2021) for seasonality tests, Mblm (Komsta 2019) to compute the Sen's slopes, and Kendall (McLeod 2022) for Mann-Kendall and deseasonalized Mann-Kendal tests. Whenever a significant seasonality effect occurred, the seasonal Mann-Kendall test was performed instead of the "regular" Mann-Kendall test. The Sen's slopes were not deseasonalized as cautioned by U.S. EPA (1989) because this non-parametric method is robust to seasonality effects. The alpha level for the rejection of the null hypothesis was $\alpha = 0.050$. For all analyses, descriptive statistics computations, and data graphing, values less than the RDL were set equal to the RDL. These values, when they occurred, were identified using a triangle symbol instead of a circle in the graphs.

Due to the long time period assessed and frequent sampling, sample sizes for some areas and COPCs, namely limnological measures, were so large as to hinder completion of computations in a reasonable time. Therefore, limnological measures that were considered COPCs were included only when collected as part of the water chemistry program.

Secondary Exposure Areas

Water quality is also monitored in waterbodies potentially downgradient of mining and milling activities, as there is potential influence of groundwater and atmospheric contaminant transport on surface water quality in those areas. These included waterbodies near the McClean Lake Mill and JEB TMF (Fox, Pat, and Johannes lakes) and waterbodies near the Sue open pit mine (Sue, Sils, Bena, and Candy lakes). Data were evaluated for the JEB secondary exposure and the Sue secondary exposure areas as per the time periods presented in Table 4.3-11 and largely following the same methods described above for the primary exposure areas. The exception being that there are no predictions available for the secondary exposure areas.

Reference Areas

Reference area data are collected to provide additional context to the exposure area data, in particular, with respect to regionally expected conditions and long-term trends not related to the McClean Lake Operation. Reference area data were used to initially screen the exposure area data to help identify monitoring parameters as COPCs for inclusion in the data evaluation. Reference area data were also evaluated for long term trends as described in Table 4.3-11 following the same methods outlined for the primary and secondary exposure areas.

4.3.4.3 Results

Monitoring Performance

The full 1996 to 2024 surface water quality dataset was screened for erroneous data and data gaps as part of the initial screening and data QA/QC process. In 2024, Orano specified performance criteria for all aspects of the monitoring program to ensure data of sufficient quality and quantity are obtained to achieve EMP objectives in compliance with the CSA N288.4 requirements (CSA 2025). For surface water quality monitoring, the performance criterion was set as 95% of the total annual planned samples. All but one of the scheduled surface water quality samples were collected in the current reporting period as per the EMP requirements, exceeding the outlined target of 95%. The only missed sampling occurred in June 2024, where no water quality sample was collected at CM03 as the Sink Reservoir Outflow weir was closed from June 9th to 30th, 2024 due to flood conditions at Collins Creek.

For the current EP TID period, a few anomalous values were investigated. In September 2022, anomalously high concentrations of copper, iron, lead, manganese, and zinc were detected in the CM04 monthly grab sample. The elevated parameters were attributed to sample contamination. As these parameters were not screened in as COPCs for this assessment, no further action was required for the data analysis. In July 2023, a chromium value from Sils Lake (WQ17E) was flagged as much higher than all previous results, also attributed to sample contamination. Given the high value of this one data point (33 times higher than the next highest value), it was deemed erroneous and removed from the analysis.

Primary Exposure Areas

Graphical comparisons of the McClean Lake Operation water quality data to the maximum mean and 95th percentile predicted concentrations at each primary exposure location are presented in Figure 4.3-3. A summary of the 2022 to 2024 water quality data for the 44 COPCs is presented in Table 4.3-12, and more detailed water chemistry data for the full operational period are presented in Appendix IV.3, Tables IV.3-4 to IV.3-7. As established in previous EP TID iterations and observed in Figure 4.3-3, the variation in COPC concentrations was greatest in the S/V TEMS, with levels of many COPCs decreasing with increasing distance downstream of Vulture Lake (CM04).

For the current reporting period, mean concentrations of COPCs in the primary exposure areas generally remained well below the most recent maximum annual mean and 95th percentile predictions (Figure 4.3-3). During this period, measured concentrations of ammonia (as N), chloride, potassium, sulphate, total dissolved solids, arsenic, fluoride, molybdenum, selenium, and uranium were well below maximum 95th percentile predictions. Cobalt and nickel concentrations and radium-226 specific activity levels at Vulture Lake Outlet

(CM04) tended to align the best with predictions, with values falling slightly above or slightly below the maximum predicted mean concentrations for the current EP TID period (Figure 4.3-3). As observed in previous EP TID iterations, a couple lead-210 specific activity levels exceeded the predictions in the primary exposure areas but measured values were near or below the RDL. Notably, predictions for radionuclide activity levels in primary exposure areas downstream of McClean Lake are lower than the RDL, confounding potential comparisons.

Provincial and federal surface water quality guidelines for the protection of aquatic life are available for several of the COPCs monitored in the McClean Lake LSA (Table 4.3-9). Of the COPCs with available guidelines, dissolved oxygen, pH, sulphate, aluminum, arsenic, cobalt, fluoride, and selenium measurements were detected outside of the guideline values in at least one of the six primary exposure sampling areas during the current EP TID period (Figure 4.3-3). Dissolved oxygen concentrations tended to remain within the guideline protective of most life stages of fish (6.5 mg/L) but periodically fell below the 9.5 mg/L guideline for the protection of early life stages. This was particularly the case for McClean Lake Outlet (WQ12E), Collins Creek Downstream (WQ13E), and Kewen Lake (WQ14E). Either oxygen demand (biological and/or non-biological) is higher at these stations, or oxygen diffusion into water is lower at these stations. Growth of aquatic plants and algae as well as decomposition of these plants tends to consume oxygen in a system and lower flow conditions tend to result in reduced oxygenation of water through aeration. The pH levels in the primary exposure area were slightly acidic, and some measurements fell just below the lower guideline limit of 6.5. It is noted that slightly acidic pH is normal for the region as shown with the reference dataset and baseline values. Additionally, low pH values associated with the S/V TEMS and McClean Lake east basin have been previously discussed, and it is hypothesized they are due to decomposition and reduced photosynthesis in winter (AREVA 2017b). Sulphate and fluoride concentrations at S/V TEMS (CM03 and CM04) routinely exceeded the guidelines throughout the current EP TID period, but not downstream at McClean Lake Outlet (WQ12E), Collins Creek Downstream (WQ13E), and Kewen Lake (WQ14E) (Figure 4.3-3). There was one isolated exceedance of sulphate and fluoride at McClean Lake east basin (WQ11E) in 2022, otherwise all values remained below guidelines. Aluminum, arsenic, cobalt, and selenium concentrations only exceeded guidelines in Sink Reservoir (CM03) during the current EP TID period. Additionally, there was a notable decrease in selenium concentrations in Sink Reservoir across the current EP TID period, with no values exceeding guidelines through 2024.

Two periods of comparison were of interest for the evaluation of the primary exposure area data, 2015 to 2024 (Time Period 1; Table 4.3-11), which represents the period in which the Cigar Lake ore had been processed, and 2000 to 2024 (Time Period 2; Table 4.3-11), which represents the full period of operation of the JEB mill. Evaluations of long-term trends across the two time periods assessed are summarized in Table 4.3-13 and 4.3-14. Detailed statistical results are presented in Appendix IV.3, Tables IV.3-8 to IV.3-19. As outlined previously, temporal trends were not assessed when a relatively large number (>40%) of measured concentrations were below their respective RDLs. Where there was seasonality, a seasonal Mann-Kendall was performed to account for this variation.

At CM03 and CM04 in the S/V TEMS, temporal trends across Time Period 1 (Cigar Lake ore processing period) were somewhat consistent (Table 4.3-13). Concentrations of major ions such as chloride, magnesium, sodium, specific conductance, sulphate, sum of ions, and total dissolved solids showed an increasing trend over time at both stations. Additionally, significant increasing trends were noted for dissolved organic carbon at Sink Reservoir (CM03) and calcium, total hardness, and potassium at Vulture Lake (CM04). When assessed over Time Period 2 (JEB mill operational period; Table 4.3-14), many of the same major ions showed increasing trends including chloride, sodium, specific conductance, sulphate, and sum of ions. Additionally, total organic carbon, calcium, hardness, pH, and total dissolved solids showed a significant increasing trend across the JEB

mill operational period within the S/V TEMS. Interestingly, although there had been an apparent decrease in pH within the current reporting period (Figure 4.3-3) as well as over the Cigar Lake ore processing period; overall, the pH significantly increased over the operational period of the JEB mill (Table 4.3-14). Similarly, an increase in alkalinity and bicarbonate also occurred at Vulture Lake (CM04), over the entire JEB mill operational period (i.e. Time Period 2). Notable decreasing trends in the S/V TEMS across the Cigar Lake ore processing period included nutrients such as nitrate (as N) and total nitrogen as well as molybdenum, uranium, and radium-226. Additionally, significant decreasing trends were observed for nickel and selenium at Sink Reservoir (CM03) and alkalinity, bicarbonate, and barium at Vulture Lake (CM04) (Table 4.3-13). Fewer decreasing trends were identified across the JEB mill operational period, with consistently decreasing ammonia (as N), total Kjeldahl nitrogen, magnesium, molybdenum, and uranium. Nitrate (as N), total nitrogen, and barium also showed significant decreasing trends at Sink Reservoir (CM03), while dissolved organic carbon showed significant decreasing trends at Vulture Lake (CM04) over the full JEB mill operating period.

Within McClean Lake east basin (WQ11E) and the McClean Lake Outlet (WQ12E), fewer overall trends across Time Period 1 (Cigar Lake ore processing) or Time Period 2 (JEB mill operational period) were observed. Increasing concentrations of chloride, potassium, sodium, and specific conductance (field) were observed across the Cigar Lake ore processing period for both McClean Lake east basin (WQ11E) and McClean Lake Outlet (WQ12E) (Table 4.3-13). Additional increasing trends of ammonia (as N) at McClean Lake east basin (WQ11E) and specific conductance (laboratory), sulphate, sum of ions, and total dissolved solids at McClean Lake Outlet (WQ12E) were observed. When the full JEB mill operational period was assessed, the only increasing trends observed were for total organic carbon, aluminum, and fluoride at McClean Lake east basin (WQ11E), and sodium and aluminum at McClean Lake Outlet (WQ12E). Notable decreasing trends in McClean Lake across the Cigar Lake ore processing period included decreasing alkalinity, bicarbonate, pH, and molybdenum at McClean Lake east basin (WQ11E) and decreasing pH, aluminum, and molybdenum at McClean Lake Outlet (WQ12E). When the full JEB mill operating period was assessed, ammonia (as N), total nitrogen, total Kjeldahl nitrogen, calcium, hardness, magnesium, potassium, specific conductance (laboratory), sulphate, sum of ions, total dissolved solids, arsenic, barium, molybdenum, nickel, strontium, and titanium all showed decreasing trends at both McClean Lake east basin (WQ11E) and McClean Lake Outlet (WQ12E). Inorganic carbon, total carbon, and specific conductance (field) also showed decreasing trends at McClean Lake east basin (WQ11E).

Far-field downstream at Collins Creek Downstream (WQ13E) and Kewen Lake (WQ14E), few temporal trends were noted across Time Period 1 (Cigar Lake ore processing; Table 4.3-13). Increasing concentrations of chloride at Collins Creek Downstream (WQ13E) and potassium and sodium at both Collins Creek Downstream (WQ13E) and Kewen Lake (WQ14E) were observed. Additionally, decreasing inorganic carbon, alkalinity, bicarbonate, and molybdenum at Collins Creek Downstream (WQ13E) and pH, barium, and molybdenum at Kewen Lake (WQ14E) were observed. Comparatively more temporal trends were observed across Time Period 2 (JEB mill operating period; Table 4.3-14). Levels of ammonia (as N), inorganic carbon, total carbon, total Kjeldahl nitrogen, calcium, hardness, magnesium, potassium, specific conductance (laboratory), sulphate, , arsenic, barium, molybdenum, nickel, and strontium decreased across the JEB mill operating period for both of these monitoring stations. Additionally, sum of ions, total dissolved solids, and titanium at Collins Creek Downstream (WQ13E) and total nitrogen, alkalinity, and bicarbonate at Kewen Lake (WQ14E) decreased across the JEB mill operation period (Table 4.3-14). Increasing trends were only noted in aluminum at Collins Creek Downstream (WQ13E) and total organic carbon and dissolved oxygen at Kewen Lake (WQ14E).

Across the primary exposure areas, COPC concentrations with very few exceptions were below both maximum mean and 95th percentile predictions for the current reporting period and below available guidelines for the

protection of freshwater aquatic life. Long-term temporal trends of the JEB mill operating period demonstrated many decreasing trends in COPCs downstream of the S/V TEMS while consistent decreasing trends of total Kjeldahl nitrogen, magnesium, and molybdenum were observed across all six primary exposure areas. No consistent increasing trends were identified across all primary exposure areas. Overall, these trends align with the most recent ERA that demonstrated there were only short-term increasing trends of some COPCs in the primary exposure areas over the course of the operating period.

Secondary Exposure Areas

JEB

Graphical comparisons of the McClean Lake Operation water data at each JEB secondary exposure location are presented in Figure 4.3-4. A summary of the 2022 to 2024 water quality data for the 44 COPCs is presented in Table 4.3-15, and more detailed water chemistry data are presented in Appendix IV.3, Tables IV.3-4 to IV.3-7. As established in previous EP TID iterations and observed in Figure 4.3-4, COPC concentrations tended to be low across secondary exposure sampling areas and in many cases near to or below the RDL within the current EP TID period.

Of the COPCs with available guidelines, dissolved oxygen and pH measurements were detected outside of the guideline values in at least one of the three JEB secondary exposure sampling areas during the current EP TID period (Figure 4.3-4). With two exceptions, dissolved oxygen concentrations tended to remain within the guideline protective of most life stages of fish (6.5 mg/L) in the current EP TID period. In Fox Lake (WQ04E), dissolved oxygen levels fell just below this guideline during the winter. Low dissolved oxygen levels are apparent in Fox Lake on occasion, dating back to when monitoring first began for this parameter in 2010 (Figure 4.3-4). The pH levels in the JEB secondary exposure area were slightly acidic with some measurements falling at or just below the lower guideline limit of 6.5. It is noted that slightly acidic pH is normal for the region as shown with the reference dataset and baseline values.

Temporal trend analysis was completed on the JEB secondary exposure station data for two time periods. Time Period 1 (Table 4.3-16) represents the JEB TMF operational period of 2000 to 2024. Time Period 2 (Table 4.3-17) represents all the years since the JEB pit was developed from 1996 to 2024. Detailed statistical results are presented in Appendix IV.3, Tables IV.3-20 to IV.3-25. A few notable temporal trends occurred across both periods assessed. Through the TMF operational period, increasing trends were only noted for calcium, aluminum, and barium in Fox Lake (WQ04E), total organic carbon, dissolved organic carbon, and total dissolved solids in Pat Lake (WQ05E), and aluminum and fluoride in Johannes Lake (WQ08E). All of these trends were also present through the JEB pit development period except aluminum at Johannes Lake. Additional increasing trends through the longer assessment period were noted for hardness, pH, sodium, and strontium at Fox Lake (WQ04E), barium at Pat Lake (WQ05E), and sulphate at Johannes Lake (WQ08E). Of all these parameters, only barium (in Fox Lake WQ04E) exceeded the upper limit of the current EP TID reference range.

Across the JEB TMF operational period, decreasing trends were noted for ammonia (as N) across all three JEB secondary exposure areas as well as total nitrogen and total Kjeldahl nitrogen at both Fox Lake (WQ04E) and Pat Lake (WQ05E). When the longer JEB pit development period was assessed, consistent decreasing trends in ammonia (as N), total nitrogen, and total Kjeldahl nitrogen were observed across all three JEB secondary exposure areas. Total and dissolved organic carbon also showed a decreasing trend at Fox Lake (WQ04E) over the JEB pit development period. At Pat Lake (WQ05E), bicarbonate, calcium, specific conductance (laboratory),

sum of ions, aluminum, and strontium decreased significantly in both time periods assessed, while hardness showed a significant decreasing trend only in the JEB TMF operational period. At Johannes Lake (WQ08E), alkalinity, bicarbonate, specific conductance (laboratory), sum of ions, and strontium have trended down over both time periods assessed, while barium showed a significant decreasing trend in the JEB TMF operational period only.

Sue

Graphical comparisons of the McClean Lake Operation water data at each Sue secondary exposure location are presented in Figure 4.3-5. A summary of the 2022 to 2024 water quality data for the 44 COPCs is presented in Table 4.3-15, and more detailed water chemistry data are presented in Appendix IV.3, Tables IV.3-4 to IV.3-7. As established in previous EP TID iterations and observed in Figure 4.3-4, COPC concentrations tended to be low across secondary exposure sampling areas and in many cases near to or below the RDL within the current EP TID period.

There were a few instances where COPCs with available guidelines exceeded these guidelines within the current reporting period in the Sue secondary exposure areas (Figure 4.3-5). Similar to other monitoring stations, dissolved oxygen measurements fell below the guidelines for the protection of early life stages of fish (9.5 mg/L) during some sampling events but otherwise remained above the guideline protective of other life stages (6.5 mg/L). The pH was low in the four Sue secondary exposure areas, which is anticipated for the region. However, levels were lower in Sue (WQ16E) and Sils (WQ17E) lakes than Candy (WQ18E) and Bena (WQ19E) lakes, with all pH values measured below the lower limit of 6.5 (Figure 4.3-5). These pH levels are reflective the bog-like conditions of these two shallow waterbodies. The aluminum concentrations in Sue (WQ16E) and Sils (WQ17E) lakes equaled or exceeded available guidelines throughout the current reporting period. Levels have regularly measured above guidelines since monitoring began in 1998 (Figure 4.3-5) and are related to the low pH and thus reduced guideline for aluminum in these waterbodies. There was one instance in July 2023 when nickel exceeded the available guideline at Sils Lake (WQ17E), but all other values were below the guideline over the current reporting period (Figure 4.3-5). Nitrate (as N) concentrations in Bena Lake (WQ19E) were also elevated at two sampling events during the current reporting period beyond the available guideline; however, these concentrations were lower than the peak levels observed in 2021 during the previous 2022 EP TID (Figure 4.3-5). In 2024, Orano completed a preliminary risk evaluation that confirmed the observed short-term increase in the nitrate concentrations in Bena Lake had negligible impact on the receiving aquatic ecosystem, with no need for immediate corrective actions (Orano 2024). Orano further implemented an action plan to investigate the source and assess the long-term impacts, including additional sampling at Bena Lake and further risk assessment implemented as part of the 2025 ERA update (2025 EP TID Volume 2; Orano 2025a).

Temporal trend analysis was completed on the Sue secondary exposure station data for two time periods. Time Period 1 (Table 4.3-18) represents the period after which mining activities was completed at Sue Site (2009 to 2024). Time Period 2 (Table 4.3-19) represents the entire Sue Site operational period (1998 to 2024). Detailed statistical results are presented in Appendix IV.3, Tables IV.3-26 to IV.3-33. A few notable temporal trends occurred across both periods assessed. Since mining activities were completed at the Sue Site, no increasing trends were observed at Sue Lake (WQ16E); however, when the entire Sue Site operational period was assessed, a significant increase in potassium was observed though levels remained comparable to reference. Alkalinity and bicarbonate concentrations at Sils Lake (WQ17E) have shown an increasing trend since mining activities were completed at Sue Site; however, levels have remained comparable to reference and the trend is not present when the full Sue Site operating period is assessed. Potassium and aluminum concentrations also

showed an increasing trend at Sils Lake (WQ17E) over the full Sue Site operating period assessed, with potassium concentrations remaining similar to reference and aluminum concentrations falling above the reference range. More temporal trends were noted in Candy (WQ18E) and Bena (WQ19E) lakes. Candy Lake (WQ18E) and Bena Lake (WQ19E) showed increasing trends in most major ions and barium since the Sue E mining was completed and over the entire Sue Site operational period. Total Kjeldahl nitrogen also significantly increased in Bena Lake only (WQ19E) over the entire Sue mining operational period (Period 2) but not when considering only Time Period 1. These levels have also often exceeded the upper reference range from the current reporting period, particularly in Bena Lake (WQ19E). Increasing concentrations of ammonia (as N), nitrate (as N), total nitrogen, pH, fluoride, and nickel were also observed in Bena Lake (WQ19E) since Sue E mining has been completed. The relatively recent increases in COPCs observed in Candy (WQ18E) and Bena (WQ19E) lakes are being further investigated as part of the 2025 ERA which is detailed in the 2025 EP TID Volume 2 report (Orano 2025a).

Since Sue E mining was completed in 2009, decreasing trends were noted for calcium, specific conductance, sulphate, arsenic, and nickel at Sue Lake (WQ16E) and Sils Lake (WQ17E) as well as barium, strontium, and titanium at Sils Lake (WQ17E). Over the entire Sue Site operational period, ammonia (as N), bicarbonate, calcium, specific conductance (laboratory), and sum of ions have decreased at Sue Lake (WQ16E), while total organic carbon, bicarbonate, specific conductance, sum of ions, and polonium-210 have decreased at Sils Lake (WQ17E). Fewer decreasing trends were noted at Candy and Bena lakes. Total and dissolved organic carbon, sulphate, aluminum, and arsenic have decreased since mining activities ended at Sue at both Candy (WQ18E) and Bena (WQ19E) lakes. Additionally, titanium decreased significantly at Bena Lake (WQ19E) since mining activities ended at Sue. These trends hold true for dissolved organic carbon and aluminum at both Candy Lake (WQ18E) and Bena Lake (WQ19E) and sulphate at Bena Lake (WQ19E) when the full Sue Site operational period is assessed.

Reference Areas

There are four reference areas assessed as part of the McClean Lake Operation surface water monitoring program. Reference area data were used to screen the exposure area data for potential COPCs for further evaluation and to provide context to guideline exceedances. To provide additional context to potential temporal trends identified in the exposure area datasets, the reference area data have been graphed and evaluated for temporal trends over two time periods. Graphical comparisons of the reference area water data are presented in Figure 4.3-6. A summary of the 2022 to 2024 water quality data for the 44 COPCs is presented in Table 4.3-15, and more detailed water chemistry data are presented in Appendix IV.3, Tables IV.3-4 to IV.3-7. The only parameters to vary from guidelines were dissolved oxygen and pH. During the current EP TID period, there were a few instances where dissolved oxygen concentrations were below the early life stages guideline of 9.5 mg/L; however, concentrations remained above the 6.5 mg/L guideline for other life stages (Figure 4.3-6). Additionally, pH in the region is slightly acidic, with some values having measured at or below the lower pH guideline range of 6.5 both within the current EP TID period and historically since monitoring began in 1996 (Figure 4.3-6).

Temporal trend analysis was completed on the Reference Areas data for two time periods. Time Period 1 (Table 4.3-20) represents the Cigar Lake ore processing period (2015 to 2024). Time Period 2 (Table 4.3-21) represents the entire McClean Lake Operation monitoring period (1996 to 2024). Detailed statistical results are presented in Appendix IV.3, Tables IV.3-34 to IV.3-41. The focus of the reference area trend analysis was on identifying consistent trends across the region that might provide additional context to trends observed in the exposure data analysis. No consistent increasing or decreasing trends were observed across all four reference areas in either

the Cigar Lake ore processing period; however, when the full monitoring dataset is assessed, specific conductance has shown a slight decreasing trend in all areas.

4.3.5 Monitoring Adjustments and Supplementary Studies Recommendations

Based on the COPC screening and data analysis findings, it is recommended that ongoing monitoring efforts continue based on the current monitoring design except for the S/V TEMS. A supplementary study of the water quality data collected at Sink Reservoir and Vulture Lake suggested a potential opportunity to optimize the monitoring program at the S/V TEMS with more details outlined in Section 4.7.8. Further validation of the monitoring program was implemented based on the 2025 ERA update as presented in 2025 EP TID Volume 2 (Orano 2025a).

4.3.6 Summary and Conclusions

The primary objectives of the surface water quality monitoring programs during the operational phase are to: 1) determine the pattern and distribution of contaminants in surface water downstream from treated effluent discharge and 2) evaluate the monitoring results against expected conditions available from the most recent ERA modelling results. As expected, loadings of COPCs decreased with increasing distance from the treated effluent release point in the S/V TEMS. The current monitoring locations and data quality are sufficient to meet the monitoring needs of the EMP and assess the potential effect of the McClean Lake Operation on surface water COPC loading. In terms of monitored parameters, there were no noted deficiencies.

Most parameters were below available guidelines and radionuclide activity levels were generally below or near to the RDL. The influence of treated effluent discharge on the primary exposure waterbodies has been less than originally predicted in the 1991 McClean and 1995 Midwest EISs (Minatco 1991 and COGEMA 1995), and throughout the current reporting period, COPC concentrations generally did not exceed the most recent maximum annual mean or 95th percentile ERA predicted levels. Where parameters exceeded recent predictions during some sampling events, the exceedances either 1) occurred for brief periods of time, 2) were not consistent across all primary exposure areas, or 3) were due to the RDL being higher than the prediction. Overall, the current EP TID surface water quality monitoring data agrees with the original Joint Panel EAs and more recent ERAs that predicted limited effects downstream of the S/V TEMS. Long-term temporal trends of the JEB mill operating period demonstrated many decreasing trends in COPCs downstream of the S/V TEMS while consistent decreasing trends of total Kjeldahl nitrogen, magnesium, and molybdenum were observed across all six primary exposure areas. No consistent increasing trends were identified across all primary exposure areas.

Water quality monitoring conducted in the secondary exposure areas indicated that COPC concentrations were often below RDLs, generally within the range of concentrations measured in the reference areas, and/or below water quality guidelines for the protection of aquatic life. A few COPCs varied notably from available guidelines as has previously been observed. The pH of Sue and Sils lakes is quite low (below the lower limit of 6.5), which has been observed at these waterbodies since monitoring began in 1998. The associated low pH, combined with the low dissolved organic carbon and total hardness lowers the aluminum guideline (that varies with these measures) to 0.047 to 0.049 mg/L, resulting in aluminum levels that regularly exceed available guidelines in both secondary exposure areas. In Bena Lake, nitrate (as N) concentrations have been regularly elevated above available guidelines since the last EP TID period. Notably, concentrations appear to show a recent decrease from the peak levels observed in 2021. Additionally, several COPCs, mostly major ions, have shown a recent

increase in Candy and Bena lakes that is being further investigated as part of the 2025 ERA reported in 2025 EP TID Volume 2 (Orano 2025a).

Currently, surface water quality monitoring is completed on a regular basis at an abundance of primary and secondary exposure areas and multiple references. Monitoring adjustments to at the S/V TEMS were recommended based on the outcome of the supplementary study of the water quality data as captured in Section 4.7.8. Further validation of the monitoring program was implemented based on the 2025 ERA update as presented in 2025 EP TID Volume 2 (Orano 2025a).

4.4 Sediment Quality

4.4.1 Pre-Development Baseline

Monitoring of the quality of sediment within the McClean Lake Operation LSA has a long history dating back to the initial baseline investigation in 1979. The objective of the initial baseline investigations was to document the physical and chemical properties of lake and creek sediments within the vicinity of the uranium mining and milling operation (Figure 4.4-1). Sediment sampling for nutrient, metal, and radionuclide analyses was often completed at the water quality monitoring stations. In 1994 and 1996, the baseline sediment sampling program established a BACI study design, similar to the water quality monitoring program. Permanent sampling area codes were established for sediment locations in 1996. An index of available baseline sediment quality data for the McClean Lake Operation is provided in Appendix IV.4, Table IV.4-1.

Initial baseline studies (1979 to 1981, 1983, and 1988) used Ekman grabs to collect sediment from lake depositional zones and creeks within the McClean Lake LSA. Sample sizes during this period depended on the objectives of the field program and often varied with sampling location. Baseline collections in 1994 were completed using a KB sediment corer and coincided with water quality sampling stations in Tail Lake, Fox Lake, Pat Lake, Isis Lake, Osiris Lake, Johannes Lake, McClean Lake east and west basins, Sink Lake, Vulture Lake, Kewen Lake, and three areas in Collins Creek. In 1996, sediment sampling using a KB corer coincided with the collection of benthic invertebrate samples in Mallen Lake and McClean Lake west basin (reference areas). In 1994 and 1996, permanent sediment sampling stations were established in Mallen Lake, Collins Creek (one upstream and three downstream), Sink Reservoir, Vulture Lake, McClean Lake east basin, McClean Lake west basin, and Kewen Lake. Triplicate samples were collected from two horizons (0 to 5 cm and 5 to 15 cm) at each station. Sediment samples were submitted to an analytical laboratory for metal and radionuclide analysis.

Baseline data are summarized and discussed in the context of available sediment quality guidelines presented in Table 4.4-1. The guidelines provide interpretative definitions as follows:

- Interim sediment quality guidelines (ISQG) represent the concentration below which there is unlikely to be any adverse biological effects (CCME 2025).
- The probable effect level (PEL) is the concentration above which adverse effects are expected to occur frequently (CCME 2025).
- The LEL represents the concentration below which harmful effects on benthic invertebrates are not expected to occur, while the SEL represents the concentration above which harmful effects are expected (Thompson et al. 2005).

- Sediment parameter concentrations were also compared to regional toxicity benchmarks established by Liber et al. (2011). These included:
    - the no-observed-effect concentration (NOEC),
    - lowest-observed-effect concentration (LOEC), and
    - the IC25 and IC50, the concentrations at which growth of Chironomus dilutus and Hyalella azteca were inhibited by 25% and 50%, respectively.
- Sediment COPC concentrations were compared to proposed sediment quality values (SQVs) for uranium operations in northern Saskatchewan.
    - Reference (REF) values were derived using sediment metal and trace element concentrations from reference sites, and
    - no—effect values (NE2) were derived from exposed sites where benthic invertebrates were unaffected by effluent (Burnett-Seidel and Liber 2013).

Tables 4.4-2 to 4.4-5 summarize baseline parameter levels and demonstrate that concentrations of major ions, metals, and radionuclides were typically low with a few exceptions. Arsenic exceeded several guidelines in several lakes within the LSA during the baseline monitoring period, and at Pat Lake lead, vanadium, and zinc exceeded the ISQG and/or LEL concentrations. In addition, lead-210 and polonium-210 were elevated above LEL levels in Johannes Lake and some of the reference locations. Sediment monitoring stations established during the baseline period were consistent with those monitored during operations and facilitate direct comparisons with operational monitoring programs. While both the later baseline and operational sediment collection methods utilized coring, the 1994 and 1996 baseline data consisted of 0-5 cm horizons. During operations, 0-2 cm horizons were sampled, providing a more conservative monitoring approach.

4.4.2 Study Design and Objectives

The primary objectives of the sediment quality monitoring programs during the operational phase are to: 1) determine the pattern and distribution of contaminant accumulation in the sediments downstream from treated effluent discharge and 2) validate model predictions and facilitate model refinement.

Operational sediment monitoring retained the original BACI study design and sediment horizon sampling, and evolved to incorporate a gradient design, with sediment sampling coinciding with benthic invertebrate collections in depositional zones in 1999, 2002, 2005, 2008, 2011, 2013, 2015, 2018, 2021, and 2024 (Figure 4.4-2). Other changes to the program have included:

- The assessment of additional replicate stations, moving from three replicates in 1999 and 2002 to five replicates in subsequent monitoring years.
- The introduction of laser diffraction particle size in 2015. Laser diffraction is considered more efficient and provides higher resolution and better reproducibility than the sieve/pipette method (EC 2012) which was previously used for assessing particle size. Since less material is required to complete laser diffraction analysis, particle size analysis could also be completed on the same sample horizon submitted for chemical analysis (0-2 cm). Additional discussion of the laser diffraction particle method was discussed during review of the 2022 EP TID (Orano 2024).

- The removal of the 2-4 cm horizon collection requirements following the 2015 program as per the recommendations of the 2016 EP TID (AREVA 2016a).

- The reduction of reference lakes to Konner Lake and McClean Lake west basin following the 2015 program.

- The addition of Fox Lake as a secondary exposure sampling area in 2018.

Nine cycles of the sediment quality monitoring programs have been completed in the McClean Lake Operation LSA. The first operational monitoring cycle was completed in 1999 (COGEMA 2000), as required under the McClean Lake Operation licences issued by Saskatchewan Environment and Resource Management and the CNSC. Monitoring between 2002 and 2024 was completed as a requirement under the McClean Lake operating licences. Detailed sediment quality results for 2002, 2005, and 2008 can be found in the respective Status of Environment (SOE) reports for the McClean Lake Operation (Jacques Whitford and COGEMA 2003; AREVA 2006; AREVA 2009b), while detailed results from 2011, 2015, 2018, and 2021 are presented in the respective EP TIDs (AREVA 2012a, 2016a, Orano 2022). Additional data included in this discussion since the last EP TID includes the data collected in 2024 as part of the EMP.

4.4.3 Impact Predictions

The 1991 and 1995 EAs predicted that treated effluent released into Sink Reservoir and Vulture Lake would result in the incorporation of some chemical species (metals and radionuclides) into the bottom sediments (Minatco 1991; COGEMA 1995). A pathways model was run on a yearly basis for 200 years to investigate the concentrations of seven parameters (arsenic, cadmium, copper, lead, nickel, zinc, and radium-226) in the sediment at primary exposure areas in the McClean Lake Operation LSA (COGEMA 1995). Moderate, short-term impacts were predicted for the sediment in the S/V TEMS and McClean Lake east basin. The Sue E EA (COGEMA 2004) incorporated more advanced ERA methodologies that were subsequently applied in both the Caribou and Midwest EAs (AREVA 2009a and 2011a). These ERAs have since been updated as part of Volume 2 of the 2016 EP TID (AREVA 2016b) and the 2018 Selenium Review and Assessment Report (Orano 2018). Predicted maximum annual mean and 95th percentile concentrations for parameters in Sink Reservoir, Vulture Lake, McClean Lake, and Kewen Lake sediment from the original EAs are presented in Table 4.4-6 alongside the most recently updated maximum annual mean and 95th percentile predictions for the current EP TID period (2022 to 2024).

4.4.4 Operational Monitoring

4.4.4.1 Sampling Methods

Sediment from lake depositional areas have been collected primarily using a Tech-Ops Extruder Corer, except for the sampling program in 2002, where a gravity slide-hammer corer was used. The Tech-Ops coring method is preferred because this technique ensures minimal disturbance of the sediment profile while allowing for the collection of larger diameter cores. The corer consists of a 1 m length of Lexan polycarbonate core tube and an aluminum headpiece. Cross-contamination was avoided by thoroughly cleaning the sampling equipment between sampling stations and using a new core tube at each lake. The tube was attached to the headpiece containing a valve that creates a vacuum in the tube, thereby preventing the sediment core from sliding out of the tube while retrieving it from the lake bottom. The corer is lowered into the sediment until a sufficient depth of

sediment is reached. Once retrieved to the surface, sediment is extruded from the core using a pressure system, which forces a rubber stopper up through the core tube. Measured sediment horizons are then sliced from the top of the core tube as the sediment core is extruded.

Consistent with previous sediment sampling cycles, sediment sampling in 2024 was conducted at the same time as lake depositional benthic invertebrate sampling (March). Sediment samples were collected from five replicate stations at two reference (McClean Lake west basin and Konner Lake), four primary exposure (Sink Reservoir, Vulture Lake, McClean Lake east basin, and Kewen Lake), and one secondary exposure (Fox Lake) areas (Figure 4.4-2). Each of the five replicate sampling stations consisted of an area approximately 10 x 10 m in size and minimally separated by a distance of 20 m. This allowed for sufficient physical separation for the samples to be considered as statistical replicates, according to EEM guidance (EC 2012). Sediment sampling was conducted in depositional zones at depths as close to 2 m as possible and at locations consistent with the 1999 to 2021 monitoring programs. Field sub-sample sediment cores were taken at each of the five replicate stations to collect composite samples (0-2 cm and 2-4 cm sediment horizons) of sufficient size for chemical and particle size analyses. However, composite samples were only collected from the 0-2 cm sediment horizons, which were subject to chemical and particle size analyses. It is noted that prior to 2015, only the 0-2 cm horizon was chemically analysed, and particle size analysis was completed on a separate 0-5 cm horizon.

Sediment sampling in riverine areas in Collins Creek was conducted at stations where benthic invertebrates were collected for the EEM program. Sediment samples were collected using an Ekman dredge grab sampler. Each sample was a composite of three grabs, and the 0-5 cm horizon was retained for analysis of sediment particle size and total organic carbon (TOC). Historically (2008, 2013, and 2015), metals analysis was also completed on these sediments and results can be found in the previous monitoring reports (AREVA 2016a).

Table 4.4-7 shows the lakes that were sampled for the sediment chemistry monitoring programs completed between 1999 and 2024 along with sampling coordinates for lakes sampled during the current EP TID period. Monitoring in previous years followed the same methods described above; however, only three replicate sampling stations were assessed in 1999 and 2002. Additionally, following 2015, reference area lakes were reduced to Konner Lake and McClean Lake west basin. Sampling locations during the operational monitoring period closely matched the 1994 sampling locations discussed in Section 4.4.1.

Frozen sediment samples were submitted to the SRC Environmental Analytical Laboratory for chemical and particle size analyses. Chemical analysis included 37 parameters including 2 nutrients, 4 major ions, 25 metals and trace elements, 4 radionuclides, and 2 physical properties. The full list is provided with the detailed data in Appendix IV.4. The particle size breakdown (Wentworth 1922) followed the recommended categorization in the EEM program technical guidance document (EC 2002), which is as follows:

Classification	Particle Size
Gravel	2.0 to 16.0 mm
Coarse Sand	2.0 to 0.2 mm
Fine Sand	0.2 to 0.062 mm
Silt	0.062 to 0.0039 mm
Clay	< 0.0039 mm

Data collected since 2018 used laser diffraction for particle size determination while previous data (prior to 2015, exclusive) followed the sieve/pipette method.

4.4.4.2 Data Analysis

Initial Screening

Sediment chemistry data were initially screened to identify potentially erroneous data and data gaps prior to data analyses. This included screening for duplicate data, errors or omissions, and investigating potential anomalous values or extreme outliers. Any identified outliers were screened against the entire dataset for that constituent to ascertain whether the value appeared erroneous. No data were removed from the analysis unless they were confirmed to be erroneous.

Evaluation Criteria

The following EvCs were applied for sediment quality data analysis:

- EvC 1: RDL – all measured parameters were first screened against laboratory RDLs. If less than 90% of a parameter's concentration were below the RDL during the reporting period, then it was retained for further evaluation under EvC 2.
- EvC 2: Upper Reference Range – data retained from EvC 1 was compared to recent reference data. If mean concentrations in at least one of the exposure monitoring locations were more than two reference standard deviations above the reference mean, then it was carried forward for evaluation under EvC 3.
- EvC 3: Comparison to most recent ERA predictions – data retained from EvCs 1 and 2, were evaluated to ensure that concentrations remained within the most recent ERA predictions listed in Table 4.4-6.
- EvC 4: Comparison to applicable Sediment Quality Criteria – data retained from EvCs 1 and 2, were also evaluated to ensure that concentrations remained within applicable sediment quality criteria detailed on Table 4.4-1.
- EvC 5: Confirmed temporal trends – data retained from EvCs 1 and 2 was also analysed to identify changes in trends over time using appropriate statistical methods. Data with statistically significant change in trend were identified and discussed further in the detailed analysis section.

EvCs 1 and 2 were applied for COPC selection, while EvCs 3, 4 and 5 were used for detailed data analysis for selected COPCs as described below.

COPC Selection

Although a full suite of parameters has been assessed (See Appendix IV.4, Table IV.4-2), COPCs were identified through the screening process described in Section 1.6.2.4 and shown in Tables 4.4-8 and IV.4-3. EvCs 1 and 2 listed above was applied as part of the COPC screening process. The following table lists the COPCs specifically addressed in this report:

COPCs
Major Ions
Calcium
Sodium
Metals and Trace Elements
Aluminum
Antimony
Arsenic
Barium
Boron
Cadmium
Cobalt
Copper
Iron
Lead
Manganese
Mercury
Molybdenum
Nickel
Selenium
Strontium
Thallium
Uranium
Vanadium
Nutrients and Physical Properties
Total Organic Carbon
Phosphorus
Loss on Ignition
Radionuclides
Lead-210
Polonium-210
Radium-226
Thorium-230

Detailed Data Analysis

Primary Exposure Areas

Primary exposure area COPC data from the current reporting period were evaluated as follows:

- Spatially against available reference data;
- To predictions (maximum mean and 95th percentiles) for the current reporting period from the most recent ERA;

- To available sediment quality criteria established for the protection of freshwater aquatic life; and
- Temporally against previous monitoring data, including the 1994 baseline[1].

Sample parameter concentrations that were less than their respective RDL were assigned a value equal to the RDL for calculating descriptive statistics. COPC levels from the current reporting period (2022 to 2024; data available from 2024) were compared between the exposure and reference areas using analysis of variance (ANOVA), or non-parametric Kruskal-Wallis (K-W) tests. Prior to performing ANOVAs, the assumptions of normality and homogeneity of variance were assessed using Anderson-Darling and Levene's tests, respectively. If data were found to depart from assumptions, non-parametric K-W tests were used. If significant differences were identified in the main[2] ANOVA or K-W test, post-hoc pairwise comparison were completed to identify which areas differed statistically. All statistical analyses were performed using the R statistical software (R Core Team 2024) and packages MASS (Venables and Ripley 2002) and vegan (Oksanen et al. 2020). For all statistical analyses, the alpha level (α) used for rejection of the null hypothesis was 0.05.

The current EP TID monitoring period sediment quality data were assessed against the most recent ERA predictions. While all the original 1991 and 1995 EA predictions were incorporated in the evaluation, the focus of the comparisons to predictions was on the maximum annual mean and maximum 95th percentile predictions for the Base Case scenario from the 2016 EP TID Volume 2 and 2018 Selenium Assessment Report for the current EP TID period (Table 4.4-6).

A graphical approach, in consideration of within-area variability and the parameter-specific RDL, was used to assess for potential temporal patterns. The mean concentrations and specific activities of COPCs were classified as showing an increasing or decreasing trend over time if mean values changed in the same direction and the change was sustained over two or more consecutive sampling periods, in consideration of the variability of the data (i.e., the standard deviation).

To provide context to any temporal changes, the sediment data were also compared to available SQVs, LELs, and federal sediment quality guidelines, herein referred to collectively as sediment quality criteria. The criteria preferentially utilized in this report were the NE2 SQV developed by Burnett-Seidel and Liber (2013), which are directly relevant to northern Saskatchewan and generally recommended by the SMOE, and the LELs, derived by the CNSC. Where no NE2 or LEL were available, comparisons were made to the federal ISQG and the PEL (CCME 2025). Table 4.4-1 provides a summary of the available sediment quality criteria with relevant NE2, LEL, ISQG, and PEL where available. In some cases, the highest available guidelines were not graphed (e.g., NE2 for uranium) if their inclusion affected the ability to visualize the temporal and spatial monitoring data.

Secondary Exposure Areas

Fox Lake was added to the sediment monitoring program as a secondary exposure area in 2018 and was sampled again during the current EP TID period. The potential influence of the operation on Fox Lake was evaluated by comparison between exposure and reference (control) areas, to available baseline concentrations,

[1] Baseline data were also collected from Mallen Lake and McClean Lake west basin in 1996, however, due to the limited dataset, these data are not included in the temporal comparisons.

[2] A main ANOVA consists of a test on all groups and doesn't yield specific pairwise comparison results only that a significant difference occurs amongst one of the groups.

and by qualitative comparisons to relevant guidelines for the protection of aquatic life following the same methods described above for the primary exposure area. There are no available predictions for Fox Lake from the original 1991 and 1995 EAs or from the most recent ERAs.

4.4.4.3 Results

Monitoring Performance

No erroneous data or data gaps were identified as part of the evaluation of the current EP TID period monitoring data. As mentioned previously, Orano specified performance criteria for all aspects of the monitoring program in 2024 to ensure data of sufficient quality and quantity are obtained to achieve EMP objectives in compliance with the CSA N288.4 requirements (CSA 2025). For sediment quality monitoring, the performance criterion was set as 80% of the total planned samples. All sediment quality samples (100%) were collected in the current reporting period as per the EMP requirements, exceeding the outlined performance criteria of 80%.

Sediment Chemistry

Primary Exposure Areas

Sediment COPC results from the 2024 sediment sampling program in the primary exposure are summarized in Table 4.4-9. The complete 2024 sediment chemistry results in the reference and primary exposures areas are provided in Appendix IV.4 (Table IV.4-2). Spatial differences in COPC levels from the 0-2 cm sediment horizon between reference and primary exposure areas were assessed statistically with detailed results presented in Appendix IV.4 (Table IV.4-4) and summarized in Table 4.4-9 alongside predictions from the 2016 and 2018 ERAs.

During the current reporting period, levels of most COPCs tended to be highest in Sink Reservoir and Vulture Lake, decreasing with increasing distance from the treated effluent discharge. This is most easily viewed in Figure 4.4-3. Most COPCs were significantly higher in the primary exposure areas as compared to the reference areas. In total, 26 of 28 COPCs assessed were found to be significantly higher in at least one of the primary exposure areas as compared to reference. Kewen Lake tended to be the exception, with only manganese and molybdenum occurring at concentrations significantly higher than those observed in the reference areas, though manganese in Kewen Lake remain similar to baseline. Fewer COPCs exceeding reference concentrations in Kewen Lake is expected given the downstream distance between Kewen Lake and the S/V TEMS. Some COPCs, including aluminum, iron, mercury, vanadium, and phosphorus were elevated in McClean Lake east basin only when compared to the reference areas, but were similar to reference in the other primary exposure areas. Additionally, while all radionuclides were elevated in Sink Reservoir, only lead-210 was elevated in Vulture Lake and lead-210 and polonium-210 in McClean Lake east basin. Finally, TOC and loss-on-ignition (LOI) were also assessed for spatial differences between primary exposure and reference areas. Both were significantly higher in Vulture Lake and McClean Lake east basin as compared to the reference areas.

During the current EP TID period, there were also some notable departures in the 2024 monitoring data from the most recent maximum mean and 95th percentile predictions. This is most easily viewed in Figure 4.4-3. Mean concentrations of cobalt (McClean Lake east basin and Kewen Lake), copper (McClean Lake east basin), and molybdenum (Sink Reservoir) and mean specific activities of lead-210 (Vulture Lake and McClean Lake east

basin), polonium-210 (McClean Lake east basin), radium-226 (Sink Reservoir and McClean Lake east basin), and thorium-230 (McClean Lake east basin) tended to exceed 95th percentile predictions in at least one of the primary exposure areas. Mean copper concentrations tended to be over predicted in Sink Reservoir, where mean concentrations tended to be more similar to those in Vulture Lake and McClean Lake east basin as compared to predictions. However, overall, the variances were small when considered alongside available sediment quality values. Additionally, the ERA is currently being updated (2025), and it is anticipated that the model re-calibration will increase the certainty of the model predictions.

Figure 4.4-3 shows the temporal variability of the COPCs relative the reference area as well as preferred sediment quality criteria. No notable temporal trends were observed in aluminum, cadmium, copper, iron, lead, manganese, mercury, vanadium, TOC, or LOI. Notably, vanadium has exceeded the LEL in Sink Reservoir and McClean Lake East Basin in 2024, but these concentrations remain within the range of historical data. Additionally, radionuclide specific activity levels have displayed small variation across time and have remained below sediment quality criteria in all sampling areas. Mean concentrations of calcium, sodium, antimony, arsenic, barium, cobalt, molybdenum, nickel, selenium, thallium, and uranium have demonstrated some temporal variability in at least one of the exposure sampling areas (Figure 4.4-3). Many of these COPC concentrations had shown an increase in the previous EP TID period within the S/V TEMS. However, in the current reporting period, concentrations of these COPCs have remained similar to or slightly lower to those measured in 2021, although mean nickel concentrations in McClean Lake east basin have been slowly increasing over the full temporal period assessed. Overall, these trends are in line with the 2016 ERA predictions which showed short-term increases in COPCs over the operational period. When compared to available SQVs, COPC levels have remained below available NE2 sediment quality criteria, except for molybdenum,. Molybdenum concentrations have remained consistently above the NE2 (245 µg/g) in Sink Reservoir and Vulture Lake since 2005. Conversely, McClean Lake east basin exhibited a decline in molybdenum concentrations between 2008 and 2018 and have since remained stable with levels remaining below the NE2 sediment quality criteria.

Secondary Exposure Areas

A summary of COPC concentrations from Fox Lake in 2024 is presented alongside reference and primary exposure area data in Table 4.4-9. Most COPCs were measured at levels similar to or lower than background concentrations observed in the reference areas in 2024. A few exceptions were noted as follows. Mean copper and uranium concentrations were significantly higher than the reference areas, measuring 6.8 ± 0.27 µg/g and 4.5 ± 1.7 µg/g, respectively. This is comparable to the historical dataset available for Fox Lake and presented in Figure 4.4-3. These levels are also much lower than the available LEL of 22.2 µg/g for copper and the REF of 96.7 µg/g for uranium. The other notable exception was mean lead-210 and polonium-210 specific activities. Levels were higher than reference in 2024 but decreased to levels similar to the historical dataset and the range of mean reference specific activities observed (Figure 4.4-3). Supporting physical properties and nutrient parameters including LOI, TOC, and phosphorus were also significantly higher in Fox Lake in 2024 as compared to both the McClean Lake west basin and Konner Lake reference areas. However, levels fall within the range of previous monitoring periods.

Sediment Particle Size

Particle size data are collected as supporting habitat information for the benthic invertebrate community program and as supporting information for the sediment chemistry program. Fine particles, such as clay and silt, have a higher surface-to-volume ratio which offers a larger adsorption surface for metals and other analytes compared

to sand. A greater proportion of fine particles in a sample may therefore lead to higher concentrations of COPCs. Particle size data collected during the 2024 sampling program in the McClean Lake Operation LSA are provided in Table 4.4-10. It is noted that with a change to laser diffraction for the particle size analysis (since 2015) it was anticipated that a shift in the distribution from previous years data would be apparent in that the earlier sieve/pipette method likely overestimated the contribution of clay particles to the distribution (CanNorth 2014). This was fully explored as part of the 2022 EP TID (Orano 2022).

Particle size analysis completed during the current and previous EP TID periods (2018, 2021, 2024) confirmed a large composition of silt and clay particles (>90%) within the McClean Lake Operation LSA. Within the most recent sampling period, the mean composition of silt particles was between 47% and 73%, with the reference areas generally falling between 64% and 73% and the primary exposure area decreasing from 73% in Sink Reservoir to 47% in Kewen Lake. Similarly, mean clay composition was between 14% and 28% in the reference areas and tended to decrease from the S/V TEMS (24% to 30%) downstream to Kewen Lake (7%). Fine sand made a significant contribution to the sediment particle size in McClean Lake east basin (27%) and Kewen Lake (44%,) but contributed significantly less to the particle size composition in the other waterbodies (10% or less).

4.4.5 Monitoring Adjustments and Supplementary Studies Recommendations

Operational sediment monitoring has retained the original BACI study design and sediment horizon sampling and evolved to incorporate a gradient design, with sediment sampling coinciding with benthic invertebrate collections in depositional zones and increased replication. Sediment monitoring is completed on a three-year sampling cycle, and the consistency and long record of available data has resulted in a reliable dataset for evaluating spatial and temporal differences. Collecting the 0-2 cm sediment horizon has proved sufficient for assessing sediment quality and developing predictions based on the general agreement between the monitoring data and most recent ERA predictions. Additionally, the available reference data were sufficient to describe background variability in the region. No changes to the routine sediment quality monitoring have been identified with the current assessment. However, it has been recommended that the next benthos lake depositional monitoring, originally scheduled for 2027, be deferred to 2028 (Section 4.5.5). Consequently, the sediment monitoring will also be rescheduled if accepted, as both sediment and benthos are sampled concurrently.

As discussed in Section 4.3, some COPCs have shown an overall increasing trend in the surface water of Candy and Bena lakes. No sediment quality data are available from these lakes to evaluate whether deposition of these COPCs is occurring. Given that increasing trends have been occurring incrementally over the last 10-year period, it is recommended that additional sediment sampling at Bena and Candy Lakes should be completed as a supplementary study. Given the shallow nature of Candy and Bena Lakes, the feasibility of sampling during the winter may need to be established.

4.4.6 Summary and Conclusions

The primary objectives of the sediment quality monitoring programs during the operational phase are to: 1) determine the pattern and distribution of contaminant accumulation in the sediments downstream from treated effluent discharge and 2) validate model predictions and facilitate model refinement. Analysis of sediment chemistry data from baseline and operational monitoring periods collected in the McClean Lake Operation LSA indicated that several COPCs have accumulated in the surficial sediment layer (0-2 cm) above historical and reference values, particularly in the S/V TEMS sampling locations. Elevated concentrations or specific activities in the current EP TID period were most prominent for arsenic, cobalt, molybdenum, nickel, selenium, and

uranium. As expected, loadings of COPCs to the sediment decrease with increasing distance from the treated effluent release point in the S/V TEMS. Only molybdenum concentrations remained elevated above reference in Kewen Lake, and these levels were substantially lower than those measured in the S/V TEMS. Molybdenum concentrations have decreased in the surface water of the receiving environment and have shown a slight decrease from the previous EP TID period the S/V TEMS. However, levels of molybdenum in Sink Reservoir remained above predictions during the current EP TID period.

Increased sediment concentrations of metals and radionuclides in the primary exposure area were predicted as part of the various McClean Lake Operation EAs and more recent ERAs. The predicted maximum means and 95th percentile concentrations are an important tool in assessing the current, historical, and future monitoring data. Overall, the sediment quality data collected during the current EP TID monitoring period agreed with the most recent predictions from the 2016 and 2018 ERAs, generally falling within the mean and 95th percentile predictions. Departures from the recent ERA predictions for the current EP TID period were generally small when evaluated against the available sediment quality guidelines. It is anticipated that following the ERA update (2025) and model re-calibration, the monitoring data will be better aligned with predicted concentrations in the S/V TEMS.

In addition to the primary exposure sampling program, Fox Lake was added as a secondary exposure area to the sediment monitoring program in 2018. Overall, levels of COPCs in Fox Lake remained similar to reference and baseline levels. Copper and uranium concentrations and lead-210 and polonium-210 specific activities were slightly elevated above background but remained well below available sediment quality criteria for the protection of freshwater aquatic life. LOI, TOC, and phosphorus levels were also higher in Fox Lake as compared to reference, though similar to previous monitoring periods.

No adjustments to the existing sediment monitoring was warranted under the current assessment, however, in accordance with the recommendation to defer the next benthos EMP lake depositional monitoring event from 2027 to 2028 (see Section 4.5.5), the next sediment monitoring will also be shifted to 2028 if accepted, as both are done at the same time. It is recommended that additional sediment sampling should be conducted at Bena and Candy Lakes as a supplementary study. As increasing trends of COPCs have been recorded in the surface water of Candy and Bena lakes, sediment sampling should be completed to evaluate the potential deposition of these parameters to the sediment.

4.5 Benthic Invertebrate Community

Collections of benthic macroinvertebrate communities are included in the monitoring of the McClean Lake Operation LSA as per the requirements of the MDMER, as well as CNSC licenses and provincial Approval to Operate. Benthic macroinvertebrates are considered an indicator of the condition of fish habitat under the MDMER. Where indices of benthic community composition (e.g., abundance, richness, diversity) are shown to be impaired, fish habitat is considered impaired (EC 2002; Kilgour et al. 2005). Benthic community composition relates to the condition of fish communities both directly and indirectly. Because most fish eat benthic organisms during at least part of their life cycle, benthic production influences fish production through bottom-up effects (e.g., Matuszek 1978; Waters 1988; Boisclair and Leggett 1989). Fish can also directly influence the composition of the benthic community through top-down feeding effects (e.g., Elliott 1986; Morgan and Ringler 1994). Finally, the composition of fish and benthic communities may simply co-vary because of similarities in environmental tolerances, both natural and anthropogenic (e.g., Berkman et al. 1986; Kilgour and Barton 1999). Because

benthic macroinvertebrates have shorter life spans than most species of fish, surveys of benthos should provide early warning of impending effects on fish communities or populations (Kilgour and Barton 1999).

4.5.1 Pre-Development Baseline

In March 1993 and 1996, benthic invertebrate samples were collected with an Ekman dredge (0.052 m^2) at lake depositional zones from the same locations as the sediment chemistry cores (Table 4.5-1). In 1993, a 603 µm-mesh bag was used to wash samples on site, while 500-µm mesh was used to wash samples in subsequent years. In both 1993 and 1996, a single Ekman grab was collected from each replicate station. Within all lake depositional habitat assessed, benthic invertebrate communities were dominated by chironomids, though more so in Sink Reservoir and Vulture Lake, than other depositional sampling areas (Tables 4.5-2 and 4.5-3). Additionally, taxon richness tended to be somewhat lower in Sink Reservoir and Vulture Lake as compared to McClean Lake.

A Neill-Hess cylinder sampler (0.10 m^2; Neill and Hogben 1938) was used to collected benthic invertebrates from erosional habitat within Collins Creek in 1993 and 1996 (Table 4.5-1). Five replicate stations in two exposure (BM6E and BM7E) and two reference (BM2C and BM17C) areas within Collins Creek erosional habitat were sampled during the fall of 1993 and 1996 (Figure 4.4-2). The benthos of Collins Creek contained a typical riffle benthic fauna during the baseline sampling of 1993 and 1996 (Table 4.5-4). Communities were numerically dominated by Chironomidae, which comprised between 50% and 70% of the fauna. Lesser dominant forms included fingernail clams (Sphaeriidae; 2% to 16% of total numbers), Hydropsychidae caddisflies (up to 10%), Baetidae mayflies (up to 8%) and nematodes (up to 7%).

4.5.2 Study Design and Objectives

The primary objective of the benthic invertebrate community monitoring program is to assess the potential influence of effluent discharge on the benthic invertebrate communities in the primary exposure areas. Early baseline investigations collected sediment chemistry and benthic invertebrate community data to characterize the McClean Lake Operation LSA environment in support of the 1991 McClean and 1995 Midwest EAs. Data from 1993 and 1996 provide the baseline for assessing potential effects of exposure from 1999 to present.

Benthic invertebrate communities have been assessed in both erosional and depositional habitats. Table 4.5-1 outlines the benthic invertebrate community monitoring program in the McClean Lake Operation LSA; locations are shown in Figure 4.4-2 and UTM coordinates are provided in Table 4.4-7. The principal lake environment benthic communities that are considered in this design are those in Sink Reservoir, Vulture Lake, the east basin of McClean Lake, and Kewen Lake. Benthic communities from those four lakes are compared to benthos from four reference lakes (Henday Lake, Konner Lake, Mallen Lake, and the west basin of McClean Lake). These depositional lake sampling areas form the basis of the long-term monitoring associated with the EMP.

Riffle habitats in Collins Creek (Figure 4.4-2) were sampled on eight occasions between 1993 and 2015 (baseline in 1993 and 1996; operational in 1999, 2002, 2005, 2008, 2011, 2015; Table 4.5-1). These were sampled as a component of the EMP and adopted as the EEM benthic invertebrate sampling program in 2005. Riffle habitats in Collins Creek are limited in size and preclude nesting of sub-samples and spacing of replicate stations, as per EC (2012) Technical Guidance. Environment and Climate Change Canada (ECCC) considered Orano's riffle design insufficient in that it did not include the collection of sub-samples per station (because of a lack of habitat

for replicate sampling), potentially with a reduced statistical power. In response to the criticisms by ECCC, AREVA (2008) carried out a revised EEM survey design in 2008 that involved collection of three-minute traveling kick samples in depositional habitats following a modified (CABIN; Reynoldson et al., 2004) protocol. Samples were collected from one single depositional reference area (BM18C) and one single depositional exposure area (BM19E). Because depositional habitats are more available in Collins Creek, sub-samples could be nested within stations, while replicate stations could be distributed as recommended by EC's guidance. The depositional benthic invertebrate sampling program was replicated in 2013, 2016, 2019, and 2022. The riffle habitat sampling was removed from the EMP following the 2015 program as it was determined Collins Creek was sufficiently assessed with the riverine depositional sampling completed as part of the EEM.

4.5.3 Impact Predictions

The 1991 and 1995 EAs predicted that the benthic invertebrate communities in the McClean Lake Operation LSA would be negatively affected because of treated effluent discharge. More specifically, they predicted that the benthic invertebrate communities in Sink Reservoir and Vulture Lake would be "adversely impacted" by the predicted metal concentrations in the sediments of these lakes (COGEMA 1995). The potential for effects downstream of McClean Lake was predicted to be negligible (Minatco 1991; COGEMA 1995). These effects were further supported by the subsequent 2004 Sue E, 2009 Caribou Project, and 2011 Midwest Project EAs. The ERA completed as part of Volume 2 of the 2016 EP TID identified potential risks to aquatic biota present in the S/V TEMS as a result of exposure to ammonia, chloride, potassium, sulphate, and TDS, although the effects of these COPCs were limited in duration. Selenium also illustrated effects on aquatic biota within and downstream of the S/V TEMS. Following review of additional monitoring data and an update to the selenium forecast, the selenium component of the risk assessment was revised in 2018 (Orano 2018). The anticipated risk associated with the continued processing of Cigar Lake ore at the operation was anticipated to remain consistent with environmental effects previously described in the EAs, with predicted effects on aquatic biota limited to the S/V TEMS.

4.5.4 Operational Monitoring

4.5.4.1 Field and Laboratory Methods

Lake Depositional Habitat

Benthic invertebrate samples were collected with an Ekman dredge (0.052 m^2) at lake depositional zones in winter of 1999, 2002, 2005, 2008, 2011, 2015, 2018, 2021, and 2024. The lakes sampled are listed in Table 4.5-1. A mesh of 500 µm was used to wash samples on site. Triplicate Ekman grabs were composited to make a "sample" at each replicate station. Samples were preserved on site with 10% buffered formalin.

River Erosional Habitat

Benthic invertebrate samples were collected at five replicate stations in two exposure and one reference area within Collins Creek erosional habitat during the fall of 1999, 2002, 2005, 2008, 2011, and 2015 (Table 4.5-1; Figure 4.4-2), as per the baseline period. A second reference area in Collins Creek was sampled in 2005, 2008, 2011, and 2015. Sampling methods were the same as those used in the baseline period.

River Depositional Habitat

In early October of 2008 2013, 2016, 2019, and 2022, benthic invertebrate samples were collected at five replicate stations in one exposure (BM19E) and one reference (BM18C) area within Collins Creek depositional habitat (Figure 4.4-2). Each replicate sampling location was spaced approximately 100 m apart. Samples were collected using a modified kick and sweep method, described by Reynoldson et al. (2003, 2004), that has been used successfully to quantify benthic invertebrate communities in large and small rivers across Canada. A 30 cm diameter D-net equipped with a 500-µm mesh was used to complete the sampling. Kick net sampling periods were each 3 min in duration and traversed approximately 10 m of shoreline, zigzagging between the shore and 0.6 m in depth. Each sample consisted of a composite of three kick net sampling periods. After each 3-minute sample was completed, the contents of the mesh net were rinsed into a sample jar and preserved with 10% buffered formalin.

Laboratory Analyses

Benthic invertebrate enumeration was completed by Dr. Jack Zloty in 2022 and 2024. Samples were sieved in the laboratory using a 500-µm mesh sieve to remove the preservative and any remaining fine sediments. The material retained by the sieve was elutriated using a flotation technique to separate organic material from sand and gravel, and invertebrates from organic material. Inorganic material was scanned under a magnifying lens, and any remaining invertebrates were removed before discarding. The remaining organic material was separated into coarse and fine size fractions using a 1 mm sieve. The fine size fraction of large samples was sub-sampled using a modification of the method described by Wrona et al. (1982) in which fine materials were scanned for invertebrates with the aid of a dissecting microscope at a magnification of 6× to 10×. All sorted material was preserved for random checks of removal efficiency in 2002 and later samples. A reference collection of identified taxa is available.

4.5.4.2 Data Analysis

Initial Screening

To ensure that only true benthic macroinvertebrates were included in the analysis as well as consistency with the prior 2022 EP TID, the benthic datasets were filtered to remove taxa not typically representative of the benthic community but often identified by taxonomists. This included planktonic, periphytic, or meiofaunal organisms that are either too small, primarily pelagic, or ecologically distinct from the targeted benthic macroinvertebrate assemblage. Specifically, the following families and orders were excluded: Daphniidae, Lebertiidae, Arrenuridae, Ilyocryptidae, Macrothricidae, Polyphemidae, Sididae, Chydoridae, Candonidae, Krendowskiidae, Oxidae, Hydrodromidae, Pionidae, Sperchontidae, and the order Calanoida and Cyclopoida. Additionally, specific genera and species known to be planktonic or surface-associated – *Daphnia*, *Eurycercus*, *Ilyocryptus*, *Latona setifera*, *Polyphemus pediculus,* and *Simocephalus* – were also removed prior to analysis. All samples were reviewed for completeness and adherence to QA/QC requirements. Outliers and anomalous values were assessed for potential field or laboratory error before statistical analysis. Community composition was then summarized using core indices (total density or abundance, taxa richness) and non-core indices (Simpson's Diversity, Simpson's Evenness, Bray–Curtis distances, correspondence analysis axis scores), calculated at the lowest practical taxonomic level as described in the following section.

Indices

Benthic invertebrate community sampling for the McClean Lake Operation LSA has focused on the S/V TEMS (Sink Reservoir and Vulture Lake), the receiving environment of McClean Lake (east basin) and Collins Creek, as well as lake and river locations that are considered representative of reference locations. The collections have produced data that have been summarized using a variety of conventional indices of composition, including those required under the MDMER (EC 2012). The following indices of composition are included as summary variables:

- Core Variables
    - Total density (number of organisms/m^2, lake samples and erosional river samples) or total abundance (number of organisms/kick net period, depositional river samples);
    - Taxa richness (S, number of taxa at lowest practical level (LPL));
- Non-Core Variables
    - Simpson's Diversity;
    - Simpson's Evenness;
    - Bray-Curtis distances; and
    - Multivariate ordination axis scores (correspondence analysis – CA)
- Additional Supporting Variable
    - Biomass

For the purpose of the following evaluations, total density or abundance and richness are considered "core" variables, because changes in these two measures can only occur if substantial changes (functional changes, as per Schindler 1987) in species composition have occurred (Kilgour et al. 2004). Extreme high abundances (relative to a baseline condition), and extreme low richness tend to co-occur with changes in water quality that negatively impact fish communities (Kilgour et al. 2005).

Simpson's Diversity, Simpson's Evenness, Bray-Curtis distances, and multivariate scores are considered non-core variables. These variables detect more subtle variations in composition (Kilgour et al. 2004) that results from changes in species and genera. Diversity and evenness re-express richness relative to the total number of organisms. High diversity and lower evenness values generally imply a benthic habitat that is more suitable for aquatic organisms.

In addition to the primary exposure areas, Fox Lake was added to the benthic invertebrate community sampling program in 2018. The focus of the data analysis in Fox Lake is on the core variables, with an emphasis on tracking changes over time.

All indices were calculated at the lowest-practical level as follows.

Density and Abundance

Total density is simply the total count of organisms, expressed on a per m^2 in lake depositional areas and riverine erosional areas. Total abundance is simply the total count of organisms, expressed on a per sample basis in riverine depositional areas.

Taxa Richness

Taxa richness is the number of unique taxa as identified to the LPL, common across all sample periods.

Simpson's Diversity

Simpson's Diversity index is calculated by determining the proportion of individuals for each taxonomic group (identified to LPL) that contributes to the total number of individuals in the sample. The value of the Simpson's Diversity index ranges between zero and one where the greater the value, the greater the sample diversity, suggesting a more stable biological community. Simpson's Diversity (D) was computed as:

$$D = 1 - \sum (p_i)^2$$

Where p_i is the proportion that the i^{th} taxon contributes to the total number of invertebrates in a sample.

Simpson's Evenness

Simpson's Evenness index is a measure of the distribution of abundance among taxa (Smith and Wilson 1996). As recommended by the EEM guidance document, evenness was calculated as diversity over the total number of taxa, identified to LPL, at each station. In this case, diversity was calculated as one over Simpson's Dominance as described by Williams (1964). Simpson's Evenness (E) was computed using:

$$E = \frac{1}{\frac{\sum (p_i)^2}{S}}$$

Where S is the number of taxa.

Bray-Curtis Distances

The Bray-Curtis distances are a conventional measure of ecological dissimilarity. The measure has a maximum value of one for two samples (communities) that are entirely different in composition (i.e., there are no common taxa) and a minimum value of zero for two samples (communities) that are identical in terms of composition (EC 2012). The Bray-Curtis (BC) distance measure is calculated using the following equation:

$$BC = \frac{\sum |y_{i1} - y_{i2}|}{\sum (y_{i1} - y_{i2})}$$

Where y_{i1} is the count of individuals (percent abundance) of taxon *i* in sample (community) 1, and y_{i2} is the count (percent abundance) of individuals of taxon *i* in sample (community) 2. Bray-Curtis distances were computed between all pairs of samples for comparisons of interest (described below under the heading “Mantel Tests”). Percentage abundance was used here to eliminate the effect of overall abundance on assemblage, so that the variations in Bray-Curtis distances were assessing compositional variation, not abundance variation (which was assessed separately). These Bray-Curtis calculations were completed using LPL taxa, with all taxa reported across all years as relevant for the distances being computed.

The recommended computation of the Bray-Curtis distance measure, as per EC (2002 and 2012), has an inflated Type I error rate; that is, it could lead to a conclusion that there is a significant effect more frequently than expected by chance alone (Huebert 2011; Borcard and Legendre 2013). Borcard and Legendre (2013) recommended a variety of approaches to more appropriately determine the likelihood that two communities differ, including the Mantel’s test, which is used herein. In addition to the Bray-Curtis distance measure, this report used a multivariate ordination (CA) as a holistic measure to assess differences in community composition. Ordinations, like CA, tend to identify statistical differences more frequently than do the less complex measures, like total abundance (density), biomass, and richness (Kilgour et al. 2005).

Correspondence Analysis

In addition to the indices described above, CA was used to summarize variations in community composition among stations. CA is more useful than some ordination methods because it automatically ordinates both the samples and the taxa. The CA ordination procedure is designed to calculate a set of theoretical (synthetic) variables (axes) that best explain the variations in abundances of taxa across samples. Calculation of sample and taxa scores on the first ordination axis is done by iteratively estimating the weighted average sample scores and the weighted average taxa scores. For the first iteration, axis scores are arbitrarily assigned to each taxon. For each sample, the procedure determines the weighted average axis score, which is the average of the taxa scores weighted by the abundances of each taxon. The next iteration produces new weighted average axis scores for the taxa, calculated from the sample scores. The iterative procedure continues until there is little change in the sample and taxa scores. Estimation of second and third ordination axes follows a similar routine, except that the sample scores of additional axes are made orthogonal (uncorrelated) with the first and other axes. Sample scores in CA are usually scaled to have a mean of 0 and SD of 1 (ter Braak 1992). The distribution of samples in a CA diagram indicates the relative similarities and differences in composition based on taxa abundances. Samples with similar scores will have taxa in similar proportions, while samples with different scores will have taxa in different proportions. The scatter diagram for taxa portrays the dispersion of taxa along the theoretical variables (axes). Thus, a sample with an Axis-1 score of 2 would be dominated by those taxa that also had Axis-1 scores close to 2.

With CA, the configuration of ordination diagrams tends to be sensitive to rare taxa (Gauch 1982). An ordination was carried out with each set of data (i.e., riverine depositional, riverine erosional, and lake depositional). Taxa abundances were $\log_{10}$ transformed prior to analysis, while taxa (at lowest practical taxonomic level) accounting for 1% or more of the total abundances were included in the analysis. The CA was conducted using the *factoextra* package (Kassambra and Mundt 2017) in RStudio (ver. 4.1.2, Boston, MA, USA).

Biomass

Benthic community biomass (g/m^2) was determined on samples collected in 2005, 2008, 2011, 2015, 2018, 2021, and 2024 as an additional measure.

Evaluation Criteria

The primary method used to assess the status of the benthic invertebrate community in the McClean Lake Operation LSA was to compare the exposure and reference areas in accordance with the EEM Guidance Document (EC, 2012), with emphasis on identifying differences in core community composition variables and interpreting their ecological relevance. Secondary to that objective was assessing temporal trends in core variables for which mine-related effects were predicted and evaluating conditions in secondary exposure areas in relation to reference and baseline data. The overall benthic invertebrate monitoring design is a control–impact design, and because of consistency with the baseline study design, comparisons can also be made to pre-operational data.

The following EvCs were applied for benthic invertebrate community data analysis:

- EvC 1: Comparison to Reference Area Data – Differences between reference and exposure areas were assessed using ANOVA or analysis of covariance (ANCOVA) ($\alpha = 0.05$), with covariates such as TOC or substrate characteristics included where appropriate. For Bray–Curtis distances, Mantel tests were used to assess significance. Normal range estimates were also used where index values from exposure areas were compared to the normal range (NR) of variation derived from baseline and reference data (enclosing 95% of observations). Values outside the NR were considered unusual and potentially indicative of degraded habitat quality.
- EvC 2: Effect size (ES) and critical effect size comparison – Differences in benthic effect endpoints were expressed as multiples of within-reference area standard deviations, with results compared to EEM Critical Effect Sizes (CES; $\pm 2\ SD_{ref}$) to determine biological relevance.
- EvC 3: Temporal trends – Time-series analysis was conducted to detect changes over the operational period, with differences in trends between reference and exposure areas interpreted in the context of potential effluent-related effects.

Detailed Data Analysis

Analysis of Variance

ANOVA were used to assess whether variation in indices of composition supported a conclusion of an effluent-related difference. Benthic community samples collected from areas exposed to treated effluent are here classified as “exposed.” Samples collected from reference areas unexposed to treated effluent are here classified as “reference.” Samples collected prior to the operational period, i.e., in 1993 or 1996, are classified as “baseline,” while samples collected in 1999 or later are classified as “operational.”

Effluent-related variations, in indices of benthic community composition, will manifest as:

- Change in index values from before to after operations, in exposure areas, in a way that differs from changes observed in reference areas; and/or,
- Time trend in index values after operations began, in exposure areas, in a way that differs from time trends observed in reference areas.

Lake depositional habitat baseline data were collected from Sink Reservoir, Vulture Lake, McClean Lake east basin, and Kewen Lake in both 1993 and 1996. Baseline data were collected in 1993 and 1996 for McClean Lake west basin but only in 1996 for Mallen Lake (Table 4.5-1). The formal statistical tests for the depositional lake benthos data, then, involved comparison of variations in individual exposure areas (i.e., Sink, Vulture, McClean east basin, and Kewen) to variations in McClean Lake west basin. Linear contrasts (Hoke et al. 1990) were used within ANOVA to test the following specific hypotheses (as per AREVA 2009c):

- H01: no difference in before to after operations between reference and exposure areas (i.e., a classic BACI contrast); and,
- H02: no difference in linear time trends during operations between reference and exposure areas.

With depositional riverine habitats, there were no baseline data (Table 4.5-1; AREVA 2009b). The assessment of potential effluent-related effects could only involve a comparison of variations in the single reference and the single exposed sampling areas (AREVA 2009b; AREVA 2014). The following hypotheses were tested with the depositional data collected in 2022 (Phase 7 EEM; CanNorth and Kilgour 2023):

- H01: no difference between reference and exposure areas in 2022.
- H02: no step-change in the reference-exposure differences before 2022, i.e., the difference in 2022 vs the average of differences in all prior years.
- H03: no step-change in the reference-exposure differences before 2019, i.e., the average difference in 2019, and 2022 vs the average of differences in all prior years.
- H04: no step-change in the reference-exposure differences before 2016, i.e., the average difference in 2016, 2019, and 2022 vs the average of differences in all prior years.
- H05: no step-change in the reference-exposure differences before 2013, i.e., the average difference in 2013, 2016, 2019, and 2022 vs the average of differences in 2008.
- H06: no difference in linear time trends between reference and exposure areas.

Rejection of any of these null hypotheses (H02 through H06) would indicate that there had been a change in the difference between reference and exposure communities, indicating either degrading or improving conditions. H02 would imply that the change in the difference was recent and potentially related to effluent exposure during the most recent EEM period (i.e., between 2019 and 2022).

With the erosional riverine habitats, there were baseline data collected from a single reference area and two exposure areas, in both 1993 and 1996. Data were also collected from those locations in the operational period (1999, 2002, 2005, 2008, 2011, and 2015). Linear contrasts (Hoke et al. 1990) were used within ANOVA to test the following specific hypotheses (as in AREVA 2009a):

- H01: no difference in before to after operations between reference and exposure areas (i.e., a classic BACI contrast); and
- H02: no difference in linear time trends during operations between reference and exposure areas.

Mantel Test

EC (2012) previously recommended using ANOVA to test for variations in Bray-Curtis distances that were computed relative to a median reference community. Borcard and Legendre (2013) demonstrated that EC's methodology has an inflated Type I error rate (higher than expected likelihood of declaring communities to be different when they are not actually different). Borcard and Legendre then recommended a variety of approaches to more appropriately determine the likelihood that two communities differ. One of the proposed methods is Mantel's test, which was used here.

Mantel tests involve computing the correlation (Mantel r) between two distance matrices: the first matrix is the Bray-Curtis distance matrix, which contains distances between all possible pairs of samples from the sets of samples to be compared. That is, if there are n = 5 reference samples and n = 5 exposure samples, then Bray-Curtis distances will be computed for all possible pairs of the n = 10 samples. The second matrix defines the 'contrast' of interest (per Hoke et al. 1990). For a classic reference versus exposure contrast, and assuming that there are n = 5 reference and n = 5 exposure samples, the contrast matrix is defined by hypothetical means of say 1,1,1,1,1 for reference and -1,-1,-1,-1,-1 for exposure. The distance matrix for this hypothetical scenario is the Euclidean distances between all possible pairs of means. The correlation between the Bray-Curtis matrix, and the hypothetical matrix (i.e., the 'observed' Mantel r) is compared to a distribution of random Mantel *r* values computed through a permutation exercise (normally 1,000 x) of randomly shuffling one of the matrices and re-computing 'random' Mantel *r* values. If the observed Mantel *r* is > 95% of the random Mantel *r* values, the Bray-Curtis distances can be concluded to be significantly associated with the hypothetical contrast, with a conclusion that the communities differed between reference and exposure conditions. The hypothetical contrast can be as simple as the reference versus exposure comparison provided here, or as complicated as any BACI-type contrast per what is described in the section above in ANOVA. Thus, Mantel tests were used to test the significance of variations in Bray Curtis distances, in a fashion analogous to what was carried out with the single univariate measures described above.

Normal Range Estimates

ANOVA is a formal test of the statistical significance of observed variations in relation to exposure to operations effluent. The NR of variation in indices of benthic community composition were estimated using data from the exposure locations during baseline periods, and from the four reference locations (Henday, Konner, Mallen, and McClean Lake west basin). The NR were used to put into a broader context, the relevance of the observed variations in benthic community indices. Measures falling outside of the NR of variation were considered to be effects due to released treated effluent. As benthic indices can vary with TOC, it was considered as a potential modifying factor. Relationships between benthic indices and TOC were evaluated with a regression analyses. Statistically significant relationships between benthic indices and TOC were used to put into context any potential differences observed in benthic indices.

All reference observations for abundance or density, taxa richness, Simpson's Evenness, and Simpson's Diversity from the various surveys were used to compute NR estimates. NR estimates here are defined as the

region enclosing 95% of observations (Kilgour et al. 2017). The NR is estimated with error when small sample sizes are involved (the case here, and generally in biological surveys). Tolerance regions can be estimated that provide confidence regions (intervals) for the estimated limits of the 95% region. Here, we computed tolerance regions for the lower 2.5th and upper 97.5th percentiles for indices of benthic community composition using the following formulae:

The tolerance limit for the *p*th percentile is:

$$\bar{x} \pm k \bullet sd$$

Where:

$$k = \frac{t_{\gamma,N-1,\delta}}{\sqrt{N}}$$

$t_{\gamma,N-1,\delta}$ is a non-central t-statistic (where $\gamma, N-1, \delta$ indicates the lower 5th or upper 95th percentile of the non-central t distribution

$$\delta = z_p \sqrt{N}$$

Z_p is the Z-statistic at the *p*th percentile

Here the 97.5th percentile of the data, Z = 1.96. The value δ depends on sample size, as then does the non-central statistic *t* statistic and ultimately k.

The McClean Lake design has four lakes that are considered to be in a reference condition (i.e., Lake Depositional Habitat). They are Konner Lake, Mallen Lake, Henday Lake, and McClean Lake west basin. There are also baseline period data from McClean Lake east basin and from Kewen Lake (i.e., data from 1993 and 1996). All of the data from these lakes (and baseline years) were used to compute NR estimates for lake annual means per the equation above. NR estimates based on reference data (i.e., baseline data from exposure lakes and all data from reference lakes) generally produced similar ranges. All data from all lakes and baseline years were therefore used in this presentation of the data. NR estimates for the CA Axis scores were illustrated in bivariate plots of axis 1 versus axis 2 scores, using ellipses to approximate tolerance bands for the 90% (inner tolerance) and 99% (outer tolerance) region for the reference area data. Index values (or CA Axis scores) from Sink Reservoir, Vulture Lake, McClean Lake east basin, or Kewen Lake falling outside of the computed NR would be considered unusual, potentially indicating degraded habitat quality relative to a baseline condition.

For benthic data collected from Collins Creek (i.e., Riverine Erosional and Depositional Habitats), there is no baseline period, and thus NR estimates are based on reference data only.

Effect Size

For riverine depositional sites, effect sizes were computed for core variables (density or abundance, Taxa Richness (LPL)) and non- core variables (Simpson's Diversity, Simpson's Evenness, scores on CA Axes 1 and 2) using the following:

$$ES = \frac{\bar{X}_{\text{exp}} = \bar{X}_{\text{ref}}}{SD_{ref}}$$

Where $\bar{X}_{\text{exp}}$ is the exposure area mean index value, $\bar{X}_{\text{ref}}$ is the reference area mean index value, and SD_{ref} is the within reference area SD. Under the MDMER, differences in benthic effect endpoints are expressed as multiples of within-reference area standard deviations with the CES for benthic effect endpoints consisting of $\pm 2SD_{ref}$.

4.5.4.3 Results

Monitoring Performance

No erroneous data were identified as part of the evaluation of the current EP TID period monitoring data. As mentioned previously, Orano specified performance criteria for all aspects of the monitoring program in 2024 to ensure data of sufficient quality and quantity are obtained to achieve EMP objectives in compliance with the CSA N288.4 requirements (CSA 2025). For benthic invertebrate community monitoring, the performance criterion was set as 80% of the total planned samples. Benthic invertebrate community samples were collected in the current reporting period as per the EMP requirements and the EEM Study Design reviewed by the TAP (Orano 2021). All benthic invertebrate community samples (100%) were collected in the current reporting period, exceeding the outlined performance criteria of 80%.

Lake Depositional Habitat

Reference Lakes

The benthic community of Henday Lake was sampled three times during the operational period, in 1999, 2002, and 2008 (Table 4.5-1). Substrate in the lake bottom is principally fine and coarse sand and organic matter (> 50% loss on ignition: AREVA 2016a). The benthic community of Henday Lake has been dominated by chironomids (49% to 93%), followed by freshwater bivalves Venerida (5 to 30%) and Sphaeriidae (0% to 13%). Valvatid snails, leptocerid caddisflies, ceratopogonidae midges, and caenid mayflies have been present, but in low relative abundances (Table 4.5-2). Glossiphoniid leeches and naidid worms have also been present in low relative abundances. Index values produced by samples from Henday Lake have been incorporated into the NR of variation of reference conditions.

The benthic community of Konner Lake was sampled nine times during the operational period, in 1999, 2002, 2005, 2008, 2011, 2015, 2018, 2021, and 2024 (Table 4.5-1). Substrate in the lake bottom is principally silt, clay, and organic matter (Table 4.4-8). The benthic community of Konner Lake has been dominated by chironomids (39% to 87%), amphipods (Hyalellidae, accounting for between <1% and 33%), and fingernail clams (4 to 17%; Table 4.5-2). Larger aquatic insect larvae have included members of the Leptoceridae, Molannidae, and Phryganeidae families. The lake contained phantom midges, Chaoboridae, which accounted for up to 3% of the total benthic fauna. Glossiphoniid leeches, as well as tubificid, naidid, and enchytraeid worms have been documented in Konner Lake in low relative abundances (Table 4.5-2). Erpobdellid leaches were documented from 2005 onwards, yet in low abundances (< 1%). Index values produced by samples from Konner Lake have been incorporated into the NR of variation of reference conditions.

The benthic community of Mallen Lake was sampled once during baseline periods, in 1996, and six times during the operational period in 1999, 2002, 2005, 2008, 2011, and 2015 (Table 4.5-1). The substrate of Mallen Lake is principally fine and coarse sand, with variable organic content (AREVA 2016a). Benthic communities of Mallen

Lake, during the operational period, have been relatively consistent with what was observed during baseline periods. Communities are dominated principally by chironomids (64% to 85%), with fingernail clams (Sphaeriidae) sub-dominant (1% to 16%). Valvatid snails have been reported from the lake in all monitoring years, while planorbid snails have been reported only in the last three monitoring years (2008, 2011, and 2015; Table 4.5-2). Mayflies (Caenidae, Ephemerellidae), and caddisflies (Hydroptilidae, Molannidae) have been present in low relative abundances, as have phantom midges (Chaoboridae), ceratopogonidae midges, amphipoda (*Hyalella azteca*), glossiphoniid leeches, and tubificid and naidid worms. Ephemerid mayfly larvae, polycentropid caddisfly larvae, and corduliid dragonfly larvae were documented for the first time in the 2015 sample, yet in low abundances (≤ 1%). Index values produced by samples from Mallen Lake have been incorporated into the NR of variation of reference conditions.

The benthic community of McClean Lake west basin was sampled twice during the baseline period in 1993 and 1996, and nine times during the operational period (1999, 2002, 2005, 2008, 2011, 2015, 2018, 2021, and 2024; (Table 4.5-1). Substrate of the west basin of McClean Lake is principally silt with high organic matter content (Table 4.4-8). The benthic community of the west basin has remained relatively consistent in composition since baseline periods. Benthos have been dominated by chironomids (29% to 76%) and fingernail clams (3% to 43%; Table 4.5-2). The other benthic fauna in the lake includes worms (tubificids, naidids, enchytraeids), leeches (glossiphoniids), midges (Ceratopogonidae), mayflies (baetids and caenids), caddisflies (hydroptilids, molannids, phryganeids, and polycentropids), and gastropods (valvatids), all at low relative abundances (≤ 5%; Table 4.5-2). Erpobdellid leaches were documented across multiple sampling years yet in low abundances (< 1%). Index values produced by samples from McClean Lake west basin have been incorporated into the NR of variation of reference conditions.

Normal Ranges

Observed variation in indices of benthic community composition are illustrated in Figures 4.5-1 through 4.5-4 while multivariate ordinations and taxa scores are illustrated in Figure 4.5-5 and 4.5-6, respectively. Among reference lakes and during baseline years, total benthic densities have ranged from ~6 to 39,321 organisms/m² (average of 2,754 organisms/m² unlogged), and taxa richness (at LPL) from ~1 to 33 taxa per sample (average of 18 taxa). Simpson's Diversity has ranged from 0 to 0.91 (average of 0.77), and Simpson's Evenness from 0.11 to 1.0 (average of 0.34). Total benthic biomass has ranged from 0.012 and 17 g ww/m^2 (average of 3.2 g ww/m^2 unlogged).

The NR estimates of CA axis 1 and axis 2 scores are illustrated in Figure 4.5-5, while the taxa scores are provided in Figure 4.5-6. The first CA Axis reflected a contrast of lake samples that had higher relative abundances of chironomids *Microtendipes* and those samples that had higher relative abundances of chironomids *Chironomus* and the *Tubificinae* family of worms. The second CA axis contrasted samples that had higher relative abundances of the chironomids Corynocera, chironomids *Microtendipes,* and the amphipod *Hyalella azteca*.

Primary Exposure Lakes

Sink Reservoir

The benthic community of Sink Reservoir was sampled nine times during the operational period (1999, 2002, 2005, 2008, 2011, 2015, 2018, 2021, and 2024; Table 4.5-1). The substrate of Sink Reservoir is principally silt with high organic carbon content (Table 4.4-9 and 4.4-10). Like the baseline period, the benthic community of

Sink Reservoir was dominated by chironomids during the operational period, with relative abundances varying between 34% and 97% between 1993 and 2015; however, notably decreased to 15-24% during 2018 and 2021 sampling and then subsequently increased once again in 2024 to 60% (Table 4.5-3). Benthic communities in 2015, 2018, 2021, and 2024 were also dominated by Sphaeriidae fingernail clams (50%, 74%, 25%, 16% respectively), but clams generally accounted for a more minor fraction (~ 5% of total numbers) in other operational years. Tubificinae worms were observed at lower abundances (< 1 to 9%) across baseline and operational years. Several families of larger insects were found in operational surveys, and not in baseline surveys, including baetid and caenid mayflies, and leptocerid and phryganeid caddisflies. Corixid water boatmen and leptophlebiid mayflies were documented for the first time in the 2015 sample, yet in low abundances (< 1%)

Variations in indices of community composition for Sink Reservoir are illustrated in Figure 4.5-1, while variations in CA Axis scores are illustrated in Figure 4.5-5. In Figure 4.5-1, the inner tolerance limits are represented by the dashed lines, while the outer tolerance limits are represented by the solid black lines. Values falling within the upper and lower bounds can be considered “normal.” Values falling within inner (dashed) and outer (solid) ellipses (for the ordination scores) can also be considered normal (Figure 4.5-5). Variations are discussed below.

There was a change in difference between Sink Reservoir benthic indices and McClean Lake west basin benthic indices from before to after operations in taxa richness, Simpson’s Diversity, and CA Axis 1 and 2 scores (Table 4.5-5) which explained 10, 23, 55, and 6% of the observed variance, respectively. There was a difference in linear time trends observed after operations began (i.e., from 1999 to present) in Simpson’s Diversity and Evenness between Sink Reservoir and McClean Lake west basin (Table 4.5-5), explaining 6 and 7% of the observed variance. Simpson’s Diversity and Evenness have been generally stable in McClean Lake west basin while slightly increasing over time in Sink Reservoir (Figure 4.5-1).

Densities were at the outer tolerance limit of variation for reference lake samples in 1996 and 1999 but have been within the NR of variation since then. In 2024, the average density in Sink Reservoir was equal to the mean of density in the McClean Lake west basin reference (Figure 4.5-1). Taxa richness and Simpson’s Diversity tended to increase in the west basin in the operational period relative to what was observed in 1993 and 1996, while taxa richness and Simpson’s Diversity in Sink Reservoir did not increase (about equal in 2024 to the baseline mean). Taxa richness in Sink Reservoir was below the mean reference values in all years including baseline. Simpson’s Diversity was below the mean reference values from 2005 to 2018, attaining values similar to the reference mean in 2021 and 2024. In the McClean Lake west basin, taxa richness has declined steadily from 2018 through 2024, dropping below the baseline mean value, although values remain higher than those observed during 1993 and 1996. Simpson’s Evenness values in Sink Reservoir were higher in 2024 than in the baseline period; slightly higher than the west basin of McClean Lake in the same period (Figure 4.5-1). Simpson’s Evenness values have been within the NR of variation of reference values in all survey years including baseline. Biomass values were similar to mean values observed in reference lakes up until 2015, following which biomass has decreased to below the lower outer limit in 2024 (Figure 4.5-1).

Mantel tests indicated significant change in the difference between Sink and McClean Lake west basin benthos community composition from baseline to operational periods ($p = 0.001$, Table 4.5-5), and a difference in time trends in composition during the operational period ($p = 0.019$, Table 4.5-5), reflecting the variations illustrated with CA Axis scores. The multivariate (CA) ordination axis scores (Figure 4.5-5) indicated that the benthic community of Sink Reservoir was most unusual (relative to reference lakes) in 1996 but was within the NR of variation during all other sampling years, until the most recent sampling event in 2024 where the CA axis scores once again exceeded the outer limit along CA axis 1. Communities in 1996 only had 5 identified families, which

was lower than other sampling years, whereas communities in 2024 had a higher abundance of chironomids relative to other recent sampling years.

A significant positive linear relationship was observed for both density (log transformed) and richness when regressed against TOC ($p < 0.05$, Figure 4.5-7). No significant relationship was observed among the other biological indices and TOC.

Vulture Lake

The benthic community of Vulture Lake was sampled twice during the baseline period (1993 and 1996), and nine times during the operational period (1999, 2002, 2005, 2008, 2011, 2015, 2018, 2021, and 2024; Table 4.5-1). The sediment of Vulture Lake is principally silt with high organic carbon content (Table 4.4-9 and 4.4-10). Benthic communities were dominated during the operational period by chironomids (68% to > 95%; Table 4.5-3) until 2018, 2021, and 2024, where abundances dropped to 4%, 1%, and 12%, respectively. Larger insects, which were not found during the baseline period, were detected in samples during the operational period, including leptocerid and phryganeid caddisflies. Freshwater clams Sphaeriidae represented a higher percent abundance in Vulture Lake in 2018, 2021, and 2024 (90%, 98%, and 88%, respectively) compared to the baseline period. Erpobdellidae leeches were documented for the first time in the 2021 sample, yet in low abundances (< 1%).

Variations in indices of community composition for Vulture Lake are illustrated in Figure 4.5-2, while variations in CA Axis scores are illustrated in Figure 4.5-6. Differences in total density, taxa richness, Simpson's Diversity, Simpson's Evenness, and CA axis 1 and 2 scores between Vulture Lake and McClean Lake west basin changed from baseline to operational periods, with the BACI contrast explaining up to 42% of the observed variance in annual means (Table 4.5-5). Time trends in density and Simpson's Diversity differed between Vulture and McClean Lake west basin during the operational period (i.e., from 1999 to present; Table 4.5-5).

Total density in Vulture Lake was lower in 1999 to 2011, relative to what was expected given the change in density from baseline to operational periods in the west basin of McClean Lake and dropped below the outer tolerance range of variation in 2008 (Figure 4.5-2). Density in 2015, however, had increased above the mean to about the same level as in the west basin of McClean Lake, and then slightly decreased once again in 2018 and 2021, followed by a subsequent increase in 2024 to just above levels in the west basin of McClean Lake. Taxa richness and Simpson's Diversity did not increase in Vulture Lake, while those indices did increase in value in the west basin of McClean Lake since operations commenced. Taxa richness in Vulture Lake has varied between about 5 and 15 taxa, with values always (in both baseline and operational periods) below the mean of expected reference values for small lakes. Simpson's Diversity fell below the outer tolerance range of variation in 2011, 2015, and 2021, but fell within the range in 2018 and 2024. Simpson's Evenness in Vulture Lake was always within the upper and lower bounds, except for the 2008 sampling period when evenness exceeded the upper bound. Total benthic biomass had been within NRs from 2005 to 2011 (i.e., around 2 to 3 g/m^2) but was about 10 times higher (~ 30 g/m^2) in 2015 and then subsequently decreased to far below the lower outer limit in 2018 and 2021, followed by an increase back to within the NRs in 2024 (Figure 4.5-2).

Mantel tests indicated significant change in the difference between Vulture Lake and McClean Lake west basin benthos community composition from baseline to operational periods ($p = 0.001$, Table 4.5-5) but no difference in time trends in composition during the operational period ($p = 0.298$, Table 4.5-5). The multivariate ordination axis scores (Figure 4.5-5) indicated that the benthic community of Vulture Lake was outside the NR of variation

for reference lake baseline conditions in 2002 only, all other sampling years, including 2024 were within the normal tolerance range.

A significant negative linear relationship was observed for richness when regressed against TOC ($p < 0.05$, Figure 4.5-7) and a significant positive linear relationship was observed for CA Axis 2 scores when regressed against TOC ($p < 0.05$, Figure 4.5-7). No significant relationship was observed among the other biological indices and TOC.

McClean Lake East Basin

The benthic community of McClean Lake east basin was sampled twice during the baseline period (1993, 1996) and nine times during operations (1999–2024; Table 4.5-1). Substrate in the east basin is dominated by silt with high organic carbon content (Table 4.4-9 and 4.4-10). During operations the assemblage was numerically dominated by Chironomidae and Sphaeriidae. Chironomidae proportions fluctuated through time, reaching a low in 2021 and rebounding in 2024. Sphaeriidae were present in baseline years and were relatively low in 2011–2015, then increased markedly in 2018–2024 (peaking in 2021). Tubificinae were the primary oligochaetes, highest in early operational years (notably 1999) and generally low thereafter. Valvatid snails (Valvatidae) occurred in all operational years with variable abundance. Veneroida bivalves were common early in operations (1999–2008) but were not recorded in later surveys. Other taxa occurred intermittently at low levels, including Glossiphoniidae (leeches), Naididae, Ceratopogonidae, Chaoboridae, and several mite groups (Prostigmata, Limnesiidae, Unionicolidae—the latter recorded in 2018–2021). Hyalellidae were observed only during baseline, Corixidae appeared in 2011, and Leptophlebiidae were noted in 2011. Trichoptera were represented by Leptoceridae and Phryganeidae in scattered years at low abundance.

Variations in indices of community composition for McClean Lake east basin are illustrated in Figure 4.5-3, while variations in CA Axis scores are illustrated in Figure 4.5-5. Differences in Taxa richness, Simpson's Diversity, and CA axis 1 and 2 scores relative to McClean Lake west basin changed subtly but statistically significantly in the operational period, with the BACI contrast explaining up to 31% of the observed variance in annual means, but typically much less than that (Table 4.5-5). Time trends after operations began (i.e., from 1999 to present) in density and CA Axis 2 scores also differed significantly between the McClean Lake east and west basins (Table 4.5-5), explaining 8 and 2% of the observed variance, respectively. From 2015 to 2021, total density declined in both the McClean Lake east and west basins; however, the east basin rebounded in 2024 above the baseline mean, whereas the west basin showed no recovery and were below the baseline mean (but within the inner tolerance limit) in 2024.(Figure 4.5-3). CA Axis 2 scores tended to become more negative in the later sampling years (i.e., 2018, 2021, and 2024) in the east basin, whereas the scores for the west basin remained positive in the same years (Figure 4.5-5).

The BACI changes in differences are illustrated in Figure 4.5-3. Taxa richness means were higher in the east basin than the west basin during baseline periods, however from 2015 onwards taxa richness means were marginally greater in the west basin compared to the east basin (2015 – 2021) except for in 2024, where mean taxa richness in the east basin was slightly higher than the west basin. Simpson's Diversity values were greater in the east basin compared to the west basin during baseline periods but levelled out during operational periods showing little difference between east and west basins (Figure 4.5-3). Biomass in McClean Lake east basin in 2008 (~ 21 g wet/m^2) was above the outer tolerance limit. By 2021, biomass was greater in the east basin compared to the west basin and this trend continued into 2024 (Figure 4.5-3). All other indices of composition were within the NR of variation of reference/baseline conditions (Figure 4.5-3). The multivariate ordination axis

scores (Figure 4.5-5) indicated that the benthic community of McClean Lake east basin was outside the outer tolerance level for reference lake baseline conditions in 1996 and 2008, all other sampling years, including 2024 were within the NR.

Mantel tests indicated significant change in the difference between McClean Lake east basin and McClean Lake west basin benthos community composition from baseline to operational periods ($p = 0.001$, Table 4.5-5), but no differences in time trends in composition during the operational period ($p = 0.903$, Table 4.5-5), reflecting the variations illustrated with CA Axis scores. That is, benthic community composition was generally more similar during the operational period. No significant relationships were observed among any of the biological indices and TOC (Figure 4.5-7).

Kewen Lake

The benthic community of Kewen Lake was sampled twice during baseline periods (1993 and 1996) and nine times during the operational period (1999, 2002, 2005, 2008, 2011, 2015, 2018, 2021, and 2024; Table 4.5-1). The benthic community, during the operational period was numerically dominated by chironomids (~ 60% to 91%; Table 4.5-3). Phantom midges (Chaoboridae) were not as abundant during the operational period as in the baseline period. Mayflies (Ephemeridae; up to 13%) and Tubificinae worms (< 1% to 4%) were present during all baseline and operational periods, while fingernail clams (Sphaeriidae; ~ 3% to 25%) were present during baseline and re-emerged from 2008 onwards. Larger insects consisted of low relative abundances of alderflies (Sialidae) in 2008, 2011, 2015, 2021, and 2024 and caddisflies (hydroptilids, leptocerids, phryganeids) in 2002, 2015, 2018, and 2024 (Table 4.5-3). Valvatid snails were present in 2002, 2008, 2011, 2015, 2018, 2021, and 2024 in low relative abundances. Corixid water boatmen (Corixidae) were documented in 2002, 2008, 2011, 2015, 2018, and 2024, yet in low abundances (< 1%).

Variations in indices of community composition for Kewen Lake are illustrated in Figure 4.5-4, while variations in CA Axis scores are illustrated in Figure 4.5-5. Density, Simpson's Diversity, Simpson's Evenness, and CA Axis 1 and 2 scores of the benthic community of Kewen Lake produced statistically significant differences in time variation, explaining up to 22% of the observed variance (Table 4.5-5). There were significant differences in density and CA Axis 2 score time trends after operations began (i.e., from 1999 to present) between Kewen Lake and the McClean Lake west basin, accounting for up to 22% of the observed variance (Table 4.5-5). These significant time trends were likely driven by the increase in density observed in Kewen Lake in 2018 (Figure 4.5-4).

Mantel tests indicated significant change in the difference between Kewen Lake and McClean Lake west basin benthos community composition from baseline to operational periods ($p =0.001$, Table 4.5-5), and no difference in time trends in composition during the operational period ($p = 0.770$, Table 4.5-5). The illustration of CA Axis scores also suggested that the compositions of both Kewen Lake and McClean Lake west basin were similar during both baseline (1993) and operational (1999 onwards) periods, aside from the 1996 timepoint which fell outside of outer tolerance level in both lakes, and the 1993 timepoint that feel outside the outer tolerance limit in the McClean Lake west basin (Figure 4.5-5).

Indices of composition from Kewen Lake fell within the outer tolerance level of variation for all operational years for all indices, except for biomass in 2011, which exceeded the outer limit (Figure 4.5-4). The multivariate ordination axis scores (Figure 4.5-5) indicated that the benthic community of Kewen Lake was within the NR of

variation of reference conditions in all operational years. No significant relationships were observed among any of the biological indices and TOC (Figure 4.5-7).

Secondary Exposure Lake

Benthic invertebrate community data are available from Fox Lake from the 2018, 2021, and 2024 sampling programs. A summary of the relative abundance of taxa, density, and taxon richness (at the LPL) is presented in Table 4.5-6. Similar to the lakes described for the reference and primary exposure areas, Fox Lake was numerically dominated by Chironomidae, though there was some variation between sampling years. Relative abundances of Hyalellidae and Ceratopogonidae increased between the 2018 and 2021 sampling periods and then subsequently decreased again in 2024. Similar to community composition described for the reference lakes, Sphaeriidae, and Caenidae, also occurred within the Fox Lake benthic invertebrate community.

Density of benthic invertebrates per m^2 dropped from 2018 to 2021 and then subsequently increased again in 2024 (Table 4.5-6), though this is associated with a drop in the number of chironomids within the community in 2021. Taxon richness remained comparable between sampling periods, measuring 29 ± 2, 27 ± 1, and 25 ± 5 taxa in 2018, 2021, and 2024, respectively. Both density and taxon richness fall well within the NRs for the region.

Summary

The reference and exposure lakes were consistently dominated by chironomids and Sphaeriidae clams, with various other worms, mollusks, and insects occurring at low abundances. Reference lakes, including Henday, Konner, Mallen, and McClean Lake west basin, provided consistent benchmarks for evaluating community change. All index values from reference lakes were used to establish the NR of variation. The core variables of total density and taxa richness (LPL) in 2024 fell within the inner tolerance limits (ITL) based on reference data at the four exposure lakes of Sink Reservoir, Vulture Lake, McClean Lake east basin, and Kewen Lake. In this broader context, observations at the exposure lakes are considered to be expected, not indicative of substantial changes due to released treated effluent. The supporting indices of Simpson's Diversity and Evenness, Biomass, and CA axis also fell within the ITL at all exposure lakes, with the exception of Sink Reservoir. Formal tests, however, used to assess variations in indices of composition using a BACI design and linear time trend after operations began resulted in numerous significant differences between the exposure lakes and the reference site of McClean Lake west basin.

Using the BACI design, the benthic community of Sink Reservoir showed notable differences in taxa richness, Simpson's Diversity, and multivariate composition relative to the McClean Lake west basin reference site. Taxa richness and Simpson's Diversity remained near or below baseline levels through the operational period, in contrast to increases observed in the reference lake. Simpson's Diversity in Sink Reservoir equaled reference means by 2021 and 2024, while Simpson's Evenness improved slightly and exceeded reference values in 2024, remaining within natural variation. Community composition shifted markedly in 1996 and again in 2024, based on CA ordination scores. Chironomids declined sharply in 2018 and 2021 but rebounded in 2024, while Sphaeriidae clams dominated from 2015–2021 but decreased in 2024. Larger aquatic insects appeared only during operations, suggesting community turnover. Biomass declined after 2015, falling below natural variation and remaining low in 2024; however, because no other benthic community indices showed comparable trends, this isolated biomass signal is not, on its own, indicative of degrading conditions. Richness was positively

correlated with TOC, suggesting environmental factors may be influencing long-term trends. Overall, the benthic community in Sink Reservoir reflects ongoing community change with intermittent signs of recovery.

In Vulture Lake, the benthic community exhibited strong shifts from baseline conditions, particularly in dominant taxa and diversity metrics. Chironomids, historically dominant, declined dramatically after 2015, falling to only 1% of the community in 2021. In their place, Sphaeriidae clams dominated the community in the three most recent surveys (2018–2024), accounting for over 85% of taxa in each year. Larger insects and new taxa, including Erpobdellidae leeches, appeared during operations. Richness and Simpson's Diversity did not recover to baseline or reference values, and diversity was occasionally below the expected range. Density fluctuated significantly, dropping below the lower outer tolerance level in 2008, then rebounding in 2024. CA ordination showed the community was most distinct in 2002, though 2024 remained within the expected range. Biomass peaked sharply in 2015 and fell well below reference conditions in 2018 and 2021, recovering in 2024. Richness and CA Axis 2 scores showed significant correlations with TOC, suggesting possible effects from organic enrichment. Overall, Vulture Lake's benthic community indicates a persistent deviation from baseline conditions and high variability in dominant taxa.

McClean Lake east basin showed relatively stable benthic community trends compared to the west basin reference site, with subtle but statistically significant BACI differences in richness, Simpson's Diversity, and CA scores. Richness and Simpson's Diversity were initially higher than in the west basin but converged over time. From 2015 to 2021, richness was lower than in the west basin but slightly exceeded it again in 2024. Community composition, as reflected in CA Axis 2 scores, became increasingly negative over time, diverging from west basin trends. Most other indices remained within the natural range of variation. Biomass was notably elevated in 2008 and remained higher than in the west basin in 2021 and 2024. Despite some temporal shifts in ordination space, the benthic community remained within expected ranges in most years, and no strong correlations were observed between indices and TOC. Overall, the east basin showed subtle compositional differences while maintaining general community stability.

In Kewen Lake, the benthic community remained consistent with reference conditions across most years. Chironomids continued to dominate, and while other taxa such as mayflies, worms, clams, and larger insects were present, their abundances were low and variable. Density, Simpson's Diversity and Evenness exhibited moderate fluctuations, including a pronounced increase in density in 2018, which likely drove observed time trend differences. CA ordination scores and all biological indices fell within the natural variation of reference lakes during all operational years, with the exception of 1996, which was an outlier. Biomass values remained within expected bounds except for a single elevated value in 2011. No significant relationships were observed between biological indices and TOC. Overall, Kewen Lake's benthic community remained stable with only limited variation across years.

Fox Lake, a secondary exposure lake, was sampled in 2018, 2021, and 2024. Its benthic community was dominated by chironomids, though relative abundances of Hyalellidae and Ceratopogonidae increased in 2021 before declining in 2024. Other consistent taxa included Sphaeriidae clams and Caenid mayflies, mirroring patterns seen in reference lakes. Invertebrate density dropped in 2021 due to lower chironomid abundance but rebounded in 2024. Taxon richness remained stable across all sampling periods and fell well within regional reference ranges. Despite some interannual variation, the Fox Lake benthic community structure has remained within natural variation and broadly aligned with reference expectations.

River Erosional Habitat

Neil-Hess Cylinders produced a high Simpson's Diversity of benthic fauna in both reference and exposure areas (Table 4.5-4). Chironomids and Sphaeriid clams were the most numerically dominant groups in the riffle-area samples. Chironomids comprised between 50% and 75% of the fauna in 2015, with higher relative abundances occurring in the exposure area stations. Sphaeriid clams comprised ~ 13% of the fauna in the reference areas in 2015, and only 4% of the fauna in the exposure areas in the same period. Plecoptera stoneflies were more abundant in the exposure areas compared to the reference areas (comprising 5% and < 1%, respectively). Less dominant groups, but nonetheless represented in both reference and exposure areas, included oligochaete worms, trombidiform mites, a variety of mayflies including Baetidae, Ephemerellidae, Leptophlebiidae, and various caddisflies. Stoneflies were present in both reference and exposure areas, but in low relative abundances.

Figure 4.5-8 shows the variations in indices of benthic community composition among sampling areas and over time. The inner tolerance limits are represented by the dashed lines, while the outer tolerance limits are represented by the solid black lines. Total density of benthic invertebrates in Neil-Hess cylinder samples have ranged from a low of about 10,000 organisms/m^2, to a high of about 125,000 organisms per m^2. Number of taxa has generally been higher in the exposure area than the reference areas, with a NR in taxa richness of 21 to 50. Simpson's Diversity and Evenness from both reference and exposure areas have generally been within the limits of the NR of reference values, except for samples from BM7E in 2005 and 2015 slightly exceeding the upper limit of normal.

There was no indication that variations in abundance were strongly operations related. Total organism density increased slightly in the exposure areas and decreased in the upstream Reference Area 1 (BM2C) from baseline periods to 2015, with no changes in the difference between reference and exposure areas, and no difference in time trends (all $p > 0.05$; Table 4.5-7). There was a drop in density to below the lower limit of normal in all Reference and Exposure Areas in 2005 (Figure 4.5-8). Density for all areas, however, was within the NR again by the 2008 cycle. Reference Area 2 (BM17C) and Exposure Area 1 (BM6E) exceeded the upper limits of normality in 2011 and 2015, respectively. All other measures of density were within the NR of variation.

There was no indication that variations in taxa richness were operations related. Exposure areas generally produced a similar number of taxa as were observed in the reference area (BM2C; Figure 4.5-8), while there was no change in the difference in taxa richness between reference and exposure areas from baseline periods to operational periods (Table 4.5-7). Taxa richness in the exposure area of Collins Creek, after exceeding the NR of variation in the 1990`s, has been well within the NR of observed reference richness values (Figure 4.5-8).

Variations in Simpson's Diversity generally indicated, like richness, no operational influences. The only significant variation was a minor ($p = 0.039$; Table 4.5-7) difference in the time trend in the operational period between BM7E and the reference area. Diversity was higher in BM7E in 2015 relative to the NR (Figure 4.5-8), an observation that is not consistent with a degrading habitat.

Similarly, there was no indication that variations in Simpson's Evenness were strongly operations related. There was no significant change in the difference in Simpson's Evenness from the baseline period to the operational period (Table 4.5-7). A difference was observed in time trend after operations commenced between the exposure area BM7E and the reference area BM2C ($p < 0.001$) explaining 13% of the observed variance (Table 4.5-7). Variations in Simpson's Evenness in BM7E exceeded (were above) the estimated 95th percentile for reference

means in 2005 and 2015 (Figure 4.5-8). here was a statistically significant change in the differences in CA axis 1 and 2 scores from baseline to operational periods (all $p < 0.01$; Table 4.5-7), as well as differences in time trends during the operational period (all $p < 0.01$; Table 4.5-7). Those statistical 'effects' however, explained a trivial proportion of the total variation in annual means (always < 3%).

Inspection of the biplot in Figure 4.5-9 shows the similarity of the benthos community of the two exposure areas (BM6E, BM7E) with the reference areas (BM2C, BM17C) over time. Some slight deviations between reference and exposure areas can be observed in 2005, where BM6E and BM7E separate from BM17C and BM2C along CA Axis 2, driven by elevated abundances of micropsectra, plecoptera, and pseudosmittia in the reference samples. Aside from this, the reference and exposure areas tend to group closely together at each sampling timepoint.

Benthic communities of both exposure areas in Collins Creek have been as diverse as those observed in the reference areas within Collins Creek. These locations have contained several benthic genera typically associated with robust/stable conditions such as nemourid, perlodid, pteronarcid, leuctrid and capniid stoneflies, hydropsychid, hydroptilid, leptocerid and brachycentrid caddisflies, in addition to the baetid, ephemerellid, leptophlebiid, heptageniid and baetiscid mayflies.

Summary

There were no differences in either the baseline to operational periods (i.e., before-after, control-impact) or in time trends in abundance or richness (i.e., two core variables) in the erosional exposure area of Collins Creek. Non-core variables, including CA axis scores 1 and 2, produced some detectable differences in the baseline to operational periods and time trends (compared to time trends in reference areas). Although statistical differences are noted, the variance explained by these variables is trivial, and the observed benthic invertebrate community characteristics, based on the indices examined, generally fall within the NR of natural variation observed.

River Depositional Habitat

Kick and sweep sampling in Collins Creek has demonstrated that the depositional habitats of Collins Creek in both reference (BM18C) and exposure (BM19E) areas are diverse and contain several sensitive groups (Table 4.5-8). Over 80 taxa (lowest practical identification) have been documented in the five years (2008, 2013, 2016, 2019, 2022) of sampling. Communities in both reference and exposure areas have been dominated numerically by Chironomidae (up to 35% at the reference; 20% at the exposure) Sphaeriidae (fingernail clams; peaking at 37**%** at the reference and 31**%** at the exposure in 2019), Leptophlebiidae (consistently higher at the exposure, 19 to 37**%**, vs. 2 to 7**%** at the reference), and Hyalellidae (amphipods; 21% at the reference and 30% at the exposure in 2008, declining mid-series with a partial recovery by 2022). Hydroptilidae (micro-caddisflies) occurred at both sites but were routinely higher at the reference (3–15%) than at the exposure (<1–3%). Polycentropodidae were more prominent at the exposure (peaking at 6% in 2016 and 4% in 2019). Plecoptera were detected at trace levels in the reference area but not at the exposure site (Table 4.5-8). Overall, both areas shared the same dominant groups, but the exposure area was characterized by persistently higher Leptophlebiidae, whereas the reference area contributed relatively more Hydroptilidae and Chironomidae, and Sphaeriidae peaked at both sites in 2019.

Boxplots demonstrating temporal and spatial variations are provided in Figure 4.5-10. The mean abundance for samples collected from both the reference and exposure area in 2022 were similar and were just slightly above the overall reference mean across all years, indicating that community conditions in that year were not distinct from the typical range observed in the reference area. Noticeably, mean abundance in 2019 did fall slightly above the inner tolerance limit of the reference range, however given the natural year-to-year variability, the 2019 exposure area deviation from the normal range is not considered ecologically significant. The means of LPL richness, Simpson's Evenness and Simpson's Diversity were all within the inner tolerance limits of the reference NRs, indicating that values were within the NR of variation for background reference areas.

The benthic data (including all years of data) was ordinated using CA to produce synthetic variables that summarize the multivariate composition of the benthic community data. Two ordination axes were computed and are shown for all years of sampling in Figure 4.5-11. The upper panel indicates the Pearson correlation of individual taxa percentage abundances with the axis scores. The lower panel indicates the CA axis scores produced by each sample. The top panel can be overlain on the bottom panel to illustrate the association of taxa with samples. Taxa with strong positive associations with CA axis 1, for example, had higher abundances in samples that produced larger positive axis 1 scores. In general, Exposure (azure) and Reference Area (jade) samples collected in 2008, 2013, and 2022 tended to demonstrate some variation along CA Axis 1 and group rather tightly along CA axis 2, but all grouped within the inner tolerance ellipse (i.e., the normal range) about the reference data. In 2022, sample scores from the reference and exposure areas showed substantial overlap in ordination space, with no distinct separation along CA Axis 1 or 2. Both areas exhibited similar distributions, and the broader spread across CA Axis 1 compared to Axis 2 suggests greater variation in community composition along the primary ecological gradient, reflecting higher abundances of *Hyalella azteca,* Leptophlebia, and Gyraulus (negative CA Axis 1 scores) and Paraleptophlebia, Leptophlebiidae, and Hydra (positive CA Axis 1 scores). The variation however is irrespective of sampling area. Samples collected in 2019 from both Reference and Exposure Areas tended to produce more positive CA Axis scores while 2019 samples collected from the exposure area produces highly positive CA Axis 2 scores with three samples plotting outside of the outer tolerance limit, reflecting higher abundances of Hydra, in 2019 from both Reference and Exposure Areas tended, Hydroptila, and Paraleptophlebia.

Summary index values for 2008, 2013, 2016, 2019, and 2022 computed using the LPL identifications are provided in Table 4.5-9. Analysis of variance of LPL community indices for 2022 (Table 4.5-10; Figure 4.5-10) indicated that no indices differed significantly between areas (i.e., all p-values were greater than 0.05 alpha threshold; Table 4.5-10). Abundance was marginally higher in the Exposure Area ($p = 0.689$; ES = 0.66), while CA Axis 1 scores were slightly lower ($p = 0.634$; ES = –0.69) and CA Axis 2 scores slightly higher ($p = 0.676$; ES = 1.25) in the Exposure Area. LPL Richness, Simpson's Evenness and Simpson's Diversity showed minimal differences. Effect sizes for all indices were well below the Metal Mining Critical Effect Size (±2 SD) relative to the 2022 Reference Area mean and variance.

ANOVA results for the various hypotheses testing for temporal variations (across years from 2008 to 2022) in benthic indices of composition are provided in Table 4.5-11. Comparisons were considered significant if the associated *p* value was less than 0.05 and if the variance explained by the contrast was greater than 20% of the total variation in Area-Year means. For perspective, in a simple control-impact design with one year of data (i.e., the classic EEM program), an effect size of ±2 SD will be significant only if the model (i.e., control vs impact) explains at least 50% of the variation. To require that a temporal comparison explain at least 20% of the variation is at least twice as sensitive as the typical CES. No benthic indices were significantly different in 2022 relative to prior years (H02, $p > 0.05$, Table 4.5-11).

For abundance, and CA Axis 2 scores, ANOVA testing revealed statistically significant (H03, $p < 0.001$ and 0.002, respectively, Table 4.5-11) step-changes in the Reference-Exposure difference, indicating a shift occurring prior to 2019, both of which explained more than 20% of the total variation in Area-Year means and thus exceeded the CES of ±2 SD. The step change was also significant for richness and CA Axis 1 scores (H03, $p < 0.001$ and 0.048, respectively, Table 4.5-11), however the amount of total variance explained in both cases was less than 20% and is thus negligible. This suggests that the average difference in abundance and CA Axis 2 scores between Reference and Exposure sites changed significantly in 2019 and 2022 compared to earlier years.

For richness, Simpson's Diversity, and CA Axis 1 and 2 scores, ANOVA testing revealed statistically significant (H04, $p < 0.001$, 0.016, < 0.001, and 0.002, respectively, Table 4.5-11) step-changes in the Reference-Exposure difference, indicating a shift occurring prior to 2013, all four of which explained more than 20% of the total variation in Area-Year means and thus exceeded the CES of ±2 SD. No other indices yielded a significant difference for H04.

Both richness and Simpson's Diversity yielded a significant difference in step-change between areas indicating a shift occurring prior to 2016 (H05, $p = 0.022$ and 0.062, respectively, Table 4.5-11), however the amount of total variance explained in both cases was less than 20% and thus the effect is of less magnitude than the CES of ±2 SD.

Linear time trends in the reference and exposure area were significantly different for richness only (HO6, $p = 0.008$, Table 4.5-11), however the contrast only explained 7% of the total variation in area means, and so was based on an effect of less magnitude than the CES of ±2 SD.

Results from the Mantel tests are provided in Table 4.5-12. There was a significant difference in Bray-Curtis distances between Exposure and Reference Areas in 2022 (H01: Mantel $r = 0.147$, $p = 0.001$). Contrasts for the various hypotheses testing for temporal variations in Bray-Curtis distances determined the only significant step-change in the Reference-Exposure difference was before 2019 (H03, Mantel $r = 0.099$, $p = 0.004$, Table 4.5-12), all other step-changes were not statistically significant (i.e., $p > 0.05$, Table 4.5-12).

Summary

Benthic communities sampled in Collins Creek were diverse and composed of a range of aquatic organisms, with Chironomidae, Sphaeriidae, Leptophlebiidae, and Hyalellidae being the most numerically dominant taxa across both reference and exposure areas. The presence of sensitive taxa such as fingernail clams, mayflies (Ephemeroptera), and various caddisflies (including Hydroptilidae and Polycentropodidae), along with permanent aquatic organisms like amphipods and gastropods, indicates that the benthic habitat in Collins Creek is of generally high quality. While both areas shared dominant taxa, notable differences in their relative abundances and temporal patterns were observed—for instance, Leptophlebiidae and Polycentropodidae were more prominent at the exposure site, whereas Hydroptilidae and Plecoptera were more abundant or exclusively found at the reference site.

Overall, data collected since 2008 has indicated that core metrics of abundance and richness, along with the supporting metrics of Simpson's Diversity and Evenness, and CA Axis scores generally remained within the NR for reference site for the region. CA ordination results demonstrated overlap between reference and exposure

sites in multivariate space, with variation across years but no persistent separation by site. Significant differences in CA Axis scores and abundance were detected in 2022, though effect sizes remained below the CES. Temporal analyses indicated that certain community differences between sites began to emerge prior to 2019 and 2013, with significant step changes detected in several indices, though not all exceeded CES thresholds. Bray-Curtis dissimilarity tests also confirmed a shift in community structure between reference and exposure areas in 2022. However, no consistent long-term divergence between the sites was evident, suggesting that natural variability continues to be a predominant influence on benthic community structure in Collins Creek.

4.5.5 Monitoring Adjustments and Supplementary Studies Recommendations

In the most recent EMP sampling year (i.e., 2024), no benthic indices were outside of reference-derived normal-range tolerance limits, except for biomass in Sink Reservoir, which fell below natural variation and remained low in 2024; however, because no other benthic community indices showed comparable trends, this isolated biomass signal is not, on its own, indicative of degrading conditions. Aside from this, values across the EMP exposure lakes were often near or below baseline means across exposure lakes. Collins Creek (EEM) communities remain generally high quality with no persistent reference–exposure separation, and effect sizes for the most recent sampling year (i.e., 2022) were below critical thresholds, indicating a slow-changing system that is well resolved at the EEM sampling frequency. Thus, the overall benthos monitoring scope is sufficient to provide early warning, if guidelines or ERA triggers are exceeded.

That said, benthos sampling in McClean Lake (west and east basins) under the routine EMP and in Collins Creek (upstream and downstream of McClean Lake) under the EEM currently occurs more than a year apart. Aligning these timelines would provide spatially continuous data for the same period, improving comparability and interpretation. Therefore, Orano recommends deferring the next EMP lake-depositional benthos survey from 2027 to 2028 to align with Phase 9 EEM, while keeping seasons unchanged (EMP sediment and benthos in winter 2028; EEM river benthos in fall 2028). This alignment will ensure all biological monitoring occurs in the same year on a three-year cycle and enable evaluation of environmental performance under consistent operational and hydrological conditions, enhancing data interpretation.

4.5.6 Summary and Conclusions

The primary objective of the benthic invertebrate community monitoring program is to assess the potential influence of effluent discharge on the benthic invertebrate communities in the primary exposure areas. The 1991 and 1995 EAs predicted moderate to major impacts on the biological environment within the S/V TEMS (Sink Reservoir and Vulture Lake), implying impacts to benthic macroinvertebrate density and richness that would fall outside of the NR of variation of baseline conditions. Subsequent assessments and the more recent ERAs supported these predictions, with negligible effects predicted to McClean Lake east basin and Collins Creek. The long-term EMP of the benthic invertebrate community within lake depositional habitat has demonstrated that there was a reduction in both density and taxa richness in both Sink Reservoir and Vulture Lake from baseline to the operational period when compared to the west basin of McClean Lake. However, the observed density and richness values in 2024 fell within the NR of variation of values observed during baseline periods and/or in reference waterbodies. Some subtle differences in Simpson's Diversity, Simpson's Evenness, CA axis 1 and 2 scores, and Bray-Curtis (i.e., non-core variables), were evident, suggesting some changes in benthic invertebrate community structure. In addition, several of the indices produced statistically significant changes in differences when compared to the McClean west basin reference, from before to after operations (BACI and time trend). The observed variations in indices of benthic community composition in these two exposure

waterbodies were, however, relatively subtle, and in all cases, within the NR of variation. Some of the statistically significant differences seem to result from observed variations in the McClean Lake west basin. Predictions related to impacts on benthos in Sink Reservoir and Vulture Lake in the 1991 and 1995 EIS were derived from predicted changes in sediment quality for those waterbodies and did not specify any criteria for assessing impact severity based on benthic invertebrate community parameters. Therefore, the observed significant effects in Sink Reservoir and Vulture Lake cannot be classified as adverse within the McClean Lake Operation Environmental Assessment framework.

Within McClean Lake east basin, density and richness were reduced from the baseline to the operational period when compared to McClean Lake west basin, but there were no differences over time and differences were within the NR. Benthic biomass was unusual in 2008 but returned to near normal values in 2021 and 2024. There is no indication, however, that the high biomass value in 2008 reflects degraded conditions given that the fauna remain diverse with a typical assortment of taxa. Some subtle differences in Bray-Curtis (i.e., non-core variable) were evident, suggesting some changes in benthic invertebrate community structure. The maintenance of the core characteristics of the McClean Lake east basin benthic invertebrate community and subtle differences in composition suggest negligible effects (Table 4.5-4).

The EAs and more recent ERAs predicted negligible effects on the benthic environment in Collins Creek, implying no change in benthic community abundance or richness outside of the NR of variation of baseline conditions. The benthos of erosional habitats was sampled using a Neill-Hess cylinder. There were no detectable differences in either the baseline to operational periods (i.e., before-after, control-impact) or time trends in abundance or richness (i.e., two core variables) in the erosional exposure area of Collins Creek. There were no detectable differences in time trends in taxa richness, while richness values also fell within the NR of variation observed in the reference areas. Non-core variables, including CA axis scores 1 and 2, produced detectable differences in the baseline to operational periods and time trends (compared to time trends in reference areas). Although statistical differences are noted, the observed benthic invertebrate community characteristics, based on the indices examined, fall within the NR of natural variation observed. The effects of treated effluent release on the erosional benthic community are therefore considered negligible in Collins Creek. Depositional habitats within Collins Creek were surveyed using a semi-quantitative method as part of the EEM biological monitoring in 2008, 2013, 2016, 2019, and 2022. Similar to the evaluation of the erosional dataset from Collins Creek, depositional data demonstrated that mean richness, evenness, Simpson’s diversity, and CA axis scores within the Collins Creek exposure area fell within the NR for the region in 2022. Additionally, temporal variation was small (general less than 10%; always less than 20%), indicating that natural variations were predominant. The observed variations in composition of the depositional habitat, therefore, were also consistent with the predictions of the EAs, that effects would be negligible in Collins Creek.

The overall benthos monitoring scope is sufficient to provide early warning, if guidelines or ERA triggers are exceeded, however the routine EMP and EEM sampling occurs over one year apart. It is therefore recommended to defer the next EMP lake-depositional benthos survey from 2027 to 2028 to align with EEM Phase 9 at Collins Creek, while keeping seasons unchanged (EMP sediment/benthos winter 2028; EEM river benthos). This alignment will ensure all biological monitoring occurs in the same year on a three-year cycle and enable evaluation of environmental performance under consistent operational and hydrological conditions, enhancing data interpretation

4.6 Fish

Baseline fish community surveys were completed in the late 1970s and early 1980s to provide information on the fish communities present within the lakes of the LSA in support of the 1991 EA (Minatco 1991; Figure 4.6-1 highlighted waterbodies). These studies included habitat surveys, community inventory (presence and relative abundance), and tissue chemistry (metals and radionuclides). In the early 1990s, additional habitat and community surveys were completed. In 1994, the fish tissue sampling program within the LSA incorporated a BACI design in anticipation of future monitoring requirements. The baseline program included McClean Lake west basin (reference area), Vulture Lake (S/V TEMS), McClean Lake east basin and Kewen Lake (primary exposure areas), and Johannes Lake and Moffat Lake (secondary exposure areas) (Figure 4.6-1). The information provided within this EP TID will focus on the most recent baseline data collected during the 1994 fish monitoring program. This allows the discussion to focus on the sampling areas and fish species most consistent with the monitoring programs completed during operations.

The primary objective of the fish surveys completed during the operational period was to identify potential influences of treated effluent discharge on fish tissue COPC levels and sentinel species population characteristics in the McClean Lake Operation LSA. This objective was achieved by the implementation of a fish chemistry monitoring program (Section 4.6.2) and a fish population monitoring program (Section 4.6.3). Additionally, supplementary studies are performed to complement monitoring data for risk assessment or monitoring program adjustment purposes as needed (Section 4.7).

4.6.1 Fish Community and Habitat

The following sections provide a high-level overview of the available fish community and habitat within the McClean Lake Operation LSA. These data are meant to provide supporting information for the fish chemistry and fish population monitoring programs.

4.6.1.1 Pre-Development Baseline

A variety of methods (e.g., gillnets, seine nets, dip nets, minnow traps, electrofishing, angling) were used to capture fish during the baseline period for community and tissue chemistry investigations (Appendix IV.6; Table IV.6-1). Captured fish were identified to species and population health measurements were recorded (length, weight, reproductive condition, etc.). Depending on the objectives of the investigation, fish were either released or sacrificed for internal examination and organ measurements (e.g., liver weight). As part of some surveys, bone and flesh were collected from large-bodied fish and submitted to an analytical laboratory for trace metal and radionuclide analyses (see Section 4.6.2). A summary of baseline fish population data is presented in Appendix IV.6, Tables IV.6-2 and IV.6-3.

Fish habitat assessments were conducted via boat survey, visual habitat inspections, analysis of sediment and vegetation characteristics, spawning habitat observations, and habitat evaluation procedures. Methods used for spawning surveys included spawning gillnets, egg searches and collections, hoop nets, trap nets, and aerial surveys. Fish habitat assessments and spawning studies focused on fish species of commercial and recreational importance and included northern pike (*Esox lucius)*, walleye (*Sander vitreus*), lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), and Arctic grayling (*Thymallus arcticus*) (MacLaren and SRC 1979, 1980; TAEM 1989, 1990, 1991). Table IV.6-4 (Appendix IV.6) summarizes the fish habitat

assessments and/or spawning investigations conducted in the LSA. Maps and associated descriptions of the habitat type corresponding to the figures are provided in AREVA (2016a).

4.6.1.2 Operational Monitoring

In addition to baseline investigations, fish community information has been collected during the operational period in conjunction with the fish chemistry monitoring program (Section 4.6.2) and the fish population monitoring program (Section 4.6.3). A supplemental fish community and chemistry study was also completed in 2016 in McClean Lake east basin. The results of this investigation have been integrated with the catch per unit effort (CPUE) information available from the operational period fish population and fish chemistry monitoring program data to provide an overview of abundance and richness of fish species in the primary exposure areas.

A total of 16 species of fish are known to occur in the LSA (Table 4.6-1). Lakes known to support the greatest variety of species are Mallen Lake (13 species), McClean Lake (10 species), Torwalt Lake (10 species), and Moffat and Pat lakes (8 species). In the LSA, northern pike is the most widespread species, collected in all study lakes, except in Esto and Tut lakes. White sucker (*Catostomus commersonii*), lake whitefish, walleye, lake trout, are the next most predominant species found in the LSA. Arctic grayling is known to occur in Collins Creek. Sue and Sils lakes were found to be devoid of fish (SENES and TAEM 1991). The relative abundance of fish species based on the average number and weight of each species captured per standard gang, in the LSA is presented in Tables IV.6-2 and IV.6-3 (Appendix IV.6).

A summary of operational period CPUE data by species is provided for half standard gang gill netting, short-length gill netting, and electrofishing in Tables 4.6-2 to 4.6-4. The CPUE of target large-bodied species for fish chemistry, northern pike, white sucker, and lake whitefish, is further depicted through time in Figures 4.6-3 to 4.6-5. It is noted that Sink Reservoir was not assessed during the operational period prior to 2008, as fish were removed from Sink Reservoir prior to mill start up in 1997 (AREVA 2016a). In 2008, it became apparent that fish once again occurred in Sink Reservoir, and regular fish chemistry sampling was initiated. Species captured included northern pike and white sucker, with CPUE numbers comparable to reference, despite the fish removal program that was conducted in 1997 (COGEMA 1997) (Figures 4.6-3 and 4.6-4). The CPUE of northern pike in Sink Reservoir tended to increase up until 2015 and subsequently decreased from 2018 to 2024. CPUE values have also dropped substantially for white sucker in Sink Reservoir from 2011 onwards. In Vulture Lake, the CPUE of northern pike has increased over time since 1998, to levels comparable to reference CPUE. The highest CPUE of northern pike at Vulture Lake was observed in 2018 and subsequently declined in 2021 followed by a slight increase in 2024. White sucker CPUE at Vulture Lake has been consistently low—no white sucker have been captured there since 2008. In 2024, reference lakes also showed very low white sucker catch despite extensive effort (three fish in Konner Lake and none in Henday Lake; Tables 4.6-2 and 4.6-3), suggesting regionally low abundance/catchability during this survey year. Northern pike and white sucker were targeted for fish tissue chemistry in Kewen Lake, and both species have CPUE through time similar or higher than the available reference CPUE (Figures 4.6-3 to 4.6-4). Although, a drop in white sucker CPUE was documented in Kewen Lake in both 2018 and 2021, there was a marked resurgence of white sucker catch in 2024, reaching the highest CPUE observed at Kewen Lake to date (Figure 4.6-3). In Collins Creek, the CPUE of target species for the fish MDMER EEM population monitoring program, slimy sculpin (*Cottus cognatus*) and burbot (*Lota lota*), has been higher in the near-field exposure area when compared to upstream reference areas during each of the given sampling years (Table 4.6-4).

In McClean Lake east basin, the same five species of fish were captured in the 2016 investigation as were captured during the 1988 baseline investigation: burbot, lake whitefish, northern pike, walleye, and white sucker.

Lake whitefish, northern pike, walleye, and white sucker were also captured during the 2021 and 2024 fish chemistry program completed in the east basin of McClean Lake. The low capture success of small-bodied fish during the 2016 investigation as well as the lack of suitable desired sentinel species captured in McClean Lake east basin indicates that McClean Lake may not support a robust enough small-bodied fish population to conduct routine EEM sampling in the east basin.

4.6.2 Fish Chemistry

4.6.2.1 Pre-development Baseline

The baseline surveys in the late 1970s and early 1980s were completed to provide information on the fish tissue chemistry within the lakes of the LSA in support of the 1991 EA (Minatco 1991). In 1994, the fish tissue sampling program within the LSA incorporated a BACI design in anticipation of future monitoring requirements. The baseline program included McClean Lake west basin (reference area), Vulture Lake (S/V TEMS), McClean Lake east basin and Kewen Lake (primary exposure areas), and Johannes Lake and Moffat Lake (secondary exposure areas) (Figure 4.6-1). Baseline sampling included the assessment flesh and bone from up to six different species.

An index of tissue chemistry studies is provided in Table IV.6-5 (Appendix IV.6). In total, six species of fish (northern pike, lake trout, white sucker, lake whitefish, walleye, and Arctic grayling) were collected for tissue chemistry analysis, although northern pike and white sucker were the most common species analyzed. Results of trace element and radionuclide analyses were typically reported on an ash, dry, or wet weight basis depending on the analytical technique employed. To facilitate comparisons of analytical results among studies as fish tissue data are now analyzed on a dry weight basis, baseline parameter concentrations were converted to a dry weight basis. In calculating mean concentrations, parameters with concentrations less than the RDL were set equal to the RDL.

In 1994, baseline arsenic, cadmium, lead, molybdenum, and vanadium concentrations in bone and flesh from northern pike and white sucker were either below or near RDLs in all areas (Table 4.6-5). Mean copper concentrations were slightly above RDLs; however, tissue concentrations were similar in the exposure and reference areas. As with copper, tissue concentrations of zinc were similar between areas. Zinc concentrations in flesh were lower than concentrations in bone tissue (e.g., zinc concentrations ranged from 4.46 µg/g to 9.34 µg/g in northern pike flesh and ranged from 26.6 µg/g to 49 µg/g in northern pike bone). In addition, zinc concentrations in white sucker bone were two to five times lower than concentrations in northern pike bone. Baseline mean nickel concentrations in northern pike ranged from 0.158 µg/g to 0.280 µg/g in bone, and from below the RDL (< 0.02 µg/g) to 0.300 µg/g in flesh. Nickel concentrations in white sucker tissues and northern pike tissues were similar. Nickel concentrations in northern pike and white sucker flesh samples from lakes within the primary and secondary exposure area were slightly elevated in comparison to reference fish. However, concentrations of trace metals in fish tissues collected during the baseline period were low. Baseline radionuclides from 1994 are presented in Table 4.6-6. All radionuclides were either below or near RDLs. Radium-226 was below RDLs in both species from all areas.

In summary, adequate baseline fish tissue chemistry data are available to allow comparisons with operational monitoring data.

4.6.2.2 Study Design and Objectives

Operational monitoring of fish tissue chemistry (i.e., large-bodied fish species) maintained consistency with the baseline program, retaining the original BACI design. In addition, permanent area codes were assigned to reference and exposure areas (Figure 4.6-2). A few changes occurred in the monitoring program between 1998 and 2005, including the removal of Johannes and Moffat lakes as potential secondary exposure areas and the incorporation of Fox Lake as a potential secondary exposure area. In 2008, all secondary exposure areas were removed from the monitoring program as secondary exposure areas were determined to pose limited risk to fish. Sink Reservoir was added into the fish chemistry monitoring in 2008. Additionally, in 1998, kidney and liver samples were added to the EMP in addition to the bone and flesh samples[3]. Sampling completed in the waterbodies are throughout the lakes, but generic lake UTM coordinates have been provided for waterbodies sampled in the current EP TID period in Appendix IV.6 (Table IV.6-15) for reference.

During the last EP TID period, additional fish tissue monitoring was completed to specifically address the potential effects of selenium in the receiving environment. In 2016, a supplementary study was performed to characterize the fish community, assess the feasibility of completing an EEM fish population survey, and collect chemistry data for large-bodied fish tissue (i.e., flesh and ovary) in the east basin of McClean Lake. Subsequent to this investigation, ovaries were opportunistically sampled from any female fish captured for the fish tissue monitoring program since 2018 to assess selenium concentrations and in 2021 the east basin of McClean Lake was added to the EMP to evaluated selenium risk. Finally, the 2019 and 2022 Phase 6 and 7 EEM studies incorporated selenium fish tissue monitoring of burbot and slimy sculpin in Collins Creek as per the MDMER requirements. The available McClean Lake east basin data and EEM selenium fish tissue monitoring data have been incorporated into analysis of the routine monitoring results and presented in this section to ensure continuity of the fish chemistry data interpretation.

4.6.2.3 Impact Predictions

Impact predictions presented in the 1991 and 1995 EAs focused on potential changes to the aquatic environment in primary exposure area waterbodies within and immediately downstream of, the treated effluent discharge point (Minatco 1991; COGEMA 1995). The assessments predicted minor and negligible effects to the fish of McClean Lake and Collins Creek downstream of McClean Lake as a result of exposure to the McClean Lake Operation treated effluent. Impact predictions were not made for fish in Sink Reservoir, as fish were anticipated to be removed from Sink Reservoir as part of the development of Sink Reservoir (AREVA 2016b). The incorporation of some heavy metals into fish flesh and bone was predicted to occur in Vulture Lake (Minatco 1991). These effects were categorized as “moderate to major,” and were anticipated to be for the lifetime of the operation. These effects were further supported by the subsequent 2004 Sue E, 2009 Caribou Project, and 2011 Midwest Project EAs. The 2011 Midwest Project EA (AREVA 2011a) provided predictions related to fish tissue selenium concentrations, which were further characterized for several scenarios in the 2016 ERA (AREVA 2016b). Following the completion of the 2016 update of the Cigar Lake life-of-mine plan, an improved selenium forecast was available (Orano 2018). The updated forecast was used in the 2018 Selenium Review and Assessment Report to provide updated predictions related to selenium, including fish tissue predictions.

[3] In 2011, kidney and liver samples were archived.

The available fish flesh tissue predictions from the 2016 ERA are provided in Table 4.6-7. Additionally, the selenium specific predictions are provided in Table 4.6-8 alongside conversions to various tissue endpoints (i.e., whole body and ovary) as well as available benchmarks. As part of the 2018 ERA, a site-specific benchmark was established and is also provided in Table 4.6-8. The 2018 predicted mean and 95th percentile selenium fish flesh concentrations exceeded the established site-specific fish flesh benchmark of 13 µg/g dw in the S/V TEMS, suggesting effects to fish within Vulture Lake as described in the previous EAs. The mean predicted fish flesh concentration in McClean Lake east basin was expected to remain below the benchmark with some exceedances observed for the 95th percentile predictions. Levels in Kewen Lake were predicted to remain well below the site-specific benchmark. This supports the original environmental predictions of negligible effects downstream of McClean Lake.

4.6.2.4 Sampling Methods

Fish chemistry was monitored at six locations during the recent monitoring periods specific to the EMP, including reference areas and primary exposure areas (Figure 4.6-2). Among these locations, two areas were reference lakes (Henday, and Konner lakes) and four were primary exposure lakes (Sink Reservoir, Vulture Lake, McClean Lake east basin, and Kewen Lake). Mallen Lake was historically sampled as a reference lake (1998 to 2015) but has since been removed from the EMP. The fish sampling species selection was based on a bottom feeding species (lake whitefish or sucker, *Catostomus* sp.) and a predatory fish species (northern pike) from each location. Northern pike and white sucker were the primary target species. In each lake, five northern pike and five white sucker were collected for chemical analysis. In the past, five lake whitefish have also been collected in Kewen Lake on occasion. Fish were captured by angling and/or gill nets[4]. To minimize unnecessary fish mortality, gill net sets were checked frequently.

Non-target large-bodied fish were measured (total or fork length, depending on species) to the nearest millimetre (mm), weighed with spring-type scales to the nearest 1 gram (g), 5 g, or 20 g[5], and were subsequently released. Body weight was measured using spring-type scales. Liver, kidney, and gonads were weighed using a two-decimal scale (± 0.01 g accuracy) calibrated to a standard weight at least once per processing event. Internal and external fish health characteristics of target fish were also recorded. Fish samples were frozen before shipping to SRC Environmental Analytical Laboratory for chemical analyses.

Bone, flesh, kidney, liver, and gonad (ovaries) were processed and analyzed separately for each fish. Fish flesh and bone samples were analyzed for metals and radionuclide concentrations. Kidney, liver, and gonads samples were analyzed for total metals only as they were of insufficient mass for the radionuclide analysis. All fish tissue chemistry samples were submitted to the SRC Environmental Analytical Laboratory for chemical analysis.

[4] Spawning nets with a 7.6 cm (stretch measure) mesh size (10 m long, 1.8 m deep) and half standard gang gill nets (23 m long, 1.8 m deep) with 3.8, 5.1, 7.6, 10.2, and 14 cm (stretch measure) mesh sizes were used

[5] Scale accuracies as follows: 0 to 100 g range, 1 g accuracy; 0 to 500 g range, 5 g accuracy; 0 to 10,000 g range, 20 g accuracy.

4.6.2.5 Data Analysis

Initial Screening

Fish chemistry data were initially screened to identify potentially erroneous data and data gaps prior to data analyses. This included screening for duplicate data, errors or omissions, and investigating potential anomalous values or extreme outliers. Any identified outliers were screened against the entire dataset for that constituent to ascertain whether the value appeared erroneous. No data were removed from the analysis unless they were confirmed to be erroneous.

Evaluation Criteria

The following EvCs were applied for fish chemistry monitoring:

- EvC 1: RDL – all measured parameters were first screened against laboratory RDLs. If less than 90% of a parameter's concentration were below the RDL during the reporting period, then it was retained for further evaluation under EvC 2.
- EvC 2: Upper Reference Range – data retained from EvC 1 was compared to recent reference data. If mean concentrations in at least one of the exposure monitoring locations were more than two reference standard deviations above the reference mean, then it was automatically included as a COPC.
- EvC 3: Principal Component Analysis (PCA) – an expanded list of chemicals were used in a PCA to understand other potential COPCs that may be driving variation in the fish tissue chemistry dataset, aside from those identified from EvCs 1 and 2. Chemicals that had high loadings on the main principal components and had less than 90% of concentrations below the RDL (see EvC 1), were included in the final list of COPCs.
- EvC 4: Normal range estimates – COPC tissue concentrations from exposure areas were compared to the normal range of variation derived from baseline and reference data. Values outside the NR were considered unusual and potentially indicative of degraded habitat quality.
- EvC 5: ERA Prediction Evaluations – COPCs with available predictions in fish tissue were compared to the most recent ERA-predicted maximum mean and 95th percentile for the 2022 to 2024 period listed in Table 4.6-8.
- EvC 6: Selenium-specific evaluation – Because selenium risk is tissue-based, all available fish tissue selenium data (i.e. McClean Lake east basin: 2016, 2021, 2024; Collins Creek: 2019, 2022) were compiled and assessed against ERA predictions and site-specific benchmarks (13 µg/g dw muscle; 19 µg/g dw egg/ovary).

EvCs 1, 2, and 3 were applied for COPC selection, while EvCs 4 to 6 were used for detailed evaluation and interpretation of potential effects, as described in the following sections.

COPC Selection

A full suite of parameters was assessed in fish tissues, similar to the water and sediment quality assessments (Appendix IV.6, Tables IV.6-6 to IV.6-12). COPCs were initially identified through the screening process

described in Section 1.6.2.4 (using EvC 1 and 2 listed above) and was further refined through PCA process described below.

Principal Component Analysis

To capture additional patterns not reflected in the initial screening, a PCA was used as an additional screening tool to summarize variations in fish metal and radionuclide levels among species, tissues, and locations for all available data (1994 to 2024). This analysis identified parameters with strong influence on overall data variation, highlighting additional constituents that may warrant consideration as COPCs.

Because not all analytes were measured in all tissues, the PCA was carried out on subsets of the larger dataset that had a consistent set of parameters across species, tissues, locations, and time periods. This subset included the metals aluminum, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, silver, strontium, titanium, vanadium, and zinc. The PCA generated a set of "scores" on derived PCA axes. Correlations of the original parameters (all log10 transformed) with the site scores were used to indicate the degree of covariation of parameters. The correlation between measured concentrations (log10 transformed) and PCA axis scores of an additional sub-set of less-frequently measured parameters (uranium, phosphorus, potassium, selenium, lead-210, polonium-210, radium-226, thorium-230, thallium, and mercury) and/or tissues were also computed. Correlations of ≥ |0.6| were considered to indicate a strong degree of correlation with an axis. Parameters that were highly correlated on an axis were considered to generally co-vary. Axes were interpreted when they accounted for ≥ 10% of the variation in the data. Using PCA, additional parameters were added to the list of COPCs initially identified using EvC 1 and EvC 2. To ensure PCA-identified results reflect measurable and meaningful signals, rather than artifacts caused by data values measuring below the RDL, analytes were advanced to COPC status from PCA only if they also satisfied EvC 1 (≥10% detections in the reporting period).

The following table lists the final COPCs specifically addressed in this report and the detailed screening process is outlined in Table 4.6-9:

COPCs
Metals and Trace Elements
Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Copper
Iron
Lead
Manganese
Molybdenum
Nickel
Selenium
Silver

Strontium Thallium Titanium Uranium Vanadium

Detailed Data Analysis

Normal Ranges

The incorporation of COPCs in fish tissues in fish from Sink Reservoir, Vulture Lake, Kewen Lake, and McClean Lake east basin during the operational period (i.e., after 1998) was evaluated by comparing measured tissue concentrations with "normal" ranges of tissue concentrations. NRs were computed using fish from Sink Reservoir, Vulture Lake, Kewen Lake, and McClean Lake east basin collected during the baseline period (i.e., up to 1998), in addition to fish from Konner Lake, Henday Lake and Mallen Lake (all available years). NRs here are defined as the region enclosing 95% of observations (per Kilgour et al. 2017). The NR is estimated with error when small sample sizes are involved (the case here, and generally in biological surveys). Tolerance regions can be estimated that provide confidence regions (intervals) for the estimated limits of the 95% region. Here, we computed tolerance regions for the lower 2.5th and upper 97.5th percentiles for indices of community composition using the following formulae:

The tolerance limit for the pth percentile is:

$$\bar{x} \pm k \bullet sd$$

Where:

$$k = \frac{t_{\gamma,N-1,\delta}}{\sqrt{N}}$$

$t_{\gamma,N-1,\delta}$ is a non-central t-statistic (where $\gamma, N-1, \delta$ indicates the lower 5th or upper 95th percentile of the non-central t distribution

$$\delta = z_p \sqrt{N}$$

Z_p is the Z-statistic at the *p*th percentile

Here the 97.5th percentile of the data, Z = 1.96. The value δ depends on sample size, as then does the non-central statistic *t* statistic and ultimately k.

This exercise produces an inner and outer tolerance range calculated based on the sample size of "reference" data points. This range of values will generally enclose 95% of typical observations (i.e., here lake average tissue concentrations) (Kilgour et al. 1998). Any observed mean tissue concentration falling outside of the outer tolerance limit can be considered an indication of difference in tissue COPC concentration relative to reference.

Principal Component Analysis

Variations in PCA scores were examined similarly but in a multivariate context. Scores from the first two PCA axes were visualized in a scatterplot. A 95% confidence ellipse around the mean scores for baseline lake-

species-tissue combinations was generated (in R version 4.1.3). Lake mean scores falling outside the outer tolerance ellipse are an indication of a difference (enrichment) of tissue chemistry relative to what is observed in baseline fish.

Selenium

In addition to the above analyses, selenium fish tissue data available from the McClean Lake Operation LSA operational monitoring period, including data available from McClean Lake east basin (2016, 2021, and 2024) and from Collins Creek (2019 and 2022) were assessed against recent ERA predictions, several selenium tissue criteria, and site-specific guideline of 13 µg/g dw for fish flesh and 19 µg/g dw for fish ovaries (Table 4.6-8). The site-specific benchmark was established in Orano (2018a) based on the U.S. EPA (2016) egg/ovary dataset and following the U.S. EPA (2013) guidance on site-specific species detection procedure.

To compare a comprehensive dataset to the selenium fish tissue guidelines, concentrations of selenium from monitoring periods prior to 2018 were converted from a wet weight to a dry weight basis[6]. Sample specific percent moisture data were used to convert the data, while the mean percent moisture from each species from the previous year's dataset was used to convert data where individual sample percent moisture data were not available. Data were converted using the following equation:

Dry weight concentration = wet weight concentration*(100/(100-%moisture))

Although some ovary data are available from the current EP TID period, limited data were available historically. To provide a more comprehensive fish ovary dataset for an evaluation of the temporal changes, the fish muscle selenium concentrations were utilized to estimate egg-ovary concentration. This was accomplished as follows:

1. Using the paired ovary and muscle tissue data presented for northern pike (n=14) and white sucker (n=40) in the U.S. EPA (2015), linear regression can be used to estimate egg-ovary selenium concentrations. For northern pike, the regression equation is available from Muscatello et al., (2006[7]) to estimate egg-ovary selenium concentrations based on the known muscle tissue concentrations. For white sucker, the data presented in U.S. EPA (2015) can be used to estimate egg-ovary selenium concentrations[8].

2. The regression equations[9] derived for northern pike (n=9) and white sucker (n=9) by Muscatello (2009) specific to the McClean Lake site can be used to estimate egg-ovary selenium concentrations based on the known muscle tissue concentrations; or

3. The median conversion ratio approach can be used as per the U.S. EPA (2015). Using this approach, the muscle[Se]/ovary[Se] ratio can be calculated for each available paired data presented in the U.S.

[6] Fish tissue samples collected in 2018 and 2021 were analyzed and reported on a dry weight basis by the laboratory.

[7] Muscle[Se] = -1.13 + 0.74*Egg-Ovary[Se], r^2 = 0.97

[8] Egg-Ovary[Se] = 3.498 + 0.484*Muscle[Se], r^2 = 0.59

[9] Northern pike Muscle [Se] = -0.04 + 0.49*Egg-Ovary[Se], r^2 = 0.60; White sucker Muscle [Se] = -0.87 + 1.01*Egg-Ovary[Se], r^2 = 0.98

EPA (2015). The median value for each species can then be used as the conversion ratio; 1.875 of northern pike and 1.0 for white sucker.

All three approaches were completed to assess the range of estimated egg-ovary selenium concentrations.

4.6.2.6 Results

Detailed northern pike, white sucker, and lake whitefish chemistry data are provided in Appendix IV.6, Tables IV.6-6 to IV.6-12. COPC concentrations (mean and SD) for fish bone, flesh, gonad, kidney, and liver are presented in Tables 4.6-9 to 4.6-29.

Monitoring Performance

No erroneous data were identified in the fish chemistry dataset. As recommended in the previous EP TID, fish ovaries were retained and analyzed for selenium concentrations opportunistically (i.e., ovaries were retained from any female fish captured within the target sample size for the flesh and bone analysis) with the fish chemistry EMP through 2024. However, the sample size of ovaries remained limited throughout the current EP TID period; thus, additional conversions of flesh selenium to ovary selenium estimates were required to evaluate the potential effect of selenium of fish reproduction in the McClean Lake Operation receiving environment.

As mentioned previously, Orano specified performance criteria for all aspects of the monitoring program in 2024 to ensure data of sufficient quality and quantity are obtained to achieve EMP objectives in compliance with the CSA N288.4 requirements (CSA 2025). For small-bodied fish tissue monitoring, the performance criterion was set as 80% of the total planned samples or 13 of the 16 targeted samples for the 2022 EEM monitoring cycle. All targeted small-bodied fish samples (100%) were obtained during the current reporting period. The large-bodied fish tissue program performance criterion was also set as 80%, or 52 of the 65 targeted samples for 2024 EMP monitoring cycle. In cases where fish capture success was low, fishing effort was used instead, and the target set was a minimum of full 2 days and 1 night to reduce the risk of fish mortality. A total of 51 of the targeted samples were achieved in the current reporting period. Notably, no white sucker samples were obtained from Sink Reservoir or Vulture Lake during the current reporting period despite extensive fishing effort. Fishing effort included 136 hours of net sets over 3 days and 2 nights in Sink Reservoir and 55 hours of net sets in Vulture Lake over 2 days and 1 night. Fishing in Vulture Lake was ended after 55 hours of net sets due to the northern pike bycatch occurring.

General Fish Chemistry

Principal Component Analysis

The results of the PCA conducted are shown in Table 4.6-10. The first three axes each explained ≥ 10% of the total variation in analyte concentrations, with the fourth explaining 8%. The first axis represented a concentration gradient select parameters: high axis 1 scores corresponded with higher levels of cadmium, cobalt, lead, molybdenum, nickel, silver, and vanadium. The second PCA axis reflected variations in barium, copper, iron, strontium, selenium, radium-226, thorium-230, and total phosphorus: higher axis 2 scores corresponded with higher concentrations of copper, iron, and selenium and lower concentrations of barium, strontium, radium-226, thorium-230, and total phosphorus. The third axis reflected variations in concentrations of radium-226, thorium-

230, and total phosphorus (Table 4.6-10). The fourth axis explained less than 10% of the variation and was not further evaluated.

The remaining analytes did not correlate strongly with any of the three major principal component axes, reflecting that levels of these analytes were generally less variable than the other analytes across different tissue, species, and waterbodies. Based on the COPC screening criteria (Table 4.6-9) and PCA correlations (Table 4.6-10), the following compounds were selected for more detailed temporal examination: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, iron, manganese, molybdenum, nickel, selenium, silver, strontium, thallium, titanium, uranium, and vanadium. Total phosphorus, radium-226, and thorium-230 were not carried forward even though they did have high loadings on the first three axes because they did meet the criteria of EvC 1 and/or EvC 2.

Available Predicted fish flesh concentrations from the most recent ERAs were summarized alongside the results of the 2024 COPC data in Tables 4.6-11 to 4.6-31. Overall, predictions agreed with or over predicted COPC fish flesh concentrations for the current EP TID period. This was particularly evident with mean cobalt concentrations in Sink and Vulture Lake (Table 4.6-18). Mean selenium concentrations closely agreed with the 2018 ERA predictions, indicating the risk associated with selenium was captured within the more recent ERA.

The scatterplot of axis scores for fish tissue from reference lakes (Henday, Konner, and Mallen lakes) and baseline years (prior to 1998) of all lakes is presented in Figure 4.6-6. Bones of both northern pike and white sucker differed, generally, from that of flesh, kidney, liver, or gonad. Bone produced lower axis-2 scores than liver, kidney, and, gonad, reflecting generally lower concentrations of copper and iron and higher concentrations of strontium and barium in bone. Axis scores tended to be more variable in fish flesh than the other tissues. These general observations were consistent in both northern pike and white sucker.

Northern Pike

Variations in tissue chemistry of northern pike are illustrated in Figures 4.6-7 through Figure 4.6-10 (PCA results) and Figure 4.6-11 (temporal results) for Sink Reservoir, Vulture Lake, McClean Lake East and Kewen Lake. Except for selenium (discussed separately), northern pike COPC data available from McClean Lake east basin in 2024 was very similar to the Kewen Lake northern pike data (within two SDs of Kewen Lake mean).

In 2024, northern pike bone, liver, flesh, and gonad samples collected from Sink Reservoir produced PCA Axis 1 and 2 scores that fell within the inner tolerance ellipses (Figure 4.6-7). Northern pike kidney samples collected from Sink Reservoir in 2024 produced higher PCA Axis 2 scores that fell slightly outside the inner tolerance level (as observed in 2021) but within the outer tolerance level. At Sink Reservoir, several COPCs showed notable tissue-specific and temporal trends over time (Figure 4.6-11). Aluminum increased in gonads (within NR) and consistently exceeded the NR in kidneys. Arsenic remained above NR in flesh, gonads, and kidneys, with liver exceedances in 2008 declining since. Barium, cadmium, lead, and strontium showed decreasing trends across tissues. Cobalt was above NR in kidneys throughout and elevated in gonads but showed a slight decrease in 2024 to just below the NR. Copper mostly remained within NR, with earlier exceedances decreasing over time. Molybdenum declined in bones post-2015 but remained elevated in kidneys. Nickel consistently exceeded NR in liver, gonads, and kidneys. Thallium, uranium, and vanadium mostly exceeded NR particularly in gonads and kidneys and occasionally in other tissues, but thallium showed signs of decline in recent years. Other COPCs, including antimony, beryllium, chromium, iron, manganese, silver, and titanium, showed no consistent increasing trend and were generally within or near the NR by tissue.

Bone, liver, flesh, and gonad tissues of northern pike collected from Vulture Lake in 2024 have remained within the inner tolerance limits based on PCA axis 1 and 2 scores (Figure 4.6-8). In general, most metal and radionuclide concentrations remained within or near the NR, with a few notable exceptions (Figure 4.6-11). Aluminum stayed consistently within NR across all tissue types. Arsenic exceeded NR in kidneys from 2004 onward. Barium, cadmium, strontium, and lead showed decreasing trends across all tissues, with concentrations generally within NR. Cobalt and molybdenum were consistently above NR in kidneys since 2005 and 2002, respectively. Copper was largely within NR, with early kidney exceedances declining over time. Nickel exceeded NR in liver, gonads, and kidneys. Selenium remained elevated in all tissues, while thallium exceeded NR in gonads and kidneys but showed declining trends toward NR. Uranium showed early spikes above NR in some tissues but has since returned to within range, except for in gonads, where 2024 exceeded the NR. Vanadium consistently remained near or within NR levels. Other COPCs (antimony, beryllium, chromium, iron, manganese, silver, titanium) were generally stable within or near NR without sustained upward trends.

All 2024 tissue samples of northern pike from McClean Lake east basin produced PCA axis scores that fell well within the inner tolerance range of baseline values (Figure 4.6-9). The only notable temporal change in tissue concentrations from McClean Lake east basin involved lead in gonad tissues, nickel in gonad and kidney tissues, and selenium in flesh tissues, which exceeded the outer tolerance limits in 2024 and were at or near the outer tolerance limits in other tissue types. All other COPCs (e.g., antimony, beryllium, chromium, cobalt, copper, iron, manganese, molybdenum, silver, strontium, thallium, titanium, uranium, vanadium) were within NR across tissues (Figure 4.6-11).

All 2024 tissue samples of northern pike from Kewen Lake produced PCA axis scores that fell well within the inner tolerance range of baseline values (Figure 4.6-10). In general, COPC concentrations from Kewen Lake were noticeably lower than the other exposure lakes (Sink Reservoir and Vulture Lake). The only notable temporal change in tissue concentrations from Kewen Lake involved nickel in liver and kidney tissues, which exceeded the outer tolerance limits in 2021 but decreased to below the outer tolerance limits in 2024, all other COPCs remained within the baseline NR (Figure 4.6-11).

Selenium concentrations in flesh of northern pike in 2024 were highest in fish from Sink Reservoir (28 µg/g) and Vulture Lake (19 µg/g dw), exceeding the available site-specific benchmark of 13 µg/g (dw). However, concentrations were substantially lower in McClean Lake east basin (4.2 µg/g dw) and Kewen Lake (1.3 µg/g dw) (Table 4.6-25). Discussion on selenium results is presented separately further below.

Another interesting trend was observed for strontium, particularly in Northern Pike bone sample collected in 2024. Means were substantially higher in reference lakes (Henday Lake 150 µg/g dw and Konner Lake 170 µg/g dw; Table 4.6-27) than at exposure lakes. Within exposures, there was a downstream increase: Vulture Lake (12 µg/g dw) < Sink Reservoir (26 µg/g dw) < Kewen Lake (64 µg/g dw) < McClean Lake East (76 µg/g dw). Thus, while all exposure sites remain below reference, bone strontium rises from the upstream reservoirs (Vulture Lake/Sink Reservoir) to the downstream basins (Kewen Lake/McClean Lake East), consistent with a longitudinal gradient.

White Sucker

Variations in tissue chemistry of white sucker are illustrated in Figures 4.6-12 through Figure 4.6-15 (PCA results) and Figure 4.6-16 (temporal results). As previously mentioned, no white sucker samples were collected from Sink Reservoir or Vulture Lake in 2024, consequently, evaluations for the current EP TID period could not be

completed for these lakes and discussion presented is based on available historical dataset. Additionally, except for selenium (discussed separately), white sucker COPC data available from McClean Lake east basin in 2024 was very similar to the Kewen Lake data (within two SDs of Kewen Lake mean).

White Sucker were only collected from Sink Reservoir between 2008 and 2018. All tissue samples fell within inner tolerance limits, except for 2008 kidney samples, which produced slightly higher PCA Axis 1 and 2 scores (Figure 4.6-12). Based on historical data, COPCs that exceeded the outer tolerance limit include cobalt in 2018 gonad samples and 2015 liver samples, copper in kidney samples across all years, molybdenum in bone, kidney, and liver tissues, nickel in liver and kidney samples, selenium across all tissue types, and uranium in bone and kidney samples (Figure 4.6-16). All other COPCs have remained within the normal range of variation throughout the years in which samples were collected.

No white sucker samples were collected from Vulture Lake after 2008. Based on historical data, there were some indications from the PCA that white sucker from Vulture Lake had unusual chemistry. Bone of white sucker in 2005 produced higher PCA Axis 1 and 2 scores that caused it to fall outside of the outer tolerance limit (Figure 4.6-13). Further, kidney samples collected in 2002, 2005, and 2008 all produced higher PCA Axis 1 scores, falling between the inner and outer tolerance levels (Figure 4.6-13). Nickel concentrations in the kidneys and liver exceeded outer tolerance limits from 2002 to 2008, as did selenium concentrations in bone, flesh, kidney and liver tissues in 2005 and 2008 (Figure 4.6-16). Kidney samples also exceeded the outer tolerance limit for aluminum in 2002, copper in 2002 and 2005, and molybdenum from 2002 to 2008. Molybdenum was also above the outer tolerance limit from 2002 to 2008 in bone and liver. All other COPCs have remained within the normal range of variation throughout the years in which samples were collected.

Tissues in white sucker from McClean Lake east basin produced PCA axis scores that fell well within the inner range of baseline values for all tissue types in 2024, while liver and kidney samples from 2021 produced PCA axis scores that fell outside of the inner tolerance range of baseline values (Figure 4.6-14). The only notable temporal change in tissue concentrations from McClean Lake east basin involved aluminum and nickel in liver tissues, copper in gonad tissues, and selenium in gonad tissues, which exceeded the outer tolerance limits in 2024. Additionally, molybdenum notably decreased from 2021 to 2024 to values within the outer tolerance level for all tissue types. It is important to note that the apparent 2024 increases in liver aluminum and nickel were driven by single high results that inflated the mean (aluminum: 2, 4, 130 µg/g dw; nickel: 0.05, 0.07, 0.42 µg/g dw; n = 3). For gonad tissues, the 2024 means for copper and selenium were each based on a single sample (Copper: 4.9 µg/g dw; Selenium: 5.0 µg/g dw; n = 1), providing limited basis to infer a general tendency to exceed tolerance limits. All other COPCs remained within the baseline NR (Figure 4.6-16).

Tissues in white sucker from Kewen Lake produced PCA axis scores that fell well within the inner range of baseline values for all tissue types in 2024 (Figure 4.6-15). Similar to the northern pike, historical data showed that COPC concentrations from Kewen Lake were noticeably lower than the other exposure lakes (Sink Reservoir and Vulture Lake). The only COPCs that exceeded the outer tolerance limits in 2024 was arsenic, copper, molybdenum, and selenium and silver in gonad tissues exclusively (Figure 4.6-16).

Selenium concentrations for white sucker in 2024 was noted to only be elevated above baseline concentrations in gonad samples from Kewen Lake (see Figure 4.6-16). However, historical data also showed elevations in selenium in several tissues of white sucker in both Sink Reservoir (2008, 2011, 2015 and 2018) and Vulture Lake (2005 and 2008). Further discussion on selenium is presented below.

Selenium

Selenium is a micronutrient, nutritionally essential but potentially toxic at higher concentrations (U.S. EPA 2015). A variety of anthropogenic activities, including mining and irrigation are known to cause the mobilization of selenium into aquatic systems. Fish are considered to be the most sensitive aquatic organisms to selenium toxicity (U.S. EPA 2015). In 2004, the U.S. EPA first published draft guidelines for selenium in fish tissue, with a whole-body fish criterion of 7.91 µg/g dry weight and later updated to 8.5 µg/g dry weight in 2016 (U.S. EPA 2016). Selenium in fish eggs and ovaries are now considered the most appropriate measure of potential selenium toxicity in fish (DeForest et al. 2011; U.S. EPA 2015), although it is acknowledged that measurements in these tissues may not always be practical. The revised U.S. EPA guidelines include criteria for eggs/ovaries (15.1 µg/g dry weight), whole body (8.5 µg/g dry weight), muscle (11.3 µg/g dry weight), and water (U.S. EPA 2016). In Canada, DeForest et al. 2011 utilized the protocol for deriving national water quality guidelines for the protection of aquatic life as described by the (CCME 2007) to develop a fish ovary criterion (20 µg/g dry weight). In December 2017, ECCC and Health Canada (HC) released a screening assessment of selenium and its compounds and established a predicted no-effect concentration (PNEC) of 14.7 µg/g (dw) for fish eggs or ovaries and 6.7 µg/g (dw) in whole-body fish tissue (GC 2017). In 2018, Orano derived site-specific selenium benchmarks of 13 µg/g dry weight for fish muscle tissue and 19 µg/g dry weight for fish ovaries (Orano 2018).

A summary of the available McClean Lake Operation fish tissue selenium concentrations is presented on a dry weight basis in Table 4.6-32. Mean selenium concentrations in northern pike and white sucker flesh have increased in both Sink Reservoir and Vulture Lake since 2005, aside from a slight drop in egg/ovary tissues from 2021 to 2024 (39 to 34 µg/g dw, respectively; Table 4.6-32), but have remained similar through time in Kewen Lake (Table 4.6-32). Additionally, data available for northern pike from McClean Lake east basin during the current EP TID period have shown a recent decrease is selenium fish tissue concentrations between 2016 and 2024. During the current reporting period, mean concentrations of selenium in northern pike exceeded the site-specific benchmark of 13.0 µg/g (dw) and 19.0 µg/g (dw) for flesh and ovary respectively within Sink Reservoir (27.6 µg/g in muscle and 33.0 µg/g in egg/ovary) and Vulture Lake (18.6 µg/g in muscle and 34.5 µg/g in egg/ovary), but not at McClean Lake east basin (4.18 µg/g in muscle and 8.55 µg/g in egg/ovary) or Kewen Lake (1.34 µg/g in muscle and 6.2 µg/g in egg/ovary). Selenium concentrations in white sucker flesh from Sink Reservoir (12.8 µg/g) were just below the site-specific muscle benchmark in 2018 (the last sampling period they were collected) and were well below criteria in both McClean Lake east basin (2.6 µg/g in muscle and 5.0 µg/g in egg/ovary) and Kewen Lake (1.13 µg/g in muscle and 2.53 µg/g in egg/ovary) in 2024. No white sucker have been captured in Vulture Lake since 2008. Fish tissue selenium concentrations available for sentinel species assessed for the EEM fish population program (Section 4.6.3) were below the available criterion in both reference and exposure areas of Collins Creek (Table 4.6-32).

The available mean and 95th percentile predicted selenium concentrations in fish tissue are presented in Table 4.6-8. Mean muscle concentrations for northern pike and white sucker in 2024 (Table 4.6-25) were similar to the most recent selenium fish tissue predictions in Sink Reservoir, Vulture Lake, McClean Lake east basin, and Kewen Lake (Table 4.6-8). In some cases, concentrations marginally exceeded the 2018 mean predictions, but overall, remained below the 95th percentile predictions.

During the current EP TID period, ovary selenium concentrations were available for comparison to the available egg/ovary criteria. To provide historical context to the current values, historical selenium concentration in fish flesh were converted to an estimated fish ovary concentration. These data are summarized in Table 4.6-33 based on the three approaches described in the methods, the median ratio approach, using the regressions from

U.S. EPA 2015, and using regressions from Muscatello 2009. Detailed data are presented in Appendix IV.6, Table IV.6-14 including conversions.

As shown in Table 4.6-33, the 2024 estimates of northern pike egg-ovary tissue concentrations in Sink Reservoir and Vulture Lake exceeded the PNEC of 14.7 µg/g, the U.S. EPA criterion of 15.1 µg/g, and the DeForest et al. (2011) criterion of 20 µg/g as well as the site specific benchmark of 19 µg/g. Based on concentrations of selenium in fish flesh and using all three estimation approaches, mean egg/ovary concentrations were estimated to range from 26.66 to 51.8 µg/g and 34.9 to 38.82 µg/g, respectively (Table 4.6-33), which aligns with the corresponding measured selenium concentrations (33 µg/g and 34.5 µg/g respectively; Table 4.6-25). The estimates of northern pike egg-ovary tissue concentrations from McClean Lake east basin and Kewen Lake remained below all criteria across the entire operational period.

Estimates of egg/ovary concentrations of selenium in white sucker from Sink Reservoir and Vulture Lake could not be completed for the current reporting period due to lack of white sucker samples in 2024. Based on available historical fish flesh data and when using the median ration approach, the estimated ovary concentrations of selenium in white sucker consistently exceeded available criteria in Sink Reservoir and Vulture Lake (2008 only), but not with the other two estimation methods. Conversely, both measured and estimated ovary concentrations of selenium in white sucker remained below all egg/ovary criteria in McClean Lake east basin and Kewen Lake when all 3 estimation approaches were applied through out the entire operational period (Tables 4.6-32 and 4.6-33).

4.6.2.7 Monitoring Adjustments and Supplementary Study Recommendations

For future large-bodied fish monitoring programs, it is recommended that the performance criteria should be adjusted to a full 3 days and 2 nights of fishing effort in each waterbody if capture success is low.

The 2024 results indicate a slow-changing system: most tissues at McClean Lake East and Kewen Lake plotted within inner tolerance bands on the PCA, and exposure–reference differences for COPCs were generally within ERA prediction envelopes. The notable 2024 elevations are limited and tissue/site-specific (e.g., selenium in northern pike at Sink Reservoir and Vulture Lake; select metal exceedances in a small number of tissues), rather than pervasive across species, tissues, and lakes. Several metals show stable or declining trajectories. The overall fish monitoring scope is sufficient to provide early warning if guideline/ERA triggers are exceeded.

That said, fish sampling in McClean Lake (west and east basins) under the routine EMP and in Collins Creek (upstream and downstream of McClean Lake) under the EEM currently occurs more than a year apart. Aligning these timelines would provide spatially continuous data for the same period, and improving comparability (same year, methods, and reference derived tolerance limits) and interpretation of fish tissue data analysis (especially for selenium). Therefore, Orano recommends deferring the next EMP fish tissue sampling from 2027 to 2028 to align with Phase 9 EEM. Aligning routine EMP with EEM will ensure all biological monitoring occurs in the same year on a three-year cycle and enables evaluation of all endpoints under consistent operational and hydrological conditions, enhancing data interpretation. This adjustment will also allow more efficient use of resources, as all sampling can be completed within one coordinated campaign.

4.6.2.8 Summary and Conclusions

Fish tissue chemistry monitoring remains focused on the primary exposure area downstream of the McClean Lake Operation, including Sink Reservoir, Vulture Lake, and extending to Kewen Lake, representing a gradient from potential effects to background conditions. These monitoring locations align with areas of predicted impact as outlined in the 1991 and 1995 EAs (i.e., S/V TEMS), and subsequent ERAs (2016 and 2018). In 2024, multivariate analysis of northern pike and white sucker tissue chemistry demonstrated that most tissue concentrations remained consistent with baseline or reference conditions, particularly in Kewen Lake and McClean Lake east basin, where PCA scores fell within inner tolerance ranges and most COPCs were within normal ranges (NR). Some elevated concentrations of select COPCs observed were mostly limited to S/V TEMS. In northern pike from Sink Reservoir and Vulture Lake, selenium, nickel, thallium, and uranium remained elevated across multiple tissues in 2024, with selenium in pike flesh exceeding the site-specific benchmark at both locations. Similarly, aluminum, arsenic, cobalt, and molybdenum continued to exceed NR in specific tissues, with some elements showing gradual declines (e.g., cadmium, copper, lead, and barium). At Kewen Lake, northern pike tissue chemistry remained largely within baseline ranges, except for a prior exceedance of nickel in 2021, which declined below tolerance limits by 2024. White sucker data for 2024 were available only for Kewen Lake and McClean Lake east basin, with both sites showing low COPC concentrations and PCA scores within baseline ranges. Exceedances in 2024 white sucker samples were limited to arsenic, copper, molybdenum, selenium, and silver in gonad tissue. Overall, 2024 data reaffirm spatial trends observed in past sampling years, with localized elevations in metal and radionuclide concentrations persisting primarily in S/V TEMS.

The 2024 fish tissue data show continued trends in selenium concentrations, with levels in northern pike flesh and ovary samples from Sink Reservoir and Vulture Lake exceeding the site-specific benchmark and available toxicity criteria. Specifically, estimated selenium concentrations in northern pike ovaries in these lakes exceeded both the PNEC and U.S. EPA criteria, indicating potential reproductive risks. In contrast, selenium concentrations in McClean Lake east basin and Kewen Lake remained low and within expected ranges. Notably, McClean Lake demonstrated a decrease in selenium concentrations between 2016 and 2024, while Kewen Lake showed only minor fluctuations. The trends in CPUE of northern pike and white sucker suggest potential effects. CPUE values for northern pike in Sink Reservoir and Vulture Lake have decreased since their peak, particularly in 2021 and 2024, which could reflect impacts on the fish populations, potentially related to contaminants such as selenium. White sucker CPUE in Sink Reservoir has shown a decline since 2011, and though CPUE in Kewen Lake declined in 2018 and 2021, a marked resurgence in 2024 suggests that the population is recovering. These shifts in CPUE, alongside the elevated selenium concentrations in fish tissues from exposure lakes, underscore the importance of continued monitoring to assess both contaminant levels and fish population health.

The higher levels of contaminants measured in both northern pike and white sucker tissue samples from Sink Reservoir and Vulture Lake in 2024, relative to the reference values, reflect the influence of treated effluent on fish tissue COPC concentrations. The 1991 and 1995 EAs predicted potential incorporation of some heavy metals into Vulture Lake fish flesh and bone resulting in “moderate to major” effects limited to the lifetime of the operation (Minatco 1991; COGEMA 1995). The results presented here are consistent with the anticipated effects reviewed by the Joint Panel.

4.6.3 Fish Population

EEM biological monitoring programs are a requirement for metal mine operations in Canada under the amended MDMER of the Fisheries Act. One of the key components of this program is fish population investigations, which were most recently completed in 2022 in the McClean Lake Operation LSA.

4.6.3.1 Overview of Recent Studies and Data Gaps

Prior to MDMER Section 7 coming into force, consistent methodologies have been utilized for fish monitoring studies. A summary of the components of the 2002 field study which are pertinent to the most recent EEM study, along with a summary of the previous fish population monitoring results, are provided below (see AREVA 2006, 2009c, 2011b, 2014, 2017a, and Orano 2020 for complete details). Subsequent sections focus on the most recent 2022 fish population monitoring results as detailed in CanNorth and Kilgour (2023).

In 1999, small-bodied fish community surveys were conducted to examine the feasibility of completing small-bodied fish population surveys in several lakes within the primary exposure (Vulture Lake, McClean Lake east basin, and Kewen Lake) and reference (McClean Lake west basin, and Dwarf Lake) areas. Slimy sculpin and yellow perch *(Perca flavescens*) were captured in sufficient numbers in 1999 and were recommended as sentinel fish species for a future small-bodied fish monitoring program. A lethal small-bodied fish survey was conducted in 2002. The program included assessing survival (age), energy use (size at age, relative gonad size, and relative fecundity), and energy storage (condition and relative liver size) of yellow perch and slimy sculpin from reference and exposure areas. Capture success of yellow perch and slimy sculpin in the lakes sampled was poor in 2002; therefore, detailed analyses of the endpoints were limited to slimy sculpin captured in Collins Creek. The examination of slimy sculpin population characteristics upstream and downstream of effluent discharge from the S/V TEMS found several differences. Downstream exposed slimy sculpin were found to be younger, had smaller gonads, grew larger, were heavier (higher condition), and had larger livers than upstream reference fish. Though gonad weights tended to be lower for both males (not statistically significant) and females (statistically significant) downstream of McClean Lake, the magnitude of differences were less than 25% for both genders. Other differences included liver sizes (> 40% larger downstream for both males and females), and growth (+25% increase in carcass weight at age for downstream males and +48% for females).

Based on the results of the 2002 monitoring program and discussions with the TAP, the study design for the 2005 EEM program incorporated a slimy sculpin survey in Collins Creek at two reference areas and one exposure area. Because of concerns related to the sustainability of the monitoring program, a non-lethal survey was chosen. A minimum of 100 slimy sculpins (not including young-of-the-year, YOY) representing a broad range of size classes were sampled from each study area in Collins Creek using electrofishing techniques. In the initial study design, two reference areas were to be located upstream of McClean Lake. However, despite substantial fishing effort in suitable habitat in Collins Creek upstream of McClean Lake, a second reference area was not located. Therefore, a decision was made to pursue a far-field downstream location. Thus, in 2005 three locations were sampled: Collins Creek Upstream (Reference 1), Collins Creek near-field exposure (Exposure 1), and Collins Creek far far-field downstream that was utilized as an additional reference area (Reference 2) (Figure 4.6-17). Overall, based on CPUE (Table 4.6-4), slimy sculpin were more abundant in Collins Creek Exposure 1 and had higher energy use (larger YOY) and energy storage (larger condition) than the reference population. Relative abundance of YOY was also lower in the exposure area, but similar on an absolute basis.

In 2008, the proposed fish population sampling program replicated the 2005 survey and included a non-lethal slimy sculpin population survey at one upstream reference area (Reference 1) and one downstream exposure area (Exposure 1) in Collins Creek. However, during the non-lethal fish population survey, CPUE of burbot proved to be sufficiently high to sustain a lethal burbot fish population sampling program. The EEM guidance document (EC 2002) recommended completing fish population surveys on two species, thus, upon discussion with the TAP, a lethal burbot population survey was added to the 2008 EEM program. This included sampling 20 male and 20 female burbot from the upstream reference area and downstream exposure area in Collins Creek. Slimy sculpin and burbot (where available) were also collected from a second reference area (Umpherville River) and two far-field exposure locations in Collins Creek (Exposure 2 and Exposure 3) during the 2008 investigations (Figure 4.6-17).

In the 2008 slimy sculpin dataset, response parameters reflecting survival, energy use, and energy storage differed somewhat in the Collins Creek exposure areas relative to the two reference areas with differences indicating no net negative effects. Size-class distributions were significantly different in Collins Creek Exposure 2 compared to the size-class distribution for reference fish, suggesting that survival of YOY fish was potentially higher in exposure than reference areas. However, the other two exposure sampling areas (Exposure 1 and Exposure 3) did not differ significantly from both reference areas, suggesting the difference observed at Collins Creek Exposure 2, which is located at an intermediate distance from the treated effluent release, was not related to the McClean Lake Operation. Condition factor was modestly higher in each of the exposure area populations of slimy sculpin but observed variations in condition factor were within the NR of values of reference populations.

Similar to the slimy sculpin dataset, there were no effects on the 2008 burbot response patterns in the exposure area that were consistent with a net negative effect. Female burbot from Collins Creek Exposure 1 were similar to reference burbot in terms of survival, energy use, and energy storage parameters. Male burbot from Collins Creek Exposure 1 were significantly younger and had significantly larger gonads in comparison to the reference area. Female and male burbot in Exposure Area 3 had higher survival, were larger, and were in higher condition than fish elsewhere in the study.

Since the Phase 1 (2005) and Phase 2 (2008) studies identified consistent differences between reference and exposure effect endpoints, the operation was required to undergo an IOC study in 2010 (Phase 3). The IOC study tested thermal and nutrient enhancement hypotheses. The results of the IOC study supported the hypothesis that natural thermal differences between the reference and exposure areas were responsible for the differences in the effect endpoints. Subsequent to the submission of the Interim Interpretative IOC Report (AREVA 2011b), the operation was advised by ECCC and the TAP to return to periodic monitoring (AREVA 2013).

The Phase 4 EEM survey was completed in 2013, while the Phase 5 EEM survey was completed in 2016. The 2013 and 2016 fish population sampling programs included a non-lethal burbot and slimy sculpin survey conducted upstream (Reference 1) and downstream (Exposure 1) of the S/V TEMS (Figure 4.6-17). The CPUE of target species was higher in the exposure area as compared to the reference area. There were no differences between reference and exposure burbot and slimy sculpin with regards to survival and energy use (growth). While there was no difference found in energy storage (condition) for burbot, a 5% difference was found in slimy sculpin, which was below the CES of 10%. Insufficient numbers of YOY burbot and slimy sculpin were captured; therefore, there was no opportunity to determine differences in reproduction between the reference and exposure area for each species. The stability of exposure area fish over time suggested that much of the observed

differences were a function of the exposure area habitats being downstream of a lake environment, as determined in the 2010 IOC study.

The Phase 6 EEM was completed in 2019. In this Phase 6 program, fish were not sampled due to potential confounding factors (asymmetrical harvest of sentinel fish in the Exposure Area). Instead, a wild bivalve survey was completed using two species of fingernail clams (*Sphaerium nitidum, Pisidium casertanum*) collected from the reference and exposure areas of Collins Creek. Both species are well represented in both the reference and exposure areas and relatively easy to collect. The study of these two species of clam produced measures of survival, energy use (growth, reproduction) and energy storage (condition), similar to a fish population study. Differences in these required endpoints were statistically strong and detectable. Observed differences in *Sphaerium nitidum* were generally consistent with what has been reported for fish populations in the same system (i.e., increased growth, reproduction and condition of exposure area individuals). There was no indication from the assessment of *S. nitidum* and *P. casertanum that* the population performance of those two species was degraded as a result of exposure to effluent, especially considering the biomass of the two species was higher in the exposure area (Orano 2020). Therefore, routine monitoring was recommended for the Phase 7 EEM.

The most recent Phase 7 EEM fish population survey was conducted in 2022. That program design with results is provided below.

4.6.3.2 Study Design and Objectives

The objective of the 2022 EEM fish survey was to examine differences in growth, reproduction, survival, and condition of fish from areas exposed to treated mine effluent and reference areas. An “effect” is determined by a statistically significant difference in a measured endpoint between the fish from the reference area and the fish from the exposure area in two successive surveys (EC 2012). Historical data (from 2002, 2005, 2008, 2013, and 2016) have been incorporated into the data analyses to (1) increase the statistical power of the analysis and (2) provide greater ability to test for a change in the apparent natural differences before and after the 2010 IOC phase using BACI type analysis of variance (Orano 2021).The objectives were to then (1) compare populations in 2022 only, and (2) test for changes in fish the populations using the historical data.

The study design proposed that the sentinel fish species for the non-lethal population survey in 2022 would be slimy sculpin and burbot, based on prior biological monitoring studies and discussions with the TAP (Orano 2021). The study design proposed that sentinel species would be collected from a single reference area (Reference 1) and single exposure area (Exposure 1) on Collins Creek to identify possible differences between reference and mine effluent exposure fish. In 2022, there was a deviation from the planned study design due to substantial beaver activity, a deep pool and areas of fast-moving water were created, making for unsafe fishing conditions. Thus, only the wadable parts of the riffle section of Reference 1 were fished. As the target sample size of slimy sculpin was considered low after two days of fishing effort at Reference 1, another riffle area upstream of McClean Lake west basin (between the west basin and BM18C-1) was proposed and accepted by ECCC, designated as Reference 2 herein. Reference 2 was fished for two days. A third riffle area on Collins Creek upstream of Indigo Lake was approved by ECCC to help with efforts to achieve the target sample size (Reference 3) (Figure 4.6-17).

4.6.3.3 Field Data Collection Methods

Fish capture for the fish population survey was conducted via electrofishing in the exposure and reference areas in fall 2022.

A minimum of 100 non-YOY burbot and slimy sculpin, plus any YOY captured were processed for the fish population survey, representing a broad range of size classes were targeted. The following measurement endpoints were recorded:

- total body weight (± 1.0%);
- total length (± 1 mm); and
- external health (body form, skin, snout, eyes, gills, fins, and parasites).

In addition, 17 slimy sculpin and 15 burbot per sampling area, from a broad range of sizes, were kept for ageing via otoliths. Age was determined from otolith structures by North Shore Environmental Services in Thunder Bay, Ontario.

4.6.3.4 Data Analysis

Initial Screening

All fish collection records were reviewed for completeness and adherence to QA/QC requirements. Outliers and anomalous weight, length, and/or age values were assessed for potential field or laboratory error before statistical analysis. The fish population was then summarized using core endpoints (survival, body weight, and conditions) and non-core indices (total length).

Evaluation Criteria

The primary method used to assess the status of the fish population in the McClean Lake Operation LSA was to compare exposure and reference areas in accordance with the EEM Guidance Document (EC 2012), with emphasis on identifying differences in core and supporting fish monitoring endpoints. Secondary to that objective was assessing temporal trends in these endpoints in relation to reference and baseline data. The overall fish population monitoring design is a control–impact design, and because of consistency with the baseline study design, comparisons can also be made to pre-operational data.

The following EvCs were applied for fish population data analysis:

- EvC 1: Comparison to Reference Area Data – Differences between reference and exposure areas were assessed using ANOVA or ANCOVA ($\alpha = 0.05$). NR estimates were also used, where endpoint values from the exposure area were compared to the NR of variation derived from baseline and reference data (enclosing 95% of observations). Values outside the NR were considered unusual and potentially indicative of degraded habitat quality.

- EvC 2: Effect size and critical effect size comparison – Differences in fish population endpoints were expressed as EEM (CES; % difference) to determine biological relevance.
- EvC 3: Temporal trends – Time-series analysis was conducted to detect changes over the operational period, with differences in trends between reference and exposure areas interpreted in the context of potential effluent-related effects.

Interpretation of Age Classes

Burbot and slimy sculpin were classified as YOY or non-YOY on the basis of visual inspection of probability plots and histograms of length data for each sampling area (exposure and reference). Probability plots are plots of the standard normal deviate of a measure (length) in relation to the measured value. A normally distributed parameter will produce a straight line in such plots. A population of fish that has a single age class should have an appropriately normal distribution of sizes, producing a histogram with a single mode, and a straight line in a probability plot. A population with multiple age classes (and thus multiple size classes) will produce a histogram with multiple peaks (modes) and a probability plot that has multiple inflection points that indicate breaks between age classes. It is possible to distinguish YOY from non-YOY fish using this visual tool, but per Gray et al. (2002), separation of older age classes can be challenging because of variability in individual growth rates. Length frequency analysis was used to assign ages to fish for the 2022, in addition to fish from prior years.

Condition Factor

Condition factor (K) was computed for all fish using the following:

$$K = 10^5 \times \frac{body\ weight}{(fork\ length)^3}$$

Variations in condition factor (K) among sampling areas (and years) were examined visually with box plots.

Formal Statistical Tests

Formal statistical tests for EEM endpoints (i.e. survival, energy use and energy storage) are summarised on Table 4.6-34 which included use of Kolmogorov-Smirnov (KS) test and ANOVA/ANCOVA. All ANOVA and ANCOVA were carried out on log10 transformed data. All statistical analyses were performed in R (version 4.1.3). The significance level for the statistical tests was $\alpha = 0.05$. Previous results reported in the Phase 7 EEM (CanNorth and Kilgour 2023), carried out using the statistical software SYSTAT 13 were re-computed in R for consistency; small numerical differences are attributable to different software defaults (e.g., for KS tests: p-value computation and tie handling; for ANOVA: sums-of-squares definitions, variance-heterogeneity corrections, and post-hoc procedures), not to changes in the underlying data.

Where ANCOVA was used, a statistically significant interaction ($p < 0.05$) was used to infer that there are differences in the rate of change of the dependent variable with changes in the covariable (age, length or weight), between Reference and Exposure Areas. Where the interaction term was significant (i.e., $p < 0.05$), and is a large effect (i.e., when the inclusion of the interaction term explains an additional >2% of the variation in the "dependent" variable (Barrett et al. 2010)), the interaction was retained in the model and the observed effect size was computed at the largest and smallest values of the covariable common to both Reference and Exposure

populations (as per Lowell and Kilgour 2008). Where the interaction term was not significant, or not a large effect, effect sizes were computed for an average sized fish using least-squared means as per recommendations by Barrett et al. (2010).

Analysis of 2022 Data

Tests were carried out for 2022 fish only, aligning with the Phase 7 EEM (CanNorth and Kilgour 2023), to test the following:

1. H01: no differences between reference and exposure areas in 2022.

Tests carried out for the 2022 comparison utilized YOY and non-YOY fish (of all ages). Rejection of this null hypothesis implies a potential effluent related variation.

Multi-Year Analysis

Burbot had been collected in 2008, 2013, and 2016, while slimy sculpin had been collected in 2002, 2005, 2008, 2013, and 2016. Burbot were not present in reference and exposure areas 2002 and 2005 in adequate numbers for EEM purposes. These historical data allowed for assessment of multi-year null hypotheses testing for differences in time trends involving step changes such as:

- H02: no step-change in the reference-exposure difference in 2022, i.e., the difference in 2022 vs the differences in all prior years (averaged);
- H03: no step-change in the reference-exposure difference before 2016, i.e., the average difference in 2016 and 2022 vs the average of differences in all prior years.
- H04: no step-change in the reference-exposure difference in 2008, i.e., the differences in 2008, 2013, 2016, and 2022 vs differences in prior years (2002, 2005); and,
- H05: no step-change in the reference-exposure difference in 2005, i.e., the differences in 2005 through 2022 vs the difference in 2002.

Tests carried out using the historical datasets utilized YOY and non-YOY fish (of all ages), except for growth endpoints which were conducted on YOY and age 1+ fish only as these were the aged groups used for similar comparisons in previous phases of EEM (CanNorth and Kilgour 2023).

Rejection of any of these null hypotheses would indicate that there had been a change in the difference between reference and exposure populations, indicating either degrading or improving conditions. H02 would imply that the change in the difference was recent and potentially related to exposure in the most recent EEM period (i.e., between 2016 and 2022). Not all hypotheses could be tested for both burbot and sculpin endpoints, depending on the availability of comparable data among years.

Tests for Survival

Survival, or variation in size/age-class-distributions, was evaluated on the 2022 data only using a two-sample Kolmogorov-Smirnov test. Tests were run separately on YOY fish (length), non-YOY fish (length and age), and all fish combined (length) to compare differences between the reference and exposure areas.

Tests for Energy Use (Growth)

ANOVA/ANCOVA were applied to the 2022 dataset to test for differences in size-at-age (growth) by age class (YOY and non-YOY, as available). Consistent with EC (2012), body weight was treated as the core response and total length as a supporting response. For YOY (single age class), simple ANOVA tested reference–exposure differences in weight and length. For non-YOY, ANCOVA tested reference–exposure differences with age as a covariate (evaluating and retaining an area × age interaction only if slopes were non-parallel). Box plots of body weight and total length by age class were developed in order to visualize variations. The multi-year trends used ANOVA with contrast to test for variations in size of YOY fish and size of age 1+ fish only, as these were the age groups used for similar comparisons in previous phases of EEM and EP TID. In addition to the ANOVA's, the assessment of 2022 and multi-year trends also involved computing a NR for body weight and total length. The NR for weight and length of reference fish was computed as +25% of the highest annual mean, and -25% of the lowest annual mean.

Tests for Energy Use (Reproduction)

The relative (or percent) abundance of YOY fish was computed for both sampling areas. Confidence limits on those proportions were estimated as per equations in Zar (1984), and those limits were used to test for differences in % YOY for the 2022 data.

NRs (95% region) were computed for % YOY for slimy sculpin based on all years of sampling. Computations were per equations described above for benthos measures, and per Kilgour et al. (2017). None of the surveys of reference burbot populations produced any YOY burbot; therefore, the NR for %YOY burbot in the reference area was simply zero (0%).

Tests for Energy Storage (Condition)

ANCOVA was also used to test for variations in body weight at total length (i.e., condition), using weight at the response, length as the covariable, and area as the category (Table 4.6-34). The ANCOVA was carried out on YOY and non-YOY fish for both the 2022 and multi-year comparisons, as condition is not depended on the age covariable. Scatterplots of weight in relation to length, in addition to box plots of condition factor (K) were developed in order to visualize variations in condition among areas and across years.

Normal Ranges

In addition to the ANCOVA's, the assessment of 2022 and multi-year trends also involved computing a NR for condition factor and for percent of the population as YOY. The NR for condition factor (K) for reference area fish was computed as +10% of the highest annual mean K, and -10% of the lowest annual mean K.

Effect Sizes

Differences in “core” response parameters were computed using log-transformed 2022 data. Differences, therefore, were based on geometric means. Differences in geometric means were then re-expressed as percentages. Differences in logarithms are ratios in raw data.

4.6.3.5 Results

Monitoring Performance

No erroneous data or data gaps were identified in the fish population monitoring program in the current reporting period. As mentioned previously, Orano specified performance criteria for all aspects of the monitoring program in 2024 to ensure data of sufficient quality and quantity are obtained to achieve EMP objectives in compliance with the CSA N288.4 requirements (CSA 2025). The performance criterion specified for the small-bodied fish population program is based on completion of a maximum amount of fishing effort to achieve the target sample size. If the target samples size from the EEM specific study design is not achieved after 7 days of fishing effort per area, sampling effort can discontinue. The 2022 fish population program met this performance criterion, with the target sample size achieved within each area.

Non-lethal Burbot Survey

A total of 229 Burbot were processed, 104 from the reference area and 125 from the exposure area. Several YOY fish were collected from the reference area (n = 8) and exposure area (n = 31) as verified through the inspection of otoliths and length-frequency data. In the reference area, 96 non-YOY fish were processed along with 94 non-YOY fish from the exposure area.

Summary statistics for burbot in the reference and exposure areas are provided for YOY and non-YOY in Table 4.6-35. YOY burbot collected in 2022 from the reference area ranged in length from 82 to 118 mm in total length and between 3.21 and 14.82 g in body weight, with condition factor (K) varying between 0.51 and 1.32. YOY burbot from the exposure area ranged in length from 66 to 119 mm in total length and between 2.14 and 13.71 g in body weight, with condition factor varying between 0.40 and 0.86 (Table 4.6-35). Non-YOY burbot from the reference area in 2022 ranged in size from 120 to 411 mm, ranged in body weight from 8.2 to 248.5 g and had condition factor values ranging between 0.21 and 0.80 while non-YOY burbot from the exposure area ranged in size from 122 to 306 mm, ranged in body weight from 9.2 to 134.5 g, and had K values ranging between 0.35 to 0.75 (Table 4.6-35).

Age Classes

YOY and non-YOY burbot in 2022 were confidently identified through the analysis of probability plots (Figure 4.6-18) and length-frequency histograms (Figure 4.6-19). In the reference area, YOY burbot (age 0+) were between 82 and 118 mm, age 1+ were between 120 mm and 153 mm, age 2+ were between 155 and 176 mm, age 3+ were between 180 and 206 mm, 4+ were between 211 and 246 mm, 5+ were between 262 and 272 mm, 6+ were between 282 and 304 mm, the 7+ individual was 316 mm and the 8+ fish was 411 mm. In the exposure area, YOY burbot (age 0+) were between 66 and 119 mm, age 1+ were between 122 and 154 mm, age 2+ were

between 155 and 182 mm, age 3+ were between 185 and 209 mm, age 4+ were between 211 and 253 mm, no 5+ fish were captured and the one 6+ individual was 306 mm in total length.

Age classes used for analysis for all other years for burbot (2008, 2013, and 2016) are shown in Figure 4.6-19. There were no YOY fish in the reference area in 2008, 2013 and 2016. In 2008, the reference area fish < 135 mm were considered to be 1+ years of age, while in the exposure area, fish <120 mm long were considered to be YOY and fish between 121 and 150 mm long were considered 1+. In 2013, reference area fish between 117 to 150mm were considered to be 1+ years of age, while exposure area fish < 115 mm in length were considered YOY and fish between 116 and 135 mm were considered to be 1+ years of age. In 2016, fish from the reference area with total length between 116 and 149 mm were classified as being 1+ years of age, while fish from the exposure area with total length of between 123 and 145 mm were classified as 1+. Fish shorter than 123 mm were classified as YOY in the exposure area (Figure 4.6-19).

Survival (Size-Class Distribution, Age-Class Distribution)

Results from the Kolmogorov-Smirnov test assessing survival of YOY burbot (i.e., difference in size class distributions) collected in 2022 indicated that there was no significant difference amongst all YOY burbot between the reference and exposure ($p = 0.934$; Table 4.6-36). Results from the Kolmogorov-Smirnov test assessing survival of non-YOY burbot (i.e., difference in size class and age distributions) collected in 2022 indicated that there was no significant difference amongst all non-YOY burbot in terms of age ($p = 0.229$; Table 4.6-36) or length ($p = 0.279$; Table 4.6-36) between reference and exposure areas. Finally, when assessing survival of all burbot collected in 2022 (i.e., both YOY and non-YOY combined), results from the Kolmogorov-Smirnov test indicated no significant difference in survival (i.e., difference in size class) between reference and exposure areas ($p = 0.060$; Table 4.6-36).

Energy Use (Growth)

For YOY burbot, there was no significant difference in growth, in terms of both body weight and total length, between the reference and exposure areas in 2022 ($p = 0.292$ and 0.924, respectively; Table 4.6-36) as illustrated in Figure 4.6-20. There was a significant difference in body weight at age of non-YOY burbot between the reference and exposure areas in 2022 ($p < 0.001$, Table 4.6-36). Variations in weight at age of non-YOY burbot are illustrated in Figure 4.6-21. Fish from the exposure area were 22% heavier than fish from the reference area, based on least squared means. There was no significant difference in length (supporting variable) of non-YOY burbot between the exposure and reference areas in 2022 ($p = 0.796$; Table 4.6-36, Figure 4.6-21). The ANCOVA testing for differences in weight and length at age for non-YOY burbot showed that the interaction term between area and age was not significant, an thus the interaction was not retained and the reduced model is presented in Table 4.6-36.

Multi-year effects could not be tested on YOY burbot considering 2022 was the first monitoring year that YOY burbot were collected from the reference area. For multi-year comparisons of growth, analyses were restricted to YOY and 1+ fish, to remain consistent with previous EEM and EP TID phases. There were changes in the reference vs exposure difference among years, per hypotheses 2 and 3. Statistical testing indicated significant step-changes in the difference in total body weight and total length between reference and exposure areas. Specifically, a significant change in body weight was observed in 2022 relative to all prior years for total body weight (; $p = 0.009$; Table 4.6-37) but not total length (H02; $p = 0.696$; Table 4.6-37) as illustrated in Figure 4.6-22. A significant step-change was also evident beginning prior to 2016 and continuing through 2022 for both

body weight and total length (H03; p = 0.004 and < 0.001, respectively; Table 4.6-37). These results suggest that the reference-exposure difference in total body weight shifted measurably starting before 2016, with a further or sustained change evident in 2022 with heavier and longer fish found in the exposure area (Figure 4.6-22).

Energy Use (Reproduction)

In 2022, 8 YOY burbot were collected from the reference area while 31 YOY burbot were collected from the exposure area (Table 4.6-35). Variations in percent YOY burbot over time are presented in Figure 4.6-23. Confidence limits (95%) for percent of Burbot as YOY, based on samples, were (1) 3.9 % to 13.5% for the reference area and (2) 18.6 % to 32.0% for the exposure area. As there is no overlap in the confidence intervals, it seems the exposure area contained a higher relative abundance of YOY (i.e., higher reproductive success).

Energy Storage (Condition)

There was no significant difference in condition of YOY burbot between the reference and exposure areas (p = 0.081; Table 4.6-36), as illustrated in Figure 4.6-24 (see left panel). There was, however, a significant difference in condition of non-YOY burbot between the reference and exposure areas (p < 0.001; Table 4.6-36). Variation in condition factor between the exposure and reference areas is illustrated in the plot of body weight and length (Figure 4.6-24, see right panel). Burbot from the exposure area were approximately 21% heavier at length than burbot from the reference area, based on least-squared means (Table 4.6-36). The ANCOVA testing for differences in weight at length for both YOY and non-YOY burbot showed that the interaction terms between area and length were not significant, and thus the interactions were not retained and the reduced models are presented in Table 4.6-36.

The multi-year ANCOVA (Table 4.6-37) indicated that there were significant changes in the differences in condition of burbot between reference and exposure areas among years. Specifically, the difference in 2022 was larger than the average of the differences in 2008, 2013, and 2016 (H02; p = 0.043; Table 4.6-37). A significant step-change in condition was also evident beginning prior to 2016 and continuing through 2022 (H03; p < 0.001; Table 4.6-37). The box plot of K values in Figure 4.6-25 illustrates that the condition of burbot in the exposure area was similar to previous sampling years, while the condition of burbot in the reference area was modestly lower than observations in prior years. The median condition of exposure burbot in 2008, 2013, 2016, and 2022 was within the range of expected values for reference fish as indicated in the box plots (Figure 4.6-25).

Non-lethal Slimy Sculpin Survey

A total of 243 slimy sculpin were processed, 134 from the reference area and 109 from the exposure area. Several YOY fish were collected from the reference area (n = 38) and exposure area (n = 6) as verified through the inspection of otoliths and length-frequency data (Table 4.6-38). In the reference area, 96 non-YOY fish were processed along with 103 non-YOY fish from the exposure area.

Summary statistics for slimy sculpin in the reference and exposure areas are provided for YOY and non-YOY in Table 4.6-38. YOY slimy sculpin collected in 2022 from the reference area ranged in length from 30 to 47 mm in total length and between 0.29 and 1.08 g in body weight, with condition factor (K) varying between 0.73 and 1.78. YOY slimy sculpin from the exposure area ranged in length from 34 to 47 mm in total length and between 0.39 and 1.37 g in body weight, with condition factor varying between 0.55 and 1.32 (Table 4.6-38). Non-YOY

slimy sculpin from the reference area ranged in length from 50 to 133 mm and between 1.16 and 32.15 g in body weight, with condition factor varying between 0.76 and 1.77. Non-YOY slimy sculpin from the exposure area ranged in length from 53 and 122 mm and between 1.6 and 23.88 g in body weight, with condition factor varying between 0.61 and 3.46 (Table 4.6-38).

Age Classes

YOY and non-YOY slimy sculpin in 2022 were confidently identified through the analysis of probability plots (Figure 4.6-26) and length-frequency histograms (Figure 4.6-27). In the reference area, YOY slimy sculpin (age 0+) were between 30 and 47 mm, age 1+ were between 52 mm and 77 mm, age 2+ were between 79 and 99 mm, age 3+ were between 103 and 105 mm, 4+ were between 107 and 120 mm and 5+ were between 131 and 133 mm. In the exposure area, YOY slimy sculpin (age 0+) were between 34 and 47 mm, age 1+ were between 53 and 72 mm, age 2+ were between 74 and 88 mm, age 3+ were between 89 and 112 mm and age 4+ were between 117 and 122 mm.

Age classes used for analysis for all other years for slimy sculpin (2002, 2005, 2008, 2013, and 2016) are shown in Figure 4.6-27. There were no YOY fish in the reference area in 2002 or in the exposure area in 2013. In 2002, reference area fish between 51 and 67 mm were identified as 1+ whereas exposure area fish less than 45 mm were identified as YOY and between 56 and 74 mm were identified as 1+. In 2005, reference area fish less than 44 mm were identified as YOY and between 49 and 70 mm were identified as 1+ whereas exposure area fish less than 51 mm were identified as YOY and between 56 and 82 mm were identified as 1+. In 2008, reference area fish less than 39 mm were identified as YOY and between 48 and 64 mm were identified as 1+ whereas exposure area fish less than 53 mm were identified as YOY and between 55 and 82 mm were identified as 1+. In 2013, reference area fish less than 56 mm were identified as YOY and between 58 and 72 mm were identified as 1+ whereas exposure area fish between 58 and 80 mm were identified as 1+. Finally, in 2016, reference area fish less than 47 mm were identified as YOY and between 61 and 80 mm were identified as 1+ whereas exposure area fish less than 61 mm were identified as YOY and between 61 and 80 mm were identified as 1+.

Survival (Size-Class Distribution, Age-Class Distribution)

Results from the Kolmogorov-Smirnov test assessing survival of YOY slimy sculpin (i.e., difference in size class distributions) collected in 2022 indicated that there was a significant difference amongst all YOY between the reference and exposure ($p = 0.025$; Table 4.6-39). Results from the Kolmogorov-Smirnov test assessing survival of non-YOY slimy sculpin (i.e., difference in age distributions and size class) collected in 2022 indicated that there was no significant difference amongst all non-YOY slimy sculpin in terms of age ($p = 0.776$; Table 4.6-39) but there was a significant difference in terms of length ($p = 0.027$; Table 4.6-39) between reference and exposure areas. Finally, when assessing survival of all slimy sculpin collected in 2022 (i.e., both YOY and non-YOY combined), results from the Kolmogorov-Smirnov test indicated a significant difference in survival (i.e., difference in size class) between reference and exposure areas ($p < 0.001$; Table 4.6-39). The significant differences in length distributions observed in YOY, non-YOY, and all fish, can be collectively observed in Figure 4.6-26, where it is clear that fish from the exposure area are longer than those from the reference area.

Energy Use (Growth)

For YOY slimy sculpin, there was no significant difference in growth (in terms of body weight) between the reference and exposure areas in 2022 ($p = 0.069$; Table 4.6-39), as illustrated in Figure 4.6-28, where mean

weight of YOY sculpin in 2022 fell within the NR inner tolerance limit of weights of reference fish. There was, however, a significant difference in total length of YOY sculpin between the reference and exposure areas in 2022 ($p = 0.007$; Table 4.6-39) with exposure area fish being 16% longer than reference area fish, however mean length of YOY sculpin collected from the exposure area in 2022 still fell within the NR inner tolerance limit of lengths of reference fish (Figure 4.6-28). For non-YOY slimy sculpin, there was a significant difference in body weight at age between the reference and exposure areas in 2022 ($p = 0.029$, Table 4.6-39). Variations in weight at age of non-YOY burbot are illustrated in Figure 4.6-29. Fish from the exposure area were 9% lighter at age than fish from the reference area, based on least squared means. There was also a significant difference in length (supporting variable) of non-YOY slimy sculpin between the exposure and reference areas in 2022 ($p < 0.001$; Table 4.6-39), as illustrated in Figure 4.6-29, where fish from the exposure area were 4% shorter at age than fish from the reference area, based on least squared means. The ANCOVA testing for differences in weight and length at age for non-YOY slimy sculpin showed that the interaction terms between area and age were not significant, and thus the interactions were not retained and the reduced models are presented in Table 4.6-39.

As mentioned previously, multi-year comparisons of growth, analyses were restricted to YOY and 1+ fish, to remain consistent with previous EEM and TID phases. The multi-year ANOVA indicated that there was change in the difference in mean weight of YOY slimy sculpin from 2022 when compared to prior years (H02, $p = 0.014$, Table 4.6-40), with the difference between reference and exposure areas being much less pronounced in 2022 compared to prior years (Figure 4.6-30). There was a significant change in the difference in mean weight of YOY sculpin from 2016 to 2022 when compared to prior years (H03, $p < 0.001$, Table 4.6-40). Inspection of Figure 4.6-30 indicates that exposure area YOY have always been heavier than reference YOY, but that the difference in weight was less in 2016 and 2022 than in prior years. Finally, there was a significant change in the difference in mean weight of YOY slimy sculpin from 2008 to 2022 when compared to prior years (H04, $p < 0.001$, Table 4.6-40).

The multi-year ANOVA indicated that there was change in the difference in mean length of YOY sculpin from 2022 when compared to prior years (H02, $p = 0.009$, Table 4.6-40), with the difference between reference and exposure areas being less pronounced in 2022 compared to prior years (Figure 4.6-30). There was a significant change in the difference in mean length of YOY sculpin from 2016 to 2022 when compared to prior years (H03, $p < 0.001$, Table 4.6-40). Inspection of Figure 4.6-30 indicates that exposure area YOY have always been longer than reference YOY, but that the difference in length was less apparent in 2016 and 2022 than in prior years. Finally, there was a significant change in the difference in mean length of YOY sculpin from 2008 to 2022 when compared to prior years (H04, $p < 0.001$, Table 4.6-40).

The multi-year analysis, however, indicated a change in the difference in mean weight of 1+ sculpin from 2022 when compared to prior years (H02, $p < 0.001$, Table 4.6-40), with the difference between reference and exposure areas being much less pronounced in 2022 compared to prior years (Figure 4.6-31). There was no significant change in the difference in mean weight of 1+ sculpin in 2016 and 2022 when compared to prior years (H03, $p = 0.146$, Table 4.6-40), neither was there a change in the difference in mean weight in the last four years of sampling (2008 to 2022) and the first 2 years of sampling (2002 and 2005) (H04, $p = 0.699$; Table 4.6-40, Figure 4.6-31). Finally, there was a significant change in the difference of body weight between areas from 2002 to the last five years of sampling (H05, $p < 0.001$; Table 4.6-40, Figure 4.6-31), where the difference in body weight between areas observed in 2002 (i.e., exposure > reference) was much less pronounced across 2005 to 2022 (Figure 4.6-31).

There was no significant difference in growth rate (in terms of length) of 1+ sculpin in 2022 between the reference and exposure areas ($p = 0.520$; Table 4.6-40). The similarity in growth rates in 2022 is illustrated in Figure 4.6-31. The multi-year analysis, however, indicated a change in the difference in mean length of 1+ sculpin from 2022 when compared to prior years (H02, $p < 0.001$, Table 4.6-40), with the difference between reference and exposure areas being less pronounced in 2022 compared to prior years (Figure 4.6-31). There was no significant change in the difference in mean length of 1+ sculpin in 2016 and 2022 when compared to prior years (H03, $p = 0.464$, Table 4.6-40) neither was there a change in the difference in mean length in the last four years of sampling (2008 to 2022) and the first 2 years of sampling (2002 and 2005) (H04, $p = 0.520$; Table 4.6-40, Figure 4.6-31). Finally, there was a significant change in the difference of total length between areas from 2002 to the last five years of sampling (H05, $p < 0.001$; Table 4.6-40, Figure 4.6-31), where the difference in total length between areas observed in 2002 (i.e., exposure > reference) was much less pronounced across 2005 to 2022 (Figure 4.6-31).

Energy Use (Reproduction)

There were 38 YOY in the reference area and 6 YOY in the exposure area in 2022, based on length-frequency interpretation. The proportion of YOY in 2022 did differ significantly between reference and exposure areas (Figure 4.6-32). Percent of the catch as YOY was higher in 2022 than in prior years in the reference area but much lower in the exposure area. Confidence limits (95%) for percent of slimy sculpin as YOY, based on samples, were (1) 31.2 to 48.5% for the reference area and (2) 2.4 to 10.6% for the exposure area. As there is no overlap in the confidence intervals, it seems the Exposure Area contained a lower relative abundance of YOY (i.e., lower reproductive success).

Energy Storage (Condition)

There was no significant difference in condition of YOY or non-YOY slimy sculpin between the reference and exposure areas of Collins Creek in 2022 ($p = 0.446$ and 0.248, respectively; Table 4.6-39), as illustrated in Figure 4.6-33). The ANCOVA testing for differences in weight at length for both YOY and non-YOY slimy sculpin showed that the interaction terms between length and area were not significant, and thus the interactions were not retained, and the reduced models are presented in Table 4.6-39.

The multi-year analysis, carried out on all adult fish, indicated a change in the difference in condition of non-YOY sculpin from 2022 when compared to prior years (H02, $p = 0.002$, Table 4.6-40), with the difference between reference and exposure areas being less pronounced in 2022 compared to prior years (Figure 4.6-34). There was a significant change in the difference in condition of non-YOY sculpin in 2016 and 2022 when compared to prior years (H03, $p = 0.003$, Table 4.6-40) and a significant change in the difference in condition in the last four years of sampling (2008 to 2022) and the first 2 years of sampling (2002 and 2005) (H04, $p = 0.028$; Table 4.6-40, Figure 4.6-34). Finally, there was no significant change in the difference in condition in the last five years of sampling (2005 to 2022) and the first year of sampling (2002) (H05, $p = 0.236$; Table 4.6-40, Figure 4.6-34).

4.6.3.6 Monitoring Adjustments Recommendations

In comparing results from the fish population studies between the previous EP TID assessment (inclusive of studies up to 2021; Orano 2022) to the current EP TID assessment (addition of most recent 2022 study), some similar effects were observed as well as some changing and/or emerging effects. Condition in non-YOY burbot showed a persistent effect across both phases, with an increase from 7% to 21% in effect size between the

previous and current assessment, indicating consistently higher body weight at length in the exposure area. Reproductive differences also emerged in the current assessment, with YOY present in the reference area after none were caught in earlier years. No significant differences were found in survival (based on length frequency) for either year in burbot.

Slimy sculpin showed a persistent difference in length frequency distributions across both phases, with stronger significance in current assessment, however the direction was different. In the previous TID (Orano 2022), non-YOY slimy sculpin were longer in the reference area, whereas in the current TID, non-YOY slimy sculpin are longer in the exposure area. Total length in YOY slimy sculpin (supporting endpoint) showed consistent positive effects across both assessment periods, though the effect sizes declined from 22% to 16%. Condition effects in non-YOY fish diminished in the current assessment, and lower reproductive output in the exposure area was consistently observed in both phases.

Considering no confirmed large effects (i.e., > 25%; EC 2012) were observed in both the current EP TID as well as the previous EP TID assessment and that many of the observed effects have been previously explained in an Investigation of Cause study carried out in 2011 (AREVA 2011b), continued routine monitoring targeting the same fish species and age classes is recommended.

That said, fish sampling in McClean Lake (west and east basins) under the routine EMP and in Collins Creek (upstream and downstream of McClean Lake) under the EEM currently occurs in different years. Aligning these timelines would provide spatially continuous data for the same period, improving comparability and interpretation of fish tissue data analysis (especially for selenium) and providing additional insights into potential effects on the EEM downstream locations. Therefore, Orano recommends deferring the next EMP fish survey from 2027 to 2028 to align with Phase 9 EEM. This alignment will ensure all biological monitoring occurs in the same year on a three-year cycle and enable evaluation of environmental performance under consistent operational and hydrological conditions, enhancing data interpretation. This adjustment will also allow more efficient use of resources, as all sampling can be completed within one coordinated campaign.

4.6.3.7 Summary and Conclusions

The fish population data indicate that burbot and slimy sculpin in the exposure area showed species-specific and, in some cases, divergent responses in 2022. For burbot, fish in the exposure area were in comparatively good condition, with higher relative abundance of YOY and significantly higher growth and condition metrics (in non-YOY fish) in 2022 compared to the reference area. There were no significant differences in growth rates of YOY burbot in terms of both weight and length between the two areas. Non-YOY burbot from the exposure area were approximately 22% heavier and had condition factors about 21% higher, than reference area fish. Unlike previous years, there was a significant difference in reproductive output, with YOY burbot comprising a greater proportion of the population in the exposure area. Interestingly, 2022 was the first EEM year that YOY burbot were collected from the reference area, no YOY were collected in 2008, 2013, or 2016.

Step-change analyses indicated that these differences became more pronounced in 2022, suggesting either a recent shift or a continuation of improvements beginning prior to 2016. These observations are consistent with previous EEM rounds where burbot in the exposure area typically had equal or higher condition than those in the reference area, though the 2022 data show a clearer divergence.

In contrast, slimy sculpin exhibited signs of reduced reproductive success but increased survival in the exposure area in 2022. The proportion of YOY was significantly lower in the exposure area, suggesting potential effects on recruitment. In contrast, fish from the exposure area were generally longer than those from the reference area, indicating a shift in size structure consistent with enhanced growth and/or size-selective survival at the exposure area. Growth rates of YOY in terms of total length remained 16% higher in the exposure area, though the magnitude of this difference was less than in earlier years. Non-YOY slimy sculpin from the exposure area were approximately 9% lighter and 4% shorter at age, than reference area fish. However, multi-year analyses showed that several growth and condition metrics for both YOY and 1+ sculpin have undergone step-changes, with 2022 data generally indicating narrowing differences between reference and exposure areas. For non-YOY sculpin in 2022, condition (i.e., body weight at length) was significantly higher in exposure area fish relative to the reference area (4%); however, multi-year analysis has indicated the gap has reduced over time and values remain within the NR bounds established from historical reference data.

As in previous assessments, age class determinations relied on length-frequency analysis, supported by otolith data where available. While the separation of YOY and 1+ was considered reasonably confident, uncertainties remain for older age classes, particularly for sculpin. Nonetheless, the overarching conclusions from 2022 remain robust: burbot in the exposure area continue to show strong growth and condition performance, now coupled with improved YOY abundance; slimy sculpin, however, show signs of reduced YOY recruitment in the exposure area despite continued adequate growth and condition. These findings, supported by step-change testing, emphasize the importance of ongoing temporal comparisons, and suggest that while conditions for burbot may be improving, slimy sculpin populations could be experiencing subtle stressors affecting reproduction.

4.7 Supplementary Studies

Supplementary studies for the aquatic environment are typically conducted outside of the EMP and EEM were designed to be flexible in their timing and application. Previous supplementary studies which were completed in aquatic environment at the McClean Lake Operation before the current reporting period (2022 - 2024) are listed below:

- Sink Reservoir Fish Removal Program – 1997
- Elevated pH Investigation – 1999
- Plume Delineation - 2005
- Aquatic Macrophyte Chemistry – 2008
- Investigation of Cause (Phase 3 EEM) - 2010
- Benthic Invertebrate Chemistry - 2010
- Sediment Chemistry (Tessier Extractions) – 2011
- Sink Upper Compartment Sampling - 2011
- Fish Habitat Compensation – 1998-2012
- McClean Lake East Basin Fish Community and Chemistry Investigations – 2016
- Plume Delineation in McClean Lake East Basin – 2021

More detailed information about the above supplementary studies is provided in the 2023 EM DD (Orano 2023a), 2016 EP TID Volume 1 (AREVA 2016a), and 2022 EP TID Volume 1 (Orano 2022). The following sections outline supplementary aquatic studies implemented for the operation in 2022-2024.

4.7.1 2018-2023 University of Saskatchewan Research on Selenium Trophic Transfer

In 2018, Orano, in collaboration with the University of Saskatchewan (USask) Toxicology Centre, initiated a research and development project to fulfil the role of a selenium-related supplementary study. The project study design examined selenium trophic transfer in Vulture Lake and the potential differential trophic transfer due to incomplete mixing in McClean Lake east basin. The research included collection of metal and trace element data for benthic invertebrates and associated water, sediment, and periphyton data in Vulture and McClean lakes. Details of work completed, and collected data were presented in the 2022 EP TID Volume 1 (Orano 2022). The study was completed in 2023. The research team concluded that there was a low risk of adverse effects of selenium on aquatic receptors in McClean Lake. The research results were released via peer reviewed publications (Appendix IV.7-1). The study results have been used to validate Orano's monitoring approach and inform modelling for the 2025 ERA update (Orano 2025a).

4.7.2 2021-2022 Plume Delineation in McClean Lake East Basin

Plume delineation in the McClean Lake East Basin was first conducted in 2005 (AREVA 2006) and repeated in 2021-2022. The objective of these studies was to determine the spatial extent of the effluent mixing and exposure in McClean Lake. The most recent plume delineation study replicated the 2005 study which involved the measurement of specific conductance in the winter (under ice) and in fall (during the open-water season). The fall study was done in September 2021 and reported in the 2022 EP TID Volume 1 (Orano 2022). The winter study was done in March 2022 and its outcome was discussed in detail in Orano's response to CNSC comments on the 2022 EP TID update (Orano 2023b). Overall, the effluent patterns in the McClean Lake east basin were similar across the 2005 and 2021-2022 studies and the results demonstrated that:

- The treated effluent from the McClean Lake Operation enters the east basin of McClean Lake, mixes within the relatively shallow basin, and exits at the outlet to Collins Creek.
- The treated effluent remains within the east basin, without dispersing into the west basin.
- The more condensed plume is observed in the deepest areas of the east basin in winter.

The plume delineation results have been used to inform modelling for the 2025 ERA update (Orano 2025a).

4.7.3 2021-2023 Fox and Pat Lake Sediment Study

In 2021, Orano began a collaboration with the University of Saskatchewan, Department of Geological Studies, to evaluate the potential for COPC attenuation in Fox and Pat lakes. The objective of this project was to understand the geochemical characteristics of the sediments directly downstream of the TMF in more detail to improve contaminant transport modelling accuracy. Water collected from the JEB TMF was passed through columns containing sediments cores collected from nearby Fox Lake, Wallace Lake, and Pat Lake. To assess COPC attenuation capacities and mechanisms, influent and effluent water samples were collected at regular time intervals, while reacted sediment samples were collected following the experiment. Results show substantial

attenuation of As, Se, Mo, U, Ni and other COPCs by all lake sediments (USask 2025). However, sediment characteristics, including organic matter and mineral content, strongly influence attenuation mechanisms and capacities. Sediments with higher organic matter contents generally exhibited greater COPC attenuation capacities. Overall, this study demonstrates that lake sediments exhibit substantial capacity for COPC attenuation downgradient of the McLean Lake Operation.

4.7.4 2023-2024 Sink Upper Compartment Investigation

In 2023, Orano performed an investigation of gypsum deposition observed in the Sink Upper Compartment (SUC), wetland area located between the JEB treated effluent discharge pipeline and Sink Reservoir. Gypsum deposition within the SUC area raised concerns regarding potential impact on the contaminant attenuation capacity of the SUC area and validity of the ERA model performed based on the 2011 SUC sampling data (AREVA 2012b). The field work was completed by CanNorth in September 2023. It included delineation of visible impact of the effluent discharge in the wetland, limnology measurements, and sampling of the surface water and top 5 cm of the sediment or organic material in the SUC area. The water and sediment samples were submitted to the SRC Environmental Analytical Laboratory for further analysis (i.e., water chemistry, sediment chemistry, sediment particle size, Tessier extraction, and porewater chemistry) (CanNorth 2024a). The 2023 data obtained was compared to the results of the 2011 SUC sampling (AREVA 2012b) to evaluate potential changes to SUC properties overtime as a result of the gypsum deposition and used to confirm validity of the current ERA model.

The results showed that gypsum deposition only impacted 8% of the overall SUC surface area and minimal gypsum formation was occurring outside the gypsum deposition area. There were changes observed in water and sediment quality between 2011 and 2023; however, these changes were primarily reflective of the changes to effluent quality over time. Gypsum precipitation/dissolution seemed adequately modeled as the sulphate and calcium predictions fit well with the 2023 measured data, therefore confirming that the current model adequately accounts for gypsum precipitation over the time period (CanNorth 2024b). The study therefore suggests that there was no significant impact of gypsum deposition on the SUC properties.

Gypsum precipitation in the Sink area was considered in the 1991 EA (Minatco, 1991). It was predicted that gypsum deposition in the Sink Reservoir would be minor and localized near the treated effluent discharge point. The SUC investigation confirmed that these predictions remain valid. The collected data was used during the McClean Lake Operation 2025 ERA update (Orano 2025a).

4.7.5 2024 Aquatic Surveys at Candy Creek and Caribou Lake

Aquatic surveys were completed to collect current information on the aquatic environments in Candy Creek and Caribou Lake within the future McClean and Sue F mining footprints (Figure 4.7-1). The new data were needed to validate historical data, inform the mining design, and support regulatory application for the future McClean and Sue F deposits. The field surveys were completed from August to September 2024. Fish community surveys and limnology measurements were completed at both Caribou Lake and Candy Creek. Additionally, a hydrological survey and a quantitative habitat assessment to determine fish habitat suitability and fish passage was completed at Candy Creek. The results of the surveys completed for each waterbody are summarised below:

- **Caribou Lake** - Caribou Lake surveys showed that the lake was slightly acidic, with a low specific conductivity and was moderately oxygenated, with both DO and pH being outside the SEQG for aquatic

life. No fish were captured, which was consistent with previous fish surveys in this waterbody. There were no clear hydrological connections to any other waterbodies or watercourses that could provide fish passage into the lake from other known fish-bearing waters and the lake could likely freeze in the winter because of it's shallow depth. Caribou Lake is therefore unlikely to support a fish community year-round. The results of the Caribou Lake survey will be used to support the future mining application to develop the Sue F deposit.

- **Candy Creek** – Candy Creek survey results were presented in Orano's application for approval to proceed with the mining of McClean deposits using SABRE mining method (Orano 2025b). Overall, the results indicated that Candy creek had unfavorable water quality conditions (low oxygen and acidic), minimal fish presence (only 1 juvenile fish was caught at the inlet to Candy creek from Candy Lake), unsuitable spawning conditions and multiple barriers to fish passage (i.e. beaver dams). It is therefore unlikely that Candy creek would support a stable large-bodied fish population. Further aquatic studies including spring spawning and hydrological surveys were scheduled for spring 2025 to confirm fish usage of the creek all-year round.

4.7.6 2024 Aquatic Vegetation Surveys

In 2024, aquatic vegetation surveys were completed to detect aquatic plant species of conservation concern (SOCC) including federally listed species at risk, provincially listed rare plants and invasive species (Stantec, 2025). These surveys were conducted by Stantec from August to September when aquatic plants were mature and identifiable via reproductive and/or vegetative features in order to maximize the probability of detection of aquatic rare plant species (Species Detection Research Permit 24SD152). Surveys were conducted in accordance with the SMOE Species Detection Survey Protocol (SDSP): 20.0 Vascular Plant (SMOE, 2021) using the point intercept method to inventory submerged, floating-leaved, and emergent vegetation in the waterbody.

The surveys were conducted in the littoral zones of 10 waterbodies around the McClean Lake and Midwest LSAs. (Figure 4.7-2). Littoral zones were estimated using maximum depth tolerances of aquatic rare plants, bathymetric maps, and satellite imagery. Mapped littoral zones were gridded and individual grid blocks randomly selected. Grid sizes were selected to ensure that sample points were no more than 70 m apart and no closer than 25 m. A subsample of grid intercept locations was randomly selected, and 47 sample points were surveyed in total across all waterbodies (Figure 4.7-2). Aquatic vegetation was collected using either a pole- or rope-mounted rake samplers from the shoreline or while on board a watercraft. All equipment, including the watercraft, rake samplers, and sample buckets were decontaminated between waterbodies to prevent the potential spread of invasive species and pathogens. Data collected during the aquatic plant SOCC surveys included, Universal Transverse Mercator (UTM) coordinates, environmental conditions (i.e., temperature, cloud cover, and wind speed), representative photographs, and an inventory of observed aquatic vascular plant species. If a plant SOCC was detected, either at a sample point or incidentally along shorelines, occurrence data (UTM coordinates, abundance, and photographs) were recorded. Specimen of aquatic plants that could not be confidently identified in the field were collected in plastic bags, for later identification.

The results of the 2024 aquatic vegetation surveys are summarized in Tables 4.7-1 and 4.7-2. A total of 22 aquatic species were detected during the field program (Table 4.7-1). Two aquatic rare plant species were observed at the McClean Lake Operation LSA including water lobelia (*Lobelia dortmanna*) and water awlwort (*Subularia aquatica ssp. americana*). In total, eight rare plant occurrences were documented (Table 4.7-2; Figure 4.7-3). No federally legislated aquatic plant species or invasive aquatic plant species were detected during the

2024 surveys. The data collected from the survey was used to update the vegetation species list observed around the McClean Lake Operation area.

4.7.7 2024 Aquatic Vegetation and Sediment Sampling

Aquatic Vegetation and Sediment Chemistry sampling were completed to collect recent data to assess potential effects of the McClean Lake Operation activities on aquatic vegetation. Previous aquatic vegetation studies have been completed during baseline (1993) and operational period (2008). The 2024 sampling replicated the 2008 sampling which was documented in the 2016 EP TID Volume 1 (AREVA 2016a) and provided in Appendix IV.7-2. Sampling was conducted in the summer from August to September 2024 together with the 2024 aquatic vegetation surveys (Section 4.7.6). Pond-lily (*Nuphar variegata*) roots, shoots (i.e., stems and leaves with flowers/capsules removed), and the sediment adjacent to and beneath the roots were sampled at three exposure waterbodies (i.e., Vulture Lake at two locations, McClean Lake East Basin at the effluent diffuser, and Kewen Lake) and one reference waterbody (i.e., Konner Lake) (Figure 4.7-4). Five replicate samples were collected from each waterbody, i.e. twenty sediment samples, 20 pond-lily root samples, and 20 pond-lily shoot samples were collected, for a total of 60 samples. Sink Reservoir was also surveyed for pond lilies, but none were found and no samples collected. Samples were sent to SRC Environmental Analytical Laboratory for analysis of select metals and radionuclides. The 2024 data was evaluated as follows:

- Mean and standard deviations of the five samples per waterbody were computed for sediment, root, and shoot chemistry, respectively
- Mean exposure concentrations were compared to the reference mean data + 2 times the standard deviation for all substrate (i.e. sediment, roots and shoots)
- Temporal changes for roots and shoots were assessed by comparing 2024 data to the 2008 results where possible. This was completed for Konner, Vulture and Kewen Lakes. Comparison at McClean Lake East basin was not completed because this lake was not sampled in 2008.
- Additionally, sediment concentrations were compared to available SQVs and to the routine monitoring data collected in winter 2024 (Section 4.4).

The 2024 summary chemistry data are presented on Tables 4.7-3 to 4.7-5, while comparison over time is shown in Tables 4.7-6 to 4.7-8. The 2024 detailed chemistry data is also provided in Appendix IV.7-3. The results of the 2024 sampling were also used as inputs for the 2025 ERA update presented in 2025 EP TID Volume 2 (Orano, 2025a).

The results showed that COPCs concentrations in sediment, pond lily roots and shoots were generally below or within historical and reference data. Also, COPCs were generally higher and more variable in shoots than roots and sediment. Substrate specific results are discussed as follows:

- **Sediments** - The majority of the COPC concentrations in the summer 2024 sediment from exposure lakes were below the upper reference threshold (Table 4.7-3). The only exceptions were arsenic and molybdenum in Vulture Lake and molybdenum and nickel in McClean Lake east basin. In most cases, COPC concentrations decreased downstream the effluent discharge point, with Kewen Lake having the lowest concentrations. All summer 2024 concentrations were below applicable guidelines, with no exceedances for any COPC (Table 4.7-3). A comparison over time shows that sediment concentrations

from the summer 2024 sampling were the lowest when compared to the 2008 and winter 2024 sediment data (Table 4.7-6). The winter 2024 sediment concentrations were mostly the highest, likely because the monitoring samples were collected from the lake bottom, where most COPCs tend to settle and accumulate. In contrast, the summer 2024 samples were collected along the shallow lake shores.

- **Roots** – Pond lily roots COPC concentrations were mostly within reference range in McClean Lake east basin and Kewen Lake, except for molybdenum for both lakes and cobalt in Kewen Lake (Table 4.7-4). In contrast, most metals were elevated above the upper reference threshold in Vulture Lake, with the exception of copper, lead, and zinc. All radionuclides were below the reference threshold. Similar to the sediment chemistry data, the 2024 root COPC concentrations were generally much lower than 2008 concentrations, except for selenium which was higher in both reference and exposure lakes in 2024 (Table 4.7-7).

- **Shoots** – the COPC concentrations in pond lily shoots showed the most variability in 2024. Several metals in the exposure waterbodies were above the upper reference threshold while radionuclides remained within reference range (Table 4.7-5). Vulture Lake shoots generally had the highest concentrations, although there were a few COPCs where concentrations at waterbodies downstream were higher than at Vulture Lake (specifically copper in McClean Lake east basin and Kewen Lake and zinc in Kewen Lake). In terms of temporal change, the 2024 exposure shoot concentrations were generally lower than the 2008 concentrations for most metals, with slight elevations noted in arsenic, selenium, and radionuclides (except for thorium-230) in Vulture Lake and Kewen Lake (Table 4.7-8). In contrast, most metals concentrations at Konner Lake (reference) were slightly higher in 2024 than in 2008, while concentrations of most radionuclides (all but lead-210) were lower in 2024 than in 2008.

Overall, the 2024 sampling suggests that there have been no significant changes to aquatic vegetation observed since 2008 sampling.

4.7.8 2024 S/V TEMS Water Quality Monitoring Optimization

A review of the S/V TEMS water quality monitoring data was completed by Orano in 2024. Water quality data has been collected from the S/V TEMS from four monitoring stations throughout the operational period as follows: CM03 and WQ09E from Sink Reservoir and CM04 and WQ01E at Vulture Lake. The objective of this study was to identify monitoring optimization opportunities at both waterbodies.

Statistical comparisons of the dataset from the two paired stations at each waterbody was completed. For Sink Reservoir, CM03 was compared to WQ09E and for Vulture Lake CM04 was compared to WQ10E dataset. Additionally, an evaluation of water quality monitoring at the S/V TEMS in the context of the monitoring objectives was also completed. The detailed report on the S/V TEMS water quality data review is provided in Appendix IV.7-4.

The statistical analysis showed that the water quality data collected at the CM stations are representative of water quality collected at the WQ stations and provide a more conservative insight into the overall water quality of each waterbody.

The parameter list proposed monthly sampling at the CM stations was reviewed to ensure inclusion of all COPCs potentially associated with the S/V TEMS operation. It was confirmed that the proposed parameters meet the MDMER requirements for water quality monitoring and support future environmental performance and risk assessments. The review indicated several parameters (i.e., alkalinity, fluoride, silver, strontium, thallium, and dissolved oxygen) not listed in the 2023 EM DD but required under the MDMER or with water quality guidelines; these have been consistently measured by Orano as part of the surface water monitoring program (Section 4.3).

The following monitoring program optimizations are recommended:

- continue monthly monitoring at CM03 and CM04,
- remove WQ09E and WQ10E monitoring stations from the monitoring program, and
- update the EM DD parameter list to account for all parameters required under the MDMER water quality monitoring or with water quality guidelines.

These recommendations ensure that the overall objectives for water monitoring in the S/V TEMS are met while also achieving operational efficiency.

4.8 Overall Summary and Conclusions

Baseline monitoring of the aquatic environment in the McClean Lake Operation LSA collected sufficient data to provide a broad qualitative description of the environmental conditions within the LSA as well as a good foundation for the later adoption of robust operational phase monitoring programs. Since the initiation of mining and milling at the McClean Lake Operation, monitoring programs have been completed on regular cycles to meet various regulatory requirements. The primary monitoring programs include the EMP and EEM, which were initiated in 1999 and 2005, respectively.

Analysis of the EMP data indicates that although concentrations of some COPCs have exceeded applicable guidelines, water quality and sediment quality within the LSA, have remained below impact predictions outlined in the 1991 and 1995 EAs and generally agree with or are lower with predictions from the most recent 2016 and 2018 ERAs. The 1991 and 1995 EAs predicted moderate to major impacts on the biological environment within the S/V TEMS (Sink Reservoir and Vulture Lake). Subsequent EAs and ERAs supported these predictions, with negligible effects predicted to McClean Lake east basin and Collins Creek. The long-term benthic invertebrate community within lake depositional habitat has demonstrated that there has been a reduction in abundance and richness in Sink Reservoir and Vulture Lake during the operational period compared to baseline, but generally there are no differences over time or from the NR in McClean Lake east basin. Furthermore, in Collins Creek, depositional benthic invertebrate community data from the exposure area fell within the NR for the region and temporal variation was small. Overall, the monitoring results are consistent with predictions that effects would be negligible in McClean Lake east basin and Collins Creek.

Fish tissue monitoring has shown that some COPCs are higher in fish tissue from Sink Reservoir and Vulture Lake relative to reference values. IMean concentrations of selenium in northern pike tissue in Vulture Lake and Sink Reservoir have been increasing over time, and current selenium concentrations in ovaries are higher than egg-ovary criteria. The 1991 and 1995 Joint Panel EAs predicted the potential incorporation of metals into fish tissue and predicted “moderate to major” effects in Sink Reservoir and Vulture Lake over the lifetime of the operation. Additionally, the selenium concentrations generally agreed with predictions from the 2018 Selenium Review and Assessment Report. In contrast, selenium concentrations in McClean Lake east basin and Kewen

Lake remained low and within expected ranges. Notably, McClean Lake east basin demonstrated a decrease in selenium concentrations between 2016 and 2024, while Kewen Lake showed only minor fluctuations.

The fish population data collected as per MDMER EEM monitoring indicate that burbot and slimy sculpin in the exposure area showed species-specific and, in some cases, divergent responses in 2022. The main conclusions from the 2022 Phase 7 EEM are that burbot in the exposure area continue to show strong growth and condition performance, coupled with improved YOY abundance in 2022. Slimy sculpin show signs of reduced YOY recruitment in the exposure area despite continued adequate growth and condition. These findings, supported by step-change testing, emphasize the importance of ongoing temporal comparisons, and suggest that while conditions for burbot may be improving, slimy sculpin populations could be experiencing subtle stressors affecting reproduction.

In addition to the routine monitoring, eight supplementary studies have been implemented during the reporting period. The obtained data facilitates better understanding of the operation's impact on the aquatic environment and have been used to inform the 2025 ERA update.

The aquatic monitoring endpoints continue to provide valuable information related to the status of the aquatic environment downstream of the McClean Lake Operation. Orano recommends deferring the 2027 EMP fish survey to 2028 to align with Phase 9 EEM, which will improve data comparability and interpretation, provide insights into downstream effects, and enable more efficient resource use through a single coordinated sampling campaign. A supplementary sediment sampling in Candy and Bena Lakes is recommended to further assess the trends observed in surface water COPC levels. Further validation of the monitoring program was implemented based on the 2025 ERA update as presented in 2025 EP TID Volume 2.

4.9 References

AREVA (AREVA Resources Canada Inc). 2006. McClean Lake Operation Status of the Environment Report Assessment Period 2003-2005. Saskatoon, Saskatchewan. May 2006.

AREVA (AREVA Resources Canada Inc). 2008. Midwest Project Existing Environment Technical Information Document. October 2007. Saskatoon, Saskatchewan.

AREVA (AREVA Resources Canada Inc). 2009a. Caribou Project Environmental Impact Statement. February 2006 – Version 1 – Revision 2.

AREVA (AREVA Resources Canada Inc). 2009b. McClean Lake Operation Status of the Environment Report Assessment Period 2006-2008. Saskatoon, Saskatchewan. June 2009.

AREVA (AREVA Resources Canada Inc). 2009c. McClean Lake Operation Environmental Effects Monitoring 2008 Interpretative Report. June 2009. Saskatoon, Saskatchewan.

AREVA (AREVA Resources Canada Inc). 2011a. Midwest Project Environmental Impact Statement. September 2011.

AREVA (AREVA Resources Canada Inc). 2011b. McClean Lake Operation Environmental Effects Monitoring Program Investigation of Cause Interim Interpretative Report. June 2011.

AREVA (AREVA Resources Canada Inc). (AREVA). 2012a. McClean Lake Operation Technical Information Document. Environmental Performance. Part A. January 2012. Saskatoon, Saskatchewan.

AREVA (AREVA Resources Canada Inc). 2012b. Technical Memorandum: Sink Upper Compartment Sampling Report. February 2, 2012.

AREVA (AREVA Resources Canada Inc). 2013. McClean Lake Operation Proposed Study Design for the McClean Lake Uranium Mine Environmental Effects Monitoring Program Periodic Monitoring. April 2013.

AREVA (AREVA Resources Canada Inc). 2014. McClean Lake Operation Environmental Effects Monitoring 2013 Interpretative Report. May 2014. Prepared by AREVA Resources Canada Inc. in association with Canada North Environmental Services and Kilgour and Associates Ltd.

AREVA (AREVA Resources Canada Inc). 2016a. McClean Lake Operation Technical Information Document. Environmental Performance. Volume 1 of 2 – Environmental Monitoring. Version 3 Revision 0. May 2016. Saskatoon, Saskatchewan.

AREVA (AREVA Resources Canada Inc). 2016b. McClean Lake Operation Technical Information Document. Environmental Performance. Volume 2 of 2 – Environmental Risk Assessment. Version 3 Revision 0. September 2016. Saskatoon, Saskatchewan.

AREVA (AREVA Resources Canada Inc). 2017a. McClean Lake Operation Environmental Effects Monitoring Program 2016 Interpretative Report. Version 0 – Revision 0, May 2017

AREVA (AREVA Resources Canada Inc). 2017b. Correspondence: Huffman to Akhter; Re: McClean Lake Operation – Selenium Risk Management – Revision and Response to Comments. October 27, 2017.

BC WQG (B.C. Ministry of Water, Land, and Resource, Stewardship). 2023. Aluminum Water Quality Guidelines – Freshwater Aquatic Life. Water Quality Guideline Series, WQG-09-1. Prov. B.C., Victoria B.C.

Barrett, T.J., Tingley, M.A., Munkittrick, K.R., Lowell, R.B., 2010. Dealing with heterogeneous regression slopes in analysis of covariance: new methodology applied to environmental effects monitoring fish survey data. Environ Monit Assess 166, 279–291. https://doi.org/10.1007/s10661-009-1001-y.

Berkman, H.E., C.F. Rabeni, and R.P. Boyle. 1986. Biomonitors of Stream Quality in Agricultural Areas: Fish versus Invertebrates. Environmental Management, 10:413-419.

Boisclair, D., and W. C. Leggett. 1989. Among-population Variability of Fish Growth: I. Influence of the Quantity of Food Consumed. Canadian Journal of Fisheries and Aquatic Sciences 46:457–467.

Borcard, D., and P. Legendre. 2013. Review of the Pros and Cons of Available Indices Applicable to the EEM to Evaluate Changes in Benthic Invertebrate Community Structure in Response to Effluent Exposure. March 2013.

Burnett-Seidel, C., and K. Liber. 2013. Derivation of No-effect and Reference-level Sediment Quality Values for Application at Saskatchewan Uranium Operations. Environmental Monitoring and Assessment. 185(11): 9481-9494.

CanNorth (Canada North Environmental Services). 2014. The Variation in Particle Size Distribution Results between Two Methods – Technical Memorandum. April 22, 2014. Prepared for Cameco Corporation, Saskatoon, Saskatchewan.

CanNorth (Canada North Environmental Services). 2024a. McClean Lake Operation Sink Upper Compartment 2023 Field Investigations. Prepared for Orano Canada Inc., Saskatoon, Saskatchewan.

CanNorth (Canada North Environmental Services). 2024b. McClean Sink Upper Compartment Investigations and Gypsum Modelling. Prepared for Orano Canada Inc., Saskatoon, Saskatchewan. July 2024

CanNorth and Kilgour (Canada North Environmental Services and Kilgour & Associates Ltd). 2023. McClean Lake Operation, 2022 Environmental Effects Monitoring Interpretative Report – Phase 7 Periodic Monitoring. Prepared for Orano Canada Inc., Saskatoon, Saskatchewan.

CCME (Canadian Council of Ministers of the Environment). 2025. Canadian Environmental Quality Guidelines Summary Table. https://ccme.ca/en/summary-tables. Accessed April 2025.

CCME (Canadian Council of Ministers of the Environment). 2007. Canadian Environmental Quality Guidelines: A Protocol for the Derivation of Water Quality Guidelines for the Protection of Aquatic Life. Winnipeg (MB). Canadian Council of Ministers of the Environment. 37 p.

CSA (Canadian Standards Association). 2025. Environmental monitoring programs at nuclear facilities and uranium mines and mills. CSA N288.4:25.

COGEMA (COGEMA Resources Inc.). 1995. Midwest Project Environmental Impact Statement. August 1995. Saskatoon, Saskatchewan.

COGEMA (COGEMA Resources Inc.). 1997. McClean Lake Project Sink Reservoir Fish Removal Program. Prepared by Conor Pacific Environmental Technologies Inc. for COGEMA. Saskatoon, Saskatchewan.

COGEMA (COGEMA Resources Inc.). 2000. McClean Lake Annual Report 1999. Saskatoon, Saskatchewan.

COGEMA (COGEMA Resources Inc.). 2004. McClean Lake Operation Sue E Project Environmental Impact Statement. November 2004 – Version 1.

DeForest D.K., G. Gilron, S. Armstrong, and E.L. Robertson. 2011. Species Sensitivity Distribution Evaluation for Selenium in Fish Eggs: Considerations for Development of a Canadian Tissue-Based Guideline. Integrated Environmental Assessment and Management 7: 1-7.

Elliott, S.T. 1986. Reduction of a Dolly Varden Population and Macrobenthos after Removal of Logging Debris. Transactions of the American Fisheries Society, 115:392-400.

EC (Environment Canada). 2002. Metal Mining Guidance Document for Aquatic Environmental Effects Monitoring. Environment Canada, National EEM Office, Science Policy and Environmental Quality Branch, Ottawa, Ontario.

EC (Environment Canada). 2012. Metal Mining Technical Guidance for Environmental Effects Monitoring. Environment Canada, National EEM Office, Ottawa, Ontario.

Fryer, G., J. Lancaster, K. Ottenbreit, C. Metke, D. Cherniawsky, A. Griffiths, K. Foreman, and J. Mischkolz. (2022). Rare Vascular Plants of Alberta. 2nd Ed. The Alberta Native Plant Council, Edmonton, AB. 664 pp.

Gauch, H.G. Jr. 1982. Multivariate Analysis in Community Ecology. Cambridge University Press.

GC (Government of Canada). 2017. Screening Assessment: Selenium and its Compounds. Ottawa: Environment and Climate Change Canada & Health Canada. Catalogue number En14-303/2017E-PDF.

GC (Government of Canada). 2024. Federal Environmental Quality Guidelines Summary Table. Website: https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/federal-environmental-quality-guidelines-summary-table.html.

GS (Government of Saskatchewan). 1998. The Wildlife Act. Chapter W-13.12 of the Statues of Saskatchewan. Last amended 2020.

GS (Government of Saskatchewan). 2025. Saskatchewan Environmental Quality Guidelines for Freshwater Aquatic Life. Website: https://environment-quality-guides.saskatchewan.ca//. Accessed April 2025.

Gray M.A., A.R. Curry, and K.R. Munkittrick K.R. 2002. Non-lethal Sampling Methods for Assessing Environmental Impacts using a Small-bodied Sentinel Fish Species. Water Quality Research Journal of Canada, 37:195-211.

Grolemund, G and H. Wickham. 2011. Dates and Times Made Easy with lubridate. Journal of Statistical Software, 40(3), 1-25.

Hoke, R.A., J.P. Giesy, and J.R. Adams. 1990. Use of Linear Orthogonal Contrasts in Analysis of Environmental Data. Environ. Toxicol. and Chem. 9: 815-819.

Huebert, D. 2011. EEM – An Example of Why Experimental Design Matters. Abstract, Society of Environmental Toxicology and Chemistry, Prairie Northern Chapter, Annual Meeting, Winnipeg, 2011.

Jacques Whitford and COGEMA (Jacques Whitford and COGEMA Resources Inc). 2003. McClean Lake Operation Existing Environment Technical Information Document. September 2003. Saskatoon, Saskatchewan.

Joint Panel. 1993. Report of the Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan: Dominique-Janine Extension, McClean Lake Project, and Midwest Joint Venture. October.

Joint Panel. 1997. Report of the Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan: Midwest Uranium Mine Project; Cigar Lake Uranium Mining Project; Cumulative Observations, November.

Kassambara, A. and Mundt, F. 2017. Factoextra: Extract and Visualize the Results of Multivariate Data Analyses.

Kilgour, B.W., K.M. Somers, and D.E. Matthews. 1998. Using the Normal Range as a Criterion for Ecological Significance in Environmental Monitoring and Assessment. Écoscience, 5:542-550.

Kilgour, B.W., and D.R. Barton. 1999. Associations Between Stream Fish and Benthos across Environmental Gradients in Southern Ontario, Canada. Freshwater Biology, 41:553-566.

Kilgour, B.W., K.M. Somers and D.R. Barton. 2004. A Comparison of the Sensitivity of Stream Benthic Community Indices to Effects Associated with Mines, Pulp and Paper Mills and Urbanization. Environmental Toxicology and Chemistry, 23:212-221.

Kilgour, B.W., K.R. Munkittrick, C.B. Portt, K. Hedley, J. Culp, S. Dixit, and G. Pastershank. 2005. Biological Criteria for Municipal Wastewater Effluent Monitoring Programs. Water Quality Research Journal of Canada, 40:374-387.

Kilgour, B.W., K. Somers, T.J. Barrett, K.R. Munkittrick, and A. Francis. 2017. Testing Against 'Normal' with Environmental Data. Integrated Environmental Assessment and Management, 13:188-197.

Komsta, L. 2019. mblm: Median-Based Linear Models. URL https://CRAN.R-project.org/package=mblm.

Lemon, J. 2006. Plotrix: A Package in the Red Light District of R. R-News, 6(4): 8-12.

Liber, K., L.E. Doig, and S. L. White-Sobey. 2011. Toxicity of Uranium, Molybdenum, Nickel, and Arsenic to *Hyalella azteca* and *Chironomus dilutus* in Water-only and Spiked-sediment Toxicity Tests. Ecotoxicology and Environmental Safety, 74: 1171-1179.

Lowell, R., and Kilgour, B.W., 2008. Interpreting effluent effects on fish when the magnitude of effect changes with size or age of fish.

MacLaren and SRC (MacLaren Plansearch and Saskatchewan Research Council). 1979. Environmental Baseline Studies for Wolly McClean Lake Project Area. Interim Report No. 1. Prepared for Canadian Occidental Petroleum Ltd. Saskatoon, Saskatchewan.

MacLaren and SRC (MacLaren Plansearch and Saskatchewan Research Council). 1980. Environmental Baseline Studies for Wolly McClean Lake Project Area. Interim Report No. 2. Prepared for Canadian Occidental Petroleum Ltd. Saskatoon, Saskatchewan.

Matuszek, J.E. 1978. Empirical Predictions of Fish Yields of Large North American Lakes. Transactions of the American Fisheries Society, 107:385-394.

McLeod, A.I. 2022. Kendall: Kendall Rank Correlation and Mann-Kendall Trend Test. URL https://CRAN.R-project.org/package=Kendall.

Metal and Diamond Mining Effluent Regulations (MDMER). 2022. *The Fisheries Act* – Metal and Diamond Mining Effluent Regulations. SOR 22002-222. Ottawa, Ontario

Minatco (Minatco Ltd). 1991. McClean Lake Project Environmental Impact Statement. August 1991. 30706-1.

Morgan, C. and N. Ringler. 1994. Influence of Benthic Predatory Fish (*Cottus cognatus*) on Invertebrate Community Structure and Secondary Production in a Tributary of the Susquehanna River. Journal of Freshwater Ecology, 9:63-78.

Muscatello, J.R., P.M. Bennett, K.L. Himbeault, A.M. Belknap, and D.M. Janz. 2006. Larval Deformities Associated with Selenium Accumulation in Northern Pike (*Esox lucius*) Exposed to Metal Mining Effluent. Environ Sci Technol. 40: 6506-6512.Muscatello, J.R. 2009. Selenium Accumulation and Effects in Aquatic Organisms Downstream of Uranium Mining and Milling Operations in Northern Saskatchewan (Doctoral thesis). Retrieved from http://www.collectionscanada.gc.ca/obj/thesescanada/vol1/SSU/TC-SSU-02122009130012.pdf.

Muscatello, J.R. and D.M. Janz. 2009. Selenium Accumulation in Aquatic Biota Downstream of a Uranium Mining and Milling Operation. Science of the Total Environment, 407: 1318-1325.

Neill, R.M., and L. Hogben. 1938. The Food and Feeding of the Brown Trout (*Salmo trutta L.*) in Relation to the Organic Environment. Transactions of the Royal Society of Edinburgh 481-519.

Oksanen, J., Simpson, G., Blanchet, F., Friendly, M., Kindt, R., Legendre, P., McGlinn, D., Minchin, P. R., O'Hara, R. B., Simpson, G. L., Solymos, P., Stevens, M. H. H., Szoecs, E., and H. Wagner. 2020. Vegan: Community Ecology Package. R package Version 2.4-0. https://cran.r-project.org/package=veganOllech, D. 2021. seastests: Seasonality Tests. URL https://CRAN.R-project.org/package=seastests.

Orano (Orano Canada Inc). 2018. McClean Lake Operation Selenium Review and Assessment Report. Version 1. July 2018.

Orano (Orano Canada Inc). 2020. McClean Lake Operation 2019 Environmental Effects Monitoring Interpretative Report – Phase 6 Periodic Monitoring. June 2020.

Orano (Orano Canada Inc). 2021. Study Design for the McClean Lake Operation Environmental Effects Monitoring Program – Phase 7 Periodic Monitoring. December 2021.

Orano (Orano Canada Inc). 2022. McClean Lake Operation Technical Information Document 2022 Environmental Performance. Volume 1 of 1. Version 1 Revision 0. Orano Canada Inc

Orano (Orano Canada Inc). 2023a. McClean Lake Operation Environmental Monitoring Design Document. Version 4. December 2023.

Orano (Orano Canada Inc). 2023b. Correspondence: Searcy to Akhter Subject: 2022 McClean Lake Operation Environmental Performance - Technical Information Document – Responses to CNSC Staff Comments. Dated May 23, 2023.

Orano (Orano Canada Inc). 2024. McClean Lake Operation - 2022 Environmental Performance Technical Information Document – Response to SMOE Comments. Prepared by Orano Canada Inc. April 2024.

Orano (Orano Canada Inc). 2025a. Environmental Performance Technical Information Document Volume 2 of 2 – Environmental Risk Assessment. Version 1, Revision 0. December 2025. Saskatoon, Saskatchewan.

Orano (Orano Canada Inc). 2025b. Correspondence: Braithwaite to Bouris. Subject: Re: McClean Lake Operation – Mining McClean Deposit. Dated January 22, 2025.

R Core Team. 2024. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Reynoldson, T.B., W. Keller, K. Somers, G. Watson, and C. Brereton. 2003. The Development of an Invertebrate RCA Biomonitoring Network for Northern Ontario to Meet Metal-Mining EEM Requirements. Study design report, March 2003. Acadia University, Laurentian University, and INCO Limited.

Reynoldson, T.B., C. Logan, T. Pascoe, and S.P. Thompson. 2004. CABIN (Canadian Aquatic Biomonitoring Network) invertebrate biomonitoring field and laboratory manual. Environment Canada, National Water Research Institute.

Schindler, D.W. 1987. Detecting Ecosystem Responses to Anthropogenic Stress. Canadian Journal of Fisheries and Aquatic Sciences, 44:6-25.

SENES and TAEM (SENES Consultants Limited and Terrestrial and Aquatic Environmental Managers Ltd.). 1991. McClean Lake Project. Supporting Document II. Aquatic Environment. Prepared in Support of the McClean Lake Project Environmental Impact Statement for Minatco Ltd.

SKCDC (Saskatchewan Conservation Data Centre). 2025. Saskatchewan Taxa List. Regina, Saskatchewan. Retrieved from www.biodiversity.sk.ca/SppList.htm

Smith, B. and J.B. Wilson. 1996. A Consumer's Guide to Evenness Indices. OIKOS. 76: 70-82.

SMOE (Saskatchewan Ministry of Environment). (2021). Species Detection Survey Protocol: 20.0 Vascular Plant June 2021 Update. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, SK. Available at: https://publications.saskatchewan.ca/#/categories/2069. Accessed December 2024.

SMOE (Saskatchewan Ministry of Environment). (2025). HABISask Online Mapping Application. Available at: https://gisappl.saskatchewan.ca/Html5Ext/?viewer=habisask. Accessed January 2025.

Stantec (Stantec Consulting Ltd.) (2025). McClean Lake Operation Flora Inventory Update Report. Prepared for Orano Canada Inc., Saskatoon, Saskatchewan. January 2025.

ter Braak, C.J.F. 1992. CANOCO. A FORTRAN program for Canonical Community Ordination. Microcomputer Power, Ithaca, New York, USA.

TAEM (Terrestrial and Aquatic Environmental Managers Ltd). 1989. Aquatic Biological Resources of the McClean and JEB Project Areas, Saskatchewan. Prepared for Total Minatco Limited.

TAEM (Terrestrial and Aquatic Environmental Managers Ltd). 1990. Results of the 1989 Aquatic and Wildlife Field Programs for the Wolly Joint Venture Uranium Project, Draft Report. Prepared for Total Minatco Limited.

TAEM (Terrestrial and Aquatic Environmental Managers Ltd). 1991. Results of the 1990 Aquatic Field Program for the McClean Lake Uranium Project. Prepared for Minatco Limited, Saskatoon, Saskatchewan.

Thompson, P.A., J. Kurias, and S. Mihok. 2005. Derivation and Use of Sediment Quality Guidelines for Ecological Risk Assessment of Metals and Radionuclides Released to the Environment from Uranium Mining and Milling Activities in Canada. Environmental Monitoring and Assessment, 110:71-85.

U.S. EPA (United States Environmental Protection Agency). 1989. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities.

U.S. EPA (United States Environmental Protection Agency). 2004. Draft Aquatic Criteria for Selenium. Office of Water, Office of Science and Technology, U.S. EPA, Washington, DC.

U.S. EPA (United States Environmental Protection Agency). 2013. Revised Deletion Process for the Site-Specific Recalculation Procedure for Aquatic Life Criteria. EPA-823-R-13-001. April 2013.

U.S. EPA (United States Environmental Protection Agency). 2015. Draft Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater. July 2015.

U.S. EPA (United States Environmental Protection Agency). 2016. Aquatic Life Ambient Water Quality Criterion for Selenium in Freshwater 2016 Fact Sheet. EPA 822-F-16-005. Washington, D.C.

USask (University of Saskatchewan). 2025. Attenuation of Constituents of Potential Concern by Lake Sediments: Laboratory column Study. Draft Project Report. Prepared for Orano Canada Inc. Saskatoon, Saskatchewan. May 6, 2025.

Venables, W.N. and Ripley, B.D. 2002. Modern Applied Statistics with S. Fourth Edition. Springer, New York. ISBN 0-387-95457-03

Waters, T.F. 1988. Fish Production-Benthos Production Relationships in Trout Streams. Pol. Archives fur Hydrobiologia, 35:545-561.

Wentworth, C. 1922. A Scale of Grade and Class Terms for Clastic Sediments. The Journal of Geology, 30 (5): 377-392.

Williams, C.B. 1964. Patterns and balance of nature. Academic Press, London, England.

W.P. Fraser Herbarium. (2006). Virtual Herbarium of Plants at Risk in Saskatchewan: A Natural Heritage. Department of Plant Sciences, College of Agriculture, University of Saskatchewan, Saskatoon, SK. Available at: https://biolwww.usask.ca/rareplants_sk/root/htm/en/index.php. Accessed January 2025.

Wrona, F. J., J. M. Culp, and R. W. Davies. 1982. Macroinvertebrate Subsampling – A Simplified Apparatus and Approach. Canadian Journal of Fisheries and Aquatic Sciences, 39:1051-1054.

Zar, J. H. 1984. Biostatistical Analysis. Second Edition. Prentice-Hall. Englewood Cliffs, New Jersey.

5 Terrestrial Environment

5.1 Introduction

The primary components of the terrestrial environment include soil, vegetation, wildlife, and wildlife habitat. Baseline studies completed in the McClean Lake Operation LAB were designed to characterize the terrestrial environment, predict impacts, and to focus the study design on key components for the monitoring program. During the initial EA (Minatco, 1991), key components of the terrestrial environment identified for monitoring included wetland plant communities and terrestrial vegetation and soil chemistry. The EMP study designs consist of exposure areas chosen within the predicted zone of influence of the McClean Lake Operation (as per the initial EA) and reference areas anticipated to be outside of the influence of the operation.

The 1991 and 1995 EAs predicted that groundwater dewatering from the McClean Lake Operation would significantly alter wetland plant communities, shifting treed bogs and fens to drier vegetation types. To monitor these changes, twelve permanent sampling plots were established in 1993, with half located near the predicted impact zone and half in reference areas. Monitoring was conducted in multiple years between 1998 and 2015, with detailed results documented in the 2016 EP TID Volume 1 (AREVA, 2016a). Contrary to predictions, observed changes in plant communities were attributed to natural variation rather than mining-related groundwater effects. Based on these findings and the end of dewatering activities, the wetland monitoring program was discontinued in 2017.

The terrestrial vegetation and soil chemistry monitoring program assesses contaminant levels in soil and plants due to airborne exposure from the McClean Lake Operation activities. A BACI study design was implemented with permanent sampling plots in reference and exposure areas, established before development and sampled regularly from 1994 onward. Soil, labrador tea, blueberry, and lichen are sampled from each permanent plot. Until 2015, sampling was conducted every three years, after which it shifted to a six-year cycle in accordance with the approved EMP. The 2021 monitoring results confirmed most COPC levels to be within the expected ranges, with some exceptions like arsenic and radium-226, and indicated that earlier ERA predictions tended to overestimate actual concentrations. The study design for the terrestrial vegetation and soil chemistry monitoring program, predicted impacts, and monitoring results are presented in Appendix V.1. The monitoring data has been used to inform the 2025 ERA update presented in the 2025 EP TID Volume 2 (Orano, 2025a). The next soil and vegetation sampling cycle is scheduled for 2027.

Thus, no terrestrial environment monitoring was completed during the current reporting period (2022-2024). Nevertheless, a number of supplementary studies were implemented in 2023-2024 to update information on wildlife and its habitat in the McClean Lake Operation area as described in Section 5.2.

5.2 Wildlife and Wildlife Habitat

Wildlife and wildlife habitat studies were conducted within the regional and LAB to collect qualitative baseline information on species diversity, richness, and relative abundance of VCs and other wildlife species. The surveys were initiated as early as in 1976 and included air photo interpretation with ground truthing, vegetation and soil surveys, aerial and ground surveys to estimate presence and abundance of various wildlife species, and small mammal tissue sampling for background concentrations of radionuclides and metals.

Although neither wildlife nor wildlife habitat were identified by regulatory agencies as components of the EMP during licensing, wildlife data is required for updates of the ERA in line with CSA N288.6 requirements. Table 5.2-1 provides a list of supplementary studies performed to update information about wildlife and its habitat within the operation area. Appendices V.2 and V.3 provide an overview of baseline and operational surveys performed before the current reporting period. Section 5.2.3 provides an overview of studies performed in 2022-2024. The collected wildlife data have been used to update the ecosite and habitat maps, a list of species present in the area, and inform the 2025 ERA update presented in the 2025 EP TID Volume 2 (Orano, 2025a).

5.2.1 Impact Predictions

The 1991 and 1995 EAs predicted the potential effect of the McClean Lake Operation on wildlife would be limited to a small area in comparison to the overall wildlife habitat available in the region. Total land disturbances relating to development of the operation including all roads and facilities was predicted to be less than 1% of the 250 km^2 mapped as part of the 1991 and 1995 EA. This along with the fact that no critical habitats were found to occur within the project footprint, resulted in the conclusion that no additional mitigative actions would be required for the McClean Lake Operation (Minatco, 1991). Effects related to land disturbance from the McClean Lake Operation were estimated to be approximately 1% of the LAB throughout successive EAs related to the operation (COGEMA, 2004; AREVA, 2009a). The Midwest EIS (AREVA, 2011) presented an additional 655 ha of disturbance for the Midwest Project, including transportation and utility corridor route. In total, this would represent less than 2.5% total disturbance from the combined McClean Lake, Caribou, and Midwest projects.

The Sue E EIS (COGEMA, 2004), which incorporated more advanced ERA methods, predicted no significant adverse environmental effects to terrestrial wildlife as a result of the Sue E Project. The Caribou Project (AREVA, 2009a) and Midwest Project (AREVA, 2011) EAs further built on the enhanced methodologies and predicted potential effects on dabbling ducks, mink (*Neogale vison*), and muskrat (*Ondatra zibethicus*) largely confined to the S/V TEMS and contained to individuals and not respective populations.

The most recent predictions related to the risk to wildlife from the McClean Lake Operation are presented in 2016 EP TID Volume 2 (AREVA, 2016b). Limited effects of COPCs were predicted for wildlife VCs, except for selenium. Potential effects from selenium were assessed under three selenium scenarios. Potential effects as a result of selenium were predicted for mallard (*Anas platyrhynchos*), muskrat, scaup (*Aythya* spp.), merganser (*Mergus merganser*), mink, and rusty blackbird (*Euphagus carolinus*), in at least one of the scenarios. It is noted that effects would likely be limited to the S/V TEMS area where habitat is limited, though in some cases, effects could extend to Kewen Lake. This assessment was further updated in 2018 as part of the Selenium Review and Assessment report (Orano, 2018). Based on the revised 2018 selenium forecast, there was a substantial reduction in the anticipated residual selenium risks as compared to what was presented in the 2016 EP TID Volume 2 (AREVA, 2016b). Based on the updated assessment, the risks associated with the continued processing of Cigar Lake ore at the McClean Lake Mill were predicted to be within the effects previously described as part of the provincial and federal EA process.

5.2.2 Land Cover Composition and Disturbance

The ecosite phase classification within the LAB incorporated previous terrestrial vegetation field studies that were conducted from 1978 to 1994 using aerial photography (Minatco, 1991) and refined the vegetation classifications using IKONOS satellite imagery and field survey data collected in 2003 and 2004. The IKONOS satellite imagery, and resulting ecosite phase classification, covered 70% of the LAB area (46,708 ha).

In 2023-2025, the ecosite classification was updated for the entire LAB (approximately 74,170 ha; Stantec, 2025a). This update was refined using the most recent remote sensing information, ground truthing data, a wide range of publicly available satellite imagery, and several spatial data sources, including:

- Saskatchewan forest ecosystem classification field data (Government of Saskatchewan, 2002),
- ecosite classification data from University of Saskatchewan (USask, 2016),
- the Global Vegetation Canopy Height Model (Lang et al., 2020),
- ecosite classification data collected during the 2023-2024 vegetation surveys (Sections 5.2.3.1 and 5.2.3.2),
- high-resolution (30-cm) aerial imagery (USask, 2025a),
- high-resolution (1-m) LiDAR elevation and canopy-height data (Orano, 2025b),
- Sentinel-2 satellite imagery (Copernicus, 2022),
- publicly available disturbance information (Government of Saskatchewan, 2023),
- historical and recent (1972-2024) wildfire disturbance extents (CFS, 2025), and
- the most recent ESRI world satellite imagery (ESRI).

The ecosite classification was aligned as closely as practically possible with the Boreal Shield ecosite classification for Saskatchewan's provincial forests (McLaughlan et al., 2010). Table 5.2-2 and Figure 5.2-1 provides an overview of the ecosite pattern within the LAB, which includes a total of 23 ecosite types. The coniferous forests dominate within the LAB (i.e., occupy more than 50% of the area). Areas of open water occupy 18.7% of the area, while wetland habitat containing bogs, fens, and swamps are less abundant (14.3%). The ecosite data have been used to outline habitat suitability for caribou, moose, and vegetation species of conservation concern (SOCC) and identify the dominant habitat types (Appendix V.4).

Areas classified as anthropogenically disturbed during the ecosite classification process, were estimated to be 1,130 ha, representing about 1.5% of the LAB (Table 5.2-2). This estimate includes anthropogenic impacts both related and unrelated to the McClean Lake Operation (e.g. Points Norths). The total developed area within the McClean Lake Operation and Midwest Joint Venture Surface Lease Areas are estimated to be 792 ha (Orano, 2025c). This represents 1.1% of the LAB and falls within predictions of the previous EAs of less than 2.5% of the LAB.

In 2022 and 2023, revegetation and reclamation activities were undertaken at the Sue C CWRP (Figure 5.2-2). Approximately 18 ha was hydroseeded in 2022-2023, using seed mixtures approved by the SMOE ((Table 5.2-3; SMOE, 2022). The 2022-2023 revegetated area accounts for approximately 18% of the overall Sue mining area planned for revegetation with grass (i.e. 99 ha area) under the preliminary decommissioning plan (Orano 2025). Review of seed certificates was completed prior to shipment to site to ensure that all seed mixtures were free of species listed under the Saskatchewan Weed Control Act and those prohibited under the Federal Seeds Act (Orano, 2023; 2024). Assessment of vegetation establishment success is planned for the next few years. The results will be used for planning future revegetation activities at the McClean Lake Operation.

5.2.3 Supplementary Studies

Supplementary studies for the terrestrial environment are typically conducted outside of the EMP and designed to be flexible in their timing and application. Previous supplementary studies which were completed in terrestrial environment at the McClean Lake Operation before the current reporting period (i.e., before 2022) are listed in Table 5.2-1. More detailed information about the previous supplementary studies is provided in the 2016 EP TID Volume 1 (AREVA, 2016a) and 2022 EP TID (Orano, 2022). The 2022-2023 studies were implemented to update the outdated wildlife and vegetation data via targeted surveys and collaborative research as outlined in the following sections.

5.2.3.1 2023 Rare Plant Checks

In 2023, rare plant checks were conducted to confirm historical records of rare plant populations at the McClean Lake Operation and Midwest Surface Leases.

Methods

The surveys were performed by CanNorth's qualified botanist between in June 2023 to capture early blooming species and August 2023 to target late-blooming species (Research Permit for Species Detection No. 23SD089).

All known rare plant locations within 100 meters buffer around the lease boundaries (Figure 5.2-3) were revisited and censored searched, focusing on habitats most likely to support rare plant species. In cases where a location's habitat appeared unsuitable, searches were expanded to identify nearby areas with appropriate conditions. For aquatic populations, shoreline habitats were surveyed by boat, using a grid search with survey points spaced 25 m apart.

Where historical populations were confirmed, spatial data (GPS waypoints and geotagged photographs) were collected to document the rare plant species, their habitats, and population extents. Population boundaries were marked using high-visibility markers to prevent future inappropriate interactions (e.g. trampling) with sensitive species. New incidental rare plants observations were also similarly recorded. If the anticipated historical rare plant population was not detected during the survey, further investigations were completed to determine possible causes (e.g. natural vegetation community dynamics, coordinate inaccuracy, etc.).

Forest ecosite classifications were also conducted alongside the rare plant surveys to characterize both current and adjacent habitats, following the ecosite classification system by McLaughlan et al. (2010). Full ecosite assessments were conducted in 10 m × 10 m plots where habitat was homogeneous. Within each plot, vegetation community composition and structure were recorded as well as abiotic attributes, such as organic layer depth, moisture regime, slope, aspect, and topographic position. Some locations were unsuitable for full ecosite surveys (e.g., microhabitats, aquatic habitats, or sites with anthropogenic disturbance); in these cases, preliminary habitat and ecosite data was recorded to allow for rough habitat classification.

Additionally, the SABRE pad expansion area was visited to assess its potential as a rare plant habitat to inform application for the SABRE pad expansion approval (CanNorth, 2023).

Results

Results of the 2023 rare plant checks are summarized in Table 5.2-4. Eight rare plant species were observed, including Alaskan clubmoss (*Diphasiastrum sitchense*), English sundew (*Drosera anglica*), hairy butterwort (*Pinguicula villosa*), little yellow-rattle (*Rhinanthus minor ssp. minor*), long-beech fern (*Phegopteris connectilis*), moor rush (*Juncus stygius ssp. americanus*), water lobelia (*Lobelia dortmanna*), and western mountain-ash (*Sorbus scopulina*).

A total of 21 sites with previously recorded rare plant populations were surveyed (Table 5.2-4; Figure 5.2-3). Of the 23 historical rare plant occurrences, nine were confirmed, while 14 were not confirmed, due to factors such as errors in historical records, past misidentification of species, or natural causes (i.e. changes in hydrological regime shifts, vegetation dynamics, or herbivory). Additionally, nine new rare plant occurrences were incidentally discovered (Table 5.2-4). No signs of Orano's direct impact on the rare plant populations were observed at any location. Ecosite classification was completed for 10 locations and was used for further ecosite map refinement (Section 5.2.2). Finally, the SABRE pad expansion area was assessed as having a low potential to support rare plants, and no further surveys were deemed necessary for that area.

Summary

In summary, the 2023 rare plant checks verified historical rare plant populations and documented associated habitats, providing an updated information to support planning of future mining activities.

5.2.3.2 2024 Terrestrial Vegetation Surveys

In 2024, terrestrial vegetation surveys were completed to validate terrestrial ecosite mapping and detect species at risk, provincially rare plants, weeds, and invasive species (Stantec, 2025b).

Methods

The vascular plant surveys were conducted by Stantec over the course of two field visits in June and August to maximize the probability of plant SOCC detection by capturing both early and late blooming species (Species Detection Research Permit 24SD152). The ecosite validation surveys were also completed in August when plants were mature and identifiable via reproductive and/or vegetative features.

Terrestrial vegetation surveys were conducted on foot using a combination of transects and ecosite validation plots. Transects were used to survey rare plants, weeds, and invasive species, while the ecosite validation plots were used to characterize and validate ecosites that were preliminary outlined based on the remote sensing data. A total of 31 transects and 42 plots were established in specific ecosites and areas of special interest within and around the McClean Lake and Midwest LSA (Table 5.2-5; Figure 5.2-4). Locations were randomly selected prior to fieldwork commencement and were adjusted in the field as needed.

Rare plants vegetation surveys were completed in accordance with the SMOE Species Detection Survey Protocol (SDSP): 20.0 Vascular Plant (SMOE, 2021). Transects measured 100 m long by 5 m wide for forest, sparsely vegetated, wetland, and naturally disturbed sites, and 200 m long by 5 m wide for anthropogenically disturbed sites. Search speeds ranged from 0.5 to 1.3 kilometres per hour. Data collected included Universal Transverse Mercator (UTM) coordinates at the start and end of the transect, environmental conditions (i.e.,

temperature, cloud cover, and wind speed), representative photographs, and a list of observed vascular plant species. When a plant SOCC was encountered, occurrence data was collected including UTM coordinates, abundance information, phenology (i.e., buds, flowers, etc.), occurrence (i.e., patch) dimensions, and representative photographs. Spatial data was collected in accordance with the Saskatchewan Conservation Data Centre (SKCDC) Guidelines for Collecting Spatial Data During Vascular Plant Surveys (SKCDC, 2016). Occurrence data for observed weeds and non-native invasive plant species was also collected, including UTM coordinates, patch size, representative photographs, and density distribution as described in the Rangeland Health Assessment Native Grassland and Forest workbook (Saskatchewan PCAP Greencover Committee 2008). Incidentally observed SOCC, weeds, and non-native invasive plant species were also documented while travelling between survey locations. Vascular plants that could not be confidently identified in the field were collected for later identification, provided more than 50 individuals of the plant were present at the survey location. Photographs showing characteristic features were taken if fewer than 50 individuals were present.

Ecosite validation survey methods were adapted from the British Columbia Field Manual for Describing Terrestrial Ecosystems (GOBC, 2010) to support ecosite characterization following the Field Guide to the Ecosites of Saskatchewan's Provincial Forests (McLaughlan et al., 2010). Each plot equaled 400 m^2, with plot dimensions ranging from 20 m x 20 m (most forest and wetland sites) to 40 m x 10 m (narrow shorelines associated with waterbodies). Representative photographs were taken and spatial data collected. At each survey location, the presence and percent cover of each observed vascular plant species in each vegetation layer (i.e. trees, tall shrubs, low shrubs, herbaceous) were recorded. The total ground cover of vascular plants (excluding trees and shrubs >30 cm in height), bryophytes, lichens, bare ground, litter, and standing water was visually estimated. Tree and shrub heights and tree diameter at breast height (DBH) were recorded for one characteristic individual of each species present in each plot. Plots were classified to ecosite-level and disagreement with the pre-mapped classification recorded. Bryophytes, lichens, and above-ground macro-fungi with fruiting bodies were collected and submitted for post-field identification by discipline experts in a laboratory setting.

Results

A total of 178 terrestrial plant species were detected during the field program (Table 5.2-6). Subdivided by type, this total includes 128 vascular plant species, 35 lichen species, 11 bryophyte species, and four fungi taxa.

No federally legislated vascular plant, bryophyte, lichen, or fungi species at risk were detected during the 2024 surveys (Table 5.2-6). Ten vascular provincially rare plants species were detected, including northern lady-fern (*Athyrium filix-femina var. angustum*), Alaskan clubmoss, English sundew, soft-stem spikerush (*Eleocharis mamillata ssp. mamillata*), moor rush, Hickey's clubmoss (L*ycopodium hickeyi*), bog adder's-mouth orchid (*Malaxis paludosa*), labrador lousewort (*Pedicularis labradorica*), hairy butterwort, and little yellow-rattle. In total, 22 vascular rare plant occurrences were documented (Table 5.2-7). Additionally, 18 lichen and one liverwort rare species were also identified with a total of 26 unique occurrences across multiple sample sites.

Four non-native vascular plant occurrences were incidentally detected, including one noxious species and one nuisance species (Table 5.2-8). Bladder campion (*Silene vulgaris*) is designated as a noxious weed under the Saskatchewan Weed Control Act. Common dandelion (*Taraxacum officinale ssp. officinale*) is designated as a nuisance weed under the Saskatchewan Weed Control Act. Based on its known habitat preferences, bladder campion is unlikely to act as an invasive species in forested and wetland areas within the surveyed area; however, it may spread to other anthropogenically disturbed sites. The minimal presence of the common dandelion suggests that common dandelion is unlikely to act as an invasive species in mature forest stands and

wetlands within the surveyed area, but potential exists for spread within anthropogenically and naturally disturbed sites.

Results of the terrestrial ecosite validation surveys showed that 31 of the 42 plots matched the preliminary ecosite classifications, while the remaining 11 did not align with the desktop data. The most abundantly detected species included woody plants that occur in multiple vegetation layers, common species, and mat-forming herbaceous plants. Ten vascular plants including black spruce (*Picea mariana*), jack pine (*Pinus banksiana*), leatherleaf (*Chamaedaphne calyculata*), blueberry (*Vaccinium myrtilloides*), common labrador tea (*Rhododendron groenlandicum*), Alaska paper birch (*Betula neoalaskana*), tamarack (*Larix laricina*), green alder (*Alnus viridis ssp. crispa*), balsam willow (*Salix pyrifolia*), and beaked sedge (*Carex rostrata*) were detected during the ecosite validation survey. Results were used to update the ecosite classification (Section 5.2.2).

Summary

Overall, the 2024 terrestrial vegetation surveys indicate diverse plant communities within the McClean Lake Operation LAB, with variation in species richness and vegetation structure strongly influenced by ecosite type and level of disturbance. Although several provincially tracked species were observed, no federally or provincially legislated species at risk were recorded.

5.2.3.3 2024 Semi-Aquatic Furbearers Surveys

The 2024 semi-aquatic furbearer surveys were conducted to document the occurrence and distribution of four target species namely North American beaver (*Castor canadensis*), American mink, muskrat, and river otter (*Lontra canadensis*) within the McClean Lake and Midwest LSAs.

Methods

The surveys were performed by CanNorth in August 2024 (Research Permit for Species Detection No. 24SD257). Timing of the survey was designed to maximize detection, occurring after completion of the breeding season and dispersal of young (CanNorth, 2025b, 2025c, 2025d).

Semi-aquatic furbearer surveys were conducted along shoreline transects across 12 lakes and 3 watercourses using boat or on foot depending on site conditions (Table 5.2-9; Figure 5.2-5). Survey design was based on presence/absence inventory methods recommended by British Columbia Ministry of Environment, Land, and Parks (BCMOELP, 1998a, 1998b). Transect locations were selected to capture a variety of wetland habitat types (CanNorth 2025b, 2025c, 2025d).

Lake transects were surveyed by zodiac or canoe, while watercourse transects were surveyed on foot or by belly boat when canoe access was not possible. For smaller waterbodies, a complete circuit was completed, while partial shoreline surveys were completed on larger lakes or watercourses. Transects were travelled slowly to reduce disturbance and increase the probability of mammalian observations. Transects completed from a boat followed as close to the shoreline as possible to capture observations of animal sign, which are more common than direct visual observations of animals. Binoculars were used to scan the shoreline closely for signs of activity. Areas of high habitat potential or locations with substrate conducive to preserving mammalian tracks (sandy beaches, inlets, grass flats, etc.) were targeted for foot searches to maximize potential for detection.

Semi-aquatic furbearer signs were categorized by species and observation type (e.g., cuttings, dam, active lodge, inactive lodge, runway, scat, visual observation) and standardized between waterbodies by calculating the density of observations per kilometre of shoreline. Results were utilized to calculate several biodiversity indices both between species and between reference and exposure waterbodies, including species frequency (i.e. the percentage of sites where at least one sign was recorded), and relative abundance (i.e. number of observations per species divided by the total number of observations).

Results

Approximately 90 km of shoreline were surveyed across of 15 shoreline transects (Table 5.2-9; Figure 5.2-5). Observations of the semi-aquatic furbearer surveys are presented in Figures 5.2-6 to 5.2-13 and Table 5.2-10. In general, signs of all four target species were observed with a total of 155 observations recorded across all sites and the relative abundance of these four species were similar between survey areas (Table 5.2-10). It is important to note that this type of visual survey cannot confirm the absence of species that were not detected. Additionally, species such as muskrat, which share water features with North American beaver, tend to build smaller and less permanent features that may be less visible at certain times of the year or under specific water regimes.

North American Beaver

A total of 130 observations of North American beaver signs, including cuttings, dams, lodges, and runways, were recorded across the survey areas.

At the McClean Lake LSA, overall density in exposure waterbodies was 1.38 observations/km which is slightly lower that what was observed in reference waterbodies which is 1.97 observations/km (Table 5.2-10). Overall relative abundance was comparable between McClean Lake LSA exposure (86.4%) and reference (83.3%) areas. In terms of species frequency, beaver signs were observed in all locations, except for Caribou Lake.

For the Midwest LSA, the overall density was 1.17 observations/km, with Lake C2 having the highest density out of all 3 locations and South McMahon Lake having the lowest density of observations. In terms of species frequency, the beaver signs were found in all Midwest waterbodies, and the overall relative abundance was of 78%, which is lower than at the McClean Lake areas.

American Mink

A total of 13 observations of American mink were recorded across both the McClean Lake and Midwest LSAs. Mink signs included feeding sites, scats, and most notably, one visual detection along the South McMahon Lake's shoreline which is situated within the Midwest LSA. The Midwest waterbodies also recorded the highest observation density (0.28 observations/km) and highest overall relative abundance (18.8%), with Lake C1 having the highest density out of all 3 locations in Midwest LSA.

At the McClean Lake LSA, mink signs were observed at three exposure waterbodies (i.e. Fox Lake, Kewen Lake, McClean Lake East Basin) and two reference waterbodies (Collins Creek Upstream, and Konner Lake). Observation densities were similar between exposure (0.10 observations/km) and reference waterbodies (0.11 observations/km) while overall relative abundance was slightly higher in exposure areas (6.2%) compared to reference areas (4.8%) within the McClean Lake LSA (Table 5.2-10).

Muskrat

A total of 11 muskrat sign observations, including cuttings, runways, and scat, were documented exclusively within the McClean Lake LSA at two exposure locations, Collins Creek Downstream and Caribou Lake, and one reference location, Collins Creek Upstream (Table 5.2-10). Overall density in exposure waterbodies was 0.12 observations/km, which is slightly lower than what was observed in reference waterbodies at 0.28 observations/km (Table 5.2-10). Overall relative abundance was also slightly lower at exposure areas (7.4%) than at reference areas (11.9%) within the McClean Lake LSA.

No muskrat sign was observed at the Midwest locations. Given that muskrats share water features with North American beaver, they tend to build smaller and less permanent features that may be less visible at certain times of the year and under specific water regimes. e.g., it is possible that previous muskrat sign was obscured or washed away due to the flooding along the banks of the stream caused by the high beaver activity (CanNorth, 2025b, 2025c, 2025d).

River Otter

Only one occurrence of river otter sign was detected, which is an observation of an old scat along the shoreline of Lake C1, situated within the Midwest LSA. The overall density of river otter sign was calculated at 0.05 observations/km (Table 5.2-10). The low density of otter sign is consistent with previous studies completed in the LAB where only one or two observations of river otter were recorded in the area (AREVA, 2016a).

Summary

Overall, the results indicate that all four semi-aquatic furbearer species were present across the surveyed areas, though densities varied by species and site type. Beaver signs featured most prominently across all sites while river otter had the least number of observations, which is consistent with past surveys in the LAB.

Within the McClean Lake LSA, all target species except the river otter were recorded. Observation densities were slightly higher in reference waterbodies compared to exposure waterbodies, while the overall relative abundance was slightly higher in exposure waterbodies for beaver and mink, and lower for muskrat.

Within the Midwest LSA, beaver and mink signs were present; muskrat signs were not recorded, and river otter was detected only once. These findings may indicate lower semi-aquatic furbearer presence overall in the Midwest LSA, potentially reflecting differences in habitat conditions or species distribution patterns. The results confirmed the presence of the semi-aquatic furbearer species used for the ERA purposes and provided an updated information to support future mining activities.

5.2.3.4 2024 Small Mammal Surveys

The 2024 small mammal surveys included population assessments and tissue sampling targeting microtines, specifically Gapper's red-backed voles (*Clethrionomys gapperi*) and masked shrews (*Sorex cinereus*). The survey's main objective was to update information on small mammal abundance and habitat and to collect tissue samples for chemical analysis of radionuclides and trace metals.

Small Mammal Abundance and Habitat

Methods

Surveys were completed by CanNorth in August 2024 (Research Permit for Species Detection No. 24SD257). The survey locations were selected along the shores of accessible waterbodies within the LAB including one reference location, three exposure locations within the McClean Lake LSA, and one location within the Midwest LSA (Figure 5.2-14). The surveys targeted habitat of masked shrew, which is used as a representative species in the ERA (Orano, 2025a). Survey design was based on recommended inventory methods for small mammals by British Columbia Ministry of Environment, Land, and Parks (BCMOELP, 1998b).

A total of 23 sampling traplines were set for population analysis. Of the 23 traplines, 5 were set in the reference area around Mallen Lake, and 11 were set around three sites within the McClean Lake Operation LSA (i.e., at the S/V TEMS, Kewen Lake, and the JEB Site). Finally, the remaining 7 traplines were set at South McMahon Lake at the Midwest site.

Each trapline ranged in length from 100 metres (m) to 150 m, each containing 10 to 12 capture stations. Each capture station consisted of 2 Victor snap traps, or 2 dry pitfall traps deployed within a 2-m radius on either side of the trapline center line. Traps were checked daily after deployment and were left in place for one to four consecutive nights; variation in the number of trap nights was due to factors such as logistics of retrievability in relation to other traplines set and ensuring a sufficient number of captures required for chemical analysis. Peak activity for small mammals was expected to occur overnight; therefore, traps were checked in the early morning to prevent sample loss due to depredation or degradation. Any animals still alive at the time of capture were humanely euthanized using the cervical dislocation method. Small mammal specimens were placed in plastic sample bags and labelled with an identification number and capture date. Each specimen was identified to species where possible, and morphometric measurements and weight were recorded. In cases where specimens had been damaged by depredation and identifying features were absent or destroyed, they were identified to genus or family level. All specimens were frozen as soon as possible after capture to prevent tissue degradation.

Results of the population surveys were then used to calculate biodiversity indices, including species richness and frequency. The number of captures per 100 trap nights and relative abundance of each species was then calculated for each habitat type. The total number of small mammal captures per 100 trap nights was utilized as an index for estimating the overall small mammal productivity of that habitat.

Results

Across a total of 1,256 trap nights, 83 target observations comprising of two species were recorded during the small mammal population surveys. The most frequently captured species was Gapper's red-backed vole, which accounted for 87% of total captures while masked shrew represented 13% of total captures (Table 5.2-11). Provincially, Gapper's red-backed vole is ranked as S5 (secure/common), and masked shrew is ranked as S4 (apparently secure). Neither species have applicable provincial activity restriction guidelines nor are listed on any federal tracking lists (SMOE, 2017; SKCDC, 2025).

A total of 24 captures of Gapper's red-backed vole and six captures of masked shrew were recorded across the McClean Lake LSA exposure sites in a range of habitat types (i.e., coniferous, deciduous, mixed-wood, and treed wetland; Table 5.2-12). This equated to 3.86 captures per 100 trap nights. Species-wise, Gapper's red-

backed voles represented 80% of captures, while masked shrews accounted for 20%. By habitat category, coniferous habitat showed the highest productivity (46%), whereas deciduous habitat showed the lowest (11%).

A total of 21 captures of Gapper's red-backed vole and four captures of masked shrew were recorded across the Midwest LSA within coniferous and mixed-wood habitats (Table 5.2-12). This translated to a total of 10.42 captures per 100 trap nights. Gapper's red-backed voles comprised 84% of captures, while masked shrews comprised 16%. By habitat category, mixed-wood habitat demonstrated the highest productivity (73%), with coniferous habitat showing the lowest (27%).

At Mallen Lake (reference), 27 captures of Gapper's red-backed vole and one capture of masked shrew were recorded in coniferous and mixed-wood habitats (Table 5.2-12). This equated to 11.67 captures per 100 trap nights. Gapper's red-backed voles accounted for 96% of captures, with masked shrews making up 4%. By habitat category, mixed-wood habitat showed the highest productivity (55%), while coniferous habitat showed the lowest (45%).

Overall, the capture rates at the McClean Lake LSA exposure sites ranged from 3.39 captures per 100 trap nights to 14.58 captures per 100 trap nights, while capture rates at Mallen Lake and South McMahon Lake were significantly higher, 58.33 captures per 100 trap nights and 41.66 captures per 100 trap nights, respectively (Table 5.2-13). Because small mammal populations are known to fluctuate in cycles, differences in relative abundance between the sites may reflect spatial and temporal asynchrony in local populations.

Small Mammal Chemistry

Small mammals provide an important prey base for several species of raptors and furbearers within the boreal forest ecosystem. During baseline surveys, Gapper's red-backed voles were previously selected as an indicator for small mammal species due to their abundance and ease of capture (TAEM, 1997). In 2024 samples of vole tissue were collected to obtain radionuclide and trace metal (i.e., analytes) concentrations in small mammals within and adjacent to the McClean Lake Operation area (CanNorth, 2025b, 2025d).

Methods

Whole-body specimens of Gapper's red-backed vole (rodents with a primarily granivorous diet) were collected during the population survey to provide tissue samples for chemical analysis of metals and radionuclides in the McClean Lake Operation. In conjunction with the population analysis traplines, samples were collected across 16 traplines at the reference area around Mallen Lake and three exposure sites within the McClean Lake Operation LSA (i.e. JEB Site, S/V TEMS, Kewen Lake; Figure 5.2-15).

A total of 23 samples were submitted to the SRC Environmental Analytical Laboratory for chemical analysis of metals and trace elements. The remaining material from the metal analysis was combined to one to two composite samples per location to form a sufficient size to reach adequate detection limits. Thorium-230 (Th-230) was excluded from the radionuclide analysis due to limited sample sizes.

Results

Summary of the small mammal chemistry results are presented in Table 5.2-14, with the detailed chemistry data provided in Appendix V.5. Concentrations at exposure locations were compared to a reference upper threshold, defined as two standard deviations above the mean of the reference data.

In general, most COPC concentrations in vole tissues were below the reference upper thresholds. Exceedances were most frequent at the JEB Site where aluminum, arsenic, cadmium, vanadium, zinc, radium-226, and uranium were elevated. The S/V TEMS data indicated elevated concentrations of cadmium, vanadium, and radium-226. The Kewen Lake data showed elevated levels of aluminum, cadmium, titanium, and radium-226.

Across analytes, radium-226 displayed the widest distribution of exceedances, occurring at all three exposure sites, with notably higher concentrations at JEB TMF. Cadmium also exceeded reference thresholds at each exposure location. Aluminum exceedances were observed at the JEB Site and Kewen Lake, while vanadium exceedances occurred at the JEB Site and S/V TEMS. Arsenic, zinc, and uranium exceedances were limited to the JEB Site, whereas titanium exceedance was observed only at Kewen Lake.

Summary

In 2024, small mammal surveys in the McClean Lake and Midwest Surface LSAs and surrounding area indicated low species richness, with Gapper's red-backed vole dominating captures and masked shrew occurring at lower frequency. Capture rates were generally lower at exposure sites compared to the reference site, with the highest small mammal productivity observed in mixed-wood habitat.

Small mammal chemistry results indicate that most COPC concentrations in vole tissues were below reference thresholds, but exceedances occurred at all exposure sites. The JEB Site showed the highest frequency of exceedances, including aluminum, arsenic, cadmium, vanadium, zinc, radium-226, and uranium, while S/V TEMS had elevated cadmium, vanadium, and radium-226, and Kewen Lake had aluminum, cadmium, titanium, and radium-226. Radium-226 and cadmium were the most widespread exceedances, with aluminum, vanadium, arsenic, zinc, uranium, and titanium occurring at specific sites. The results from this study were used as inputs for the 2025 ERA update presented in the 2025 EP TID Volume 2 (Orano, 2025a).

5.2.3.5 2024 Great Blue Heron and Pileated Woodpecker Habitat Assessment

In 2024, a study was completed to assess the potential presence of nests belonging to pileated woodpecker (*Dryocopus pileatus*) and great blue heron (*Ardea herodias*) within the future McClean and Sue F mining footprints (Figure 5.2-16). These species were of particular interest because they are the only two species potentially present in the area with nests protected year-round under the 2022 Migratory Birds Regulations (MBR) (ECCC, 2023). The nests are protected year-round, regardless of occupancy, and may only be considered abandoned after a period of 36 months (pileated woodpecker) or 24 months (great blue heron) without use (ECCC, 2023).

Methods

A desktop review was undertaken to assess habitat suitability of the future mining footprints based on the preliminary ecosite classification, known species habitat preferences, current ranges as published in scientific literature and publicly available observations. Following the desktop study, visual surveys for pileated woodpecker cavities and great blue heron nests were carried out as part of the terrestrial ecosite validation

surveys (Section 5.2.3.2). The surveys were aimed to visually confirm the ecosite mapping used for the desktop study and further assess the likelihood of these species to occur and utilize the habitat within the future mining footprints. Survey protocols followed the 2022 MBR guidelines (ECCC, 2023), employing non-intrusive visual observations.

Results

Pileated woodpecker nesting habitat consists of mature deciduous or mixed-wood forest with large dead or dying trees (Berger, 2018). No mature deciduous or mixed-wood forest was identified within the future mining areas during the desktop study. The current range of pileated woodpecker also does not overlap with the future mining areas, although eBird observations indicate their presence southwest of Wollaston Lake (Vennesland & Butler, 2020). Consequently, the likelihood of pileated woodpecker nesting within future mining areas was considered low.

Great blue heron commonly nests in colonies or isolated wooded swamps away from human disturbance, with nests typically located in tall trees, up to 30 metres above the ground (Vennesland & Butler, 2020). Boreal heron colonies are most often found in swampy clearings, such as beaver meadows with dead standing trees (Koes, 2018). The future mining areas lie beyond the typical breeding range for this species and no eBird observations have been reported near the future mining areas (Vennesland & Butler, 2020), therefore the potential for nesting was considered low.

The outcome of the desktop review demonstrated that reconnaissance-level site investigations were not required for either species (Stantec, 2024). Furthermore, no suitable pileated woodpecker or great blue heron habitat were identified, or nests found during the visual scans of the future mining areas in the field.

Summary

The future McClean Mining and Sue F sites were found not suitable for nesting of bird species, which nests are protected year-round under the 2022 MBR.

5.2.3.6 2024 Environmental DNA surveys for Northern Leopard Frog

An environmental DNA (eDNA) survey was conducted to confirm presence of northern leopard frog, a species listed as Special Concern by Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and under *the Species at Risk Act* (SARPR, 2025) around the McClean Lake and Midwest LSAs. The survey was performed by Stantec in August 2024 (Stantec, 2025c).

Methods

eDNA survey methods were adapted from British Columbia's Environmental Protocol for Freshwater Aquatic Ecosystems (BCMOE, 2017). The samples were collected at ten waterbodies, including one reference location and ten exposure locations within the McClean Lake LSA, as well as one location within the Midwest LSA (Figure 5.2-17).

At each location, up to five replicate water samples were collected from marshy shorelines or other suitable northern leopard frog habitat, depending on waterbody size and habitat availability. Water quality parameters, including temperature, conductivity, dissolved oxygen, and pH, were recorded at one representative replicate sample location during sampling, alongside detailed weather observations. One negative field control sample (i.e. distilled water) was collected each day to monitor contamination. Samples were filtered on-site through 1.2 micrometre pore-size self-preserving Smith-Root eDNA filters using an Easy-Load Masterflex peristaltic pump. Filtration records, including start and end times and water volumes filtered were documented for each sample. Sampling equipment was decontaminated using a 50/50 bleach-water solution between waterbodies to prevent cross-contamination (Stantec, 2025c). The samples were shipped to Bureau Veritas Laboratory for analysis.

Results

In total, 48 samples were collected at the ten waterbodies. No northern leopard frog DNA was detected in any sample. Quantitative polymerase chain reaction assays were successful for all samples. Negative field controls (i.e., distilled water) at Bena Lake, Sink Reservoir, Vulture Lake, Kewen Lake, and South McMahon Lake tested positive for plant DNA. These controls were then tested for northern leopard frog DNA to determine if they were contaminated with the target species' DNA. All five negative field controls tested negative for northern leopard frog DNA. Two of the five water samples collected from Vulture Lake required laboratory clean-up to remove potential assay inhibitors (e.g., tannins and other organic acids) and amplify potential target species DNA.

Summary

The northern leopard frog DNA collected at ten locations did not confirm this species presence in the Mclean Lake or Midwest LSAs.

5.2.3.7 2024 Wildlife Camera Surveys

In 2024, a wildlife camera survey was initiated to collect additional information on large and medium-sized mammal occurrence within the McClean Lake and Midwest LSAs. The methods employed were based on British Columbia's Wildlife Camera Metadata Protocol (Resources Inventory Standards Committee, 2019) and on the study design described in Rovero et al. (2013). Twelve Reconyx HyperFire 2 Professional Covert IR remote cameras were deployed in June 2024 for a period of 12 months. Cameras were placed at the pre-determined locations shown in Figure 5.2-18, in likely high-use areas for large and medium-sized mammals (e.g., game trails). Cameras were positioned to maximize the path length the subject would take through the frame, with an open view of the target area. Cameras faced north where possible to limit false triggers by solar glare. In addition, cameras were placed in areas free of obstructing vegetation and/or vegetation was trimmed in front of the cameras, as appropriate, to avoid false triggers by vegetation blowing in the wind. All cameras were fastened to trees in armoured cases and locked using padlocks. The 2024 data indicated presence of the following species: black bear (*Ursus americanus*), Canada jay (*Perisoreus canadensis*), moose (*Alces alces*), North American porcupine (*Erethizon dorsatum*), Northern grey wolf (*Canis lupus occidentalis*), red fox (*Vulpes vulpes*), ruffed grouse (*Bonasa umbellus*), snowshoe hare (*Lepus americanus*), and willow ptarmigan (*Lagopus lagopus*).

Camera retrieval and data review were scheduled for 2025. Once completed, a more detailed overview of this study will be presented in the next iteration of the EP TID.

5.2.3.8 2023-2024 University of Saskatchewan Bat Collaborative Research

Up to five bat species are potentially present in the region, including hibernators such as the little brown myotis (*Myotis lucifugus*) and northern myotis (*Myotis septentrionalis*), as well as migratory species such as the eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), and silver-haired bat (*Lasionycteris noctivagans*). All five of them have been assessed as endangered by the Committee on the Status of Endangered Wildlife in Canada (SARPR, 2025). No baseline bat surveys were carried out at the McClean Lake Operation in the past. Therefore, in 2023, Orano initiated bat research in collaboration with the University of Saskatchewan (USask) Department of Biology (USask, 2024, 2025b). The research goal was to gain a better understanding of the bat species present in the area.

Methods

The field surveys were performed over the 2023-2024 period. Timing of the survey was designed to target the key periods of the bats' annual cycle, namely emergence from hibernation, reproduction and entry into hibernation. Bat surveys were conducted using two primary methods: acoustic monitoring and visual observations for signs of bat activity. The selection of survey sites was performed by the USask team based on published literature on bat roosting habits and an assessment of environmental factors, including proximity to water and foraging grounds, protection from predators, the physical characteristics of potential roost structures, and information about the McClean Lake Operation area provided by Orano. The survey locations are shown on Figure 5.2-19.

Acoustic monitoring began with the preliminary survey in September 2023 to determine bat diversity during the pre-hibernation fall season in 2023. Six Autonomous Recording Units (ARUs; Song Meter SM4BAT Acoustic Recorders; Wildlife Acoustics) were rotated through 17 different sites across seven nights, with each ARU being left at the sites for two nights at a time. Following this survey, six ARUs were placed at locations identified as potential hibernaculum sites (the historical mining display by the JEB Site Training Building, the back-up generator trailer by the JEB Camp, the Midwest Shaft, Sue C North, Sue C South, and Sue E South Pits) for a two-month monitoring period (September – November 2023). The recorders were later retrieved for data analysis by the USask team.

In 2024, the acoustic survey was expanded; 11 ARUs were deployed at 11 sites in April 2024 and later redeployed (either at the same site or a different site) in June 2024. However, no usable data were retrieved for the April-June period. In August 2024, six ARUs were moved to new sites while the remaining five were left to monitor the same sites. One August 2024 deployment failed to record any data, resulting in acoustic data from only 16 different sites for 2024.

The final detectors were retrieved in November 2024.

In conjunction with the long-term acoustic monitoring, a handheld Echo Meter Touch 2 (Wildlife Acoustics) bat detector was used during walking surveys across the JEB camp on two evenings to investigate bat activity in 2023. Visual surveys of man-made structures and buildings were also conducted to locate direct evidence of bat use, such as guano (feces) and urine staining. Perimeters of major structures at the JEB, Moffat, Sue, and Midwest sites were inspected.

Recorded echolocation calls were analyzed using Kaleidoscope Pro Software (v5.6.0; Wildlife Acoustics Inc, Maynard, USA) to visualize spectrograms. Calls were identified to species by trained individuals, with the initial identifications verified for quality assurance and control. The timing and frequency of calls were used to infer bat behaviour, distinguishing between foraging activity and movements associated with roosts, such as dusk emergence and dawn return.

Results

The results confirmed the presence of five bat species: little brown myotis, northern myotis, eastern red bat, hoary bat, and silver-haired bat. All five species are listed as endangered by COSEWIC, and two of them (little brown myotis and northern myotis) are also listed as endangered under the Species at Risk Act (SARPR, 2025).

In 2023-2024, a total of 5,321 bat passes were recorded, with 313 in 2023 and 5,008 in 2024. The low number of recorded passes in 2023 allowed for the successful identification of individual *Myotis* species (little brown myotis and northern myotis). However, due to the high volume of calls in 2024, identifying individual *Myotis* calls to the species level was logistically infeasible, and they were instead grouped as *Myotis spp.* A large number of recorded bat calls in 2024 (1,500-2,000) remained unclassified.

Several man-made structures and naturalized habitats were also identified as showing clear signs of bat use. A significant finding was the discovery of substantial activity of the little brown myotis and northern myotis at the historical mining display by the JEB Site Training Building, where a count of 23 emerging bats was recorded in September 2023; it is, however, unclear if this is an ephemeral fall roost, a swarming site, or a hibernaculum.

Visual surveys identified several man-made structures with signs of bat use (Table 5.2-15, primarily through the observation of guano, urine stains, bat emergence counts, and deceased bats.

Species Distribution

In 2023, acoustic monitoring indicated that the little brown myotis and northern myotis were the most frequently detected species, followed by eastern red bat and a small number of hoary bat passes. The 2024 data showed a similar trend, with little brown myotis and northern myotis calls being the most numerous, followed by eastern red bat, hoary bat, and silver-haired bat. Hoary bat and silver-haired bat were generally observed less frequently and at fewer sites compared to the other species across 2023 and 2024 (USask, 2024, 2025b).

Potential Bat Roosting

Based on the collected data, the following areas were identified as potential bat roosting sites:

- **JEB Site**
    - **Historical Mining Display by the Training Building**: This area exhibited the highest activity overall, including a bat emergence count of 23 observed in September 2023, a substantial number of social calls, and guano; an active roost of little brown myotis and northern myotis was discovered.
    - **Mill Southwest**: High activity level as well as early dusk and late dawn timing of bat calls likely indicated a nearby roost with bats travelling towards or away from Pat Lake.

- **Southeast Mill**: A few bat calls were recorded, suggesting that bats may be roosting in or around the mill.
- **Back-up Generator Trailer by the JEB Camp**: A large quantity of guano was found, but bats may have vacated the area due to the noise from the generators and may return once the generators are regularly off again.
- **Storage Tank by the Main Office and Dry Complex**: A few pellets of guano were found along the bottom of the tank adjacent to the utilities entrance at the mill. It is possible that bats may have landed on the tanks as a temporary night roost or that they could be using the abandoned cliff swallow nests on the structure.

- **Midwest Site**
  - **Shaft**: This area may serve as a spring or summer roost as very little fall activity was recorded, despite the possible observation of guano.
  - **Water Treatment Plant**: A significant amount of guano was discovered inside the old water treatment building. However, very little fall activity was recorded, indicating that it may be used as a summer roost.
- **Moffat Site**
  - **Core Storage**: Guano was identified outside a wooden structure on the east side of the core storage, suggesting a possible summer roost.
- **Kewen Lake**: This site showed significant evidence of use as a night roost. Guano samples were collected, and two deceased little brown myotis were found. These observations suggest that this bridge may have contained a maternity colony. In addition, this site had more activity in June and July, further indicating that this site is being used as maternity roost.
- **Collins Creek**
  - **Upstream of HWY905 Bridge**: There was a moderate amount of *Myotis spp.* activity recorded, and it is possible that this site may be a maternity roost during the spring and summer.
  - **Downstream of HWY905 Bridge**: Very high *Myotis spp*. activity was recorded in June, likely indicating that the area is being used for roosting intermittently or as a corridor between roosting and foraging sites.

Potential Bat Hibernacula

It is not possible to determine with certainty whether a site can support overwintering bats based on visual and acoustic monitoring alone. Suitable hibernacula must meet several specific conditions, including stable winter temperatures and limited fluctuations, appropriate humidity levels, sufficient depth within a cave, mine, or rock crevice, suitable entrance dimensions, and the height or position of the entrance relative to the surrounding ground, among other factors (Blejwas et al., 2021; Klüg-Baerwald et al., 2017; Lausen & Barclay, 2006; Neubaum et al., 2006; White et al., 2020). Little brown myotis and northern myotis are both known to use mine shafts and rock crevices, of which there are several at the McClean Lake Operation. Little brown myotis, specifically, has been reported to hibernate occasionally in man-made structures, within crevices and networks found in natural talus slope (Blejwas et al., 2021). The abundance of overburden rock piles produced from mining could thus support the correct hibernacula conditions. However, the survey scope was not sufficient to explore this possibility.

Based on these criteria, six ARUs were deployed at locations identified as potential hibernacula in September – November 2023. These locations included the historical mining display by the JEB Site Training Building, the back-up generator trailer by the JEB Camp, the Midwest Shaft, Sue C North, Sue C South, and Sue E South Pits. ARU data were successfully retrieved from five of the six sites; data from the generator trailer location were unusable, but a walking survey was conducted at that location.

Based on the collected data, the following areas were identified as potential bat hibernacula:

- **JEB Site**
    - **Historical Mining Display by the Training Building**: This display is composed of a wooding structure built into large rocks with large, open-air crevices. With the insulation of snow cover, it may be possible for the conditions of hibernaculum to be met. In addition, the presence of bats during the survey period suggests a high likelihood that it may be used for hibernation.
    - **Back-up Generator Trailer by the Permanent Camp**: Little brown myotis are known to hibernate in man-made structures such as attics, and the generator trailer may provide some of the conditions required for hibernation. The trailer is heated but maintained at relatively low temperatures, which could create suitable microclimates within its walls. However, noise and vibration from the generator would likely discourage bat use if the generator were operating during fall or winter. The presence of a substantial amount of guano, along with cracks in the trailer walls, indicates general bat activity. If the generator remains off for extended periods, bats may return to use the structure.
- **Midwest Site**
    - **Shaft**: Abandoned mine shafts are known to support bat hibernation. However, the potential for bats to use this shaft depends on several factors, including shaft depth, groundwater levels, and the presence of crevices. The shaft could not be entered, so it was not possible to confirm whether the droppings observed were bat guano or rodent droppings. Although these signs suggested possible past bat use, fall records detected very little activity. It is noted that the Midwest shaft is flooded, so its use as a hibernaculum is unlikely.
- **Sue Site**
    - **Sue C Pit North**: Several crevices were visible along the north edge of the pit, and these may provide some of the conditions required for bat hibernation. These crevices appear smaller and are situated closer to the water than those on the south side of the pit, which may make them less favourable; however, bat use is difficult to predict without directly assessing crevice depth and internal structure. Since the depth of these crevices could not be determined from visual inspection, it is difficult to assess their suitability as roosts or hibernacula. However, a moderate level of bat activity was recorded at this site during both the 2023 and 2024 seasons. No direct signs of bats were observed on the nearby pump structure, although it contains multiple potential entry points that bats could use.
    - **Sue C Pit South**: The natural rock wall on the south side of the Sue C Pit contains several large crevices visible from the opposite side of the pit. Although their exact depth could not be determined, their visibility from a distance suggests that some may be substantial in size. If any extend beyond approximately 0.6 m, they could potentially support bat hibernation. Bats also tend to select crevices located higher above the ground (typically >12 m), and such features are present on this section of the pit wall. The overall suitability of these crevices as roosts or hibernacula remains difficult to assess without direct access. However, the height of the openings and their position on the rock face indicate that they may provide suitable conditions. Additionally, the detector recorded a moderate level of bat activity at this location, suggesting some potential use by bats.
    - **Sue E Pit South**: The natural rock wall in the pit contains several crevices; however, the cliff face is relatively low. Although bats may use these crevices if they are sufficiently deep, the higher

crevices available at the Sue C North and South pits likely present more favourable options. A detector was placed above several potential crevices on the exposed rock wall. As the depth of the crevices could not be determined from visual inspection, their suitability as roosts or hibernacula remains uncertain. Activity levels recorded at this site were moderate, but dusk and dawn calls were limited. This suggests that bats may be flying over the pit during foraging.

Site-Specific Activity Levels

Acoustic activity levels varied considerably between sites and across years (Table 5.2-15). During the 2023 preliminary survey, the highest activity was recorded at the Historical Mining Display by the Training Building (over 50 average passes/night) and the Mill Southwest (nearly 30 average passes/night). In contrast, the 2024 survey showed the highest average nightly activity at Kewen Lake (approx. 27 passes/night) and Collins Creek Downstream of HWY905 Bridge (approx. 22 passes/night) during the summer months. The Historical Mining Display by the Training Building and Moffat Site Core Storage also showed substantial activity in 2024. Many sites, such as Tooth Lake, McClean Lake East Basin, Midwest Site Water Treatment Plant, Midwest Shaft, Pat Lake North, Pat Lake South, and the Mill North, recorded low activity across both years.

The timing of bat calls indicated that activity generally began after sunset and continued until just before sunrise. Across all sites in 2024, the earliest recorded bat call was about 6 pm in September, and the latest was about 6 am, also in September. Early dusk calls at locations such as the Historical Mining Display by the Training Building and the Southwest Mill, were interpreted as a strong indicator of roosting.

Summary

Overall, these results indicate that the McClean Lake and Midwest LSAs include important habitat for five endangered bat species. The high abundance of local hibernators (little brown myotis and northern myotis), particularly during the fall season, and presence of potential roosting and hibernacula sites, such as rock crevices and insulated buildings, suggest that the McClean Lake Operation facilities may harbour crucial habitat for these vulnerable species.

5.2.3.9 2024 University of Saskatchewan Large Mammal Collaborative Research

In 2024, Orano and the USask Department of Biology have collaborated on the research of large mammals in the McClean Lake Operation and Midwest areas. The research objective is to develop a better understanding of the vegetation resources and relative densities of interacting species in the SK1 Boreal Caribou Range (McLoughlin, 2024).

The partnership is based on an existing research and development applying artificial intelligence tools to detect and count wildlife species based on remote sensing data. Led by the USask Department of Biology through Natural Sciences and Engineering Research Council's (NSERC's) Alliance Grants program ("Innovation and interdisciplinary research to understand the causes and mitigate consequences of environmental change in the Boreal Plains"), the research includes aerial surveys of the McClean Lake and Midwest LSAs to collect colour and thermal imagery for further data processing and identification of large mammals (caribou, moose, wolves, and black bears), their habitat, and beaver dams present in the area. In 2024, two aerial flights were completed in May and August, with another scheduled for spring 2025 and data processing planned for 2025-2026. The results will be discussed in the next iteration of the EP TID.

5.2.4 2024 Wildlife Supplementary Observations

In addition to the observations of targeted species, incidental observations were recorded were recorded during the 2024 surveys. Figure 5.2-20 depicts locations and types summarized of the incidental observations, which included sightings, signs, or bycatch of species such as woodland caribou (*Rangifer tarandus caribou*), dark-eyed junco (*Junco hyemalis*), boreal chorus frog (*Pseudacris maculata*), wood frog (*Lithobates sylvaticus*), and common loon (*Gavia immer)* (CanNorth, 2025b, 2025c, 2025d; Stantec, 2025d).

Additionally, several sightings of bat, bear, caribou, fox, lynx, moose, owl, porcupine, and wolf were reported by staff via Orano's internal wildlife reporting system (Orano, 2025d).

5.2.5 Summary and Conclusions

To improve and update the current information related to species of conservation concern and habitat use within the LAB, additional vegetation and wildlife species information was collected during the current EP TID period. The 2023 rare plants checks were performed to confirm historical rare plant sightings while various targeted wildlife and vegetation surveys as well as collaborative research were implemented as part of Orano's flora and fauna inventory update. Additional information collected includes updated data on vegetation, avian, amphibian, bat, and mammal species, as well as updated ecosite classification and habitat mapping. The survey data has been used to inform planning for future mining activities and inform VC model characteristics for the 2025 ERA update presented in the 2025 EP TID Volume 2 (Orano, 2025a).

5.3 Species at Risk

5.3.1 Plants

5.3.1.1 Methods

Prior to completing vegetation field investigations in 2003 (AREVA, 2007), a list of Species At Risk (SAR) that were known or expected to occur within the regional assessment boundary was compiled using three sources: 1) federal status documents; 2) provincial species lists for those species requiring special management considerations (SKCDC, 2002); and 3) provincial tracking lists for vascular plants. Federal status documents included the *Species at Risk Act Public Registry* (SARPR, 2007) and COSEWIC status reports (COSEWIC, 2003).

An iterative approach, involving the ecosite phase classification and field surveys, was used to develop a list of potential plant and wildlife SAR occurring in the LAB, based on their documented distribution ranges and habitat requirements. Known occurrences of SAR in the LAB, identified during historical and recent surveys, as well as database searches, were also included. In developing this list, it was first determined if the distribution for each species overlapped the LAB. The distribution of plant species was sourced from Harms et al. (1992), SKCDC (2007), and W.P. Fraser Herbarium (2007) database search.

The list of potentially occurring rare plants was updated based on the 2023-2024 surveys and to reflect current naming and ranking information. Scientific and common names were updated according to SKCDC (2025). Conservation rankings were updated to the current rankings provided by the SKCDC. In this ranking system, species are ranked from S1 (extremely rare) to S5 (common). S1 to S3 species are considered rare and are of

conservation concern in the province. Species ranked as SH (Historical) indicate that there have not been any recent observations (within 20 to 40 years) in the province. Based on updated species names and rankings, longstem water-wort (*Elatine triandra*) was removed from the list due to its change to SNA status. Additionally, blanket-leaf willow (*Salix silicicola*) changed statuses from S2 to S3, Gastony's cliffbrake (*Pellaea gastonyi*), changed statuses from S2 to S1, large-leaved pondweed (*Potamogeton amplifolius*) and Marsh St. John's-wort (*Triadenum fraseri*) changed statuses from SH to S1.

5.3.1.2 Results

The list of rare plant, bryophyte, and lichen species with the potential to occur within the RSA as well as those plants with known occurrences in the LAB are presented in Tables 5.3-1 and 5.3-2., respectively. Seven plant species listed on Schedule 1 of SARA have the potential to occur within the RSA (Table 5.3-1); however, none have ranges that overlap with the LAB (Figure 1.6-3) based on database screening, nor were any identified during vegetation investigations within the LAB (Table 5.3-1; Table 5.3-2). Additionally, 188 species, ranked S1 to S3 in the province, have the potential to occur within the RSA.

A total of 55 provincially tracked rare vascular plant, bryophyte and lichen species have been identified in the LAB (Table 5.3-2), the locations of which are shown in Figures 5.3-1 and 5.3-2. Nine species are currently ranked as S1 (extremely rare), including black-footed reindeer lichen (*Melanelia stygia*), American starburst lichen (*Imshaugia placorodia*), arctic kidney lichen (*Nephroma arcticum*), candy lichen (*Icmadophila ericetorum*), grand foam lichen (*Stereocaulon grande*), Hickey's clubmoss, mountain club-moss (*Huperzia selago var. densa*), northern bog clubmoss (*Lycopodiella inundata*), and soft-stem spike-rush. The remaining species are ranked as either S2 (rare) or S3 (uncommon) (Tables 5.3-1; 5.3-2). None of these species are protected under the provincial Wildlife Act (GS, 1998); however, all S1 to S3 plant species have recommended activity restriction guidelines (SMOE, 2017). Additionally, the 2023-2024 rare plant surveys (Sections 5.2.3.1 and 5.2.3.2) did not locate brown sedge (*Carex buxbaumii*). This absence could be due to natural factors (e.g., shifts in hydrological regimes, vegetation dynamics, or herbivory) or to potential misidentification in previous surveys. As a result, the species has been removed from the current list (Table 5.3-1; Table 5.3-2). The majority of the rare plant species sighted in the LAB are found in moist habitats, with a few occurring in open woods (Table 5.3-2).

Many of the provincially tracked rare plant species listed in Table 5.3-2 were found to be locally abundant. Known occurrences of English sundew and Alaskan clubmoss include over 30 sightings, as well, more than 10 sightings have been documented for Michaux' sedge (*Carex michauxiana*), moor rush, water lobelia, long-beech fern, and hairy butterwort. The remaining tracked species had fewer than 10 occurrences documented within the LAB (Table 5.3-2).

5.3.2 Wildlife

5.3.2.1 Methods

A list of wildlife SAR was compiled prior to the 2003 and 2004 baseline field investigations of the LAB (AREVA, 2007, 2009b). The species list was generated using three sources: 1) federal status documents; 2) provincial species lists for those species requiring special management considerations (SKCDC, 2002); and 3) provincial tracking lists for vertebrates. Federal status documents include SARPR 2007. An iterative approach was then used (involving ecosite phase classification and field surveys) to develop a list of potential wildlife SAR occurring in the LAB, based on their documented distribution ranges and habitat requirements.

In developing this list, it was first determined if the distribution for each species overlapped the LAB. The distribution of bird species was sourced from the Birds of North America (Poole, 2006) database, and the Atlas of Saskatchewan Birds (Smith, 1996) was used to determine ranges for bird species. In addition, a recent SKCDC (2007) database search was requested for known occurrences of SAR within the LAB. The ecosite phase classification was then used to provide a basis to identify habitats within the broader LAB with a greater potential to support SAR.

For this report, the wildlife species list was updated based on observations from surveys listed in Table 5.2-1. Species of conservation concern were identified in the updated list (Table 5.3-3) based on those listed under SARA or COSEWIC (SARPR, 2025), species listed as rare (S1 to S3) or with uncertain ranking (SU) status in Saskatchewan (SKCDC, 2025), or species with provincial or federal activity restriction guidelines (EC, 2009; SMOE, 2017).

5.3.2.2 Results

The updated list of wildlife species with the potential to occur within the McClean Lake Operation LAB and the broader Athabasca region (i.e., RSA) is presented in Table 5.3-3. Regionally, approximately 207 bird species, 40 mammal species, 4 amphibian species, and 1 reptile species have been recorded or have ranges that extend through the area. Overall, within the McClean Lake Operation LAB, 123 bird species, 30 mammal species, 2 amphibian species, and 1 reptile species have been documented; this includes observations of 2 bird species, 20 mammal species, and 2 amphibian species during the 2023-2024 surveys (Table 5.3-3).

A total of sixteen species, listed as special concern, threatened, or endangered, on Schedule 1 of SARA have the potential to occur within the RSA, including: barn swallow (*Hirundo rustica*), bank swallow (*Riparia riparia*), Canada warbler (*Cardellina canadensis*), common nighthawk (*Chordeiles minor*), evening grosbeak (*Coccothraustes vespertinus*), Harris's sparrow (*Zonotrichia querula*), olive-sided flycatcher (*Contopus cooperi*), red-necked phalarope (*Phalaropus lobatus*), rusty blackbird, short-eared owl (A*sio flammeus*), yellow rail (*Coturnicops noveboracensis*), woodland caribou, little brown myotis, northern myotis, wolverine (*Gulo gulo*), and northern leopard frog.

Horned grebe (*Podiceps auratus*), lesser yellowlegs (*Tringa flavipes*), snowy owl (*Bubo scandiacus*), short-billed dowitcher (*Limnodromus griseus*), eastern red bat, silver-haired bat, hoary bat, and barren-ground caribou (*Ranginer taradus groenlandicus*) are listed as special concern, threatened, or endangered by COSEWIC but are not listed under SARA (SARPR, 2025).

Of the COSEWIC and SARA ranked species, 13 have been observed in the LAB, including barn swallow, common nighthawk, lesser yellowlegs, olive-sided flycatcher, rusty blackbird, snowy owl, barren-ground caribou, woodland caribou, eastern red bat, hoary bat, little brown myotis, northern myotis, and silver-haired bat (Table 5.3-3).

An additional 13 species of conservation concern provincially have the potential to occur within the RSA (Table 5.3-3). Five of these species have been observed within the LAB, including Cooper's hawk (*Accipiter cooperii*), great grey owl (*Strix nebulosa*), northern hawk owl (Surnia *ulula*), osprey (*Pandion haliaetus*), and red-throated loon (*Gavia stellata*).

5.4 Overall Summary and Conclusions

The main focus of the current McClean Lake Operation EMP for the terrestrial environment is soil and vegetation chemistry monitoring, which is now conducted on a six-year cycle. The most recent sampling occurred in 2021, with the next scheduled for 2027; therefore, no updates to the soil and vegetation chemistry data were made during the current reporting period.

Although not a focus of the current EMP, supplementary wildlife and vegetation studies were completed during the current EP TID period. This included rare plant surveys, vegetation surveys, targeted surveys for a number of avian, amphibian and mammalian species, and small mammal chemistry sampling. The survey data has been used to inform planning for future mining activities and to inform the 2025 ERA update presented in the 2025 EP TID Volume 2 (Orano, 2025a).

The information collected as part of these studies was also used to update the wildlife species list for the McClean Lake Operation LAB. Thirteen federally listed SARA and/or COSEWIC ranked SAR were observed in the LAB, including barn swallow, common nighthawk, lesser yellowlegs, olive-sided flycatcher, rusty blackbird, snowy owl, barren-ground caribou, woodland caribou, eastern red bat, hoary bat, little brown myotis, northern myotis, and silver-haired bat.

5.5 References

Acton, D.F., G.A. Padbury, and C.T. Stushnoff. 1998. The Ecoregions of Saskatchewan. Canadian Plains Research Centre. University of Regina, Regina, Saskatchewan. 205 pp.

AREVA (AREVA Resources Canada Inc.). 2007. Midwest Project Environmental Impact Statement. October 2007. Saskatoon, Saskatchewan.

AREVA (AREVA Resources Canada Inc.). 2009a. Caribou Project Environmental Impact Statement. February 2006 – Version 1 – Revision 2.

AREVA (AREVA Resources Canada Inc.). 2009b. Midwest Project Area Existing Environment Technical Information Document.

AREVA (AREVA Resources Canada Inc.). 2011. Midwest Project Environment Environmental Impact Statement. September 2011.

AREVA (AREVA Resources Canada Inc.). 2016a. McClean Lake Operation Technical Information Document. Environmental Performance. Volume 1 of 2 – Environmental Monitoring. Version 3 Revision 0. May 2016. Saskatoon, Saskatchewan.

AREVA (AREVA Resources Canada Inc.). 2016b. McClean Lake Operation Technical Information Document. Environmental Performance. Volume 2 of 2 – Environmental Risk Assessment. Version 3 Revision 0. September 2016. Saskatoon, Saskatchewan.

BCMOE (British Columbia Ministry of Environment). 2017. *Environmental DNA Protocol for Freshwater Aquatic Ecosystems*. Version 2.2. Available at https://nrtraininggroup.com/wp-content/uploads/171115eDNAprotocolV2.2.pdf

BCMOELP (British Columbia Ministry of Environment, Land, and Parks). 1998a. Inventory methods for beaver and muskrat: Standards for components of British Columbia's biodiversity no. 22. Province of British Columbia, Resources Inventory Committee, Victoria, British Columbia.

BCMOELP (British Columbia Ministry of Environment, Land, and Parks). 1998b. Inventory methods for small mammals: shrews, voles, mice and rats: Standard for components of British Columbia's biodiversity no.31. Province of British Columbia, Resources Inventory Committee, Victoria, British Columbia.

Berger, R.P. 2018. *Pileated Woodpecker*. (Artuso, C.A., R. Couturier, K.D. De Smet, F. Loes, D. Lepage, J. McCracken, R.D., Mooi, and P. Taylor, Editors). The Atlas of the Breeding Birds of Manitoba, 2010–2014. Bird Studies Canada, Winnipeg, MB.

Birds Canada. 2022a. Saskatchewan Breeding Bird Atlas. Website: https://sk.birdatlas.ca/

Birds Canada. 2022b. Birds in your region. Website: www.birdscanada.org

Birds Studies Canada. 2018. 2018 Monitoring Report for the McClean Lake Mine Site. Prepared for Orano Resources Canada. December 2018.

Blejwas KM, Pendleton GW, Kohan ML, Beard LO. 2021. The Milieu Souterrain Superficiel as hibernation habitat for bats: implications for white-nose syndrome. Journal of Mammalogy 102:1110–1127. DOI: 10.1093/JMAMMAL/GYAB050

Brodo, I. M., Sharnoff, S. D., & Sharnoff, S. 2001. Lichens of North America. Yale University Press.

Canada Wide Mines Ltd. 1980. Midwest Lake Environmental Baseline Study: Supporting Document 1. Prepared for Canada Wide Mines Ltd.

CanNorth (Canada North Environmental Services Limited Partnership). 2023. Technical Memorandum: 2023 Orano McClean Lake and Midwest Lease Rare Plant Status Checks. Prepared for Orano Canada Inc., Saskatoon, Saskatchewan. December 2023.

CanNorth (Canada North Environmental Services Limited Partnership). 2025a. Field data from 2025 vegetation surveys in the McClean Lake Local Assessment Area. Received October 2025.

CanNorth (Canada North Environmental Services Limited Partnership). 2025b. McClean Lake Operation 2024 Fauna Inventory Update: Semi-Aquatic Furbearer and Small Mammal Surveys – Analytical Report: Draft Rev 0. Prepared for Orano Canada Inc., Saskatoon, Saskatchewan. February 2025.

CanNorth (Canada North Environmental Services Limited Partnership). 2025c. McClean Lake Operation Caribou Lake and Candy Creek Semi-Aquatic Furbearer Surveys – Survey Report: Final Rev 2. Prepared for Orano Canada Inc., Saskatoon, Saskatchewan. April 2025.

CanNorth (Canada North Environmental Services Limited Partnership). 2025d. McClean Lake Operation 2024 Fauna Inventory Update: Semi-Aquatic Furbearer and Small Mammal Surveys – Analytical Report: Draft Rev 2. Prepared for Orano Canada Inc., Saskatoon, Saskatchewan. November 2025.

CFS (Canadian Forest Service). 2025. National Burned Area Composite (NBAC). Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta. https://cwfis.cfs.nrcan.gc.ca.

COGEMA (COGEMA Resources Inc.). 1995. The Midwest Project Environmental Impact Statement. Supporting Document III. McClean Project Area Aquatic and Terrestrial Ecological Baseline. Prepared by Terrestrial and Aquatic Environmental Managers for COGEMA Resources Inc, Saskatoon, Saskatchewan.

COGEMA (COGEMA Resources Inc.). 2003. McClean Lake Operation Existing Environment Technical Information Document.

COGEMA (COGEMA Resources Inc.). 2004. McClean Lake Operation Sue E Project Environmental Impact Statement. November 2004 – Version 1.

Copernicus Sentinel Data. 2022. Retrieved from Alaska Satellite Facility (ASF) Distributed Active Archive Center (DAAC), processed by European Space Agency (ESA). Data obtained from Open Access Hub (https://scihub.copernicus.eu).

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2003. Canadian Species at Risk. May 2003. 43 pp.

EC (Environment Canada). 2009. Petroleum Industry Activity Guidelines for Wildlife Species at Risk in the Prairie and Northern Region. Canadian Wildlife Service, Environment Canada, Prairie and Northern Region, Edmonton Alberta. 64p.

ECCC (Environment and Climate Change Canada). 2023. Frequently asked questions: Migratory Birds Regulations, 2022. Available at: https://www.canada.ca/en/environment-climate-change/services/migratory-bird-permits/faq-migratory-birds-regulations-2022.html.

ESRI et al. Various Dates. ESRI World Satellite Imagery. Accessed through ArcGIS.

FNA (Flora of North America) Editorial Committee (Eds.). 2020. Flora of North America north of Mexico. Website: http://www.efloras.org. Accessed November 2023.

FNA (Flora of North America) Editorial Committee (Eds.). 2023a. Flora of North America online. Website: http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=242357101. Accessed November 2023.

FNA (Flora of North America) Editorial Committee (Eds.). 2023b. Flora of North America online. Website: http://beta.floranorthamerica.org/Rhinanthus_minor_subsp._minor. Accessed November 2023.

GOBC (Government of British Columbia). 2010. Field Manual for Describing Terrestrial Ecosystems. 2nd Ed. British Columbia Ministry of Forests and Range, B.C. Ministry of Environment, Victoria, BC. Available at: https://www.for.gov.bc.ca/hfd/pubs/docs/Lmh/Lmh25-2.htm. Accessed January 2025.

GS (Government of Saskatchewan). 1998. The Wildlife Act. Website: http://www.qp.gov.sk.ca/documents/English/Statutes/Statutes/W13-12.pdf.

GS (Government of Saskatchewan). 2002. Forest Ecosite Classification Vegetation Survey Plot Data. Data received in by email from Sarah Vengemazer (sarah.vingemazer@gov.sk.ca) on April 27, 2023.

GS (Government of Saskatchewan). 2023. Provincial Fire History Spatial Boundaries. Accessed online from Saskatchewan GIS REST Services, July 2023.

HAB-TECH Environmental. 2011. McClean Lake Operation 2010 Semi-Aquatic Furbearer Shoreline Survey. Draft report prepared for AREVA Resources Canada Inc. Saskatoon, Saskatchewan.

Harms, V.L. and A.L. Leighton. 2011a. Ferns and Fern Allies of Saskatchewan, Fascicle 1. Flora of Saskatchewan Association, Nature Saskatchewan. Regina, Saskatchewan.

Harms, V.L. and A.L. Leighton. 2011b. Flora of Saskatchewan Fascicle 2: Lilies, Irises, and Orchids of Saskatchewan. Flora of Saskatchewan Association and Nature Saskatchewan, Regina, SK.

Harms, V.L., A.L. Leighton, and M.A. Vetter. 2018. Flora of Saskatchewan Fascicle 6: Rushes, Bulrushes, and Pondweeds Plus the Remaining Monocots of Saskatchewan. Flora of Saskatchewan Association and Nature Saskatchewan, Regina, SK.

Harms, V.L., P.A. Ryan and J. A. Haraldson. 1992. The Rare and Endangered Native Vascular Plants of Saskatchewan. Prepared for W. P. Fraser Herbarium, Univ. Saskatoon, Saskatchewan.

Klüg-Baerwald BJ, Lausen CL, Willis CKR, Brigham RM. 2017. Home is where you hang your bat: winter roost selection by prairie-living big brown bats. Journal of Mammalogy 98:752–760. DOI: 10.1093/jmammal/gyx039

Koes, R.F. 2018. *Great Blue Heron.* (Artuso, C.A., R. Couturier, K.D. De Smet, F. Loes, D. Lepage, J. McCracken, R.D., Mooi, and P. Taylor, Editors). The Atlas of the Breeding Birds of Manitoba, 2010–2014. Bird Studies Canada, Winnipeg, MB.

Lang, N., W. Jetz, K. Schindler, and J.D. Wegner. 2020. Global Canopy Height Model. A high-resolution canopy height model of the Earth. Available: https://langnico.github.io/globalcanopyheight/.

Lausen CL, Barclay RMR. 2006. Winter bat activity in the Canadian prairies. Canadian Journal of Zoology 84:1079–1086. DOI: 10.1139/z06-093

Leighton, A. 2012. Sedges (Carex) of Saskatchewan, Fascicle 3. Flora of Saskatchewan Association, Nature Saskatchewan. Regina, Saskatchewan.

Looman, J., & Best, K. F. 1979. *Budd's flora of the Canadian Prairie Provinces* (No. 1662, p. 863pp).

MacLaren, James F. Limited and the Saskatchewan Research Council (SRC). 1979. Environmental Baseline Studies for Project Wolly McClean Lake Area. Interim Report No.1. Prepared by MacLaren, James F. Limited and the SRC for Canadian Occidental Petroleum Limited.

McLaughlan, M.S., Wright, R.A., and R.D. Jiricka. 2010. Field guide to the ecosites of Saskatchewan's provincial forests. Saskatchewan Ministry of Environment, Forest Service. Prince Albert, Saskatchewan.

McLoughlin, P. 2024. *Biodiversity monitoring in the Saskatchewan Boreal Shield: Large Mammals and Vegetation*. *Interim Progress Report.* University of Saskatchewan. Prepared for Orano Canada. December 2024.

Mellichamp, T.L. 2020. *Drosera anglica*. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America [Online]. New York and Oxford. Vol. 6. Available at: http://floranorthamerica.org/Drosera_anglica. Accessed January 2025.

Minatco (Minatco Ltd.). 1991. McClean Lake Project Environmental Impact Statement. August 1991. 30706-1.

Neubaum DJ, O'Shea TJ, Wilson KR. 2006. Autumn migration and selection of rock crevices as hibernacula by big brown bats in Colorado. Journal of Mammalogy 87:470–479. DOI: 10.1644/05-MAMM-A-252R1.1

Orano (Orano Canada Inc.). 2018. McClean Lake Operation Selenium Review and Assessment Report. Version 1. July 2018.

Orano (Orano Canada Inc.). 2022. McClean Lake Operation Technical Information Document 2022 Environmental Performance. Volume 1 of 1. Version 1 Revision 0.

Orano (Orano Canada Inc.). 2023. *McClean Lake Operation 2022 Annual Report*. March 2023. Orano Canada Inc.

Orano (Orano Canada Inc.). 2024. *McClean Lake Operation 2023 Annual Report*. March 2024. Orano Canada Inc.

Orano (Orano Canada Inc.). 2025a. McClean Lake Operation Technical Information Document, Environmental Performance, Volume 2 of 2 - Environmental Risk Assessment. Version 1, Revision 0.

Orano (Orano Canada Inc.). 2025b. High-resolution (1-m) LiDAR elevation and canopy height data along the Midwest Haul Road. Collected on May 25-27, 2025.

Orano (Orano Canada Inc.). 2025c. Correspondence: Mitchell to Karwandy: Subject: Orano Canada Inc. – Mineral Surface Leases. Dated February 20, 2025.

Orano (Orano Canada Inc.). 2025d. *Wildlife Reporting Form*. Internal document, Orano SharePoint site.

Poole, A. 2006. Birds of North America. Website: http://bna.birds.cornell.edu/BNA/

Resources Inventory Standards Committee. 2019. Wildlife Camera Metadata Protocol: Standards for Components of British Columbia's Biodiversity No. 44. Available at: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/wcmp_v1.pdf. Accessed August 2025.

Robart, B.W. 2020. *Pedicularis labradorica*. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America [Online]. New York and Oxford. Vol. 17. Available at: http://floranorthamerica.org/Pedicularis_labradorica. Accessed January 2025.

Rodewald, P. (Ed). 2022. Birds of the World. https://birdsna.org/Species-Account/bna/home.

Rovero, F., F. Zimmermann, D. Berzi, and P. Meek. 2013. Which camera trap and how many do I need? A review of camera features and study designs for a range of wildlife research applications. Hystrix, the Italian Journal of Mammalogy 24: 148–156.

SARPR (Species at Risk Public Registry). 2007. Government of Canada Species at Risk Act Website: www.sararegistry.gc.ca/.

SARPR (Species at Risk Public Registry). 2025. Species Search. Available at: https://species-registry.canada.ca/index-en.html#/species?sortBy=commonNameSort&sortDirection=asc&pageSize=10. Accessed October 2025.

Saskatchewan PCAP (Prairie Conservation Action Plan) Greencover Committee. 2008. Rangeland Health Assessment Native Grassland and Forest. Available at: https://www.pcap-sk.org/rsu_docs/documents/Native_Grassland_and_Forest-Red.pdf. Accessed January 2025.

SKCDC (Saskatchewan Conservation Data Center). 2002. Species at Risk Interim List. Website: http://www.biodiversity.sk.ca/Docs/SpeciesAtRiskinSK.pdf.

SKCDC (Saskatchewan Conservation Data Center). 2007. Data Search of Rare Plant Occurrences within the Midwest Project and McClean Lake Operation Study Area. SKCDC, Fish and Wildlife Branch, Saskatchewan Environment. Regina, Saskatchewan.

SKCDC (Saskatchewan Conservation Data Center). 2016. SKCDC Guidelines for Collecting Spatial Data during Vascular Plant Surveys, no. December. http://biodiversity.sk.ca/Docs/SKCDCSpatialDataGuidelinesforPlants.pdf. Accessed November 2023.

SKCDC (Saskatchewan Conservation Data Center). 2025. Saskatchewan Taxa List. Regina, Saskatchewan. Retrieved from www.biodiversity.sk.ca/SppList.htm

Smith, A. 1996. Atlas of Saskatchewan birds. Saskatchewan Natural History Society. Saskatoon, Saskatchewan.

SMOE (Saskatchewan Ministry of Environment). (2025). Hunting, angling and biodiversity of Saskatchewan (HABISask). Fish, Wildlife and Lands Branch, Regina, Saskatchewan. https://gisappl.saskatchewan.ca/Html5Ext/?viewer=habisask.

SMOE (Saskatchewan Ministry of Environment). 2017. Saskatchewan Activity Restriction Guidelines for Sensitive Species. Fish and Wildlife Branch, Saskatchewan Ministry of Environment. Regina, Saskatchewan.

SMOE (Saskatchewan Ministry of Environment). 2021. Species Detection Survey Protocol: 20.0 Vascular Plant June 2021 Update. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, SK. Available at: https://publications.saskatchewan.ca/#/categories/2069. Accessed December 2024.

SMOE (Saskatchewan Ministry of Environment). 2022. Ministry Review of Orano Proposed Seed Mix for Re-vegetation of the of Sue Waste Rock Pile. Correspondence Merkowsky to Huffman, dated on April 6, 2022.

Stantec (Stantec Consulting Ltd.). 2024. 2024-2025 Flora and Fauna Inventory Update: Pileated Woodpecker and Great Blue Heron Assessment. Prepared for Orano Canada Inc., Saskatoon, Saskatchewan.

Stantec (Stantec Consulting Ltd.). 2025a. McClean Lake Operation Project Ecosite Refinement: 2025 Terrestrial Habitat Mapping and Habitat Suitability: Draft Report. Prepared for Orano Canada Inc, Saskatoon, Saskatchewan. November 2025.

Stantec (Stantec Consulting Ltd.). 2025b. McClean Lake Operation Flora Inventory Update Report. Prepared for Orano Canada Inc., Saskatoon, Saskatchewan. January 2025.

Stantec (Stantec Consulting Ltd.). 2025c. 2024-2025 Vegetation and Wildlife Surveys – Summer 2024 Field Report. Prepared for Orano Canada Inc, Saskatoon, Saskatchewan.

Stantec (Stantec Consulting Ltd.). 2025d. 2024-2025 Vegetation and Wildlife Surveys – Spring 2024 Field Report. Prepared for Orano Canada Inc., Saskatoon, Saskatchewan.

Stantec (Stantec Consulting Ltd.). 2025e. Daily Updates (June 2024–February 2025). Unpublished internal communications provided to Orano Canada Inc., Saskatoon, Saskatchewan.

Stantec (Stantec Consulting Ltd.). 2025f. McClean Lake Operation Ecosite Refinement: Terrestrial Habitat Mapping and Habitat Suitability. Technical Memorandum. Prepared for Orano Canada Inc., Saskatoon, Saskatchewan. November 2025.

TAEM (Terrestrial and Aquatic Environmental Managers Ltd.). 1995. McClean Project Baseline Investigations 1993 – 1995. Prepared for Minatco Limited.

TAEM (Terrestrial and Aquatic Environmental Managers Ltd.). 1997. McClean Project Additional Baseline Collections 1995 – 1996. Prepared for COGEMA Resources Inc.

Tucker, G.C. and B.M. Daugherty. 2020. *Rhinanthus minor* subsp. *minor*. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America [Online]. New York and Oxford. Vol. 17. Available at: http://floranorthamerica.org/Rhinanthus_minor_subsp._minor. Accessed January 2025.

USask (University of Saskatchewan). 2016. SK1 Ecosite Data, “bs_veg-map_2016_v0.3.tif”. Data received from Philip McLoughlin, University of Saskatchewan, January 12, 2023.

USask (University of Saskatchewan). 2024. McClean Lake Operation Preliminary Bat Survey – Fall 2023. Prepared for Orano Canada Inc. Saskatoon, Saskatchewan. March 2024.

USask (University of Saskatchewan). 2025a. High-resolution (30-cm) aerial imagery. Collected on May 25-27, 2025.

USask (University of Saskatchewan). 2025b. McClean Lake Operation 2023-2024 Draft Bat Survey Report. Prepared for Orano Canada Inc. Saskatoon, Saskatchewan. June 2025.

Vennesland, R.G. and R.W. Butler. 2020. *Great Blue Heron* (*Ardea herodias*), version 1.0 In Birds of the World (A.F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, NY.

W.P. Fraser Herbarium. 2006. Virtual Herbarium of Plants at Risk in Saskatchewan: A Natural Heritage. Department of Plant Sciences, College of Agriculture, University of Saskatchewan, Saskatoon, SK. Available at: https://biolwww.usask.ca/rareplants_sk/root/htm/en/index.php. Accessed January 2025.

W.P. Fraser Herbarium. 2007. Data Search of Rare Plant Occurrences within the McClean Lake Operation Study Area. W.P. Fraser Herbarium, University of Saskatchewan. Saskatoon, Saskatchewan.

White JA, Freeman PW, Otto HW, Lemen CA. 2020. Winter Use of a Rock Crevice by Northern Long-Eared Myotis (*Myotis septentrionalis*) in Nebraska. Western North American Naturalist 80:114–119. DOI: 10.3398/064.080.0114

6 Culture

6.1 Introduction

Archaeological research and a review of previous ethnohistoric research were completed in advance of project work at the McClean Lake Operation. Furthermore, public consultation with local interest groups were conducted and traditional land use (TLU) data from the Prince Albert Grand Council (PAGC) was reviewed. This section summarizes archaeologists' and anthropologists' current understanding of precontact and ethnohistoric use of land within the RSA and LAB by local Indigenous Peoples (Figures 1.6-2 and 1.6-3 respectively). Particular attention was paid to studies specific to the McClean Lake Operation and Midwest Project LSAs (Figure 1.6-3), as well as assessments and regional overviews that may be useful in interpreting how Indigenous Peoples have used, and continue to use, northern environs. All mining and milling infrastructure managed by Orano is located within the McClean Lake Operation and Midwest Project Surface Lease areas (Figure 1.6-3).

6.2 Culture History

This culture history refers to archaeological cultures, which are based on material categories, and are not necessarily indicative of groups of people with shared belief systems, values, organization, etc. The archaeological cultures that developed and persisted in central and northern Saskatchewan represent a rich record of human response to the area's changing environment and its resources. Understanding the recognized material cultural sequence in the RSA is considered relevant to the McClean Lake Operation and Midwest Project as it provides a framework within which the heritage resources identified can be interpreted and evaluated.

Archaeologically, the culture history of northern Saskatchewan can be separated into a northern and southern zone using the ecological classifications system outlined by Acton, Padbury, and Stushnoff (1998). The far northern Saskatchewan culture zone includes both the Taiga Shield Ecozone and the Boreal Shield Ecozone and roughly covers the upper one-third of Saskatchewan from the headwaters of the Douglas and MacFarlane rivers on the western side of the province to Deschambault and Amisk lakes on the eastern side of the province. The far northern zone contains several large lakes, including Lake Athabasca, Black Lake, Cree Lake, Wollaston Lake, and Reindeer Lake. The LAB is associated with the far northern zone and will be referred to as far northern Saskatchewan.

The culture histories, ancient land-use patterns, and ancient lifeways of northern Saskatchewan (including far northern zone) are poorly understood due to boreal forest archaeology. Poor organic preservation, a lack of stratified sites, and a paucity of archaeological work conducted in the north all contribute to this knowledge gap (Wright, 1972; Hamilton, 1988; Reid, 1988; Ives, 1993; Meyer, 1995).

In general, the culture history of far northern Saskatchewan can be separated into (from earliest to latest) the Early Precontact period, the Middle precontact period, the Late Precontact period, and the Post Contact period.

6.2.1 Precontact Period in the Regional Study Area

Table 6.2-1 summarizes the periods of human occupation that have been proposed for northern Saskatchewan. The timing of the initial human habitation of far northern Saskatchewan was contingent on the melting of the Laurentide ice sheet. Far northern Saskatchewan was not fully deglaciated until shortly after 8,000 years before present (B.P.); however, southern portions may have been deglaciated and habitable as early as 9,500 B.P. (Dyke 2004). Caribou would have inhabited northern Saskatchewan soon after deglaciation and would have been the primary food source for people in this region from the Precontact Period through to the Historic Period (Gordon, 1996; Meyer, Beudoin, & Amundson, 2011; Pettipas, 2011; 2012).

Northern Plano is the first recognized archaeological culture in far northern Saskatchewan (Minni, 1976; Meyer, 2005). This culture is characterized by lanceolate points that closely resemble Agate Basin projectile points from the northern Plains (Meyer, 1999). It has been suggested that Northern Plano archaeological sites in far northern Saskatchewan date to approximately 8,000 to 7,000 years B.P. (Dyck, 1983; Walker, 1999).

Northern Plano is followed by the Shield Archaic archaeological culture. Shield Archaic sites are believed to date to approximately 7,000 to 3,000 B.P. in the barren lands of the Northwest Territories and Nunavut (Wright, 1972). The projectile points found at Shield Archaic sites are similar to those found in the barren lands of the Northwest Territories, Nunavut, and northern Manitoba and are characterized as lanceolate in form with clearly defined side-notches (Wright, 1972). It is believed that the Shield Archaic culture was not the result of a movement of people, but the result of *in-situ* technological changes in tool type by the proceeding Northern Plano culture (Meyer, 1983a; 1983b; 2005). There are differing views regarding the existence of this culture in northern Saskatchewan, and at best, the Shield Archaic culture is ill defined in Saskatchewan until further archaeological data can be provided from future research (Hanna, 1980; Amundson, 1996; Meyer, 1999).

Approximately 3,500 years ago, the Arctic Small Tool tradition (ASTt, also known as the Pre-Dorset culture) entered northern Saskatchewan. The culture likely originated from the Arctic coastline, with some bands moving south to hunt caribou because of severe climatic conditions along the coast (Gordon, 1996). Evidence of the finely made ASTt tools have been found along some of the larger waterbodies in northern Saskatchewan, including Lake Athabasca, Black Lake, and Reindeer Lake areas (Wright, 1975; Minni, 1976; Meyer, 1983a; Meyer, 1999). It is believed that the ASTt represents ancestral Inuit (Gordon, 1996).

Taltheilei tradition materials have been recovered from the Churchill River system and northern Saskatchewan, dating to approximately 2,600 B.P. (Gordon, 1996). Taltheilei people used a strategy of following migratory barren-ground caribou from their winter range north of the Thelon River and Beverly Lake in Nunavut to their summer range in northern Saskatchewan (Gordon, 1996; Meyer, 1999). The presence of Taltheilei archaeological sites as well as oral histories from the southern zone suggests that the southernmost range of barren-ground caribou during this time was much further south than it is at present (Holland & Kkailther, 2003; Millar, 2009; Korejbo, 2011). Artifacts that are diagnostic of the Taltheilei tradition include stemmed and lanceolate projectile points, and chithos. The latter is a distinct disc tool manufactured from coarse-grained lithic materials such as sandstone and schist. These tools were likely used in hide preparation. Later Taltheilei diagnostic artifacts, from approximately 1,200 years B.P. through to proto-historic times include smaller side-notched and corner-notched projectile points that were used as arrow tips. These projectile points were manufactured not only from locally available lithic materials, but from bone and native copper as well. It is proposed that the groups who manufactured these materials were ancestral to Dené peoples (Gordon, 1996; Clark, 1991; Meyer, 1999; Minni, 1976; Wright, 1995).

Influences from the more southern Churchill River region are also evident in far northern Saskatchewan. The Churchill River region was inhabited primarily by ancestral Cree peoples as represented by Selkirk pottery, which has also been recovered from Reindeer Lake and as far north as Black Lake (Clark, 1991; Minni, 1976). The area near Reindeer Lake and Wollaston Lake is considered part of a Cree-Athapaskan overlap zone (Clark, 1991).

The Protohistoric period is the time window during which European goods are available to Indigenous populations prior to their contact with Europeans themselves. Meyer (1983a) suggests that the Dené obtained European goods as early as the 1620s. Although, no inland trading posts had been established at this time, European goods made their way inland through middlemen, trading goods from fur traders wintering and trading along Hudson Bay (Ray, 1978; Burley, et al., 1982). Europeans would not reach the RSA until approximately 150 years later.

6.2.2 Historic Period

6.2.2.1 Fur Trade

The first European to see land that is now Saskatchewan was the Hudson's Bay fur trader Henry Kelsey who entered the province in the winter of 1690/1691. In far northern Saskatchewan, the Historic period begins around 1770 following Samuel Hearne's journey to Lake Athabasca in 1769 to 1772 (Meyer, 1983a). The first trading post to be established in proximity to far northern Saskatchewan was established by the Northwest Company's (NWC) Peter Pond in 1778 on the Athabasca River near its junction with the Embarras River (Atlas of Alberta Lakes, 2004). Following the abandonment of Pond's post, Fort Chipewyan was built on the southwest shore of Lake Athabasca by Roderick Mackenzie in 1788 (Parker, 1987; Meyer & Russell, 1999; Atlas of Alberta Lakes, 2004). Several other fur trade posts were established in the RSA by the Hudson Bay Company and their rivals the NWC. They placed several posts near Fond du Lac, Cree Lake, and Reindeer Lake (Table 6.2-2). In 1821, the two companies amalgamated under the Hudson's Bay Company banner leaving Fond du Lac as the only trading post in the region until the early twentieth century.

6.2.2.2 Adhesion to Treaties 10 and 8

Prior to the signing of the numbered treaties, most formalized negotiations between European and First Nations groups revolved around maintaining peaceful relationships to facilitate trade (Ray, Miller, & Tough, 2000). *The Royal Proclamation of 1763*'s purpose was to discourage violence between British Colonists and First Nations groups in both Canada and the United States (Ray, Miller, & Tough, 2000). The proclamation stated that the land outside of the current colonial settlements was the lands of First Nations peoples and, thus, could not be obtained without appropriate negotiations for the surrender of the land, which usually involved cash payments (Barry, 1999; Ray, Miller, & Tough, 2000). Furthermore, these negotiations could only be conducted by the crown. Most of the early treaties were small, one-time deals, but throughout the mid-nineteenth century, treaties gradually evolved to include annual payments (annuities), the protection of First Nations hunting and fishing rights, and the development of reserves (Ray, Miller, & Tough, 2000).

Early treaty negotiations in Saskatchewan focused on southern Saskatchewan, as it was important to the Canadian government to set aside Aboriginal title in areas that had agricultural and settlement potential. First Nations communities in northern Saskatchewan initiated treaty negotiations with the Canadian government as

falling fur prices and declining food resources in the north made treaties a necessity (Coates & Morrison, 1986). The first petitions to the government to be included in the treaty system occurred in 1879 and came from the First Nations groups in Stanley Mission, Lac La Ronge, and Pelican Narrows but were not advanced at that time because the areas were not part of the Canadian government's settlement plans.

Northern Saskatchewan is covered by three treaties, Treaty 6 in the north central Saskatchewan, Treaty 8 in northwestern portion of the province and Treaty 10 in the northeastern portion. The LAB falls within Treaty 10 territory. Negotiations for what would become Treaty 10 did not begin until after Saskatchewan became a province in 1905. Treaty 10 was established in 1906 with terms that included land grants, education, rights to hunt, fish, and trap over the treaty area (not to be limited to reserve areas) except on land needed for mining, lumbering or settlement, and annuities in the form of monetary payments and supplies of ammunition and twine (Coates & Morrison, 1986). Although reserves were created, reserve settlement was not enforced. First Nations peoples who have signed treaties are considered Status Indian under Canadian Law.

6.2.2.3 Mining and Prospecting

The mining and prospecting of precious minerals played an important role in the history of far northern Saskatchewan. Rumours of gold, silver, and other valuable minerals resulted in moderate population growth in the early 1900s (Kupsch, 1986). A mineral staking rush in this area occurred shortly after a substantial discovery of gold at Amisk Lake in 1913 (Reeves, 2005). Additionally, gold prospectors discovered a massive discovery of copper/zinc northeast of Amisk Lake on the Saskatchewan/Manitoba border (Reeves, 2005). Gold was also discovered on the northeastern edge of Lake Athabasca (Goldfields) in the 1930s (Kupsch, 1986). Pitchblende, a mineral with uranium content, was discovered at Lake Athabasca in the late 18th Century, but its value was not recognized until the 1930s (Kupsch, 1986). The first significant mining for uranium occurred after a later discovery of this mineral near the north shore of Lake Athabasca in the Beaverlodge area (Uranium City) during the mid to late 1940s (Kupsch, 1986; Reeves, 2005). Mining for uranium, gold, and other rare minerals, metals, and stones continue to be an important activity in far northern Saskatchewan.

6.2.3 Summary

The cultural sequence based on material culture discoveries provides evidence that several archaeological cultures utilized the RSA through the last 8,000 years. In addition, the fur trading posts constructed on select lakes and waterways in the RSA in the 18th, 19th, and 20th centuries to utilize skills of local hunters and trappers indicate that Indigenous Peoples use of the region continued through the historic period.

6.3 Heritage Assessment

6.3.1 Introduction

In Saskatchewan, heritage resources include Precontact period and Historic period archaeological sites, built heritage sites and structures of historical and/or architectural interest, and palaeontological sites. Heritage resources are the property of the Provincial Crown and are protected under the *Heritage Property Act* (GS, 2024).

The Heritage Conservation Branch (HCB) of the Ministry of Parks, Culture and Sport has identified two primary triggers for determining if a Heritage Resource Impact Assessment (HRIA) is required for a project (per Section 63 of the *Heritage Property Act*); if an area is considered heritage sensitive based on the presence of known heritage resources and the potential for new heritage resources to be discovered (GS, 2024). The extent of previous land disturbance and nature and scope of the proposed project is also taken into consideration.

In addition, the HCB has developed screening criteria (GS, 2008) for northern Saskatchewan (northern parklands and boreal forest) to determine heritage potential, including:

- within 500 m of a Site of Special Nature (SSN) (per. S. 64 of the *Heritage Property Act*), or other previously recorded site(s), unless the site has been determined to have low interpretive value;
- along dry, upland margins of a major bog or fen (> 1 km in length);
- within 250 m of watercourses or lakes (> 1 km in length) ;
- within 50 m of historic trails;
- within 250 m of strandlines; and
- on escarpments (defined by two or more contour intervals within 200 m), prominent uplands, and hills/ridges (including eskers) within 500 m of a water source.

Based on the criteria above, most areas in the LAB have heritage potential due to proximity to lakes and watercourses. A few heritage resources have been identified in the LAB during archaeological surveys (Figure 6.3-1; Table 6.3-2). The following sections provide a summary of known HRIAs completed to date in the LAB and outline locations and characteristics of known heritage resources.

6.3.2 Methods

Eighteen HRIAs have been conducted in the LAB, each under Archaeological Resource Investigation Permits issued by the HCB (Table 6.3-1). Four of the HRIAs (79-0, 12-105, 15-064, and 24-154) included work specific to the McClean Lake Operation Surface Lease area and three of the HRIAs (79-0, 02-098, 06-120) were completed for the Midwest Project Surface Lease area (Figure 6.3-2). Field programs were designed to identify and assess any heritage resources that occur within the potential development areas.

Locations situated in terrain with high potential to contain heritage resources (as defined in section 6.3.1) were investigated using a combination of surface and subsurface investigation techniques. Pedestrian transects are the most effective method for discovering sites in areas with good surface visibility, such as regions of limited soil development and sparse vegetation. Shovel testing is an effective method used by archaeologists to locate and identify sub-surface archaeological deposits. In addition to its use as a site discovery method, shovel tests provide important information on the integrity, dimensions, and density of cultural materials at an archaeological site.

6.3.3 Results

6.3.3.1 Local Assessment Boundary

Archaeological investigations in the LAB have consisted of HRIAs completed in advance of proposed industrial developments. Coordinates of all recorded heritage resources in the region were acquired from the HCB and mapped within the LAB. As shown in Figure 6.3-1 and Table 6.3-2, 34 heritage resources have been recorded in the LAB during these assessments.

In 1982, an HRIA was completed by the SRC for the proposed road option from Stony Rapids to the end of Provincial Road 105 at the Midwest Project site under Heritage Resource Investigation Permit No. 82-020 (Meyer, 1983b). Assessment of 17 different locations along the proposed right-of-way resulted in the identification of 14 heritage resources, with four of them found in McClean LSA and one in Midwest LSA (Figure 6.3-1; Table 6.3-2). Artifacts were mostly found on eskers between Torwalt and North and South McMahon lakes and consisted of quartz and silicified sandstone debitage.

In 1987, two transmission line corridors in the area have undergone heritage assessment. Saylor (1987) completed examinations of 40.7 km of the 415-km long transmission line from Uranium City to Wollaston Lake under HRIA Permit No. 87-023. A crossing of Collins Creek 4 km south of the McClean Lake Operation Surface Lease area was included in this assessment. None of the six precontact sites recorded in this HRIA are found in the lease boundaries.

In 1990, Amundson assessed 28 select portions of the Island Falls to Points North 138 kV transmission line under HRIA Assessment Permit No. 90-037 (Amundson, 1990). There was only one heritage resource recorded during this assessment, and it was located outside of the LAB.

In 1994, Brewer completed an HRIA on a proposed road from the MacArthur River Mine to Provincial Road 905 under Heritage Resource Investigation Permit No. 94-069 (Brewer, 1994). The 90-km long road connects Key Lake Mine, McArthur River Mine, and Cigar Lake Mine to Provincial Road 905 at Points North in the Midwest Project area 10 km west of McClean Lake. One site, IaNc-4, was identified during the assessment. This site is located on the shores of Waterbury Lake and is outside the LAB.

In 1996, another proposed road running from Points North Landing to Black Lake was examined by Sentar Consultants Ltd. under Heritage Resource Investigation Permit No. 96-023 (Amundson, 1996). Six sites were identified during the reconnaissance, including he precontact artifact scatter IbMx-14 located within the LAB boundary. During assessment of this site, three lithic flakes were discovered on the surface of the site, and four lithic flakes were identified in subsurface shovel tests. Based on the results of their assessment, the authors of the report determined that the site contained intact archaeological deposits and assigned “moderate” significance.

In 2002, Golder Associates completed an HRIA on behalf of Cameco Corporation for a proposed haul road to the Rabbit Lake Operation under Heritage Resource Investigation Permit No. 02-098 (Novecosky, 2002). Novecosky examined 7.6 km of road allowance, including three potential crossings of Collins Creek to the northwest of the mine site. No heritage resources were identified.

Several HRIAs were conducted in association with other mine developments in the LAB. Environmental baseline studies were completed for the Dawn Lake Area for the Saskatchewan Mining Corporation in 1983 (Meyer, 1984). Meyer completed the survey under Archaeological Resource Investigation Permit No. 83-015. The survey included a 4 km access trail, which stretched from Dawn Lake to Highway 105, and encompassed areas around Dawn Lake, the north end of Lake 17, Lake 29, the area between Dawn Lake and Lake 16, Lake 16, Lake 4, and Lake 22. The assessment looked at previously disturbed and undisturbed areas as no baseline archaeological research had been conducted in this area. Nine heritage resources were identified during the assessment.

An HRIA was conducted in association with Cameco Corporation in 2008 under Archaeological Resource Investigation Permit No. 08-304 (Hanna, 2008). This assessment is located approximately 2.3 km east of the McClean Lake Operation Surface Lease area, near Collins Creek. In total, 133 shovel probes were excavated in the project area. No heritage resources were identified.

Golder Associates completed an HRIA for Fission Energy Corp. under Archaeological Resource Investigation Permit No. 10-194 (Young, 2010). In total approximately 4 km of shoreline along North McMahon and South McMahon lakes were assessed and 137 shovel probes were excavated. No new heritage resources were identified, and IcaNc-6 could not be relocated suggesting that this site is of limited interpretational value.

CanNorth completed two HRIAs for Rio Tinto Uranium Corporation under Archaeological Resource Investigation Permit No. 12-120 (Markowski, 2012) and No. 13-163 (Korejbo, 2013). In 2012, areas along Lake A, Lake B, Lake C3, Lake C2, and Lake C1 were assessed (Figure 6.3-2). During this survey 131 ha were assessed, and 151 shovel probes were excavated. In 2013, assessment included Roughrider quarry (16 ha), preferred access road (~1 km) and alternative access road (~1.1 km) (Figure 6.3-2). The entire assessment area was located approximately three kilometres east of Points North Landing, Saskatchewan, and south of Highway No. 905. Known heritage recourses (lbNa-3, IbNa-4, and lbNa-9) were in potential conflict with the preferred Roughrider access road, and therefore the entire road was closely inspected for cultural materials (Korejbo, 2013). Overall, during 2013 HRIA 94 shovel probes and 15 shovel tests were excavated and 63 subsurface exposures were inspected for cultural materials. It was determined that lbNa-9 has been destroyed by quarrying activities. It was concluded that IbNa-3 and IbNa-4 have likely been destroyed by historic aggregate testing or quarrying activities. No new heritage resources were identified during these HRIAs.

6.3.3.2 McClean Lake Operation Surface Lease Area

Environmental baseline studies were completed in 1979 by the SRC (Meyer, 1979) on the Project Wolly McClean Lake Area, a location that encompasses all of the current McClean Surface Lease Area. An HRIA on select portions of the McClean Lake Operation Surface Lease area was completed in conjunction with these investigations (Meyer, 1979; Minatco, 1991a; 1991b). Meyer (1979) undertook the archaeological reconnaissance of the south part of the McClean Lake Operation Surface Lease area to assess its heritage potential.

Meyer's 1979 assessment examined the entire shoreline of McClean and Vulture lakes, as well as the west shore of Candy Lake (Figure 6.3-2). In addition, the east and west banks of Collins Creek were inspected for 0.8 km south from its junction with McClean Lake (Figure 6.3-2). A drill road running south of Candy Lake to the east edge of the McClean Lake Operation Surface Lease area was also assessed. As the Project Wolly McClean Lake Area was larger than the McClean Lake Operation Surface Lease area , this reconnaissance also examined undocumented portions of Torwalt and Mallen lakes. Meyer's (1979) archaeological assessment was completed

through surface examination of existing exposures and, along the ridges, judgmental shovel testing. No heritage resources were identified during the HRIA.

In 2012, Golder Associates completed an HRIA for the proposed JEB TMF expansion under Heritage Resource Investigation Permit No. 12-105 (Young, 2012). Approximately 29 ha were assessed adjacent to the south shore of Fox Lake (Figure 6.3-2). A total of 94 shovel probes were excavated. No heritage resources were identified during the HRIA.

In 2015, an HRIA was completed for the proposed road accessing a planned environmental monitoring station on Collins Creek (Figure 6.3-2). CanNorth completed the heritage assessment under Archaeological Resource Investigation Permit No. 15-064 (Korejbo, 2015). Approximately 930 m of the proposed access road right-of-way was assessed using a combination of pedestrian reconnaissance and the excavation of 14 shovel probes. No new heritage resources were identified during the HRIA.

In 2018, HCB completed a screening of the proposed McClean Mining site infrastructure expansion east of Candy Lake. HCB concluded that the area of the proposed expansion did not require an HRIA as it had been previously assessed in 1979 (HCB, 2018) and likelihood of discovering an archeological site was low.

The most recent HRIA in the McClean Lake Operation Surface Lease area was completed in 2024 for the proposed McClean Mining site expansion (Figure 6.3-2). CanNorth completed the heritage assessment under Archaeological Resource Investigation Permit No. 24-154 (Pletz, 2024). Heritage sensitive segments of the project were assessed using a combination of pedestrian reconnaissance and excavation of eight subsurface shovel tests. No heritage resources were identified within the proposed mining expansion footprint.

6.3.3.3 Midwest Project Surface Lease Area

A first heritage assessment in the Midwest Project Surface Lease area, was completed by Lifeways of Canada Ltd. in 1979 (Van Dyke, 1979) under Heritage Resource Investigation Permit No. 79-0. During a 16-day field program, 18 heritage resources were recorded along Henday, Hamilton, Glove, and North and South McMahon Lakes (Figure 6.3-1). Precontact sites were similar to those identified by Meyer (1978) in his work at Key and McDonald lakes, consisting exclusively of small campsites and workshop/quarry sources with less than 25 artifacts. Cultural materials consisted mainly of lithic debitage; tools were rare, and features were absent. Artifacts were manufactured mainly from locally available quartz and quartzite with infrequent use of exotic lithic materials. Sites are situated on river and lake benches, terraces, or on eskers and morainal deposits. Site density is low, usually consisting of less than one site per 5 km of shoreline.

Two additional HRIAs were completed for the Midwest Project in 2006 and 2008. In 2006, an HRIA was completed by Golder Associates on the western margin of Too Small Lake and along two proposed transportation corridor options between the Midwest Project and McClean Lake Operation under Archaeological Resource Investigation Permit No. 06-120 (Novecosky, 2006). The HRIA report summarized the results of previous investigations and indicated that no heritage resources were identified during the assessment. No additional archaeological work was recommended. The 2008 HRIA built on previous baseline studies conducted for the Midwest Project in 1979. The area examined as part of this project included the shoreline of North McMahon Lake and South McMahon Lake as well as portions of Shallow Lake (Figure 6.3-2). Golder Associates completed this assessment under Archaeological Resource Investigation Permit No. 08-129 (Young, 2008). Approximately

20 km of shoreline were assessed, and 609 shovel probes were excavated. No new heritage resources were identified during this assessment, and despite attempts to relocate eight previously recorded sites in the region, only IbNa-6 was positively identified (Figure 6.3-1). A subsequent shovel-testing program of the site areas determined that these locales were of limited archaeological value.

6.3.4 Summary

Due to logistics and accessibility, archaeological studies in the RSA have been limited in scope when compared to southern Saskatchewan. As a result, archaeologists understanding of the 8,000-year cultural history of the region is still considered incomplete (Korejbo, 2011).

There have been 18 previous heritage assessments in the LAB resulting in the identification of 34 historic and precontact heritage sites in the LAB. The results of these studies indicate that while there are significant cultural deposits, archaeological sites are relatively rare. Considering the number of significant heritage resources in the LAB and RSA, there is a moderate potential for archaeological sites within the surface lease areas managed by Orano.

HRIA activities have been completed on select portions of the McClean Lake Operation Surface Lease area. Assessment procedures were conducted by the SRC along the edge of McClean and Vulture lakes, the west edge of Candy Lake, portions of Collins Creek and a drill road located south of Candy Lake (Meyer, 1979). More recently, HRIAs have been completed along the shores of Fox Lake, by Collins Creek, and north of Candy Creek (Young, 2012; Korejbo, 2015; Pletz, 2024). No heritage resources were observed during these assessments; the HCB has no records of any paleontological, precontact, historic, or architecturally significant sites located within the McClean Lake Operation Surface Lease area.

Within the Midwest Project Surface Lease area, HRIAs were completed on the shores of South McMahon Lake and Shallow Lake. Assessments were conducted by Lifeways of Canada Ltd. and Golder Associates (Van Dyke, 1979; Young, 2008). One heritage resource site was positively identified (IbNa-6) within Midwest Project Surface Lease area, although a subsequent shovel-testing program determined its limited archaeological value.

Heritage resources are the property of the Provincial Crown and have been protected under the *Heritage Property Act* (GS, 2024) since 1980 (last revised in 2024). The studies discussed in this section have been compliant with the *Heritage Property Act* (GS, 2024).

6.4 Ethnohistory, Land Use, and Traditional Knowledge

6.4.1 Introduction

A literature review focussed on Ethnohistorical studies of traditional activities, practices, and land use of the Dené and Western Woods Cree in the LAB and RSA has been completed. Additionally, data accumulated through organizations such as the Northern Saskatchewan Environmental Quality Committees (NSEQCs) and the committee previously referred to as the Athabasca Working Group (AWG) was reviewed. Table 6.4-1 summarizes the local land use data as per the 1991 McClean EIS (Minatco, 1991a).

The AWG was an outcome of the Impact Management Agreement (IMA) signed by uranium mining companies (Orano Canada Inc. and Cameco Corporation) and Athabasca Basin First Nations and municipal communities. The AWG was formed to identify the concerns of local communities in the RSA. The AWG ensured the mining companies were aware of community issues through regularly scheduled meetings. AWG concerns include the identification and protection of traditionally utilized fauna and flora. In 2016, the IMA was replaced by the Ya'thi Néné Collaboration Agreement (YTN CA).

The YTN CA updated and modernized the provisions in the original IMA and structured the agreement around four key pillars: workforce development and training, community investment, business development, and environmental protection and engagement. Three subcommittees are responsible for implementation of various aspects of the YTN CA. These subcommittees include the Joint Implementation Committee (JIC); Business Advisory Committee (BAC); and Athabasca Joint Engagement and Environmental Subcommittee (AJES).

The AJES has replaced the AWG and is responsible for providing direction to the companies on engagement activities, environmental protection and stewardship initiatives, and to be a conduit back to the communities on these matters. The intent of the AJES is to be the primary point of contact for engagement and information sharing between the operations and the Athabasca Basin communities.

The NSEQC is the main consultative body representing northern Saskatchewan residents. The NSEQC was formed in 1995 in response to recommendations of the joint Federal-Provincial Panel on Uranium Developments in northern Saskatchewan and is comprised of representatives nominated by the chiefs or mayors and councils from several communities in the RSA. Amongst other duties, the NSEQC works with industry and government regulatory agencies to detail information and advice on environmental issues. It also provides a forum for the consideration of traditional knowledge and how it could be incorporated into and be used to benefit decisions about uranium development in northern Saskatchewan.

6.4.2 Background

Indigenous peoples have occupied the Athabasca region for about 8,000 years (Gordon, 1996). Dené peoples are often associated with the Early Taltheilei archaeological culture that was observed in sites in the Athabasca region, estimated to be dated to approximately 2,600 B.P. (Gordon, 1996). Cree peoples are often associated with the Selkirk archaeological culture that was observed in sites that are estimated to date between 700 B.P. to 300 B.P. in the Athabasca region (Young, 2006). Their ability to hunt, trap, fish, and gather plants in the region helped to maintain their connection to the land. Treaties 8 and 10 signed in 1906 guaranteed these rights in exchange for surrendering their traditional territories to Canada. As well, these Treaties provide payments for hunting and fishing supplies, annuities, and hospital care (see Section 6.2.2).

The right to hunt for food throughout the year, day or night, has been recognized for all Status Indians, as defined by the Crown, in Saskatchewan through the Treaties. This right extends to all Indian reserve land, unoccupied Crown land, occupied Crown land with permission of the occupant and private land with permission of the owner. The province of Saskatchewan has recognized that members of certain Métis communities have the same rights as Status Indians to hunt, fish, and trap for food in certain areas of the Province. A comprehensive Métis harvesting agreement has not been reached between the provincial government and the Métis-Nation of Saskatchewan. Currently Métis harvesting rights are recognized in northern Saskatchewan and allow recognized individuals to hunt, fish, and trap for food in the Métis Harvesting Zone in which their historic community was

located. Métis individuals who have not been recognized or are in areas outside of the Métis Harvesting Zones, are expected to follow all current hunting and fishing laws (GS, 2018).

Tables 6.4-2 to 6.4-4 provide data on trapping and fur harvest from 2004 to 2021. This is the most recent information, as the trapping and fur harvest data for the period of 2022-2024 is not available at the time of writing of this report (SMOE, 2025). Trapping in Saskatchewan is regulated by *The Wildlife Act* and the regulations made pursuant to the Act (GS, 1998). The regulations control trapping through licensing requirements, setting trapping seasons, prescribing trapping methods, and other measures. Because trapping is considered a commercial activity, it is subject to regulation. A trapping licence gives the right to take animals, not to take possession of the land. Many trappers do have cabins on their trap lines, which are held through a traditional resource-use lease, some of which are also used for domestic fishing. Trapping continues to be an important activity in the LSA. The LSA falls within Northern Fur Conservation Area N26. The number of trappers in the Northern Fur Conservation Area has decreased over time with licenses in 2004 to 2005 numbering 2,019 and 1,424 in 2020 to 2021 (GS, 2021). The total value of the furs harvested have shown an overall increase in value occurred across the operational period (Tables 6.4-2 to 6.4-4).

The federal government is responsible for the management of all inland fisheries in Canada. Treaties have provided Status Indians with the right to fish for food at all times of the year. These fishing rights can be curtailed in regions where fisheries have been closed because of conservation concerns. These moratoriums are supported through Band Council Resolutions and co-management agreements. Commercial fishing is practiced in some areas of the LSA. In the last decade, only Wollaston Lake has been fished commercially (Duffy, 2025). Licences issued for commercial fishing has fluctuated from a high of 45 licences in 2006 down to 1 licence in 2021 (Table 6.4-5 to 6.4-7). Starting from 2022 the number of commercial fishing licences started to increase again with a steady growth trend extending into 2024 (Table 6.4-6). Lake trout, lake whitefish, northern pike and walleye have been harvested in Wollaston Lake over recent years (Table 6.4-7).

6.4.3 Traditional Activities in the Regional Study Area

The Indigenous Peoples of northern Saskatchewan living in the Athabasca Region belong to two main language families: Athapaskan (Dené, also known as Chipewyan) and Algonquian (Western Woods Cree). Dené and Cree social systems are based on the extended family, and local and regional bands. The local hunting band was centred on a small number of extended families linked by kinship and friendship (Brumbach & Jarvenpa, 2006). Because of the environment in which they lived, hunting groups were primarily formed from the local bands. These bands were highly mobile, requiring a large hunting territory to subsist (Brumbach & Jarvenpa, 2006). Membership in bands was flexible and fluid, with members able to leave and join others as a result of kin ties between local and regional bands (Brumbach & Jarvenpa, 2006). Band size was dependent on environmental conditions and seasonal adaptations (ACFN, 2003). Local bands often consisted of two to five men and their families (about 10 to 30 people); regional band membership may have ranged from one hundred to several hundred individuals (Smith J. G., 1981).

Within the Dené and Cree Territories, there are several dialects spoken (Russel, 1990; Moodie, Catchpole, & Abel, 1992; Wolvengrey, 2001). Dené from Wollaston Lake, Black Lake, and Fond du Lac belong to the Ethen-edeli group and those from Patuanak are from the Thi-lan-ottine group. Cree from Canoe Lake, Cumberland House, Lac La Ronge, and Montreal Lake and the Peter Ballantyne Band speak one of three dialects: Woods Cree, Northern Plains Cree, and Western Swampy Cree.

The cultural area of the Northern Dené spans from the Hudson Bay to the Pacific Coast. There are four major divisions of Northern Dené, the T'atsan ottine ("copper people"), the Kkpest'aylekke ottine ("dwellers among the quaking aspen"), the Thi-lan-ottine ("dwellers at the top of the head") and the Ethen-eldeli ("caribou eaters") (Smith J. G., 1981; ACFN, 2003; Brumbach & Jarvenpa, 2006). The Ethen-eldeli are known to have utilized the LSA. They can be further sub-divided into five regional bands including the *Kesyeho'ine*, the *Kkrest'aylekke ottine*, the *Thilan ottine*, the *Thei lan ottine*, and the *Gank wen* Dené (Smith J. G., 1981; ACFN, 2003; Brumbach & Jarvenpa, 2006). The descendants of the Ethen-eldeli depended on the Beverly and Kaminuriak caribou herds and followed them throughout their yearly migrations and range (Smith J. G., 1976; Sharp, 1977; 1978; ACFN, 2003; Burch, 1991; Holland & Kkailther, 2003; Smith D. M., 2004; Kendrick, Lyver, & Lutsël, 2005; Brumbach & Jarvenpa, 2006).

A large area is required by regional bands to fulfill the hunting, trapping, and plant procurement needed to satisfy the needs of the community. For example, the economic resource area for Fond du Lac is estimated at 46,500 km^2 (Muller-Wille, 1974). After contact with Europeans in the late-nineteenth century, the Dené have become increasingly reliant on the northern boreal forest for their trapping needs. This has extended their range as far south as the Churchill River.

Western Woods Cree occupy portions of the Precambrian Shield and the forested interior plain (Smith J. G., 1981; Russel, 1990), areas of heavy forest cover including deciduous and coniferous tree species. When the Dené moved south to the Churchill River region in the late 18th and 19th centuries, they were likely entering territory along the Churchill River drainage that would be considered as Cree in late precontact times (Smith J. G., 1981).

Cree regional bands were usually called by the name of the lake or river from which they came during the 18th and 19th centuries (Smith J. G., 1981). The family trapping territory concept had emerged well before the end of the 19th century. In the latter part of the period between 1821 and World War II, Indigenous log-cabin communities came into existence in favourable locations oriented to a trading post–mission complex (Smith J. G., 1981). By this point, the material culture of the Western Woods Cree was almost entirely Euro-Canadian.

Cree participated in intensive harvesting of wildlife resources during the fur trade, particularly between the 1760s and 1821, eventually leading to severe depletion of fur bearing animals, moose, and caribou. Following the 1781 smallpox epidemic, there was a southerly move and consolidation of the Western Woods Cree toward the Saskatchewan River drainage, with Dené moving into the abandoned regions. However, by the end of the 18th century the Cree began to gradually return to northern areas (Smith J. G., 1981).

6.4.3.1 Seasonal Round

Historic hunter-gatherers rarely occupied the same place for longer than a single season. As foodstuffs become available in different locations, Indigenous Peoples migrated to these places to take advantage of specific resources. For instance, berries were usually gathered from select sites in the summer and fall after they ripened. Ceremonies and other social gathering also formed an integral part of the seasonal round.

Ethnographic research indicates that the Dené have strongly relied upon barren-ground caribou for survival. Following the caribou herds, the Dené would migrate north into the barren lands in the spring, returning to the boreal forest with the herds in the fall (ACFN, 2003; Brumbach & Jarvenpa, 2006). During the winters, when low

temperatures and heavy snowfall hampered movement, small game and fish were used to supplement a diet primarily focused on caribou and moose.

At Wollaston Lake, large camps were constructed seasonally; summer camps used for fishing and winter camps for hunting and trapping (Irimoto, 1981). Small, temporary camps were utilized in the fall for open-water fishing and small game hunting and in spring for trapping and fishing (Irimoto, 1981).

The Cree seasonal round in the boreal forest of Saskatchewan consisted of small co-residential hunting groups, which dispersed in the winter to focus on hunting moose and beaver with some angling on larger lakes (Meyer & Thistle, 1995; Ray, 1998). Hunting was the major activity of early winter; moose by bow and arrow and later guns, while migrating herds of woodland caribou were snared or speared in pounds (Smith J. G., 1981). Fur bearing animals were hunted and trapped, especially between November and December. January and February were times of limited activity due to harsh weather, and it was during this time that hides and pelts were processed and clothes were made or repaired (Ray, 1998). Hunting and trapping resumed as conditions moderated. In late winter, these groups would move to aggregating centres to prepare for the break-up and the return of geese, swans, and other waterfowl followed by fish spawns (Ray, 1998).

Cree groups in the RSA would fill the void of the departing Dené hunters by utilizing the LSA in the summer to fish, hunt, and trap (Meyer, 1999). Berries and other plants would be gathered in select locations in the area (Marles, The Ethnobotany of the Chipewyan of Northern Saskatchewan. Masters Thesis, 1984; Marles, Clavelle, Monteleone, Tays, & Burns, 2000). In the spring and fall, fishing and waterfowl hunting would also occur.

Availability of seasonally rich resources such as fish, berries, game, and waterfowl allowed population concentrations. This time was used to reinforce social ties, plan for winter dispersals, realign families, and socialize (Smith J. G., 1981; Meyer & Thistle, 1995). In Saskatchewan, such periods would occur during the spring break-up when migratory waterfowl was returning and fish were spawning, and perhaps in the fall for the same reasons (Meyer & Thistle, 1995). In other locations, the aggregations took place in the summer on the shores of lakes (Meyer & Thistle, 1995).

6.4.3.2 Hunting

The hunting and trapping practices of the northern Indigenous communities involve stewardship based on traditional knowledge and ritual beliefs adapted to contemporary technology. Hunting activities support “traditional values and attitudes, beliefs and perceptions, behaviours and practices that together make up an identity structure and a way of life” (Heber, 1989). Throughout the twentieth century, hunting and trapping have supplied significant amounts of food, hides, and pelts to the communities living in the RSA. Animals are also used in traditional medicines and in important ceremonies (Holland & Kkailther, 2003).

Caribou and moose were highly valued for their hides and meat (Holland & Kkailther, 2003; ACFN, 2003; Smith D. M., 2004). Their large mass was an important source of food; for instance, a single moose yields about 200 kg of meat. Caribou and moose were also an abundant source of fat, grease, marrow, and bone grease. Meat was often smoked for later use.

Caribou and moose hides could be made into a variety of clothing items, particularly for outer clothing such as jackets, gloves, moccasins, and leggings (Smith D. M., 2004). These hides would have been treated with the

brain, liver, and kidneys to assist in removing fat and hair, and to help soften the leather. The sinew was utilized as thread and in the construction of the lacing in the snowshoe. The bone could be used in the construction of scraping and cutting tools. The horns were eaten or manufactured into knife handles, while the teeth were used as ornaments.

To the Dené, barren-ground caribou remain the most important traditional wildlife resource in the RSA (Irimoto, 1981; Heber, 1989; Smith D. M., 2004). Heber (1989) notes that as recently as 1985, 50% to 75% of the people at Wollaston Lake, Black Lake and Fond du Lac went north into Nunavut and Northwest Territories to hunt caribou each year. In the 1980s, on average, one caribou was consumed per person each year (Heber, 1989).

The hunters in a family were generally between the ages of 26 and 45 (Muller-Wille, 1974). The hunter shared meat with the household unit, which includes their parents, their wife/husband, children, unmarried siblings, and grandparents that may live in the home (Muller-Wille, 1974; Rogers & Smith, 1981; Brumbach & Jarvenpa, 2006). “The value system emphasized generosity, sharing, and hospitality among kinsmen and related groups” (Rogers & Smith, 1981). In recent years, the Dené have used airplanes, snowmobiles, and dog sleds to facilitate the caribou hunt (Heber, 1989).

The Dené traditionally relied upon the barren-ground caribou to provide fresh and dried meat, lard, and bone marrow (Irimoto, 1981). The hides were used for clothing (e.g., mitts, moccasins, and jackets), lodge coverings, bags, babiche line for snowshoes, fishing nets, and snares; bones were manufactured into spear points, fishhooks, and needles among other things (Bone, Shannon, & Raby, 1973; Heber, 1989). Caribou meat was also used to feed domesticated dogs. When caribou were less plentiful, hunting pressure on moose increased (Bone, Shannon, & Raby, 1973)

In addition to caribou and moose, various fur bearers (i.e., rabbits, muskrat, and beaver), waterfowl, and game birds provided meat to the diet (Heber, 1989; Usher, 1990). Extra meat could be dried or canned for use later; dogs would consume any excess portions. Eggs were also collected for immediate consumption.

Bird feathers were usually collected. In precontact times, the feather formed an important part of the arrow; fletching ensured the true flight of the projectile. The feathers could also be made into pillows and mattresses or used for lining jackets. Further, feathers were attached to drums, spears, pipes, and clothes as decorative items. The feathers were later sold to the Hudson’s Bay Company to be used as feather pens (Smith J. G., 1981).

Historically, the Cree focused their hunting efforts on moose and woodland caribou. The Cree would enter locations in the RSA in the early summer after the Dené had migrated north following the barren ground caribou as they proceeded to their calving grounds. The hides of caribou or moose were used for shelter coverings and clothing (Smith J. G., 1981). Blankets were also made from moose, caribou or elk hides. Bones were fashioned into scrapers, awls, fish spears/harpoons, and fishhooks (Smith J. G., 1981).

Occasionally the Cree hunted barren ground caribou when the herds penetrated far south into the forest. Black bear was harvested primarily for ritual purposes, often for its fat. Bear pelts were used for bedding and seating (Smith J. G., 1981). Other species harvested for food include beaver, hare, woodchuck, muskrat, porcupine, and squirrel. The hare was the most significant of these small mammals and waterfowl were important as seasonally rich food resources (Smith J. G., 1981).

6.4.3.3 Trapping

In historic times, Dené and Cree groups utilized the lakes and rivers of the RSA as a highway to trade furs for manufactured goods at York Factory on Hudson Bay. Later, European fur traders established trading posts along the major lake and river systems to take advantage of the continuity in Dené and Cree social geography (Smith J. G., 1981).

The Dené and Cree kept many of these furs for their own personal use. Furs were used for warmth and as decorative attachments for clothes. Socks were made from hare or caribou hide/pelts, hats were fashioned from caribou, otter, eagle, and other animal and bird skins (Smith J. G., 1981).

The Dené trapped a wide variety of animals for their pelts. “Trapping is a bush activity that helps support social, cultural, and spiritual features of Chipewyan identity” (Heber, 1989). On the tundra, major fur bearers included the arctic fox and wolf. From their winter camps in the boreal forest, several species were relied upon: bear, wolf, fox, beaver, fisher, martin, mink, otter, lynx, and muskrat(Smith J. G., 1981).

The Cree harvested beaver, mink, marten, otter, lynx, fox, and muskrat for their furs. Less significant species included the grey wolf, squirrel, wolverine, and fisher (Smith J. G., 1981). Traditionally, snares, the bow and arrows and spears were used to hunt game, while deadfalls were used to trap furbearers (Smith J. G., 1981). These tools were eventually replaced by guns and steel traps.

6.4.3.4 Fishing

The Dené were less reliant on fishing for food than the Cree. Important fish species include whitefish, walleye, northern pike, and lake trout (Smith J. G., 1981). Fish were caught with hooks, spears, and nets. Domestic fishing could occur year-round at the different communities.

In recent years, commercial fishing has been important to the northern communities’ traditional subsistence cycle (Heber, 1989). Commercial fishing success varies from year to year and is unreliable. Fish make up about 15% of the protein needs of the local communities (Heber, 1989). Fish are also an important source of dog food (Muller-Wille, 1974).

Northern Cree culture is closely linked to fishing. The most important fish species to the Western Woods Cree economy were the whitefish, lake trout, walleye, and pike (Smith J. G., 1981). Most of the traditional camps are centred around major lakes and rivers such as Wollaston, Reindeer and Cree lakes and the Churchill and Fond du Lac rivers, as well as many of the smaller lakes near these larger lakes. Even in times when other resources were scarce, fish seem to have been plentiful in the larger lakes.

Fish could be harpooned/speared, netted, and trapped in weirs. With the historical decrease in big game and the introduction of the ice chisel and gill net, fish were harvested more intensively throughout more of the year than in proto-historic or precontact times (Smith J. G., 1981). Fish was also a staple food of dog teams in the 19th and 20th centuries.

Fish were usually eaten soon after they were harvested. Fish were fried or used to make soups and stews. Another common method of preparing fish was to dry it on drying racks. The fish would be flavoured by smoking over a fire of rotten aspen.

6.4.3.5 Plant Gathering

Plants were collected for subsistence, technological, medicinal, and ritual purposes (Marles, 1984; Heber, 1989). Information regarding edible plant use by the Dené and Cree largely relate to the use of the numerous types of berries that exist in the Boreal Forest. Berry picking was regarded as a highly social activity, often completed by members of an extended family (Marles, 1984). Picking would occur as different berries came into season through the summer months. Berries were usually eaten fresh, dried for use in the winter, or mixed with lard and meat for flavouring. Blueberries were the most important source of fresh fruit (Marles, Clavelle, Monteleone, Tays, & Burns, 2000).

There are several non-medicinal/non-edible uses for plants, ranging from construction material for baskets and snowshoes to absorbent material for a baby's bedding (Marles, Clavelle, Monteleone, Tays, & Burns, 2000). Plants were also used to create dyes for use on decorative items.

The wood and bark from trees, especially birch, were used widely as a source of fuel, as well as in the construction of lodges, canoes, baskets, bowls, moose callers, net weaving shuttles and spacers, toys, cups, wrapping paper, kindling, torches, and fans (Leighton, 1985; Marles, Clavelle, Monteleone, Tays, & Burns, 2000). The wood of certain trees is used in the construction of snowshoe frames, canoe paddles, carrying boards, bows and arrows, drum frames, ceremonial rattles, axe handles, needles, dog-whip handles, grease lamp bowls, spoons, hammers, hide scrapers, berry mashers, hide stretching frames, canoe frames, and tipi and sweat lodge frames (Leighton, 1985; Marles, Clavelle, Monteleone, Tays, & Burns, 2000). Artistic uses of the bark include figurine cut-outs, drawing, and etching, patterns for bead work, and birch-bark biting (Leighton, 1985; Marles, Clavelle, Monteleone, Tays, & Burns, 2000).

Many of the Dené and Cree treatments for ailments were derived from the vegetation in their traditional territory. For instance, Labrador tea was commonly made into a tea and drunk for health and recreational purposes (Marles, Clavelle, Monteleone, Tays, & Burns, 2000). Parts of this plant were also used to treat colds, chest pains, hair loss, stomach problems, rashes, pneumonia, to wash burns, and to relieve stress (Marles, Clavelle, Monteleone, Tays, & Burns, 2000). The pitch from the trees was made into a salve to treat a variety of conditions including rashes, scabies, burns, cysts, chicken pox, and infected wounds (Marles, Clavelle, Monteleone, Tays, & Burns, 2000). The cones are used to treat sore teeth, throats, infections, diarrhoea, and venereal diseases (Marles, Clavelle, Monteleone, Tays, & Burns, 2000).

Medicinal plants were usually collected in small amounts. There are likely many herbal remedies known by members of the community; however, as this information is of a sensitive nature, few details can be provided on their collection and use.

6.4.3.6 Traditional Land Use and Occupancy Research

Cultural adaptations by local Indigenous populations were modified in response to contact with Europeans, the fur trade, and twentieth century commercial developments. However, traditional practices that have sustained

the Dené and Cree peoples for generations continue to be practiced. A wealth of environmental knowledge exists among the Elders and resource harvesters of local Indigenous Peoples. This knowledge is a relevant source of information on the ecological components of the existing environment. Through oral history and living memory, knowledge of TLU can be utilized to facilitate the identification of potential project-land use interactions, and supplement and enhance archaeological evidence.

TLU and occupancy research has been undertaken under an agreement[1] between the Government of Saskatchewan and Athabasca Basin First Nation groups and communities. The PAGC is the custodian of the TLU research. A request was made of the PAGC to provide thematic maps of TLU within an area of interest encompassing the LAB as part of the 2012 Midwest EIS (AREVA, 2012). These maps are presented in Figures 6.4-1 to 6.4-6, which together illustrate 47 different TLU themes, including spiritual places, subsistence and commercial water use, overnight sites, plant and earth materials, large and other animal kill sites, and trapping area boundaries within the area of interest.

Some known subsistence and commercial water use areas are present in the LAB (Figure 6.4-2), but historical use appears to be largely confined to the relatively large waterbodies (Wollaston Lake, Hatchet Lake, Waterbury Lake, and Henday Lake) at the periphery of the LAB. Based on studies undertaken by the PAGC, no sacred sites, birth or death sites, burial sites or locations of medicinal plant use have been identified within the LAB (Figure 6.4-1).

The survey of TLU also included known sites where large animals and a variety of birds, waterfowl, and small mammals have been harvested (Figures 6.4-3 and 6.4-4). Historically, several barren-ground caribou have been harvested within the LAB. As with subsistence and commercial water use, harvesting of large and small animals has historically been accomplished at the larger lakes located at the periphery of the LAB. Similarly, traditional harvest sites for black bear and woodland caribou are outside of the assessment area, as are all moose and bear hunter guiding areas. Other animal kill sites within the local assessment area are limited.

Trapping and the fur trade are very important, both culturally and economically to the Indigenous Peoples in northern Saskatchewan. Historically, trapping density within the LAB has been low (Figure 6.4-5), with less than five trapping areas within its boundary.

As part of the Athabasca Basin TLU and occupancy research, overnight sites, plants, and earth materials areas were also compiled, and their historical utilization within the area of interest encompassing the LAB is presented in Figure 6.4-6. Nine overnight sites, one area used for special woods and two areas used for wild berries are within or adjacent to the LAB.

6.4.4 McClean Lake Operation and Midwest Project Surface Lease Areas

As defined by the Crown, most hunters in the LAB are registered under the Indian Act as “Status Indian”. As such, most people in the LAB are exempt from provincial hunting and fishing laws; therefore, a large portion of hunting in the LAB is unregulated. Trapping occurs in the McClean Lake, Midwest and Collins Creek area. As

[1] “Agreement Respecting the Land and Renewable Resource Use Planning and Management in Northern Saskatchewan – Lake Athabasca Region”

per data available at the present moment, the majority of the pelts recorded in the Harvest Block N26 continue to be marten.

The lakes and streams within the McClean Lake Operation and Midwest Project Surface Lease areas support fish. Domestic fishing occurs mainly on Wollaston Lake. There is no commercial fishing within the lease areas (Duffy, 2025). Commercial fishing quotas have been granted for Torwalt, Wollaston, McClean, Waterbury, and Charcoal lakes (Duffy, 2025); however, commercial fishing has only been conducted on Wollaston Lake in the last decade and was limited in scale (see Tables 6.4-5 to 6.4-7).

6.4.5 Regional Monitoring Programs

Orano supports regional monitoring of the traditionally harvested country foods in RSA through the Eastern Athabasca Regional Monitoring Program (EARMP) and Community Based Environmental Monitoring Program (CBEMP).

The EARMP was initiated in 2011 as a partnership between the Government of Saskatchewan, uranium mining industry and, since 2017, CNSC to monitor potential cumulative effects downstream of uranium mining and milling operations the Eastern Athabasca region of northern Saskatchewan (EARMP, 2025a). Under the EARMP, samples of water, fish, berries, and game meats are collected in communities of Northern Saskatchewan on the annual basis. The EARMP results demonstrate that country foods collected in the Eastern Athabasca region are safe for consumption. The chemical composition of water, fish, and mammal samples was generally stable and consistent with natural background levels (EARMP, 2025b). Thus, the EARMP outcome shows that local country food quality remains unaffected by uranium mining activities.

The CBEMP was launched in 2018 as a successor of the AWG Environment Monitoring Program (Cameco, 2025). The CBEMP includes dietary surveys and sampling of water and country foods in communities across Athabasca Basin. In 2020, the CBEMP was implemented for members of Wollaston and Hatchet Lake Denesuline First Nation, the communities closest to the McClean Lake Operation and Midwest Project and located downstream of the McClean Lake Operation. The 2020 CBEMP results showed that chemical levels in traditional foods were generally low and within the expected range for the region. The CBEMP data were also used to assess potential risks to human health from traditional food consumption. The risk assessment demonstrated that risks associated with eating traditional foods harvested in the area are negligible(Cameco, 2025).

The CNSC runs the Independent Environmental Monitoring Program (IEMP) to verify that the environment and public near nuclear facilities remain safe. In 2016, the CNSC collected samples of water, fish, blueberries, Labrador tea, and radon in vicinity of the McClean Lake Operation to assess radiological and non-radiological risks for this area. The IEMP results confirmed that people and the environment near the McClean Lake Operation are safe, with no significant health or environmental risks identified (GC, 2025). The next IEMP sampling in the McClean Lake Operation area is scheduled for 2025. All three regional studies affirm that Orano's operations have maintained the integrity of traditional land use within the LAB.

6.4.6 Summary

Through a review of existing archaeological and ethnographic literature, it has been demonstrated that Indigenous Peoples have utilized the RSA since the retreat of the glaciers some 8,000 years ago. In the precontact period, Dené hunters and gatherers followed the migration of the caribou herds from their winter habitat in the RSA to their summer breeding grounds in the barren lands of Nunavut. After the Dené hunters had departed for the summer, Cree groups in the RSA would likely have utilized areas across the region for hunting, fishing, and plant gathering.

In the protohistoric and historic period, trapping became an increasingly important economic activity for both the Dené and Cree groups living in the area. Firearms resulted in increased hunting pressures on the local caribou herds. However, the introduction of disease had a devastating effect on Cree and Dené populations in the 18th century, reducing the impact of modern hunting and trapping technologies.

Traditional activities continue to be practiced by Cree and Dené in northern Saskatchewan. Most boreal forest communities lived a traditional way of life that evolved as a result of the changes brought about by the fur trade up to, or shortly after, World War II (Smith J. G., 1981). Traditional medicinal practices were upheld, although supplemented by government medicine chests provided to missionaries or Hudson's Bay Company officials. Hunting, fishing, and trapping formed the basis for subsistence and the annual cycle continued as it had for many generations. After World War II, commercial fishing had developed in several areas throughout the north encouraging further sedentarization. Regional monitoring studies of traditionally harvested country foods demonstrate that current uranium mining activities do not affect the quality of local country foods, which remain safe for human consumption.

6.5 Summary and Conclusions

Indigenous occupation and use of northern Saskatchewan have taken place over an 8,000-year period. Through this time, a wide variety of social and technological adaptations were developed to make full use of the local resources. A reliance on large game, numerous fur-bearers, fish, and waterfowl as well as innumerable plant species provided for the physical, social, and spiritual needs of the boreal forest inhabitants.

There are 34 precontact and historic archaeological sites that have been identified to date in the LAB (the combined McClean Lake Operation and Midwest Project LSAs), 18 of which occur in the McClean Lake LSA. HRIAs completed in 1979, 2012, 2015, and 2024 on select portions of the McClean Lake Operation Surface Lease area did not identify any heritage resources. HRIAs were completed in 1979, 2006, and 2008 within Midwest Project Surface Lease. One heritage resource site was positively identified (IbNa-6) within Midwest Project Surface Lease area, although a subsequent shovel-testing program determined its limited archaeological value (Young, 2008). No known historic or architecturally significant sites have been identified in the lease areas.

Cultural adaptations by local Indigenous Peoples were modified in response to contact with Europeans, the fur trade, and 20th century commercial developments. However, traditional practices that have sustained the Dené and Cree peoples for generations continue to be practised. The traditional knowledge can provide relevant and reliable information on the ecological components of the existing environment and can assist in developing the criteria for determining adverse effects from commercial and industrial developments. Given the TLU data made available through the PAGC, TLU activities in the LAB are largely focused on the larger lakes located at the

periphery of the LAB. Regional monitoring programs indicate that Orano's operations sustain the safety of local country foods and continued traditional land use within the LAB.

6.6 References

ACFN. (2003). *Footprints on the land: Tracing the path of the Athabasca Chipewyan First Nation.* Fort Chipewyan, Alberta: Athabasca Chipewyan First Nation.

Acton, D., Padbury, G., & Stushnoff, C. (1998). *The Ecoregions of Saskatchewan.* Regina: Canadian Plains Research Centre.

Amundson, L. (1990). *Island Falls to Points North 138 kV Transmission Line Heritage Resources Impact Assessment. Report for Cameco Corporation (Permit No. 90-037).*

Amundson, L. (1996). *Heritage Resources Impact Assessment of a Proposed Seasonal Road from Points North Landing to Black Lake, Saskatchewan (Permit 96-23).*

AREVA. (2012). *Midwest Project Environmental Impact Statement.* AREVA Resources Canada Ltd.

Atlas of Alberta Lakes. (2004). Lake Athabasca. In *Atlas of Alberta Lakes.* Edmonton, Alberta: University of Alberta Press.

Barry, B. (1999). The motivation for Treaties. In K. Fung, *Atlas of Saskatchewan* (pp. 44-45). Saskatoon, Saskatchewan: University of Saskatchewan.

Bone, R., Shannon, E., & Raby, S. (1973). *The Chipewyan of the Stony Rapid Region.* Saskatoon: Institute for Northern Studies, University of Saskatchewan.

Brewer, G. (1994). Heritage Resources Impact Assessment of the MacArthur River to Provincial Road 905 Transportation Corridor, Final Report (Permit 94-69). Completed on behalf of Cigar Lake Mining Corporation.

Brumbach, H., & Jarvenpa, R. (2006). Chipewyan Society and Gender Relations. In *Circumpolar lives and livelihood: A comparative ethnoarchaeology of gender and subsistence.* Lincoln, Nebraska, USA: University of Nebraska Press.

Burch, E. S. (1991). Herd following reconsidered. *Current Anthropology, 32*(4), 368-439.

Burley, D., Meyer, D., Klimko, O., Russell, D., Finnigan, J., Prentice, J., & Wilson, M. (1982). Regional Overview and Research Considerations. In D. Burley, & D. Meyer, *Nipawin Reservoir Heritage Study Volume 3. Publication No. C-805-25-E-82.* Saskatoon: Saskatchewan Research Council.

Cameco. (2025). *Community Monitoring*. Retrieved July 15, 2025, from Cameco: https://www.cameconorth.com/environment/monitoring

Clark, D. W. (1991). Western Subarctic Prehistory. In J. Helm, *Handbook of North American Indians Volume 6 – Subarctic.* Washington DC.: Smithsonian Institute.

Coates, K. S., & Morrison, W. (1986). Treaty Research Report Treaty No. 10 (1906). Treaties and Historical Research Centre Indian and North Affairs Canada.

Duffy, M. (2025). Personal Communication with M.Duffy Fisheries Management Specialist, Team Lead on June 16, 2025. Saskatchewan Ministry of Environment.

Dyck, I. (1983). Prehistory of southern Saskatchewan. In H. T. Epp, & I. Dyck, *Tracking ancient hunters* (pp. 63-140). Regina, Saskatchewan: Saskatchewan Archaeological Society.

EARMP. (2025a). *About EARMP*. Retrieved July 15, 2025, from The Eastern Athabasca Regional Monitoring Program (EARMP): https://www.earmp.ca/about

EARMP. (2025b). *Reports*. Retrieved July 15, 2025, from The Eastern Athabasca Regional Monitoring Program (EARMP): https://www.earmp.ca/reports

GC. (2025). Independent Environmental Monitoring Program: McClean Lake Operation. Government of Canada. Retrieved November 4, 2025, from https://www.cnsc-ccsn.gc.ca/eng/resources/maps-of-nuclear-facilities/iemp/mcclean-lake/#background

Gordon, B. C. (1996). People of the Sunlight, People of the Starlight: Barrenland Archaeology in the Northwest. Hull: Canadian Museum of Civilization.

GS. (1998). *The Wildlife Act.* Government of Saskatchewan. Retrieved July 7, 2025, from Saskatchewan Publications Centre: https://publications.saskatchewan.ca/#/products/938

GS. (2008). Heritage Resource Impact Assessment and mitigation for forestry operations in Saskatchewan. Government of Saskatchewan. Retrieved July 30, 2025, from https://www.saskatchewan.ca/residents/parks-culture-heritage-and-sport/heritage-conservation-and-commemoration/archaeology/submit-your-land-and-resource-proposal-for-a-heritage-review

GS. (2018, December). *Saskatchewan Treaty and Aboriginal Rights for Hunting and Fishing Guide.* Government of Saskatchewan. Retrieved July 7, 2025, from Saskatchewan Publications Centre: https://publications.saskatchewan.ca/api/v1/products/79450/formats/89783/download

GS. (2021, January). *Saskatchewan Wild Fur Harvest and Cash Values 2020-21. Fish and Wildlife Branch Summary Report.* Government of Saskatchewan. Retrieved July 7, 2025, from Saskatchewan Publications Centre: https://publications.saskatchewan.ca/#/products/68904

GS. (2024). *Heritage Property Act, H-2.2.* Government of Saskatchewan. Retrieved July 3, 2025, from Saskatchewan Publications Centre: https://publications.saskatchewan.ca/#/products/558

Hamilton, S. (1988). The concept of cultural edge in the Boreal forest of Manitoba and north western Ontario. In C. Reid, *Boreal forest and sub-Arctic archaeology. Occasional Publications of the London Chapter No. 6* (pp. 37-71). London, Ontario: Ontario Archaeological Society Inc.

Hanna, M. (1980). Trends and traditions in the boreal forest: An appraisal of the Shield Archaic as defined by J.V. Wright. In L. P. (Ed.), *Directions in Manitoba prehistory: Papers in honour of Chris Vickers.* Winnipeg: Association of Manitoba Archaeologists, and Manitoba Archaeological Society.

Hanna, M. (2008). *Heritage resource impact assessment of Cameco Corporation's proposed Tamarack Project. Permit No. 08-304.* Regina, Saskatchewan: Final Report on file with the Heritage Conservation Branch.

HCB. (2018). Cloutier to Simpson: Proposed SABRE Site Expansion - New Unlined Pad, Existing Road Enlargement, Unlined Storage Expansion; Heritage Resource Review. Heritage Conservation Branch.

Heber, W. H. (1989). *Chipewyan Ethno-Adaptations: Identity Expression for Chipewyan Indians of Northern Saskatchewan. Ph.D. Dissertation.* Winnipeg: Department of Anthropology, University of Manitoba.

Holland, L., & Kkailther, M. A. (2003). They will have our words: the Dene elders project, volume 2. La Ronge, Saskatchewan: Holland-Dalby Educational consulting.

Irimoto, T. (1981). The Chipewyan Caribou Hunting System. *Arctic Anthropology, 19*, 44-56.

Ives, J. W. (1993). The ten thousand years before the fur trade in northeastern Alberta. In P. McCormack, & G. Ironside, *The uncovered past: roots of northern Alberta societies* (pp. 5-31). Edmonton.: Canadian Circumpolar Institute, University of Alberta.

Kendrick, A., Lyver, P., & Lutsël, K. D. (2005). Denésǫliné (Chipewyan) Knowledge of Barren-Ground Caribou (Rangifer tarandus groenlandicus) Movements. *Arctic, 58*(2), 175-191.

Korejbo, A. J. (2011). An archaeological survey in the Clearwater River Provincial Park, Saskatchewan; insights into the archaeology of the boreal forest of northwestern Saskatchewan. Unpublished M.A. thesis. Saskatoon, Saskatchewan: Department of Archaeology and Anthropology, University of Saskatchewan.

Korejbo, A. J. (2013). *Rio Tinto Canada Uranium Corp. Roughrider Quarry and Access Road Heritage Resources Impact Assessment Permit No.13-163.* Regina, Saskatchewan: Final Report on file with the Heritage Conservation Branch.

Korejbo, A. J. (2015). *AREVA Resources Canada Inc. Permanent Access to HVAC Collins Creek Access Heritage Resources Impact Assessment. Permit No. 15-064.* Regina, Saskatchewan: Final Report on file with the Heritage Conservation Branch.

Kupsch, W. O. (1986). Appendix C: chronology of prospecting, exploration, and mining in northern Saskatchewan to 1985. In W. Kupsch, & S. Hanson, *Gold and other stories as told to Berry Richards: prospecting and mining in northern Saskatchewan.* Regina, Saskatchewan: Saskatchewan Mining Association.

Leighton, A. L. (1985). Wild Plant Use by the Woods Cree (NIHITHAWAK) of East-Central Saskatchewan. In *Canadian Ethnology Service, Paper No. 101.* Ottawa: National Museum of Man Mercury Series.

Markowski, M. (2012). *Heritage resources impact assessment Rio Tinto Canada Corporation Roughrider deposit. Permit No. 12-120.* Regina, Saskatchewan: Final Report on file with the Heritage Conservation Branch.

Marles, R. J. (1984). *The Ethnobotany of the Chipewyan of Northern Saskatchewan. Masters Thesis.* Saskatoon: Department of Biology, University of Saskatchewan.

Marles, R. J., Clavelle, C., Monteleone, L., Tays, N., & Burns, D. (2000). *Aboriginal Plant Use in Canada's Northwest Boreal Forest.* Vancouver: Natural Resources Canada, Canadian Forest Service,.

Meyer, D. (1978). Prehistoric Pottery from Northern Saskatchewan. *Napao, A Saskatchewan Anthropology Journal, 8*(1&2), 5-30.

Meyer, D. (1979). *Environmental Baseline Studies for the Project Wolly McClean Lake Area.* James F. MacLaren Limited and Saskatchewan Research Council.

Meyer, D. (1983a). The Prehistory of Northern Saskatchewan. In *Tracking Ancient Hunters.* Saskatoon: Saskatchewan Archaeological Society.

Meyer, D. (1983b). *Heritage Resources Impact Assessment for Stony Rapids Community and Resource Access Road, Stage II. Permit No. 82-20. Report prepared for the Department of Northern Saskatchewan and MacLaren Plansearch Lavalin.* Regina, Saskatchewan: Final Report on file with the Heritage Conservation Branch.

Meyer, D. (1984). *Environmental baseline studies for the Dawn Lake area, 1983. Permit No. 83-015.* Regina, Saskatchewan: Final Report on file with the Heritage Conservation Branch.

Meyer, D. (1995). Churchill River archaeology in Saskatchewan: how much do we know? *The Churchill: A Canadian heritage river, proceedings from the conference, Saskatoon. March 8 – 10, 1995* (pp. 52-59). Gatineau, Quebec: Canadian Heritage Rivers System.

Meyer, D. (1999). Precontact Archaeology of Northern Saskatchewan. In *Atlas of Saskatchewan.* Saskatoon: University of Saskatchewan.

Meyer, D. (2005). Prehistory, Northern Saskatchewan. In A. L. Anderson, *The Encyclopedia of Saskatchewan* (pp. 720-721). Regina, Saskatchewan: Canadian Plains Research Centre, University of Regina.

Meyer, D., & Russell, D. (1999). The History of the Fur Trade ca. 1682 – post 1821. In *Atlas of Saskatchewan.* Saskatoon: University of Saskatchewan.

Meyer, D., & Thistle, P. (1995). Saskatchewan River Rendezvous Centers and Trading Posts: Continuity in a Cree Social Geography. *Ethnohistory, 42*(3), 403-444.

Meyer, D., Beudoin, A., & Amundson, L. (2011). Human Ecology of the Canadian Prairie ecozone ca. 9000 B.P.: the Paleo-Indian period. In B. A. Nicholson, *Human Ecology of the Canadian Prairie Ecozone 11,000 to 300 BP.* (pp. 5-53). Regina, Saskatchewan: Canadian Plains Research Centre, University of Regina.

Millar, M. (2009). Dene Honü: stories from the people. Birch Narrows Dene Nation, Turnor Lake, Saskatchewan.

Minatco. (1991a). *McClean Lake Project Environmental Impact Statement, Supporting Document VI and VII. A report prepared by SENES Consultants Limited and Terrestrial & Aquatic Environmental Managers Ltd. for Minatco Limited.* Minatco Limited.

Minatco. (1991b). *McClean Lake Project EIS Volume 2 Chapters 7 – 9. A report prepared by SENES Consultants Limited and Terrestrial & Aquatic Environmental Managers Ltd. for Minatco Limited.* Minatco Limited.

Minni, S. J. (1976). The Prehistoric Occupation of Black Lake, Northern Saskatchewan. *Mercury Series Paper no. 53*. Ottawa: National Museum of Man.

Moodie, D. A., Catchpole, A. J., & Abel, K. (1992). Northern Athatpaskan oral traditions and the White River volcano. *Ethnohistory, 39*(2), 148-171.

Muller-Wille, L. (1974). Caribou Never Die! Modern Caribou Hunting Economy of the Dené (Chipewyan) of Fond du Lac, Saskatchewan and N.W.T. *The Musk-Ox, 14*, 7-19.

Novecosky, B. J. (2002). Heritage Resources Impact Assessment Cameco Corporation Haul Road Project Rabbit Lake Uranium Operation (Permit 02-098).

Novecosky, B. J. (2006). *Heritage Resources Impact Assessment Conducted in the Vicinity Between the Midwest Project and the McClean Lake Operation. Permit No. 06-120.* Regina, Saskatchewan: Final Report on file with the Heritage Conservation Branch.

Parker, J. (1987). Emporium of the north. Alberta Culture and Multiculturalism. Regina, Saskatchewan: Canadian Plains Research Center.

Pettipas, L. (2011). An environmental and cultural history of the central Lake Agassiz region, with special reference. *Manitoba Archaeological Journal 21(1&2)*, 1-152.

Pettipas, L. (2012). A review of the Early Holocene environmental and cultural history of the northern Lake Agassiz region, with special reference to Manitoba. *Manitoba Archaeological Journal 22(1&2)*, 1-52.

Pletz, J. (2024). *McClean Mining Extension in NE 01-107-12 W2M and NW 06-107-11 W2M Heritage Resources Impact Assessment. Permit No. 24-154.* Regina, Saskatchewan: Final Report on file with the Heritage Conservation Branch.

Ray, A. J. (1978). History and archaeology of the northern fur trade. *American Antiquity. 43(1)*, 26-34.

Ray, A. J. (1998). *Indians in the fur trade: their role as trappers, hunters, and middlemen in the lands southwest of Hudson Bay, 1660-1870.* Toronto, Ontario: University of Toronto Press.

Ray, A. J., Miller, J., & Tough, F. (2000). *Bounty and benevolence: a history of Saskatchewan treaties.* Montreal, Quebec: McGill-Queen's University Press.

Reeves, P. (2005). Mineral resources. In A. Anderson, L. Anderson, R. August, M. Benson, B. J., C. M., . . . G. Saunders, *The encyclopedia of Saskatchewan* (pp. 618-619). Regina, Saskatchewan: Canadian Plains Research Centre, University of Regina.

Reid, C. S. (1988). Some ideas concerning the formulation of research designs and excavation methodologies on on boreal forest habitation sites. *Midcontinental Journal of Archaeology. 13(52)*, 187-221.

Rogers, E. S., & Smith, J. G. (1981). Environment and Culture in the Shield and McKenzie Borderlands. In J. Helm, *Handbook of North American Indians Volume 6 – Subarctic.* Washington: Smithsonian Institute.

Russel, D. R. (1990). The 18th Century Western Cree and their neighbours: Identity and territory. Unpublished M.A. thesis. Saskatoon, Saskatchewan: University of Saskatchewan, Department of Anthropology and Archaeology.

Saylor, S. (1987). SaskPower's Uranium City – Rabbit Lake – Wollaston Lake Electrical Transmission Line Heritage Resources Impact Assessment (Permit 87-23).

Sharp, H. S. (1977). The Chipewyan hunting unit. *American Ethnologist, 4*(2), 377-393.

Sharp, H. S. (1978). Comparative ethnology of the wolf and the Chipewyan. In R. Hall, & S. H.S, *Wolf and Man: evolution in parallel.* New York: Academic Press.

Smith, D. M. (2004). Big Stone foundations: Manifest meaning in Chipewyan myths. *Journal of American Culture, 8*(1), 73-77.

Smith, J. G. (1976). Local band organization of the Caribou Eater Chipewyan. *Arctic Anthropology, 13*(1), 12-24.

Smith, J. G. (1981). Western Woods Cree. In J. Helm, *Handbook of North American Indians Volume 6 – Subarctic.* Washington: Smithsonian Institute.

SMOE. (2025). ENV0006537 - Saskatchewan Wild Fur Harvest and Cash Values. Response from Ministry of Environment Inquiry Centre regarding the Saskatchewan Wild Fur Harvest and Cash Values report. Communications and Public Inquiries, Ministry of Environment .

Usher, P. J. (1990). *Recent and Current Land Use and Occupancy in the Northwest Territories by Chipewyan-Denescutine Bands (Saskatchewan Athabasca Region). Prepared for the Prince Albert Tribal Council, Federation of Saskatchewan Indian Nations.*

Van Dyke, S. (1979). Final Report, Historical Resources Overview, Proposed Esso Minerals Midwest Lake Road Alternates. Consultants Report prepared for Beak Consultants Limited. Saskatoon: Lifeways of Canada Limited.

Walker, E. G. (1999). Precontact archaeology of southern Saskatchewan. In K. Fung, *Atlas of Saskatchewan* (pp. 25-27). Saskatoon, Saskatchewan: University of Saskatchewan.

Wolvengrey, A. (2001). *Cree: Words.* Regina, Saskatchewan: Canadian Plains Research Center.

Wright, J. V. (1972). The Shield Archaic. National Museum of Man, Publications in Archaeology, No. 3. Ottawa, Ontario: National Museum of Canada.

Wright, J. V. (1975). The prehistory of Lake Athabasca: an initial statement. Archaeological Survey of Canada, Mercury Series Paper 29. Hull, Quebec: Canadian Museum of Civilization.

Wright, J. V. (1995). A history of the Native People of Canada, Volume I. Archaeological Survey of Canada, Mercury Series Paper 152. Hull, Quebec: Canadian Museum of Civilization.

Young, P. (2006). *An analysis of Late Woodland ceramics from Peter Pond Lake. Unpublished M.A. thesis.* Saskatoon: Department of Archaeology, University of Saskatchewan.

Young, P. (2008). *AREVA Resources Canada Inc. Heritage Resources Impact Assessment, Midwest Project. Permit No. 08-129. Midwest Project.* Regina, Saskatchewan: Final Report on file with the Heritage Conservation Branch.

Young, P. (2010). *Fission Energy Corporation Heritage Resource Impact Assessment Waterbury Lake Property Permit No. 10-194.* Regina, Saskatchewan: Final Report on file with the Heritage Conservation Branch.

Young, P. (2012). *AREVA Resources Canada Inc. McClean Lake Operation JEB Tailings Management Facility Expansion Heritage Resource Impact Assessment. Permit No. 12-105.*

7 Waste and Substance Data Analysis

7.1 Introduction

A wide variety of wastes are generated during the site activities including waste rock, tailings, waste water, domestic waste, industrial waste, radiological and chemically contaminated waste, and sewage solids. Waste generation and management was considered through all EAs starting from 1991 McClean Lake EIS. The major waste streams are waste rock, tailings, and treated effluent. The other types of waste such as sewage, domestic waste, industrial contaminated and uncontaminated waste were also considered in each EIS and it was concluded that their volumes would be negligible in comparison with the process waste volumes.

All wastes are managed and disposed of in a manner to protect human health and the environment. Orano has a framework of policies, processes and documentation to manage tasks and activities required to achieve waste management objectives. In line with the Approval to Operate Pollutant Control Facilities (PO24-012, Section 4.5.1), Orano maintains a waste management program based on the principles of Reduce, Reuse, Recycle, and Recover (the 4 R's). This program is reviewed annually, with results reported in the Annual Reports. Information about the waste management systems and waste quantity and quality can be found in the following documents:

- Facility Description Manual;
- Tailings Management TID (Orano 2025a);
- Waste Rock Management TID (Orano 2023a); and
- McClean Lake Operation Annual Reports (Orano 2023b; Orano 2024a; Orano 2025b).

The above documents are subject to periodic updates and submitted for a regulatory review on a regular basis. This section of the EP TID provides a brief overview of waste management systems, types and amount of waste generated at the McClean Lake Operation during the reporting period (2022-2024), and Orano's approach to waste segregation and disposal.

7.2 Waste Management

Tables 7.2-1, 7.2-2, and 7.2-3 show the amount of waste generated and stockpiled at the McClean Lake Operation during the reporting period. The below text provides a brief overview of each waste type and how it is handled on the site.

7.2.1 Waste Rock

Waste rock is produced during mining, as overlying and surrounding material is excavated to access uranium ore. Two types of waste rock are typically produced:

- clean waste rock is benign bedrock material, predominantly sandstone but occasionally basement rock as well, that is excavated and stored as surface stockpiles; and
- special waste rock is mineralized sandstone and basement rock in the vicinity of the ore body, which requires special consideration due to its potential to adversely affect the environment if stockpiled on surface.

In addition to waste rock, mining also generates overburden, which includes both peaty organic material and boulder-rich till material. Overburden is considered unmineralized and does not require special handling or long-term management. It can be safely stockpiled on surface for later use, primarily during site decommissioning and reclamation activities.

At the McClean Lake Operation, active mining was performed at the JEB and Sue sites from 1995 to 2008, additionally test mining (i.e., SABRE formerly MED) was perfomed periodically from 2007 to 2021 (Table 1.3-1). The locations of facilities related to waste rock management are shown in Figure 7.2-1 for the JEB site, and Figure 7.2-2 for the Sue site. Waste material produced from the mining of open pits at the McClean Lake Operation was segregated as follows:

- JEB, Sue C, and Sue E pits: waste material was segregated into organics, till overburden, clean waste rock, and special waste rock.
- Sue A: overburden and waste rock were treated as special waste.
- Sue B: overburden was removed and stockpiled, but all waste rock was treated as special waste.

Organics, overburden, and clean waste rock were stockpiled on surface, while special waste was disposed of in either the Sue C/A or Sue E pits. In total, 26,293,593 bank cubic meters of waste rock (including overburden, clean and special waste rock) were excavated at the JEB and Sue sites (Table 7.2-1). Waste rock storage facilities are managed in line with Orano's Integrated Management System which encompasses the regulatory requirements and best management practices.

Performance of waste rock management facilities is reviewed in the Waste Rock Management TID, which is intended to confirm that the impacts of waste management activities align with the initial predictions made prior to development remain valid. The most recent update of the Waste Rock Management TID was completed in 2021. It showed that the environment was protected and the water quality in nearby lakes remained within acceptable concentrations for aquatic life (Orano, 2023a). The Waste Rock Management TID was submitted to regulatory agencies for review on November 30, 2021. The Waste Rock Management TID was accepted by the CNSC on February 10, 2023 (CNSC, 2023).

7.2.2 Tailings

Tailings are a combination of waste materials remaining after uranium is extracted from the ore and processed into calcined yellowcake. The uranium is only a small part of the original rock (ore), usually from 1%

toapproximately 20%, so the majority of what is sent to the mill for processing becomes tailings. Tailings contain the leftover rock and chemical wastes used to extract the uranium, so they have a solid and a liquid component.

At the McClean Lake Operation, tailings from ore processing are disposed of into a previously mined open pit at the JEB site, which has been converted into a TMF (the JEB TMF, Figure 7.2-1). The tailings are submerged under water as a method of radiation shielding and to prevent the tailings from freezing. The milling process, the tailings, the supporting infrastructure, their outputs and related programs are subject to robust monitoring, audits, investigations and reporting to measure successes and identify opportunities for improvements.

Overall, 2,515,812 tonnes of tailings were placed into the JEB TMF from 1999 to the end of 2024; 264,442 tonnes of tailings have been generated and deposited to the JEB TMF in 2022-2024, which is below the Tailings Management TID predictions of 357,754 tonnes (Table 7.2-2). These deviations are due to the following reasons:

- During the Tailings Management TID review in 2020, it was assumed that tailings would be generated from Cigar Lake and McClean ore bodies in 2024 (Orano, 2020). However, there was no processing of McClean ore bodies during the 2022-2024 reporting period.
- Slight overestimation in 2022-2024 tailings generated due to differences between mine plan and actuals.

Orano implements the Tailings Optimization and Validation Program (TOVP) to advance the scientific understanding of the geochemical and geotechnical properties of the tailings, to identify controls on solute concentrations of constituents of concern, and to model tailings behavior over the long-term. The TOVP comprises of tailings sampling through their whole depth every five years. The TOVP results are presented in the Tailings Management TID, which provides discussion of the design, operation, and future decommissioning of the TMF at the McClean Lake Operation. It describes operational performance and provides predictions of long-term, post-closure environmental effects. The most recent Tailings Management TID was completed in 2025 and showed that the tailings placed in the JEB TMF continued to exhibit the necessary geochemical and geotechnical characteristics for long-term protection of the environment (Orano 2025a).

7.2.3 Treated Effluent

As described in Section 1, the McClean Lake Operation implements the comprehensive water management across operational areas. This water management strategy includes process water treatment, freshwater intake and site runoff from each of the operational areas, and the interception and diversion of surface runoff away from disturbed areas to minimize water treatment requirements. Infrastructure associated with the water management strategy includes water collection and diversion systems, two WTPs (JEB and Sue WTPs) and a single treated effluent management system, the S/V TEMS, to regulate treated effluent released to the receiving environment. The S/V TEMS is the final, common repository for all waste water generated at the operation. Waste water inputs to the S/V TEMS currently consist of treated effluent from the JEB and Sue WTPs. From the S/V TEMS, effluent is released through a diffuser into the east basin of McClean Lake, where it enters Collins Creek, flows through Kewen Lake, and eventually to Collins Bay of Wollaston Lake. Releases to the watershed from the McClean Lake Operation include radionuclides, metals, and other inorganic components associated with mining and milling uranium.

Orano performs extensive monitoring of effluent quality and receiving water bodies to ensure proper protection of environment and human health (Orano 2023c). The surface water monitoring results and their comparison with the most recent predictions are presented in Section 4. Data on the WTP effluent quality, effluent volume, and COPC mass loadings further confirm that the effluent quality aligns with the most recent ERA assumptions as pressented below.

Effluent Quality

Tables 7.2-4 and 7.2-5 provide the current ERA effluent quality assumptions, the regulatory limits outlined in the SMOE Approval to Operate Pollutant Control Facilities (PO24-012), and summary statistics for the actual effluent quality in 2022-2024. The data comparison indicates that the COPC concentrations in the effluent were well below the regulatory limits and most ERA assumptions, apart from the following:

- JEB WTP
    - mean concentrations of calcium (664 mg/L), arsenic (0.04 mg/L), and zinc (0.002 mg/L) exceeded the ERA assumptions (600 mg/L, 0.03 mg/L, and 0.001 mg/L, respectively), but the maximum concentrations of these constituents remained below the maximum levels assumed in the ERA (745, 0.08, and 0.005 mg/L, respectively, vs 1300, 0.11, and 0.009 mg/L, respectively);
    - maximum concentration of fluoride (1.4 mg/L) slightly exceeded the ERA assumption (1.3 mg/L), but its mean concentration of 0.77 mg/L was below the ERA assumption of 0.86 mg/L;
- Sue WTP
    - mean concentrations of fluoride (0.09 mg/L) and iron (0.3 mg/L) exceeded ERA assumptions (0.07 mg/L and 0.2 mg/L, respectively), but the maximum concentrations of these constituents remained below the maximum levels assumed in the ERA (0.10 and 0.4 mg/L, respectively, vs 0.13 and 1.7 mg/L, respectively);
    - Thorium-230 concentrations in the Sue WTP effluent were below the detection limit of 0.01 Bq/L for the entire reporting period. Since this detection limit is above the ERA assumption of 0.006 Bq/L for the mean thorium activity in the effluent and lower than the ERA assumption of 0.03 Bq/L for the maximum thorium concentration, it can be assumed that this parameter remained in line with the ERA assumptions across all three years

The ERA predictions for surface water was based on the COPC loadings to the environment, so additional analysis of the effluent discharge and actual contaminant loadings to the environment is needed to assess adequacy of the ERA assumptions.

Effluent Discharge Volume

Table 7.2-6 provides a comparison of the actual water treatment plant discharge volume for the 2022-2024 time period with the ERA assumptions. The data shows that the JEB WTP flow was 43% below the corresponding ERA assumption. Thus, actual COPC concentrations in the JEB WTP effluent do not necessarily pose a risk to the environment, even in cases of ERA assumption exceedances. The Sue WTP effluent flow was within 3% of the ERA effluent flow assumption, therefore, the actual COPC concentrations in the Sue WTP effluent align well with the recent ERA. Analysis of the COPC loadings to the S/V TEMS was also reviewed to support ERA assumptions.

COPC Mass Loadings

Table 7.2-7 provides a comparison of the 2022-2024 COPC mass loadings to the S/V TEMS, from both water treatment plants, with the corresponding ERA assumptions. Overall, the majority of loadings were well below the ERA assumptions, except for zinc which slightly exceeded the ERA mass loadings assumption (7.2 kg vs 5.7 kg, respectively).

In 2023, Orano investigated causes of the elevated zinc levels in the effluent. The investigation results showed that:

- zinc concentrations in Cigar Lake ore were higher than modelled in the 2016 ERA; and
- there was a temporary increase of zinc in the Sue C/A pit water due to the contaminated landfill construction, which was not incorporated into the 2016 ERA assumptions.

Additionally, it was indicated that elevated zinc concentrations in the 2022 samples could be due to shortages in supply of laboratory gloves during the COVID-19 pandemic. Orano had to purchase gloves from various vendors, but noted that some gloves could add zinc loads during sample handling. All glove brands were tested in the on-site lab and the test results were used to indicate brands suitable for the environmental sampling.

The noted discrepancies between the predicted and actual effluent quality and quantity has been addressed during the ERA update presented in the 2025 EP TID Volume 2 (Orano 2025c).

Acute and Sublethal Toxicity

Metal mines operating in Canada are required to conduct sublethal and acute toxicity testing of mine effluent in accordance with the EEM program requirements stipulated in the MDMER. The EEM sampling of effluent is performed at the McClean Lake Operation as follows:

- Acute lethality testing of both JEB and Sue WTP effluent is completed on *Daphnia magna* (water flea) and *Oncorhynchus mykiss* (rainbow trout). The JEB WTP operates year-round, so its effluent sampling

is typically conducted quarterly. The Sue WTP operates seasonally (i.e., in summer and fall), and its effluent sampling is also performed on a quarterly basis, but only during the operational period.

- Sub-lethal tests are completed for the JEB WTP effluent only. The tests are conducted four times per year on the most sensitive species, which was determined, as per the MDMER calculations, to be *Lemna minor* (duckweed).

There were following deviations from the routine effluent sampling for toxicity testing:

- No effluent was sampled in Q4 2023 and Q1 2024 due to the shutdown of the JEB WTP from October 2023 to April 2024.

- Additional samples were collected side-by-side with the ECCC during onsite inspections in August 2022 and August 2024.

- An additional sample was collected in response to an uncontrolled release of effluent caused by a failed connector in the discharge line in April 2023; only a *Daphnia magna* test was implemented for this sampling.

Results from the acute toxicity testing on *Daphnia magna* and *Oncorhynchus mykiss* in 2022, 2023, and 2024 indicated the Sue and JEB treated effluent is not acutely toxic based on the percent mortality recorded during the respective exposures (Orano 2023b; Orano 2024a; Orano 2025b; Table 7.2-8).

The sub-lethal toxicity results demonstrated a reduction in duckweed growth with exposure to treated effluent as summarized in Tables 7.2-9, 7.2-10, and 7.2-11. Frond increases were reduced by 25% during each sampling event between 2022 and 2024, except in December of 2024. The effluent concentrations where frond increases were decreased by 25% were between 2.2% to 28.9%. In more than half the cases, treated effluent did not reduce duckweed dry weight by 25% or more between 2022 and 2024 as indicated by IC_{25} of >97% in Tables 7.2-9, 7.2-10, and 7.2-11. This means the effluent did not reduce the endpoint by 25% or more at the highest possible concentration. In the cases where treated effluent did reduce the endpoint by causing a reduction in dry weight by 25%, effluent ranged from 17.7% to 60%.

7.2.4 Domestic Waste

Domestic waste consists of green waste (food and kitchen wastes) and non-recyclable materials originating from the camp and mill dry offices. Domestic waste is incinerated to reduce the use of the Moffat Domestic Landfill, which reduces the potential for wildlife attraction at the landfills and other site infrastructure. Approximately 1,461 m^3 of domestic waste was generated in 2022-2024 (Table 7.2-3). The majority (1,441 m^3) of the waste was incinerated. Domestic wastes that were not incinerated were transferred to the Moffat Domestic Landfill where the wastes were buried to reduce the potential spread of refuse by wind and animals (Figure 7.2-2). In total, approximately 20 m^3 of domestic waste was buried during the reporting period due to the camp incinerator being down for maintenance from December 2 to 19, 2024. Non-recyclable plastics and glass are placed in the industrial landfills located near the JEB and/or Sue CWRP and are included in the “industrial waste” category.

7.2.5 Industrial Waste

Industrial wastes consist of industrial packaging materials (Styrofoam and plastic), some scrap wood, tires, metal and other non-contaminated waste materials originating from construction and operations, as well as the ashes from the incinerator and non-recyclable plastics and glass from the camp and mill offices. Industrial waste was placed in the industrial landfills at the JEB and Sue sites until the end of April 2023. Starting May 2023, all industrial waste was sent to the Sue C Contaminated Landfill, located in the Sue C/A pit, with the JEB and Sue Industrial Waste Landfills remaining in place as a contingency. Although some waste wood does end up in the industrial landfills, the McClean Lake Operation diverts as much waste wood as possible to piles on top of the JEB CWRP. The clean wood waste is subsequently burned when authorized by a provincial Permit to Burn. Unburnable waste wood is stored to be shredded prior to placement in the industrial landfill in the future. The Sue Industrial Waste Landfill is located on the east side of the Sue C CWRP (Figure 7.2-2). The JEB industrial Waste Landfill is located at the JEB CWRP, just north of the Contaminated Waste Transfer Facility (Figure 7.2-1). Approximately 107 m^3 of industrial waste was generated in 2022-2024 (Table 7.2-3). The primary waste sources in 2022-2024 were the warehouse, the mill, the TMF construction, and the disposal of trailers from the Sue Site and JEB Camp that were no longer needed.

7.2.6 Chemically or Radiologically Contaminated Waste

Chemically or radiologically contaminated waste materials originate from the mining, milling and water treatment areas of the McClean Lake Operation. The majority of contaminated material is collected in yellow dumpsters and yellow garbage bags distributed around the site. Contamianted material that is not collected in yellow dumpsters or garbage bags is hauled as individual loads for final disposal; a waste disposal form is completed to track waste that is hauled individually. Historicaly, contaminated waste was disposed of in the Temporary Contaminated Landfill (TCL) located within the hydraulic containment area at the brow of the JEB TMF (Figure 7.2-1). Material from the temporary landfill was relocated to its permanent location on the edge of the Sue C/A pit in an area referred to as the Sue C Contaminated Landfill, which is segregated from the pit by a rock berm (Figure 7.2-2). Approximately 8,002 m^3 of contaminated materials were placed in the landfill(s) in 2022-2024.

The environmental risks associated with placing non-salvageable equipment and material into the Sue C/A pit were assessed in the Sue E Project EIS, with the conclusion that it is a suitable disposal location prior to final decommissioning of the pit. Since 2018, some materials and equipment have been staged near the edge of the Sue C/A pit, for future disposal within the pit; none were disposed of in the pit in 2022-2024.

7.2.7 Waste Dangerous Goods

Waste dangerous goods, consisting of waste oil/fuel filters, waste antifreeze, waste oil, waste batteries and fluorescent light bulbs were collected in designated containers and transported from site by Northern Resource Trucking. These substances are stored inside the designated storage containers until the accumulation of quantities warrants transport off-site. The storage containers are properly cleaned, sealed and labeled and equipped with secondary containment. The hazardous wastes were removed from site by a licensed carrier and delivered to a licensed receiver for recycling. Table 7.2-3 provides a summary of material quantities removed from the site during the reporting period.

No radiologically contaminated wastes were shipped offsite in 2022-2024.

7.2.8 Hydrocarbon Landfarm

A contained area for remediation of hydrocarbon contaminated soil is located on top of the JEB CWRP (Figure 7.2-1). The area consists of a large (10,000 m^2) remediation cell and a smaller storage cell. Hydrocarbon contaminated soil and snow originating from clean-up around the fueling areas, maintenance shops and spills are placed in the storage cell. In 2022-2024, approximately 170 m^3 of the hydrocarbon contaminated material was placed into the landfarm. Material from the storage cell is moved to the remediation cell in 15 cm thick lifts, where it is turned regularly with the use of heavy equipment during the summer months to aid in the remediation process.

Samples are collected and analyzed at the end of each summer season. Table 7.2-12 provides monitoring results for remediated soil. If the soil meets remediation criteria as outlined in the SEQG, referenced in the Saskatchewan Environmental Code – Corrective Action Plan Chapter, it is removed from the remediation cell and stockpiled for future use as construction material, after which a new lift of contaminated soil is moved to the remediation cell from the storage cell. During 2022-2024, the landfarm had demonstrated successful remediation of hydrocarbon-contaminated soil. The methods currently being used to remediate soil in the hydrocarbon landfarm are effective.

7.2.9 Recycled Materials

A “blue box” recycling program for office paper, cardboard, drink containers and laser printer toner cartridges was maintained at the McClean Lake Mill/office and the JEB Camp throughout 2022-2024. Approximately 161 m^3 of office paper and cardboard was collected and shipped to Cosmo Industries in Saskatoon. Laser printer toner cartridges were shipped to Supreme Basics in Saskatoon; drink containers are gathered and sent offsite for recycling. Recycling of co-mingle (domestic plastic and metal) continued throughout 2022-2024. Approximately 128 m^3 of these materials were shipped off-site to Loraas Disposal.

7.2.10 Sewage

Sewage collection and disposal is carried out through a system of holding tanks and septic tanks. Liquid sewage is directed to the JEB WTP where it is treated and discharged with the mill effluent stream to S/V TEMS. The solids are removed by vacuum truck on a periodic basis and deposited in the sewage solids management area, which has been developed on top of the JEB CWRP (Figure 7.2-1).

Approximately 630 m^3 of material was placed in the sewage solids management area from 2022-2024. The majority of this was from sewage lift station upgrades that were completed at the JEB Camp in 2023.

7.2.11 Segregation Procedures

Site procedures controlled the activities regarding collection, handling, and disposal of all waste. The mill and JEB WTP operation systems ensured proper management of process waste streams (tailings and effluent). The other wastes were segregated, recorded, and placed in appropriate waste collection containers or waste management facilities. The industrial landfills, dumpsters, drums and other miscellaneous waste located throughout the mill were scanned to ensure that contaminated and uncontaminated waste is being properly segregated. The environmental personnel provided guidance to waste generators regarding waste handling and disposal, implemented regular inspections of waste management facilities, and reviewed the corresponding records. All revealed non-conformances were addressed in timely manner. The segregation methods described in this section demonstrate that proper waste management is implemented at the McClean Lake Operation.

7.2.12 Waste Management Program Enhancements and Modifications

Orano regularly reviews risks associated with the process waste management and implements proper mitigation measures in case of unacceptable risks. Additionally, options for waste reduction and waste management optimization are considered and pursued if viable. Plans for proposed waste management system modifications or enhancements are discussed with regulators and summarized in the annual reports. The following initiatives were pursued in 2022-2024:

- **JEB TMF**
    - use of subaqueous deposition lines with relocation into areas of low tailings mass to optimize deposition space with adjustment of line configuration to floating configuration; and
    - continuation of TOVP program to analyze long-term evolution of deposited tailings.
- **JEB WTP**
    - building and partial commissioning of an integrated ferrous sulphate treatment system to enhance selenium removal from the mill effluent.
- **Sue Site**
    - revegetation of Sue C CWRP.

Orano continues regular reviews of waste management practices at the McClean Lake Operation to identify opportunities for improving the waste management program.

7.3 Summary

The McClean Lake Operation waste management program is based on the principles of Reduce, Reuse, Recycle, and Recover (the 4 R's). The waste streams include waste rock, tailings, treated effluent, domestic waste, industrial waste, chemically and radiological contaminated waste, hazardous waste, recycling materials,

and sewage solids. All waste types are stored on the designated facilities and handled in line with the approved procedures. Three major types of waste generated at the McClean Lake Operation – waste rock, tailings, and treated effluent – are disposed of locally at the site. Their generation and potential environmental impact are carefully monitored and regularly reviewed through comprehensive assessments presented in the Tailings Management TID, Waste Rock Management TID, and EP TID Volume 2. The assessment outcomes are documented and submitted for regulatory review.

Other waste disposed of at the site include domestic, industrial, chemically and radiological contaminated waste, and sewage. All hazardous waste, except for hydrocarbon contaminated soil, is shipped off site for disposal at the designated facilities. Orano's initiative for sustainable waste management includes on-site bioremediation of hydrocarbon contaminated soil and collection of recyclable materials for donation to local communities or recycling at designated facilities.

Orano proactively reviews all risks associated with the waste management practices and takes every opportunity for waste management optimization. In case of a significant risk to human health or environment, proper mitigation measures are developed and implemented. Such an approach ensures that environmental impact from the on-site waste handling and disposal remains within the predictions made at the EA stage.

7.4 References

CNSC. (2023). Correspondence: Akhter to Searcy. Subject: Orano response to CNSC comments on 2021 WR TID - CNSC staff acceptance. Dated February 10, 2023. Canadian Nuclear Safety Commission.

Metal and Diamond Mining Effluent Regulations (MDMER). (2025). The Fisheries Act – Metal and Diamond Mining Effluent Regulations. SOR 22002-222. Ottawa, Ontario.

Orano. (2020). McClean Lake Operation Tailings Management Technical Information Document. May 2020. Saskatoon, Saskatchewan. Orano Canada Inc.

Orano. (2022). Hydrocarbon Landfarm Remediation: 2022 Closeout Report. October 2022. Orano Canada Inc.

Orano. (2023a). McClean Lake Operation Waste Rock Management Technical Information Document. November 2021. Saskatoon, Saskatchewan.

Orano. (2023b). McClean Lake Operation 2022 Annual Report. March 2023. Orano Canada Inc.

Orano. (2023c). McClean Lake Operation Environmental Monitoring Design Document, Version 4. December 2023. Saskatoon, Saskatchewan: Orano Canada Inc.

Orano. (2023d). Hydrocarbon Landfarm Remediation: 2023 Closeout Report. December 2023. Orano Canada Inc.

Orano. (2024a). McClean Lake Operation 2023 Annual Report. March 2024. Orano Canada Inc.

Orano. (2024b). Hydrocarbon Landfarm Remediation: 2024 Closeout Report. December 2024. Orano Canada Inc.

Orano. (2025a). McClean Lake Operation Tailings Management Technical Information Document. 2025. Saskatoon, Saskatchewan: Orano Canada Inc.

Orano. (2025b). McClean Lake Operation 2024 Annual Report. March 2025. Orano Canada Inc.

Orano. (2025c). McClean Lake Operation Technical Information Document, Environmental Performance, Volume 2 of 2 - Environmental Risk Assessment. Saskatoon, Saskatchewan: Orano Canada Inc.

8 Conclusions

Orano recognizes the importance of healthy ecosystems as the backbone of vibrant communities and we remain committed to continued, strong environmental performance and the transparent communication of our environmental performance. The McClean Lake Operation plays an important role in the sustainable industrial development of Northern Saskatchewan and the Athabasca Basin in particular. The McClean Lake Operation Environmental Monitoring Program (EMP) is developed based on input from all our stakeholders including local communities. This approach provides relevant and reliable information on the ecological components of the existing environment and validates the selection of VCs that form the basis of the EMP.

The purpose of Volume 1 of the Environmental Performance Technical Information Document (EP TID Volume 1) is to provide information on the operation's environmental performance for the McClean Lake Operation in 2022-2024. The report has been developed in line with requirements of the SMOE Environmental Performance Report Guideline (EPB 453) and pursued the following objectives:

- provide a brief overview of baseline surveys performed at pre-development stage;
- summarize predictions from relevant Environmental Impact Statements (EISs) and Environmental Risk Assessments (ERAs) with a focus on comparisons to the 1991 McClean and 1995 Midwest EIS predictions and the current ERA predictions presented in the 2016 EP TID Volume 2 and the 2018 Selenium Risk Assessment;
- summarize monitoring activities and supplementary studies performed during the operational period;
- discuss the monitoring results with focus on the 2022-2024 reporting period;
- present the outcome of the environmental data analysis including
    - temporal and spatial comparisons of the monitoring results (where applicable),
    - comparison with the evaluation criteria,
    - review if the operation performs within the scope of the applicable EAs and ERAs;
- identify areas for adjustments to the EMP or collection of additional data via supplementary studies.

In 2022-2024 period, 156,503 tonnes of ore were processed at the McClean Lake Operation, which resulted in the production of about 50 million pounds U_3O_8. Additionally, 37 tonnes of ammonium sulphate (a process by-product) were generated and shipped off site during the reporting period. Several projects were implemented through the reporting period including mill upgrades, JEB Tailings Management Facility (TMF) expansion, replacement of the JEB Water Treatment Plant (WTP) effluent discharge pipeline to Sink Reservoir, and implementation of the selenium treatment system at the JEB WTP. Activities relating to the McClean Mining (formerly referred to as the Surface Access Borehole Resource Extraction (SABRE) test) Project included the mining pad expansion and drilling of four access holes in 2024.

The environmental monitoring activities are designed to meet regulatory compliance requirements, verify impact predictions, inform the evaluation of potential risks, and reduce risk assessment uncertainties, through sampling

and measuring a wide range of environmental monitoring components at the McClean Lake Operation. The EMP includes monitoring of groundwater, surface water, meteorology, air, sediment, benthic invertebrates, fish (including northern pike and white sucker), soil, and terrestrial vegetation (including lichen, Labrador tea, and blueberry). The frequency and sampling requirements for each EMP component are stipulated in the McClean Lake Operation Environmental Monitoring Design Document (EM DD). Additionally, Environmental Effects Monitoring (EEM) endpoints are assessed as per the schedule required under the Metal and Diamond Mining Effluent Regulations (MDMER).

This 2025 EP TID Volume 1 submission is comprehensive, presenting all new environmental data collected since the 2022 EP TID submission. The EMP provides the necessary information to evaluate and assess temporal trends, and provide comparisons to baseline, reference areas, and previous Environmental Assessments (EAs) and ERAs. Observed effects remain within the bounds of the 1991 and 1995 EAs in magnitude and extent and generally agree with the current ERA predictions.

Groundwater data indicates that hydraulic heads depressed by dewatering due to mining at both the JEB and Sue sites continue to recover. Hydraulic containment is maintained at both sites. Groundwater quality is generally consistent with baseline and background areas across the site and any increases are minor with no significant effects. The influence of McClean mining activities on the aquifer is limited and a drawdown state generally occurs during drilling and mining, as intended, limiting the contaminant transport.

Long-term trends in the lake level elevation generally reflect natural climate variability in the region. The water level elevation data collected throughout the operational period suggest that the expected dewatering impacts from mining activities were negligible. Impacts to the streamflow in Collins Creek by inputs to Sink Reservoir from the Sue and JEB WTPs and regular water withdrawals from Pat Lake were less than those predicted in the 1991 McClean and 1995 Midwest EISs.

The on-site meteorological data is generally consistent with the long-term climate records from the Environmental and Climate Change Canada's (ECCC's) Key Lake weather station, the 2022-2024 data from the nearby ECCC's Collins Bay station, and is in line with the original description of baseline conditions. The McClean Lake Operation has had limited effects on the local air quality, with concentrations of the TSPs, radon, and SO_2 being within the impact predictions of the 1991 McClean and 1995 Midwest EISs and consistent with the current ERA predictions.

The operational monitoring data on the water quality, sediment quality, benthic invertebrate communities, and fish chemistry in McClean Lake east basin and Collins Creek suggest that the corresponding environmental effects in these water bodies were negligible, which is consistent with the predictions. The selenium concentrations in fish tissues generally agreed with the predictions of the 2018 Selenium Review and Assessment Report. In particular, the selenium concentrations in fish downstream of the operations were well below the corresponding criteria and have not varied significantly during the monitoring period. The aquatic monitoring endpoints continue to provide valuable information related to the status of the aquatic environment downstream of the McClean Lake Operation.

The focus of the current McClean Lake Operation EMP for the terrestrial environment is soil and vegetation chemistry monitoring, which is now conducted on a six-year cycle. The most recent sampling occurred in 2021, with the next scheduled for 2027; therefore, no updates to the soil and vegetation chemistry data were made during the current reporting period. Supplementary studies were implemented during the current reporting period

to update information on wildlife species, wildlife habitat and species at risk in the McClean Lake Operation area including vegetation surveys, ecosite mapping, and targeted surveys for avian, amphibian and mammalian species. In total 13 wildlife species listed under the federal Species at Risk Act (SARA) and/or ranked by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) were recorded in the McClean Lake Operation area. No federally ranked plant species at risk was recorded in the area. The updated wildlife and vegetation data has been used to inform planning for future mining activities and the 2025 ERA update presented in the 2025 EP TID Volume 2.

The McClean Lake Operation waste streams include waste rock, tailings, treated effluent, domestic waste, industrial waste, chemically and radiological contaminated waste, hazardous waste, recycling materials, and sewage solids. All the waste types are stored at designated facilities, handled in line with the approved procedures, and disposed in line with the regulatory requirements. Orano ensures that environmental impact from the on-site waste handling and disposal remains within the predictions made at the EA stage. Additionally, initiatives for sustainable waste management include on-site bioremediation of hydrocarbon contaminated soil and collection of recyclable materials for donation to local communities or recycling at designated facilities.

Analysis of the 2022-2024 environmental performance at the McClean Lake Operation resulted in recommendations for the monitoring program optimization and revealed a need for additional studies, which can be summarized as follows:

<u>Monitoring Adjustments</u>

- Hydrogeology (Section 2.2.7)
    - no adjustments recommended
- Hydrology (Section 2.3.4)
    - add 3 simultaneous stage and discharge measurements annually at Collins Creek (SG08E)
    - improve water level measurement methodology as specified in Section 2.3.4
- Sediment and Benthic Invertebrate Community (Section 4.4.5 and 4.5.5)
    - align timelines for sediment and benthos sampling under the EMP and EEM
- Fish (Section 4.6.2.7 and 4.6.3.6)
    - adjust large-bodied fish performance criteria (fishing effort) to 3 days and 2 nights for future cycles
    - align timelines for fish sampling under the EMP and EEM
- Surface Water (Section 4.7.8)
    - continue monthly sampling at CM03 and CM04
    - remove WQ09E and WQ10E stations from the EMP
    - update the EM DD parameter list to account for all parameters required under the MDMER water quality monitoring or with water quality guidelines (these parameters were consistently measured by Orano as presented in Section 4.3)

Supplementary Studies

- Hydrogeology (see Section 2.2.7)
    - investigate causes of poor performance of JEB and Sue wells listed in Section 2.2.6.3
    - re-run modeling of mill terrace to inform whether additional monitoring is needed
    - conduct ecological risk assessment for McClean Mining to inform future monitoring
- Hydrology (see Section 2.3.4)
    - align next update of the rating curve at Collins Creek (SG08E) with the ECCC guidelines
- Air Quality (see Section 3.2.8)
    - investigate cause of increased copper and molybdenum in TSP
- Sediment (see Section 4.4.5)
    - additional sediment sampling in Bena and Candy Lakes

Further validation of the monitoring program has been implemented based on the 2025 ERA update as presented in 2025 EP TID Volume 2.

The proposed monitoring adjustments will be incorporated into the EMP upon regulatory review of this document. The supplementary studies are scheduled for 2026-2028.

.

Tables

List of Tables

Table 1.2-1	McClean Lake Operation – Environmental Assessment History.
Table 1.2-2	Licences Issued by the Canadian Nuclear Safety Commission (CNSC), and its Predecessor, the Atomic Energy Control Board (AECB).
Table 1.3-1	Key Events That Have Occurred at the McClean Lake Operation Since 1995.
Table 1.3-2	2022-2024 Mill Operation Data.
Table 1.3-3	Water Flow Volumes at the McClean Lake Operation from 2022 to 2024.
Table 1.6-1	Concordance of 2025 Environmental Performance Technical Information Document to Environmental Performance Report Guideline (EPB 453, 2013).
Table 2.2-1	Hydrostratigraphic Units
Table 2.2-2	Summary of Hydraulic Conductivity Testing for the Local Assessment Boundary
Table 2.2-3	Groundwater Monitoring Locations at the JEB Site
Table 2.2-4	Groundwater Monitoring Locations at the Sue Site
Table 2.2-5	Groundwater Monitoring Locations at the Moffat Domestic Landfill
Table 2.2-6	Groundwater Monitoring Locations at Sink Dam
Table 2.2-7	Groundwater Monitoring Locations at the McClean Mining (former SABRE Test) Site
Table 2.2-8	Performance Criteria for Groundwater Level Measurements with and without Problematic Wells
Table 2.2-9	Performance Criteria for Groundwater Quality Monitoring with and without Poor Performing wells
Table 2.2-10	Comparison of Mean Reference Groundwater Data at the McClean Lake Operation to Saskatchewan Environmental Quality Guidelines
Table 2.2-11	COPC Selection Screening results for Groundwater at the JEB Site for 2022 to 2024
Table 2.2-12	COPC Selection Screening results for Groundwater at the Sue Site for 2022 to 2024
Table 2.2-13	COPC Selection Screening results for Groundwater at the Moffat Site for 2022 to 2024
Table 2.2-14	COPC Selection Screening results for Groundwater at the McClean Mining (former SABRE Test) Site for 2022 to 2024
Table 2.2-15	Summary Statistics for Background Monitoring Locations at the McClean Lake Operation
Table 2.2-16	JEB Site Groundwater Levels - Pre-Development (1995) and Current Operations
Table 2.2-17	Summary Statistics for JEB Site Baseline Groundwater Chemistry

Table 2.2-18 Summary of Mean Groundwater Chemistry data for 2022 to 2024 and Statistical Trend Analysis results for 2011-2024 at JEB Mill and Ore Pad Wells

Table 2.2-19 Summary of Mean Groundwater Chemistry data for 2022 to 2024 and Statistical Trend Analysis for 2011-2024 at JEB TMF Area Wells

Table 2.2-20 Summary of Mean Groundwater Chemistry data for 2022 to 2024 and Statistical Trend Analysis for 2011-2024 at JEB Clean Waste Rock and Landfill Wells

Table 2.2-21 Sue Site Groundwater Levels - Pre-Development (1997) and Current Operations

Table 2.2-22 Summary Statistics for Sue Baseline Monitoring

Table 2.2-23 Summary of Mean Groundwater Chemistry data for 2022 to 2024 and Statistical Trend Analysis for 2011-2024 at the Sue Site

Table 2.2-24 Moffat Domestic Landfill Groundwater Levels - Pre-Development and Current Operations

Table 2.2-25 Summary of Mean Groundwater Chemistry data and Statistical Trend Analysis for 2011-2024 at Moffat Domestic Landfill

Table 2.2-26 Summary of Baseline Groundwater Chemistry for the McClean Mining (former SABRE Test) Site

Table 2.2-27 Summary of Mean Value for Reporting Period and Statistical Trend Analysis for 2011-2024 for the McClean Mining (former SABRE Test) Site

Table 2.3-1 Annual Mean and Extreme Lake Elevation Values for Lakes in the McClean Lake Operation LSA (1995 to 2024)

Table 2.3-2 Performance Criteria for Surface Water Hydrology Measurements - Data Availability in 2022 - 2024

Table 2.3-3 Mean and standard deviation of the Collins Creek rating curves' residuals

Table 2.3-4 Annual Inputs to Collins Creek (2011 to 2024)

Table 2.3-5 Monthly and Annual Mean Flow (m^3/s) at Sink Reservoir Outflow, Station CM03 (1999 to 2024)

Table 2.3-6 Monthly and Annual Mean Flow (m^3/s) at Vulture Lake Outflow, Station CM04 (1997 to 2024)

Table 2.3-7 Estimated Monthly and Annual Mean Discharge and Extreme Values for Collins Creek Below McClean Lake (SG08E), (1979 to 2024)

Table 3.1-1 Temperature Values, McClean Lake, Saskatchewan, 2000 to 2021

Table 3.1-2 Temperature Values, McClean Lake, Saskatchewan, 2022 to 2024

Table 3.1-3 Temperature Values, Collins Bay, Saskatchewan, 2022 to 2024

Table 3.1-4 Temperature Normals, Key Lake, Saskatchewan, 1991 to 2020

Table 3.1-5 Precipitation Values, McClean Lake, Saskatchewan, 2000 to 2021

Table 3.1-6 Precipitation Values, McClean Lake, Saskatchewan, 2022 to 2024

Table 3.1-7 Precipitation Values, Collins Bay, Saskatchewan, 2022 to 2024

Table 3.1-8 Precipitation Normals, Key Lake, Saskatchewan, 1991 to 2020

Table 3.2-1 Air Quality Monitoring Stations at the McClean Lake Operation

Table 3.2-2 Predicted Concentrations of Select Ambient Air Quality Parameters in the McClean Lake Operation LSA

Table 3.2-3 COPC Selection Screening Results for 2022 to 2024

Table 3.2-4 Total Suspended Particulate (TSP) Concentrations at Reference and Exposure Monitoring Stations at the McClean Lake Operation, 2022 to 2024

Table 3.2-5 Metal and Radionuclide Concentrations at Reference and Exposure Monitoring Stations at the McClean Lake Operation, 2022 to 2024

Table 3.2-6 Average Metal and Radionuclide Concentrations at the McClean Lake Operation, 2022 to 2024 Compared to Historical Data and ERA Predictions

Table 3.2-7 Special Projects Comparison of Total Suspended Particulate (TSP) Concentrations from New and Old HVAS Units

Table 3.2-8 Baseline Ambient Radon Concentrations at Reference and Exposure Areas for the McClean Lake Operation, 1988 to1990

Table 3.2-9 Radon Concentrations at Reference and Exposure Stations at the McClean Lake Operation, 2022 to 2024

Table 3.2-10 Monthly Acid Precipitation Monitoring at the McClean Lake Operation Meteorological Station, AR02, 2022 to 2024

Table 3.2-11 Summary of the Ambient Hourly SO_2 Concentrations (ppb) at the McClean Lake Operation, 2000 to 2024

Table 4.3-1 A History of Baseline Surface Water Quality Sampling Programs.

Table 4.3-2 Summary of Baseline Surface Water Limnology from 1993 to 1995.

Table 4.3-3 Summary of Baseline Surface Water Major Ion Concentrations from 1993 to 1995.

Table 4.3-4 Summary of Baseline Surface Water Nutrient Concentrations from 1993 to 1995.

Table 4.3-5 Summary of Baseline Surface Water Metals Concentrations from 1993 to 1995.

Table 4.3-6 Summary of Baseline Surface Water Radionuclide Concentrations from 1993 to 1995.

Table 4.3-7 Waterbodies Sampled in the McClean Lake Operation LSA for the Water Quality Monitoring Program.

Table 4.3-8 Predicted Maximum Mean and 95th Percentile Water Quality Concentrations of Modelled Constituents.

Table 4.3-9 Environmental Quality Guidelines for Surface Water COPCs.

Table 4.3-10 COPC Selection Screening Results for the 2022 to 2024 EP TID Period.

Table 4.3-11 Time Periods for Surface Water Data Analysis.

Table 4.3-12 Summary of Water Chemistry Data from Primary Exposure Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Table 4.3-13 Statistical Analysis and Benchmark Comparison Results for the Primary Exposure Areas at the McClean Operation, Time Period 1, 2015 to 2024.

Table 4.3-14 Statistical Analysis and Benchmark Comparison Results for the Primary Exposure Areas at the McClean Operation, Time Period 2, 2000 to 2024.

Table 4.3-15 Summary of Water Chemistry Data from Secondary Exposure and Reference Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Table 4.3-16 Statistical Analysis and Benchmark Comparison Results for the JEB Secondary Exposure Areas at the McClean Operation, Time Period 1, 2000 to 2024.

Table 4.3-17 Statistical Analysis and Benchmark Comparison Results for the JEB Secondary Exposure Areas at the McClean Operation, Time Period 2, 1996 to 2024.

Table 4.3-18 Statistical Analysis and Benchmark Comparison Results for the Sue Secondary Exposure Areas at the McClean Operation, Time Period 1, 2009 to 2024.

Table 4.3-19 Statistical Analysis and Benchmark Comparison Results for the Sue Secondary Exposure Areas at the McClean Operation, Time Period 2, 1998 to 2024.

Table 4.3-20 Statistical Analysis and Benchmark Comparison Results for the Reference Areas at the McClean Operation, Time Period 1, 2015 to 2024.

Table 4.3-21 Statistical Analysis and Benchmark Comparison Results for the Reference Areas at the McClean Operation, Time Period 2, 1996 to 2024.

Table 4.4-1 Sediment Quality Criteria.

Table 4.4-2 Summary of Baseline Sediment Chemistry in the McClean Lake Operation LSA - Major Ions.

Table 4.4-3 Summary of Baseline Sediment Chemistry in the McClean Lake Operation LSA – Nutrients.

Table 4.4-4 Summary of Baseline Sediment Chemistry in the McClean Lake Operation LSA – Metals.

Table 4.4-5 Summary of Baseline Sediment Chemistry in the McClean Lake Operation LSA – Radionuclides.

Table 4.4-6 Predicted Maximum Mean and 95th Percentile Concentrations of Select Parameters in the Sediment of Sink, Vulture, McClean, and Kewen Lakes.

Table 4.4-7 Sediment Sampling Areas for the McClean Lake Operation EMP, 1999 to 2024.

Table 4.4-8 Identification of COPC in Sediment from the Primary Exposure Area in the McClean Lake Operation LSA.

Table 4.4-9 Summary of Sediment Chemistry from Lake Depositional Sampling Areas in the McClean Lake Operation LSA, February/March 2024.

Table 4.4-10 Summary of Sediment Particle Size from Lake Depositional Sampling Areas in the McClean Lake Operation LSA, February/March 2024.

Table 4.5-1 Benthos Sampling Design for Primary Exposure Area.

Table 4.5-2 Relative Abundances of Benthic Macroinvertebrates in the Four Reference Lakes.

Table 4.5-3 Relative Abundances of Benthic Macroinvertebrates in the Four Exposure Lakes.

Table 4.5-4 Percent Composition of Major Taxa in the Riverine Erosional Benthic Invertebrate Samples from Collins Creek.

Table 4.5-5 Results of ANOVA Testing for Significant Variations in Indices of Benthic Community Composition of Lake Depositional Areas.

Table 4.5-6 Relative Abundances, Density, and Taxon Richness of Benthic Macroinvertebrates in Fox Lake.

Table 4.5-7 Analysis of Variance Testing for Variations in Indices of Composition Between Reference and Exposure Riverine Erosional Benthic Invertebrate Samples from Collins Creek.

Table 4.5-8 Percent Composition of Major Taxa in the Riverine Depositional Benthic Invertebrate Samples Collected from Collins Creek.

Table 4.5-9 Summary of Riverine Depositional Benthic Invertebrate Biotic Indices Calculated at the Lowest Practical Level of Taxonomic Identification.

Table 4.5-10 Analysis of Variance Testing for Variations in Indices Composition (at Lowest Practical Level) Between Reference and Exposure Riverine Depositional Benthic Invertebrate Samples from Collins Creek, 2022.

Table 4.5-11 Analysis of Variance Testing for Variations in Indices Composition (at Lowest Practical Level) Between Reference and Exposure Riverine Depositional Benthic Invertebrate Samples from Collins Creek, 2008, 2013, 2016, 2019, and 2022.

Table 4.5-12 Results of the Mantel Test for Spatial and Temporal Differences in the Bray-Curtis Index (at the Lowest Practical Level) from the Riverine Depositional Area of Collins Creek.

Table 4.6-1 Fish Species Identified During Baseline and Operational Period Fish Surveys in the McClean Lake Operation LSA and Associated Reference Areas.

Table 4.6-2 Catch per Unit Effort of Short-length Gill Netting in the operational Monitoring Period at the McClean Lake LSA and Associated Reference Areas.

Table 4.6-3 Catch per Unit Effort of Half Standard Gang Gill Netting in the operational Monitoring Period at the McClean Lake LSA and Associated Reference Areas.

Table 4.6-4 Catch per Unit Effort Electrofishing in Collins Creek and Associated Reference Areas during the operational Monitoring Period.

Table 4.6-5 Summary of Baseline Fish Tissue Metal Concentrations from the 1994 Surveys, McClean Lake Operation.

Table 4.6-6 Summary of Baseline Fish Tissue Radionuclide Levels from the 1994 Surveys, McClean Lake Operation.

Table 4.6-7 Predicted Maximum Mean and 95th Percentile Concentrations of Select Parameters in Fish Flesh from the 2016 ERA.

Table 4.6-8 Predicted Maximum Mean and 95th Percentile Selenium Concentrations in Fish Tissue, 2018 ERA.

Table 4.6-9 COPC screening in Fish Tissue from the Primary Exposure Area in the McClean Lake Operation LSA.

Table 4.6-10 Correlations of Individual Analytes with Principal Component Axis Scores, Fish Tissues, All Lakes.

Table 4.6-11 Aluminum Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-12 Antimony Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-13 Arsenic Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-14 Barium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-15 Beryllium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-16 Cadmium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-17 Chromium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-18 Cobalt Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-19 Copper Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-20 Lead Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-21 Iron Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-22 Manganese Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-23 Molybdenum Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-24 Nickel Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-25 Selenium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-26 Silver Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-27 Strontium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-28 Thallium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-29 Titanium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-30 Uranium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-31 Vanadium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Table 4.6-32 Summary of McClean Lake Operation Fish Tissue Muscle, Whole-body, and Egg/Ovary Selenium Levels.

Table 4.6-33 Summary of McClean Lake Operation EMP Northern Pike and White Sucker Converted Selenium in Muscle to Selenium in Ovary Data for Comparison to Ovary Tissue Guidelines.

Table 4.6-34 Statistical Analyses Used to Test for Effects on EEM Endpoints.

Table 4.6-35 Summary Statistics of YOY and Non-YOY Burbot from the Reference Area and Exposure Area of Collins Creek, October 2022.

Table 4.6-36 Results of Various Analyses Testing for Differences in Body Size and Condition of YOY and Non-YOY Burbot Collected in the Reference and Exposure Areas of Collins Creek, October 2022.

Table 4.6-37 Results of Various Analyses Testing for Differences in Body Size and Condition of Non-YOY Burbot Among years (2008, 2013, 2016, and 2022) Collected in the Reference and Exposure Areas of Collins Creek, October 2022.

Table 4.6-38 Summary Statistics of YOY and Non-YOY Slimy Sculpin in Reference Area and Exposure Area in Collins Creek, October 2022.

Table 4.6-39 Results of Various Analyses Testing for Differences in Body Size and Condition of YOY and Non-YOY Slimy Sculpin Collected in the Reference and Exposure Areas of Collins Creek, October 2022.

Table 4.6-40 Results of Various Analyses Testing for Differences in Body Size and Condition of Slimy Sculpin among years (2002, 2005, 2008, 2013, 2016, and 2022) Collected in the Reference and Exposure Areas of Collins Creek, October 2022.

Table 4.7-1 Sediment Chemistry Data from the 2024 McClean Lake Aquatic Vegetation Sampling Program.

Table 4.7-2 Pond Lily Root Chemistry Data from the 2024 McClean Lake Aquatic Vegetation Sampling Program.

Table 4.7-3 Pond Lily Shoot Chemistry Data from the 2024 McClean Lake Aquatic Vegetation Sampling Program.

Table 4.7-4 Comparison of Mean Sediment Chemistry Data from the 2008 and 2024 Sampling.

Table 4.7-5 Comparison of Mean Pond Lily Root Chemistry Data from 2008 and 2024 Sampling Programs.

Table 4.7-6 Comparison of Mean Pond Lily Shoot Chemistry Data from 2008 and 2024 Sampling Programs.

Table 5.2-1 Summary of Wildlife and Wildlife Habitat Surveys

Table 5.2-2 Ecosites Within the McClean Lake Operation Local Assessment Boundary

Table 5.2-3 Revegetation Activities at the Sue C Clean Waste Rock Pile at the McClean Lake Operation, 2022-2023

Table 5.2-4 Rare Plant Population Status Within the McClean Lake and Midwest Local Study Areas, June and August 2023

Table 5.2-5 2024 Vegetation Survey Transects and Plots per Ecosite Type and Areas of Specific Interests

Table 5.2-6 Vascular Plant, Bryophyte, Lichen and Fungi Species Detected During 2024 Terrestrial Vegetation Surveys

Table 5.2-7 Rare Species Detected During the 2024 Terrestrial Vegetation Surveys

Table 5.2-8 Non-native Plant Species Detected During the 2024 Terrestrial Vegetation Surveys

Table 5.2-9 Shoreline Survey Locations, Survey Dates, and Shoreline Length for Each Semi-Aquatic Furbearer Survey Area, August 2024

Table 5.2-10 Shoreline Survey Observations by Semi-Aquatic Furbearer Survey Area and Species, August 2024

Table 5.2-11 Relative Abundance of Small Mammals Captured for Population Surveys Across McClean Lake and Midwest LSAs, August 2024

Table 5.2-12 Relative Abundance of Small Mammals Captured in the Study Area by Species and Habitat Category, August 2024

Table 5.2-13 Number of Captures of Small Mammal Species per 100 Trap Nights at McClean Lake and Midwest Local Study Areas, 2024

Table 5.2-14 Metal and Radionuclide Concentrations in Gapper's Red-backed Voles Trapped at Exposure and Reference Areas, August 2024

Table 5.2-15 Recorded Bat Activity at McClean Lake Operation, 2023-2024

Table 5.3-1 Potential Rare Plants, Bryophytes and Lichens of the Regional Assessment Boundary and those Documented within the Local Assessment Boundary

Table 5.3-2 Rare Vascular Plants, Bryophyte and Lichen Sightings in the Local Assessment Boundary

Table 5.3-3 Wildlife Species that have been Observed Within the McClean Lake Area and Species that Potentially Occur in the Region

Table 6.2-1 Archaeological Cultures of Northern Saskatchewan.

Table 6.2-2 Fur Trade Posts in the Regional Study Area.

Table 6.3-1 Archaeological Resource Investigation Permits Issued for the Local Assessment Boundary.

Table 6.3-2 Previously Recorded Heritage Resources in the Local Assessment Boundary.

Table 6.4-1 Land Uses in the Vicinity of the McClean Lake Operation.

Table 6.4-2 Value of Saskatchewan Fur Harvest 2004-2005 to 2020-2021.

Table 6.4-3 Saskatchewan Trapper Licence Sales 2004-2005 to 2020-2021.

Table 6.4-4 Northern Fur Conservation Area – N26 Wollaston Harvest and Cash Values 2004-2005 to 2019-2020.

Table 6.4-5 Commercial Fishing Quotas, by Waterbody.

Table 6.4-6 Commercial Fishing Licences for Wollaston Lake.

Table 6.4-7 Wollaston Lake Commercial Fishing Data 2004 to 2024

Table 7.2-1 Current Waste Rock Inventory.

Table 7.2-2 Tailings Discharged to JEB TMF in 2022-2024.

Table 7.2-3 Summary of Waste Materials Generated and Shipped Off Site in 2022-2024.

Table 7.2-4 JEB WTP Effluent Quality in 2022-2024.

Table 7.2-5 Sue WTP Effluent Quality in 2022-2024.

Table 7.2-6 Water Treatment Plant Discharge in 2022-2024.

Table 7.2-7 Mass Loadings to S/V TEMS for 2022-2024.

Table 7.2-8 Acute Lethality Toxicity Testing Results from the McClean Lake Operation, 2022-2024.

Table 7.2-9 Sub-lethal Toxicity Testing Results on the JEB Treated Effluen from the McClean Lake Operation, 2022.

Table 7.2-10 Sub-lethal Toxicity Testing Results on the JEB Treated Effluen from the McClean Lake Operation, 2023.

Table 7.2-11 Sub-lethal Toxicity Testing Results on the JEB Treated Effluen from the McClean Lake Operation, 2024.

Table 7.2-12 Hydrocarbon Soil Remediation Analytical Data.

Table 1.2-1 McClean Lake Operation – Environmental Assessment History

Project	Environmental Assessment	Subsequent Approval/Licensing Actions	Key Aspects
McClean Lake Operation	McClean Lake EIS: 1991 Joint Panel Approved: 1993 Subsequent assessment to confirm acceptability of JEB TMF (Cigar Lake Project 1995)	Construction Licence: Atomic Energy Control Board (AECB) Ministerial Approval: Saskatchewan Ministry of Environment Provincial Approval to Construct and Operate the McClean Lake Mine and Mill	Initial approval for the overall McClean Lake Project, which included one underground mine (McClean), four open pit mines (JEB and Sue), and the JEB mill, as well as the waste management system for the entire project. Subsequent approval for the JEB TMF facility Production Limit: 6 million lbs U_3O_8 (licence)
McClean Lake Operation – Change in Mill	Change in Stripping Process in Mill Solvent Extraction Circuit: July 1994	Ministerial Approval change: Saskatchewan Ministry of Environment Construction Licence Amendment	Change the strong acid stripping process in the mill solvent extraction circuit to an ammonium sulphate stripping process. This change in the mill design based to reduce reagent consumption, reduce chemical loading on the environment and allow ammonium sulphate to be recovered and marketed as a byproduct: ammonium sulphate fertilizer.
McClean Lake Operation – Change in JEB pit	Change in Dewatering Procedures at JEB Pit: April 1995	Ministerial Approval change: Saskatchewan Ministry of Environment Construction Licence Amendment	Changed the JEB pit dewatering method from pumping and treating groundwater inflows from in-pit sumps with treatment of all waters prior to release into Sink Lake to dewatering the groundwater with a ring of dewatering wells around the JEB pit which would intercept groundwater prior to entry into the pit, separation of any groundwater which requires treatment and discharge to Sink Lake.
Midwest Project	Midwest EIS: 1995 Addenda submitted: 1996 (March, May, October) and May 1997 Joint Panel Approved: 1997	Have not proceeded with project yet	Adopted new underground mining method, jet-boring in frozen ground.
Cigar Lake Project	Cigar Lake EIS: 1995 Addenda submitted: 1996 (April, July, December) and May 1997 Joint Panel Approved: 1997	Canadian Nuclear Safety Commission (CNSC) and Provincial Approval to *Construct* Cigar Lake Mine (December 2004) CNSC and Provincial Approval to Expand the JEB Mill to Process Cigar Lake Ore (2005)	Assessment and approval to process up to 24 million lbs (10.9 million kg) of U_3O_8 annually and of that, process 18 million pounds (8.2 million kg) U_3O_8 from Cigar Lake high grade ore slurry through the mill expansion (including deposition of tails to the JEB TMF) Assessment and approval of the activity of transporting high grade ore slurry to McClean Lake Operation

Table 1.2-1 McClean Lake Operation – Environmental Assessment History

Project	Environmental Assessment	Subsequent Approval/Licensing Actions	Key Aspects
Disposal of Cigar Lake Waste Rock	Disposal of Cigar Lake Waste Rock in the Mined-out Sue C Pit EIS: 2001 Addendum submitted: 2002 Joint Screening Report Approved: Province: September 2003 CNSC: August 2003	Have not proceeded with the project yet; project on indefinite hold	Transport and disposal of Cigar Lake waste rock in the McClean Lake Operation's mined out Sue C/A pit.
Sue E Project	Sue E EIS: 2004 Addendum submitted: 2005 Federal Screening Report Approved: Province: 2005 CNSC: 2005	CNSC and Provincial Approval to Construct and Operate the Sue E Project (2005)	Development of an open pit and the construction of a new clean waste stockpile and a temporary till stockpile. Use of existing facilities for the milling, tailings disposal and water treatment. Expected production of 8.3 million pounds U_3O_8. Subsequent assessments demonstrate that the past, current and planned future activities at the McClean Lake Operation continue to fall within the environmental effects envelope originally reviewed by the Joint Panel. These effects considered production levels from McClean Lake Operation to be up to 24 million lbs (10.9 million kg) U_3O_8 through the mill, based on the processing of high grade ore.
Mining Equipment Development Program	Change in Mining Method at McClean Mining Site: December 2004	CNSC and Provincial Approval to proceed with Mining Equipment Development Program at McClean Mining Site (2005) Provincial Approval to construct facilities for Mining Equipment Development Program (2005)	A change from previously approved underground mining to a small-scale research program at Pod 1 East of McClean Mining Site. The program was designed to develop and test the mining of ore bodies from the surface using jet boring.
Ferric Sulphate Production at McClean Lake	Federal Screening Report Approved: CNSC: October 2006	CNSC and Provincial Approval to Construct and Operate a Ferric Sulphate Production Circuit (2006)	Addition of a ferric sulphate production circuit to JEB Mill.
Rabbit Lake Solution Processing Plant	Federal Screening Report Approved: Province: August 2008 CNSC: June 2008	Did not proceed with the project	Receipt of 18 Mlbs U_3O_8 from Cigar Lake Mine, sending equivalent of 10 Mlbs U_3O_8 to Rabbit Lake Operation as Uranium Solution and processing 8 Mlbs U_3O_8 of Cigar Lake ore through McClean Lake Mill with remaining capacity for McClean Lake source ores

Table 1.2-1 McClean Lake Operation – Environmental Assessment History

Project	Environmental Assessment	Subsequent Approval/Licensing Actions	Key Aspects
Midwest Project	Midwest EIS: 2011 Comprehensive Study Level EA Approved: Provincial and Federal August 2012	Have not proceeded with project yet	Open pit mining method Includes a mill expansion: 27/16 million lbs – base case 27/27 million lbs – cumulative case
Caribou Project	Federal and Provincial Screening Approved: Province of Saskatchewan 2009 Canadian Nuclear Safety Commission 2010	CNSC Approval to Construct and Operate the Caribou Project (future) Provincial Approval to Construct and Operate the Caribou Project (future)	Development of an open pit and the construction of a new clean waste stockpile. Use of existing facilities for the milling, tailings disposal and water treatment. Expected production of 2.6 million pounds U_3O_8. Subsequent assessments demonstrate that the past, current and planned future activities at the McClean Lake Operation continue to fall within the environmental effects envelope originally reviewed by the Joint Panel. These effects considered production levels from McClean Lake to be up to 24 million lbs (10.9 million kg) U_3O_8 through the McClean Lake Mill, based on the processing of high-grade ore.
Receipt and Processing of McArthur River Ore at the McClean Lake Operation	Proposal submitted: November 2009 DEIS submitted: January 2011 FEIS submitted: May 2011 Provincial approval: January 2012 Federal approval (CNSC): April 2012 Screening Level EA	Did not proceed with project	To transport ore slurry on existing public roads, from McArthur River Mine to the McClean Lake Mill for a three-year period.
McClean Mining Project	Change in Mining Method at McClean Mining Site: April 2025	Provincial Approval to proceed with McClean Mining Project (scheduled for 2025)	Change from test mining of Pod 1 East to production mining at McClean North deposit using Surface Access Borehole Resource Extraction (SABRE) mining method.

Table 1.2-2 Licences Issued by the Canadian Nuclear Safety Commission (CNSC), and its Predecessor, the Atomic Energy Control Board (AECB)

CNSC (AECB) Licences	Licenced Activities	Date Issued	Licence Basis EAs
AECB-MFRL-148-2	Site Preparation	April 1, 1994	McClean Lake Project EIS (1991)
AECB-MFEL-167-0-2	Mining Facility Excavation	June 1, 1994	Midwest Project EIS (1991)
AECB-MFCL-169-0	Mine facility construction of all necessary surface support facilities in preparation to mine and operate mill and waste treatment systems	June 29, 1994	McClean Lake Project EIS (1991)
AECB-MFCL-169-0.1	Mill process change from Strong acid to ammonium sulphate stripping	December 19, 1994	McClean Lake Project EIS (1991)
AECB-MFCL-169-0.2	Surface stripping JEB and operation of associated dewatering and water treatment facilities	September 18, 1995	McClean Lake Project EIS (1991)
AECB-MFOL-170-0	Operation of JEB open pit mine and associated water management systems	March 12, 1996	McClean Lake Project EIS (1991)
AECB-MFEL-167-0.2	Mining Facility Excavation	December 16, 1996	Midwest Project EIS (1991)
AECB-MFOL-170-0.1	Sue C site preparation and operation of associated water management systems	March 9, 1998	McClean Lake Project EIS (1991)
AECB-MFOL-170-0.3	Preparatory work to Construct JEB TMF	August 14, 1998	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)
AECB-MFOL-170-0.4	Approval to construct JEB TMF and associated tailings and water systems	March 26, 1999	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)
AECB-MFOL-170-0.5	Approval to operate JEB Mill, TMF and associated facilities	June 21, 1999	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)
AECB-MFOL-170-0.6	Approval to mine Sue C ore;	November 9, 1999	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)
AECB-MFOL-170-0.7	Approval to possess, import and use radioactive prescribed substances;	May 29, 2000	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)

Table 1.2-2 Licences Issued by the Canadian Nuclear Safety Commission (CNSC), and its Predecessor, the Atomic Energy Control Board (AECB)

CNSC (AECB) Licences	Licenced Activities	Date Issued	Licence Basis EAs
AECB-MFRL-167-0.4	Mining Facility Excavation	May 29, 2000	McClean Lake Project EIS (1991), Midwest Project EIS (1995)
UMOL-MINEMILL-McCLEAN.08/2001	Licence extension of AECB-MFOL-170.7	June 21, 2001	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)
UMOL-MINEMILL-McCLEAN.09/2005	Mine Sue C, A and B, produce up to 8 million lbs/year	August 21, 2001	2001 Screening Report (CNSC) (No Provincial EA Required)
UMSL-Excavate-Midwest.05/Indf	Site Preparation Licence	May 31, 2002	McClean Lake Project EIS (1991), Midwest Project EIS (1995)
UMOL-MINEMILL-McCLEAN.00/2009	Licence renewal with amendments to modify the JEB mill to receive and process Cigar Lake ore	May 19, 2005	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)
UMOL-MINEMILL-McCLEAN.02/2009	Amendment to allow preparatory work at Sue E mine site	July 21, 2005	Sue E Project EIS (2004)
UMOL-MINEMILL-McCLEAN.03/2009	Amendment to allow open pit mining of Sue E orebody	December 9, 2005	Sue E Project EIS (2004)
UMOL-MINEMILL-McCLEAN.04/2009	Amendment to allow Phase II of the Mining Equipment Development Program	March 30, 2006	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)
UMOL-MINEMILL-McCLEAN.04/2009	Approval to construct and operate ferric sulphate circuit under condition 3.1 of operating licence	December 5, 2006	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995), Ferric Sulphate Production at the McClean Lake Operation Screening Report (2006)
UMOL-MINEMILL-McCLEAN.05/2009	Licence extension	May 25, 2009	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)
UMOL-MINEMILL-McCLEAN.00/2017	Licence renewal	July 1, 2009	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)

Table 1.2-2 Licences Issued by the Canadian Nuclear Safety Commission (CNSC), and its Predecessor, the Atomic Energy Control Board (AECB)

CNSC (AECB) Licences	Licenced Activities	Date Issued	Licence Basis EAs
UMOL-MINEMILL-McCLEAN.01/2017	Licence amendment; adopt the Licence Condition Handbook framework	December 19, 2012	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); McArthur River (2011); Midwest (2011)
UMOL-MINEMILL-McCLEAN.01/2017 - Licence Condition Handbook Revision 0	Original document; Increase annual production to 13 mlbs; operate high grade ore slurry receiving circuit and high-grade ore milling circuits; process high grade ore from the McArthur River Mine	March 7, 2013	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)
UMOL-MINEMILL-McCLEAN.01/2017 - Licence Condition Handbook Revision 01	Construct the Mill Upgrade Project to increase annual production capacity to 24 Mlbs	July 9, 2013	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)
UMOL-MINEMILL-McCLEAN.01/2017 - Licence Condition Handbook Revision 02	Administrative and editorial changes	April 23, 2014	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)
UMOL-MINEMILL-McCLEAN.01/2017 - Licence Conditions Handbook Revision 03	Added JEB Ore Pad as contingency measure; changed annual U3O8 production to 24,000,000 lbs; added documents to licensing basis; administrative and editorial changes.	June 23, 2016	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)
UMOL-MINEMILL-McCLEAN.00/2027	Licence renewal	July 1, 2017	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)
UMOL-MINEMILL-McCLEAN.00/2027 - Licence Conditions Handbook Revision 04	Allow placement of tailings up to 448 mASL	October 6, 2017	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)
UMOL-MINEMILL-McCLEAN.01/2027	Licence update to reflect name change from AREVA Resources Canada Inc. to Orano Canada Inc.	July 12, 2018	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)

Table 1.2-2 Licences Issued by the Canadian Nuclear Safety Commission (CNSC), and its Predecessor, the Atomic Energy Control Board (AECB)

CNSC (AECB) Licences	Licenced Activities	Date Issued	Licence Basis EAs
UML-MINEMILL-McCLEAN.02/2027	Amendment to allow JEB TMF Expansion (468.8 mASL)	January 17, 2022	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)
UML-MINEMILL-McCLEAN.02/2027 - Licence Conditions Handbook Revision 05	Reflects Licence amendment, UML-MINEMILL-McCLEAN.02/2027, includes revised financial guarantee value and introduces references to most recent CNSC regulatory documents and Canadian Standard Association documents.	April 14, 2022	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)
UML-MINEMILL-McCLEAN.02/2027 - Licence Conditions Handbook Revision 06	The LCH was updated to include CNSC regulatory documents and Canadian Standard Association documents, which were published after the last update of the LCH Rev 5 dated April 14, 2022.	May 1, 2024	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)

Table 1.3-1 Key Events That Have Occurred at the McClean Lake Operation Since 1995

Year	Event
1995	Construction begins
	JEB pit mining begins
1996	JEB water treatment plant begins operation
	JEB pit dewatering system begins operation, discharge to Sink Reservoir
1997	JEB pit mining ends
	Sue C pit mining begins
	Sue water treatment plant begins operation
1999	Mill begins operation (JEB WTP influence) and JEB TMF begins operation
2002	Sue C pit mining ends
	Back hauling of Sue C and JEB special waste to Sue C pit begins
	Back hauling of Sue C and JEB special waste to Sue C pit ends
	Sue WTP ceases operating - Sue C pit allowed to flood naturally with groundwater and surface runoff
2003	Molybdenum optimization WTP scale trials begin
2004	Optimized molybdenum WTP removal process implemented at JEB
	Sue WTP resumes operation to draw down water level in Sue C pit in anticipation of initiation of Sue A mining
2005	Sue A mining begins
	Mine equipment development (MED) program initiated
	Sue E pit mining begins
	Commence Mill Expansion Project for receipt and processing of high-grade ore and expand capacity to 13 Mlbs/year
2006	Sue A mining ends
	Start of placement of Sue E special waste in Sue C/A pit
	Mill Optimization Project (to process low grade ore and increase volume of ore feed)
2007	Ferric sulphate and oxygen plants commissioned and turned over to McClean Lake Operation
	Sue B overburden removal
	MED program mined and backfilled one hole; 81 tonnes of ore produced

Table 1.3-1 Key Events That Have Occurred at the McClean Lake Operation Since 1995

Year	Event
2008	Sue E mining ends
	Sue B mining begins, disposal of all waste rock in Sue E pit
	Initial push down of Sue E special waste in Sue C/A pit
	Sue E overburden backhauled into Sue E pit to cover Sue B waste material
	Sue B mining ends
	Till covers completed over pit bottom in Sue B and wastes in Sue E; pits allowed to flood
2009	Sue WTP operation ceases temporarily - Sue C/A pit allowed to flood naturally with groundwater and surface runoff
	Relocation of Sue E special waste deposited in Sue C/A pit
	MED program mined and backfilled four holes; 759 tonnes of ore produced
	Sue WTP testwork performed with 3-stage configuration; after test, operation ceases and Sue C/A pit allowed to flood naturally with groundwater and surface runoff
2010	MED program completed mining and backfilled one hole; 361 tonnes of ore produced
	Relocation of Sue E special waste deposited in Sue C/A pit occurred
	Temporary cessation of milling
	Tailings Preparation Circuit adapted to treat and place JEB WTP sludges
2011	Sue WTP testwork with 3-stage process and RO unit occurred. Water pumped from the Sue C/A and Sue B pits and treated.
	Enter agreement to process 100% of Cigar Lake ore slurry at the McClean Lake Mill
2012	SABRE program (formerly MED) mined and backfilled two holes; 1022 tonnes of ore produced
2012-2013	JEB TMF Optimization Project, Stage 1 - sloping improvements and liner placement to 439 mASL
2012-2017	Sue WTP testwork with 3-stage process and optimization occurred seasonally. Water was pumped from Sue C/A pit each year, and also from Sue B in 2012. When the plant ceases operating Sue C/A pit is allowed to flood naturally.

Table 1.3-1 Key Events That Have Occurred at the McClean Lake Operation Since 1995

Year	Event
2013	Installation of the new Yellowcake Packaging System
2013-2016	McClean Lake Mill Upgrade Project
2014	JEB TMF Dewatering Wells ceased operation
	Re-design and construct the Leaching Circuit to effectively mitigate in-circuit hydrogen evolution
	Cigar Lake mine starts shipping ore to McClean Lake Operation
	Restart of Milling Operations
2016	Production Level Increase to 18,000,000 lbs U_3O_8
2016	Calciner Stack Extension (to improve SO_2 dispersion)
	Target elevation level for Sink Reservoir increased to 441 mASL from 440 mASL (to improve effluent mixing)
2016-2017	Construction of the Ore Pad Runoff Pond at JEB site (to manage the stormwater)
2016	SABRE Project renewed
2017	Relocation of Temporary Contaminated Landfill to the Permanent Location in Sue C/A pit
2017-2019	Decommissioning of the JEB Dewatering Wells
2018	JEB TMF Optimization Project Stage 2 (resloping & placement of liner to 443 mASL)
	56,000-liter Hydrogen Peroxide Tank Added to the Hydrogen Peroxide Bay
	Implementation of the Sub-Aqueous Tailings Deposition as an Alternative to the Tremie Deposition
	Drilling and preparation of four pilot holes at SABRE site
2019	JEB TMF Expansion (placement of liner to 448 mASL)
	Construction and commissioning of additional SABRE infrastructure
2020	Covid Care and Maintenance Period (April-November)
	Implementation of the Selinium Mitigation Measures at the JEB TMF (increased distance between the tailings thickener overflow discharge and the reclaim intake, silt curtain installation at the reclaim intake)
2021	Covid Care and Maintenance Period (January-April)
	JEB TMF Expansion (embankment increase to 457.5 mASL)
	Extension of Sub Aqueous Deposition Lines at JEB TMF
	SABRE project completed test mining of four cavities; 1500 tonnes of ore produced

Table 1.3-1 Key Events That Have Occurred at the McClean Lake Operation Since 1995

Year	Event
2022	The tailings deposition system was modified with sub-aqueous piping extended and supported by a buoy and anchor technique to improve accessibility to tailings capacity.
	Upgrade of the JEB WTP with the integrated ferrous sulphate treatment system to enhance selenium removal from the mill effluent
	Upgrades to Solvent Extraction (SX) Circuit (installation of anhydrous ammonia isolation valves to mitigate large releases of ammonia)
	A third ferric reactor installed, commissioned and in operation
	Hydroseeding of the south and west slopes of Sue C Waste Rock Pile as part of progressive decommissioning initiatives
	Decommissioned of some outbuildings around site
	Initiated dismantling the Cigar Lake Ore Slurry Contingency Storage Cell on the JEB Ore Pad
2023	JEB TMF liner expansion was completed to increase the crest elevation from 448.0 mASL to 452.5 mASL. The previous deposition pipeline extensions were removed, new pipeline extensions were installed, the walkway between the header barge and tremie barge was removed, and the tremie barge was removed.
	Arsenic flotation pilot trial
	Initiation of mill automation in areas that were previously highly manual processes.
	Shredded waste from progressive decommissioning activities
	Completed dismantling the Cigar Lake Ore Slurry Contingency Storage Cell on the JEB Ore Pad
	Continued decommissioning of outbuildings around the site
	Graded and hydroseeded the west, north and east slopes of Sue C Waste Rock Pile
2024	New deposition lines were installed at two new locations in the TMF, with removal of the lines installed in 2023
	TMF level was increased from January 1 to March 31 to aid in proper hydration of the new liner installed in 2023
	Second arsenic flotation pilot trial
	Replacement of the JEB WTP effluent discharge pipeline to Sink Reservoir
	Major overhaul of the dry side of the Ammonium Sulphate Crystallization (CX) Plant including installation of a new centrifuge, fluid bed dryer and screw conveyor
	1st stage of gypsum mitigation system implemented (temporary mitigation, while the long-term chemical treatment is being developed)
	McClean Mining Pad (formerly known as SABRE Test Pad) extension
	McClean Mining (formerly known as SABRE Project): four pilot holes drilled and cased

Table 1.3-2 2022-2024 Mill Operation Data

Parameter	Units	2022	2023	2024	Total
Quantity of ore processed	Tonnes (Dry)	52,324	49,591	54,588	**156,503**
Quantity of U produced	Kg U	6,938,038	5,806,799	6,512,237	**19,257,074**
	lbs U3O8	18,037,443	15,096,457	16,930,450	**50,064,350**
Quantity of Ammonium Sulphate Shipped	Tonnes	12,936	11,416	12,941	**37,293**

Source: Orano 2023a, Orano 2024a, Orano 2025a

Table 1.3-3 Water Flow Volumes at the McClean Lake Operation from 2022 to 2024

Reporting Year	To TMF				To Mill General	To Process Water Tank		To Process	JWTP Feed				Sink Reservoir feed		
	Tailings O/F (m^3)	Tailings U/F (m^3)	Runoff (m^3)	Effluent Recycle (m^3)	Fresh Water (m^3)	Fresh Water (m^3)	Raise Water (m^3)	Process Water[1] (m^3)	Reclaim Water (m^3)	Process Water Tank (m^3)	Barren Strip (m^3)	Septic (m^3)	JEB WTP (m^3)	Sue WTP[2] (m^3)	Total to Sink (m^3)
2022	486,511	298,336	7,824	21,523	238,036	37,878	665,914	619,133	844,905	84,659	181,730	49,525	1,001,016	629,675	1,630,691
2023	519,817	308,903	6,757	43,633	262,033	40,306	556,858	501,192	535,384	95,972	174,873	49,130	608,429	539,494	1,147,923
2024	612,964	380,335	9,432	2,732	253,279	38,969	719,021	685,785	420,819	72,205	174,157	58,334	735,151	523,816	1,258,967
2022 - 2024 Total	**1,619,292**	**987,574**	**24,013**	**67,888**	**753,348**	**117,153**	**1,941,793**	**1,806,110**	**1,801,108**	**252,836**	**530,760**	**156,989**	**2,344,596**	**1,692,985**	**4,037,581**

[1] Calculated value - total raise and freshwater combined minus process water tank to JEB WTP

[2] Majority of water treated at the Sue WTP is from the Sue C/A Pit. Occasionally water is also pumped from the Sue site runoff pond to the WTP

Source: Orano 2023a, Orano 2024a, Orano 2025a

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
General	NA	Name of the facility	Section 1. Introduction, 1.1 Background	n/a
General	NA	Name of the operator and contact information	Section 1. Introduction, 1.1 Background	n/a
General	NA	Number of years in operation	Section 1. Introduction, 1.1 Background	n/a
General	NA	The reporting period covered in this EP report	Section 1. Introduction, 1.6 Current Environmental Performance Assessment	n/a
General	NA	The reference documents for this EP report (EIS, ERA, Environmental Site Assessment, or other)	Sections 1 to 7	n/a
General	NA	Project boundary preferably with meta data	Section 1. Introduction	Section 1 includes maps with the site boundaries. GIS files with meta data can be provided upon a request.
General	NA	If the operator is not the landowner, provide contact information for the landowner	n/a	The Government of Saskatchewan is the landowner (see Section 1.1 for more details).
General	NA	If partnership arrangements exist, provide contact information for the partners	Section 1. Introduction, 1.1 Background	Orano's contacts are provided. Denison Mines Incorporated contacts can be provided upon a request.
General	NA	If the property is leased, provide information regarding the length of the lease and expiry date along with information related to lease conditions that relate to environmental issues.	Section 1. Introduction, 1.1 Background	n/a
Operational Influences	General	A brief description of each event or occurrence in the reporting period that resulted in or could have resulted in a significant risk to the environment (such as spills or unauthorized discharges), including a discussion on the corrective measures taken or proposed to remedy the observed and/or potential impacts	Section 1. Introduction, 1.3 McClean Lake Operation History; Appendix I.3 Summary of Discharges, Incidents and Exceedances atMcClean Lake Operation – 2022-2024	n/a
Operational Influences	General	A brief description of major operational activities over the reporting period that would impact each area of evaluation	Section 1. Introduction, 1.3 McClean Lake Operation History	n/a

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Operational Influences	General	A brief description of type and quantity of products produced in the reporting period	Section 1. Introduction, 1.3 McClean Lake Operation History	n/a
Operational Influences	General	A description of any significant process changes made during the reporting period as well as a discussion of how these changes impacted the environmental protection components of the operation.	Section 1. Introduction, 1.3 McClean Lake Operation History	Significant changes in process and facility modifications are summarised in Section 1. Their impact on the environment is discussed along with analysis of monitoring results in further sections as applicable.
Operational Influences	Approval / Permit Changes	A brief description of changes to approvals and/or permits issued during the reporting period including new approvals/permits issued, renewals of existing approvals/permits, amendments, and cancelations. Where applicable, information should include dates issued, issuing agency and expiry dates.	Section 1. Introduction, 1.2 Environmental Assessment and Authorized Activities; Appendix I.2-2 CNSC and SMOE Licences, Approvals and Permits in Effect for McClean Lake Operation During 2022-2024	n/a
Operational Influences	Operational Changes	A description of any modifications made to pollution control facilities and their effect on facility emissions.	Section 1. Introduction, 1.3 McClean Lake Operation History	Significant changes in process and facility modifications are summarised in Section 1. Their impact on the environment is discussed along with analysis of monitoring results in further sections as applicable.
Operational Influences	Operational Changes	A brief description of the amount of surface water and groundwater used in the process annually as well as a description of any water minimization/ optimization efforts undertaken during the reporting period	Section 1. Introduction, 1.3 McClean Lake Operation History	n/a
Operational Influences	Operational Changes	A brief description of the amounts and dispositions of any hazardous or industrial wastes annually shipped from the facility during the reporting period	Section 7. Waste and Substance	n/a
Operational Influences	Operational Changes	A brief description of the annual amounts and dispositions of any materials recycled during the reporting period.	Section 7. Waste and Substance	n/a

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Decommissioning and Reclamation	NA	A brief description of any decommissioning and reclamation activities carried out during the reporting period	Section 1. Introduction, 1.3 McClean Lake Operation History	n/a
Decommissioning and Reclamation	NA	A comparison between the total reclamation work carried out and the EIS or equivalent predictions for reclamation and decommissioning for the EP reporting period	Section 5. Terrestrial Environment, 5.2 Wildlife and Wildlife Habitat, 5.2.2 Land Cover Composition and Disturbance	n/a
Decommissioning and Reclamation	NA	If applicable, a comparison between total reclamation work carried out in the reporting period and work presented in the most recent approved Decommissioning and Reclamation Plan	Section 5. Terrestrial Environment, 5.2 Wildlife and Wildlife Habitat, 5.2.2 Land Cover Composition and Disturbance	n/a
Decommissioning and Reclamation	NA	Evaluation of the success of decommissioning and reclamation activities as verified by monitoring programs (for example, demonstration of attenuation of contaminants in a plume)	n/a	Monitoring of Sue C CWRP to assess efficiency of the performed hydroseeding is planned for the next reporting period.
Decommissioning and Reclamation	NA	A comparison of decommissioned and reclaimed plant communities and undisturbed plant communities at the reference location, commenting on species, community structure, plant density and incidents of disease and parasites within the plant community	n/a	n/a
Decommissioning and Reclamation	NA	A brief description of revisions made to the decommissioning plan and financial assurance	Section 1. Introduction, Section 1.3 McClean Lake Operation History	n/a
Decommissioning and Reclamation	NA	An outline of the proposed enhancements and modifications to the reclamation and decommissioning program	n/a	There were no proposals for enhancements and modifications to the reclamation and decommissioning programs applicable to the reporting period.

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Decommissioning and Reclamation	NA	Changes in the amount of land disturbed, specifying any changes to land classification as a result of operational or reclamation activities.	Section 5. Terrestrial Environment, 5.2 Wildlife and Wildlife Habitat, 5.2.2 Land Cover Composition and Disturbance	n/a
Monitoring	NA	An overview of all monitoring programs in place and their results and conclusions, including any harmonized or cooperative monitoring requirements	Sections 2. Physical Environment Section 3. Climate and Air Quality Section 4. Aquatic Environment Section 5. Terrestrial Environment Section 7. Waste and Substance Data Analysis	The 2025 EP TID Vol 1 provides a short overview of the monitoring program as applicable for the reporting period. The EM DD (Orano 2023) provides a more detailed description of the monitoring program.
Monitoring	NA	A site plan showing the location of each monitoring site/station, both current and historic, noting the type of monitoring	Sections 2. Physical EnvironmentSection 3. Climate and Air QualitySection 4. Aquatic EnvironmentSection 5. Terrestrial Environment	n/a
Monitoring	NA	GPS information for current monitoring site/station locations. Meta data and spatial coordinates, including approximate elevation data, is preferred.	Sections 2. Physical Environment Section 3. Climate and Air Quality Section 4. Aquatic Environment Section 5. Terrestrial Environment	Monitoring station coordinates are provided in corresponding report sections. GIS files with meta data can be provided upon a request.
Monitoring	NA	Frequency of monitoring, parameters measured and applicable regulatory criteria; and,	Sections 2. Physical Environment Section 3. Climate and Air Quality Section 4. Aquatic Environment Section 5. Terrestrial Environment	The 2025 EP TID Vol 1 provides a short overview of the monitoring program as applicable for the reporting period. The EM DD (Orano 2023) provides a more detailed description of the monitoring program.
Monitoring	NA	Other monitoring as described in the project's approval/permit.	Sections 2. Physical Environment Section 3. Climate and Air Quality Section 4. Aquatic Environment Section 5. Terrestrial Environment	The 2025 EP TID Vol 1 provides a short overview of the monitoring program as applicable for the reporting period. The EM DD (Orano 2023) provides a more detailed description of the monitoring program.
Air Data Analysis	NA	The most recent EIS or equivalent predictions for air and noise related impacts. More specifically, predictions made with regards to the EP reporting period.	Section 3. Climate and Air Quality, 3.2. Air Quality, 3.2.3. Impact Predictions	n/a

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Air Data Analysis	NA	An analysis of the complete air and noise monitoring data for the reporting period, including the following:	Section 3. Climate and Air Quality, 3.2. Air Quality	n/a
Air Data Analysis	NA	• A review of background levels or conditions that have changed since operation began.	n/a	Orano is not aware about any significant changes in background levels or conditions since the operation began. The operational changes are described in Section 1.
Air Data Analysis	NA	• A comparison between the monitoring data and the EIS or equivalent predictions for the EP reporting period. If applicable, include information from previous EP reports in comparison.	Section 3. Climate and Air Quality, 3.2. Air Quality, 3.2.4. Operational Monitoring	n/a
Air Data Analysis	NA	• Trend analysis of the monitoring data assessing deviations, if any, from the EIS or equivalent project predictions.	Section 3. Climate and Air Quality, 3.2. Air Quality, 3.2.4. Operational Monitoring	n/a
Air Data Analysis	NA	• Suggested reasons for any deviations in the monitoring data from the EIS or equivalent project predictions.	Section 3. Climate and Air Quality, 3.2. Air Quality, 3.2.4. Operational Monitoring	n/a
Air Data Analysis	NA	• Identification of erroneous data and data gaps.	Section 3. Climate and Air Quality, 3.2. Air Quality, 3.2.4. Operational Monitoring	n/a
Air Data Analysis	NA	• Comparison of monitored parameters at impacted stations with monitored parameters at reference stations.	Section 3. Climate and Air Quality, 3.2. Air Quality, 3.2.4. Operational Monitoring	n/a
Air Data Analysis	NA	• Description of the observed range in variation (seasonally and annually) for the monitored parameters at both the reference and impacted monitoring stations.	Section 3. Climate and Air Quality, 3.2. Air Quality, 3.2.4. Operational Monitoring	n/a

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Air Data Analysis	NA	A brief description of the observed site specific weather patterns and climatic data for the reporting period, describing any variance from the historic patterns and trends during the project life and any consequential impacts on monitoring data. This would include wind direction, wind speed, temperature, and precipitation.	Section 3. Climate and Air Quality, 3.1. Climatology and Meteorology	n/a
Air Data Analysis	NA	The intended purpose of each monitoring station – when and why the monitoring station was established, what were the station objectives and how long was monitoring originally proposed?	Section 3. Climate and Air Quality, 3.2. Air Quality	The 2025 EP TID Vol 1 provides a short overview of the monitoring program as applicable for the reporting period. The EM DD (Orano 2023) provides a more detailed description of the monitoring program.
Air Data Analysis	NA	Whether or not the intended purpose of each monitoring station is being met, considering weather data gathered and the quality of data attained.	Section 3 Climate and Air Quality, 3.1 Climatology and Meteorology, 3.1.4 Results Section 3 Climate and Air Quality, 3.2 Air Quality, 3.2.4. Operational Monitoring	n/a
Air Data Analysis	NA	Other impacts that have been identified during the reporting period and discussion of their environmental significance. This may include influences from other projects, jurisdictions or naturally occurring events	n/a	Orano is not aware about any potential impacts on air quality beyond the operational changes described in Section 1.
Air Data Analysis	NA	A description of proposed enhancements and modifications to the air monitoring program.	Section 3. Climate and Air Quality, Section 3.2.5. Monitoring Adjustments and Supplementary Studies Recommendations	n/a
Water Data Analysis	Surface Water	The most recent EIS or equivalent project predictions related to impacts on surface water. More specifically, include predictions made for the EP reporting period.	Section 2.Physical Environment, 2.3. Hydrology, 2.3.2. Impact PredictionsSection 4. Aquatic Environment, 4.3. Surface Water Quality, 4.3.3. Impact Predictions	n/a

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Water Data Analysis	Surface Water	An analysis of the complete surface water monitoring data for the reporting period, including the following:	Section 2. Physical Environment, 2.3. Hydrology Section 4. Aquatic Environment, 4.3. Surface Water Quality	n/a
Water Data Analysis	Surface Water	• A review of background levels or conditions that have changed since operation began.	n/a	Orano is not aware about any significant changes in background levels or conditions since the operation began. The operational changes are described in Section 1.
Water Data Analysis	Surface Water	• A comparison between the monitoring data and the EIS or equivalent project predictions for the EP reporting period. If applicable, include information from previous EP reports in comparison.	Section 2. Physical Environment, 2.3. Hydrology, 2.3.3. Operational Monitoring Section 4. Aquatic Environment, 4.3. Surface Water Quality, 4.3.4. Operational Monitoring	n/a
Water Data Analysis	Surface Water	• Trend analysis of the monitoring data assessing deviations, if any, from the EIS or equivalent project predictions.	Section 2. Physical Environment, 2.3. Hydrology, 2.3.3. Operational Monitoring Section 4. Aquatic Environment, 4.3. Surface Water Quality, 4.3.4. Operational Monitoring	n/a
Water Data Analysis	Surface Water	• Reasons for any deviations in the monitoring data from the EIS or equivalent project predictions.	Section 2. Physical Environment, 2.3. Hydrology, 2.3.3. Operational Monitoring Section 4. Aquatic Environment, 4.3. Surface Water Quality, 4.3.4. Operational Monitoring	n/a

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Water Data Analysis	Surface Water	• Identification of erroneous data and data gaps.	Section 2. Physical Environment, 2.3. Hydrology, 2.3.3. Operational Monitoring Section 4. Aquatic Environment, 4.3. Surface Water Quality, 4.3.4. Operational Monitoring	n/a
Water Data Analysis	Surface Water	• Comparison of monitored parameters at impacted stations with monitored parameters at reference stations.	Section 4. Aquatic Environment, 4.3. Surface Water Quality, 4.3.4. Operational Monitoring	n/a
Water Data Analysis	Surface Water	• Description of the observed range in variation (seasonally and annually) for the monitored parameters at both the reference and impacted monitoring stations.	Section 2. Physical Environment, 2.3. Hydrology, 2.3.3. Operational Monitoring Section 4. Aquatic Environment, 4.3. Surface Water Quality, 4.3.4. Operational Monitoring	n/a
Water Data Analysis	Surface Water	• Loadings of metals and nutrients that have been discharged into the aquatic ecosystems from industrial sources.	Section 7. Waste and Substance Data Analysis, 7.2. Waste Management, 7.2.3. Treated Effluent	n/a
Water Data Analysis	Surface Water	• Analysis of discharged parameters of concern, what portion remains in the dissolved form, what is taken up by sediments and what is taken up by biota.	n/a	This analysis is part of the 2025 ERA update which will be presented in 2025 EP TID Vol 2.
Water Data Analysis	Surface Water	The intended purpose of each of monitoring station – when and why the monitoring station was established, what were the station objectives and how long was monitoring originally proposed?	Section 2. Physical Environment, 2.3. Hydrology Section 4. Aquatic Environment, 4.3. Surface Water Quality	The 2025 EP TID provides a short overview of the monitoring program as applicable for the reporting period. The EM DD (Orano 2023) provides a more detailed description of the monitoring program.

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Water Data Analysis	Surface Water	Whether or not the intended purpose of each monitoring station is being met, considering the quality of data attained.	Section 2. Physical Environment, 2.3. Hydrology, 2.3.3. Operational Monitoring Section 4. Aquatic Environment, 4.3. Surface Water Quality, 4.3.4. Operational Monitoring	n/a
Water Data Analysis	Surface Water	Other impacts that have been identified during the reporting period and discussion of their environmental significance. This may include influences from other projects, jurisdictions or naturally occurring events.	n/a	Orano is not aware about any potential impacts on surwace water quality beyond the operational changes described in Section 1.
Water Data Analysis	Surface Water	A description of proposed enhancements and modifications to the surface water monitoring program.	Section 2. Physical Environment, 2.3. Hydrology, 2.3.4. Monitoring Adjustments and Supplementary Studies Reccomendations Section 4. Aquatic Environment, Section 4.3. Surface Water, Section 4.3.5. Monitoring Adjustments Recommendations	n/a
Water Data Analysis	Groundwater	The most recent EIS or equivalent project predictions related to impacts on groundwater. More specifically, include predictions made for the EP reporting period.	n/a	There is no applicable groundwater quality predictions (see Section 2.2.5.3. for explanations).
Water Data Analysis	Groundwater	An analysis of the complete groundwater monitoring data for the reporting period, including the following:	Section 2. Physical Environment, 2.2. Hydrogeology	n/a
Water Data Analysis	Groundwater	• A review of background levels or conditions that have changed since operation began.	n/a	Orano is not aware about any significant changes in background levels or conditions since the operation began. The operational changes are described in Section 1.

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Water Data Analysis	Groundwater	• A comparison between the monitoring data and the EIS or equivalent project predictions for the EP reporting period, specifying hydrogeological properties of the unit, such as hydraulic conductivity, and if total or dissolved metals are being monitored and why. If applicable, include information from previous EP reports in comparison.	Section 2. Physical Environment, 2.2. Hydrogeology, 2.2.6. Operational Monitoring	n/a
Water Data Analysis	Groundwater	• If applicable, a comparison between proposed dewatering impacts and observed dewatering impacts.	Section 2. Physical Environment, 2.2. Hydrogeology, 2.2.6. Operational Monitoring	n/a
Water Data Analysis	Groundwater	• Trend analysis of the monitoring data assessing deviations, if any, from the EIS or equivalent project predictions.	Section 2. Physical Environment, 2.2. Hydrogeology, 2.2.6. Operational Monitoring	There is no applicable groundwater quality predictions (see Section 2.2.5.3. for explanations).
Water Data Analysis	Groundwater	• Reasons for any deviations in the monitoring data from the EIS or equivalent project predictions.	n/a	There is no applicable groundwater quality predictions (see Section 2.2.5.3 for explanations).
Water Data Analysis	Groundwater	• Identification of erroneous data and data gaps.	Section 2. Physical Environment, 2.2. Hydrogeology, 2.2.6. Operational Monitoring	n/a
Water Data Analysis	Groundwater	• Comparison of monitored parameters at impacted stations with monitored parameters at reference stations.	Section 2. Physical Environment, 2.2. Hydrogeology, 2.2.6. Operational Monitoring	n/a
Water Data Analysis	Groundwater	• Description of the observed range in variation (seasonally and annually) for the monitored parameters at both the reference and impacted monitoring stations.	Section 2. Physical Environment, 2.2. Hydrogeology, 2.2.6. Operational Monitoring	n/a
Water Data Analysis	Groundwater	• Evaluation of the potential for parameters to attenuate concentration along the flow path before reaching receptors.	n/a	Attenuation in contaminant transport is considered in the Waste Rock TID (Orano 2021b) and Tailings TID (Orano 2025c) .

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Water Data Analysis	Groundwater	The intended purpose of each of monitoring station – when and why the monitoring station was established, what were the station objectives and how long was monitoring originally proposed?	Section 2. Physical Environment, Section 2.2. Hydrogeology	The 2025 EP TID Vol 1 provides a short overview of the monitoring program as applicable for the reporting period. The EM DD (Orano 2023) provides a more detailed description of the monitoring program.
Water Data Analysis	Groundwater	Verification that monitoring wells are performing as intended including a comparison between current hydraulic conductivity and hydraulic conductivity at the time of well installation/ development and any other performance verification tests.	n/a	Performance verifications tests are planned for the next reporting period as recommended in Section 2.2.7. Monitoring Adjustments Recommendations
Water Data Analysis	Groundwater	Whether or not the intended purpose of each monitoring station is being met, considering the quality of data attained, well installation details, and well performance.	Section 2. Physical Environment, 2.2. Hydrogeology, 2.2.6. Operational Monitoring	n/a
Water Data Analysis	Groundwater	Other impacts that have been identified during the reporting period and discussion of their environmental significance. This may include influences from other projects, jurisdictions or naturally occurring events.	n/a	Orano is not aware about any potential impacts on groundwater quality beyond the operational changes described in Section 1.
Water Data Analysis	Groundwater	A description of proposed enhancements and modifications to the groundwater monitoring program.	Section 2. Physical Environment, 2.2. Hydrogeology, 2.2.7. Monitoring Adjustments and Supplementary Studies Recommendations	n/a
Soil Data Analysis	NA	The most recent EIS or equivalent project predictions related to impacts on soil. More specifically, include predictions made for the EP reporting period.	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Soil Data Analysis	NA	An analysis of all monitoring data for the reporting period, including the following:	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Soil Data Analysis	NA	• A review of background levels or conditions that have changed since operation began.	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Soil Data Analysis	NA	• A comparison between the monitoring data and the EIS or equivalent predictions for the EP reporting period. If applicable, include information from previous EP reports in comparison.	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Soil Data Analysis	NA	• Trend analysis of the monitoring data assessing deviations, if any, from the EIS or equivalent project predictions.	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Soil Data Analysis	NA	• Suggested reasons for any deviations in the monitoring data from the EIS or equivalent project predictions.	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Soil Data Analysis	NA	• Identification of erroneous data and data gaps.	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Soil Data Analysis	NA	• Comparison of monitored parameters at impacted stations with monitored parameters at reference stations.	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Soil Data Analysis	NA	• Description of the observed range in variation (seasonally and annually) for the monitored parameters at both the reference and impacted monitoring stations.	n/a	The monitoring is done on a six year basis.
Soil Data Analysis	NA	The intended purpose of each of monitoring station – when and why the monitoring station was established, what were the station objectives and how long was monitoring originally proposed?	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Soil Data Analysis	NA	Whether or not the intended purpose of each monitoring station is being met, considering the quality of data attained.	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Soil Data Analysis	NA	Other impacts that have been identified during the reporting period and discussion of their environmental significance. This may include influences from other projects, jurisdictions or naturally occurring events.	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Soil Data Analysis	NA	A description of proposed enhancements and modifications to the soil monitoring program.	n/a	n/a
Sediment Data Analysis	NA	The most recent EIS or equivalent project predictions related to impacts on sediment. More specifically, include predictions made for the EP reporting period.	Section 4. Aquatic Envionment, 4.4. Sediment Quality, 4.4.3. Impact Predictions	n/a
Sediment Data Analysis	NA	An analysis of all monitoring data for the reporting period, including the following:	Section 4. Aquatic Envionment, 4.4. Sediment Quality	n/a
Sediment Data Analysis	NA	• A review of background levels or conditions that have changed since operation began.	n/a	Orano is not aware about any significant changes in background levels or conditions since the operation began. The operational changes are described in Section 1.

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Sediment Data Analysis	NA	• A comparison between the monitoring data and the EIS or equivalent predictions for the EP reporting period. If applicable, include information from previous EP reports in comparison. Information provided should include the following:	Section 4. Aquatic Envionment, 4.4. Sediment Quality, 4.4.4. Operational Monitoring	n/a
Sediment Data Analysis	NA	o Concentrations of parameters of concern;	Section 4. Aquatic Envionment, 4.4. Sediment Quality, 4.4.4. Operational Monitoring	n/a
Sediment Data Analysis	NA	o Uptake of parameters of concern downstream of discharges, commenting on the extent of downstream loading;	Section 4. Aquatic Envionment, 4.4. Sediment Quality, 4.4.4. Operational Monitoring	n/a
Sediment Data Analysis	NA	o Estimation of deposition rates; and	n/a	The sediment deposition rates are presented in the 2025 EP TID Vol 2.
Sediment Data Analysis	NA	o Particle size analysis.	Section 4. Aquatic Envionment, 4.4. Sediment Quality, 4.4.4. Operational Monitoring	n/a
Sediment Data Analysis	NA	• Trend analysis of the monitoring data assessing deviations, if any, from the EIS or equivalent project predictions.	Section 4. Aquatic Envionment, 4.4. Sediment Quality, 4.4.4. Operational Monitoring	n/a
Sediment Data Analysis	NA	• Reasons for any deviations in the monitoring data from the EIS or equivalent project predictions.	Section 4. Aquatic Envionment, 4.4. Sediment Quality, 4.4.4. Operational Monitoring	n/a
Sediment Data Analysis	NA	• Identification of erroneous data and data gaps.	Section 4. Aquatic Envionment, 4.4. Sediment Quality, 4.4.4. Operational Monitoring	n/a
Sediment Data Analysis	NA	• Comparison of monitored parameters at impacted stations with monitored parameters at reference stations.	Section 4. Aquatic Envionment, 4.4. Sediment Quality, 4.4.4. Operational Monitoring	n/a
Sediment Data Analysis	NA	• Description of the observed range in variation (seasonally and annually) for the monitored parameters at both the reference and impacted monitoring stations.	n/a	The monitoring is done on a three year basis.

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Sediment Data Analysis	NA	The intended purpose of each of monitoring station – when and why the monitoring station was established, what were the station objectives and how long was monitoring originally proposed?	Section 4. Aquatic Envionment, 4.4. Sediment Quality, 4.4.4. Operational Monitoring	The 2025 EP TID Vol 1 provides a short overview of the monitoring program as applicable for the reporting period. The EM DD (Orano 2023) provides a more detailed description of the monitoring program.
Sediment Data Analysis	NA	Whether or not the intended purpose of each monitoring station is being met, considering the quality of data attained.	Section 4. Aquatic Envionment, 4.4. Sediment Quality, 4.4.4. Operational Monitoring	n/a
Sediment Data Analysis	NA	Other impacts that have been identified during the reporting period and discussion of their environmental significance. This may include influences from other projects, jurisdictions or naturally occurring events.	n/a	Orano is not aware about any potential impacts on sediment quality beyond the operational changes described in Section 1.
Sediment Data Analysis	NA	A description of proposed enhancements and modifications to the sediment monitoring program.	Section 4. Aquatic Envionment, 4.4. Sediment Quality, Section 4.4.5. Monitoring Adjustments and Supplementary Studies Recommendations	n/a
Waste and Substance Data Analysis	NA	A brief description of the project's waste and substance management system including the amount and type of materials deposited or disposed in the approved waste management facilities.	Section 7. Waste and Substance Data, 7.2. Waste Management	n/a
Waste and Substance Data Analysis	NA	If waste is segregated, a brief description of the waste segregation program and its performance. Examples would include any segregation of waste such as materials for recycling or low level radioactive waste.	Section 7. Waste and Substance Data, 7.2. Waste Management	n/a
Waste and Substance Data Analysis	NA	The most recent EIS or equivalent project predictions for volumes and types of waste and substances generated. More specifically, include predictions made for the EP reporting period.	Section 7. Waste and Substance Data, 7.2. Waste Management	The comparison is done for tailings and effluent. No waste rock was generated in 2022-2024. No predictions for other waste are available.

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Waste and Substance Data Analysis	NA	If effluent is produced, compare effluent quality and quantity for the reporting period to predicted effluent quality and quantity.	Section 7. Waste and Substance Data, 7.2. Waste Management, 7.2.3. Treated Effluent	n/a
Waste and Substance Data Analysis	NA	If there is a tailings management facility, an analysis of tailings characterization data for the reporting period, including the following:	n/a	This information is provided in the Tailings Management TID (Orano 2025c).
Waste and Substance Data Analysis	NA	• The current tailings management plan.	n/a	This information is provided in the Tailings Management TID (Orano 2025c).
Waste and Substance Data Analysis	NA	• A comparison between the monitoring data and the EIS or equivalent project predictions for the EP reporting period for the following tailings performance aspects:	n/a	This information is provided in the Tailings Management TID (Orano 2025c).
Waste and Substance Data Analysis	NA	1. Geochemistry: overall geochemical performance for pond water and insitu tailings, including both pore water and tailings solids.	n/a	This information is provided in the Tailings Management TID (Orano 2025c).
Waste and Substance Data Analysis	NA	2. Geotechnical: geotechnical performance as compared to original predictions, including hydraulic conductivity, density, void ratio, percentsolids and segregation.	n/a	This information is provided in the Tailings Management TID (Orano 2025c).
Waste and Substance Data Analysis	NA	3. Hydrogeology: including identification of solute transport pathways, including pathways caused by piping, tailings segregation and sand sloughing.	n/a	This information is provided in the Tailings Management TID (Orano 2025c).

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Waste and Substance Data Analysis	NA	4. Capacity: including generated volumes for each type of waste during the EP reporting period, total cumulative volumes generated for each type of waste, storage capacity, consolidation rates, ice lens management, pore pressure dissipation and settlement.	n/a	This information is provided in the Tailings Management TID (Orano 2025c).
Waste and Substance Data Analysis	NA	• A comparison of the monitoring data outlined above for the current EP reporting period to the previous EP reporting period.	n/a	This information is provided in the Tailings Management TID (Orano 2025c).
Waste and Substance Data Analysis	NA	• Trend analysis of the monitoring data assessing deviations, if any, from the EIS or equivalent project predictions.	n/a	This information is provided in the Tailings Management TID (Orano 2025c).
Waste and Substance Data Analysis	NA	• Reasons for any deviations in the monitoring data from the EIS or equivalent project predictions.	n/a	This information is provided in the Tailings Management TID (Orano 2025c).
Waste and Substance Data Analysis	NA	• Identification of erroneous data and data gaps.	n/a	This information is provided in the Tailings Management TID (Orano 2025c).
Waste and Substance Data Analysis	NA	• Description of the range in variation (seasonally and annually) for the monitored parameters.	n/a	This information is provided in the Tailings Management TID (Orano 2025c).
Waste and Substance Data Analysis	NA	A description of any waste related monitoring or analysis not included in other areas of evaluation. This may include vibrating wire piezometers, acid base accounting or tailings analysis for geochemical or physical properties. The description should confirm if the intended purpose of each monitoring station is being met.	n/a	Waste related monitoring is described in Facility Description Manual (Orano 2022c), Tailings TID (Orano 2025c), and Waste Rock TID (Orano 2021b).

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Waste and Substance Data Analysis	NA	A description of proposed enhancements and modifications to the waste management program.	n/a	Nothing identified at the moment. Orano continues regular reviews of waste management practices at the McClean Lake Operation to identify opportunities for improving the waste management program.
Ecological Data Analysis	Aquatic Biota / Ecosystems	The most recent EIS or equivalent project predictions related to impacts on aquatic biota and resources. More specifically, include predictions made for the EP reporting period.	Section 4. Aquatic Environment, 4.5. Benthic Inverterbrates, & 4.6. Fish	n/a
Ecological Data Analysis	Aquatic Biota / Ecosystems	An analysis of all monitoring data for the reporting period, including the following:	Section 4. Aquatic Environment, 4.5. Benthic Inverterbrates, & 4.6. Fish	n/a
Ecological Data Analysis	Aquatic Biota / Ecosystems	• A description of each monitoring location.	Section 4. Aquatic Environment, 4.5. Benthic Inverterbrates, & 4.6. Fish	n/a
Ecological Data Analysis	Aquatic Biota / Ecosystems	• Type and number of organisms collected at each monitoring location. For fish, species level identification is expected. Identification of other biota (such as plants or invertebrates) to at least the family level is expected with identification to the species level where practical.	Section 4. Aquatic Environment, 4.5. Benthic Inverterbrates, & 4.6. Fish	n/a
Ecological Data Analysis	Aquatic Biota / Ecosystems	• Comparison of community metrics at each monitoring station, including total abundance, taxa present and taxa absent that had previously been observed.	Section 4. Aquatic Environment, 4.5. Benthic Inverterbrates, & 4.6. Fish	n/a
Ecological Data Analysis	Aquatic Biota / Ecosystems	• A review of background levels or conditions that have changed since operation began.	n/a	Orano is not aware about any significant changes in background levels or conditions since the operation began. The operational changes are described in Section 1.

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Ecological Data Analysis	Aquatic Biota / Ecosystems	• A comparison between the monitoring data and the EIS or equivalent project predictions, or previous EP reports if applicable, for the EP reporting period, including the following:	Section 4. Aquatic Environment, 4.5. Benthic Inverterbrates, & 4.6. Fish	n/a
Ecological Data Analysis	Aquatic Biota / Ecosystems	o Concentrations of parameters of concern;	Section 4. Aquatic Environment, 4.5. Benthic Inverterbrates, & 4.6. Fish	n/a
Ecological Data Analysis	Aquatic Biota / Ecosystems	o Uptake of parameters of concern by biota, commenting on the extent of downstream loading;	n/a	This analysis is part of the 2025 ERA update which is presented in 2025 EP TID Vol 2.
Ecological Data Analysis	Aquatic Biota / Ecosystems	o Where applicable, an analysis of present and historic benthic communities; and,	Section 4. Aquatic Environment, 4.5. Benthic Inverterbrates, & 4.6. Fish	n/a
Ecological Data Analysis	Aquatic Biota / Ecosystems	o Incidents of disease, parasites, and deformities within the aquatic ecosystem where identified.	n/a	There are no relevant predictions.
Ecological Data Analysis	Aquatic Biota / Ecosystems	• Trend analysis of the monitoring data assessing deviations, if any, from the EIS or equivalent project predictions.	Section 4. Aquatic Environment, 4.5. Benthic Inverterbrates, & 4.6. Fish	n/a
Ecological Data Analysis	Aquatic Biota / Ecosystems	• Reasons for any deviations in the monitoring data from the EIS or equivalent project predictions.	Section 4. Aquatic Environment, 4.5. Benthic Inverterbrates, & 4.6. Fish	n/a
Ecological Data Analysis	Aquatic Biota / Ecosystems	• Identification of erroneous data and data gaps.	Section 4. Aquatic Environment, 4.5. Benthic Inverterbrates, & 4.6. Fish	n/a
Ecological Data Analysis	Aquatic Biota / Ecosystems	• Comparison of monitored parameters in biota at impacted stations with monitored parameters in biota at reference stations.	Section 4. Aquatic Environment, 4.5. Benthic Inverterbrates, & 4.6. Fish	n/a
Ecological Data Analysis	Aquatic Biota / Ecosystems	• Description of the observed range in variation (seasonally and annually) for the monitored parameters in biota at both the reference and impacted monitoring stations.	n/a	The monitoring is done on a three year basis.

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Ecological Data Analysis	Aquatic Biota / Ecosystems	The intended purpose of each of monitoring station – when and why the monitoring station was established, what were the station objectives and how long was monitoring originally proposed?	Section 4. Aquatic Environment, 4.5. Benthic Inverterbrates, & 4.6. Fish	The 2025 EP TID Vol 1 provides a short overview of the monitoring program as applicable for the reporting period. The EM DD (Orano 2023) provides a more detailed description of the monitoring program.
Ecological Data Analysis	Aquatic Biota / Ecosystems	Whether or not the intended purpose of each monitoring station is being met, considering the quality of data attained.	Section 4. Aquatic Environment, 4.5. Benthic Inverterbrates, & 4.6. Fish	n/a
Ecological Data Analysis	Aquatic Biota / Ecosystems	Other impacts that have been identified during the reporting period and discussion of their environmental significance. This may include influences from other projects, jurisdictions or naturally occurring events.	n/a	Orano is not aware about any potential impacts on aquatic biota quality beyond the operational changes described in Section 1.
Ecological Data Analysis	Aquatic Biota / Ecosystems	A description of proposed enhancements and modifications to the program.	Section 4. Aquatic Environment, 4.5. Benthic Inverterbrates, & 4.6. Fish	
Ecological Data Analysis	Terrestrial Biota / Ecosystems	The most recent EIS or equivalent project predictions related to impacts on terrestrial habitat. More specifically, include predictions made for the EP reporting period.	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Ecological Data Analysis	Terrestrial Biota / Ecosystems	An analysis of all monitoring data for the reporting period, including the following:	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Ecological Data Analysis	Terrestrial Biota / Ecosystems	• A description of each monitoring location.	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Ecological Data Analysis	Terrestrial Biota / Ecosystems	• Type and number of organisms collected at each monitoring location. For animals, species level identification is expected. Identification of other biota (such as plants or invertebrates) to at least the family level is expected with identification to the species level where practical.	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Ecological Data Analysis	Terrestrial Biota / Ecosystems	• A review of background levels or conditions that have changed since operation began.	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Ecological Data Analysis	Terrestrial Biota / Ecosystems	• A comparison between the monitoring data and the EIS or equivalent project predictions, or previous EP Report if applicable, for the EP reporting period including the following:	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Ecological Data Analysis	Terrestrial Biota / Ecosystems	o Changes in plant community structure and density and the growth ofindicator species;	n/a	The EMP doesn't include monitoring of plant communities.
Ecological Data Analysis	Terrestrial Biota / Ecosystems	o Discuss air emission loading on components of terrestrial ecosystems;	n/a	This analysis is part of the 2025 ERA update which will be presented in 2025 EP TID Vol 2.
Ecological Data Analysis	Terrestrial Biota / Ecosystems	o Uptake of parameters of concern by biota commenting on aerial extent;	n/a	This analysis is part of the 2025 ERA update which will be presented in 2025 EP TID Vol 2.
Ecological Data Analysis	Terrestrial Biota / Ecosystems	o Incidents of disease and parasites within the terrestrial ecosystem if identified; and,	n/a	The EMP doesn't include monitoring of these environmental aspects.

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Ecological Data Analysis	Terrestrial Biota / Ecosystems	o Indirect impacts on the movement and behaviour of wildlife species.	n/a	The EMP doesn't include monitoring of wildlife species.
Ecological Data Analysis	Terrestrial Biota / Ecosystems	• Trend analysis of the monitoring data assessing deviations, if any, from the EIS or equivalent project predictions.	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Ecological Data Analysis	Terrestrial Biota / Ecosystems	• Reasons for any deviations in the monitoring data from the EIS or equivalent project predictions.	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Ecological Data Analysis	Terrestrial Biota / Ecosystems	• Identification of erroneous data and data gaps.	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Ecological Data Analysis	Terrestrial Biota / Ecosystems	• Comparison of monitored parameters in biota at impacted stations with monitored parameters in biota at reference stations.	n/a	No data collected during the reporting period, 2022-2024. This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Ecological Data Analysis	Terrestrial Biota / Ecosystems	• Description of the observed range in variation (seasonally and annually) for the monitored parameters in biota at both the reference and impacted monitoring stations.	n/a	The monitoring is done on a six year basis.
Ecological Data Analysis	Terrestrial Biota / Ecosystems	The intended purpose of each of monitoring station – when and why the monitoring station was established, what were the station objectives and how long was monitoring originally proposed?	n/a	No data collected during the reporting period, 2022-2024. This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Ecological Data Analysis	Terrestrial Biota / Ecosystems	Whether or not the intended purpose of each monitoring station is being met, considering the quality of data attained.	n/a	No data collected during the reporting period, 2022-2024. This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Ecological Data Analysis	Terrestrial Biota / Ecosystems	Other impacts that have been identified during the reporting period and discussion of their environmental significance. This may include influences from other projects, jurisdictions or naturally occurring events.	n/a	Orano is not aware about any potential impacts on terrestrial ecosystems beyond the operational changes described in Section 1.
Ecological Data Analysis	Terrestrial Biota / Ecosystems	A description of proposed enhancements and modifications to the program.	n/a	No data obtained during the reporting period, 2022-2024: This monitoring is done on a 6-year cycle. The last sampling campaign was performed in 2021 and reported in the 2022 EP TID Vol 1. Next sampling will be in 2027
Verification of Modelling	NA	A discussion regarding the original modelling that was conducted for the EIS or equivalent including:	n/a	This analysis is part of the 2025 ERA update which is presented in 2025 EP TID Vol 2.
Verification of Modelling	NA	• Validity of assumptions made;	n/a	This analysis is part of the 2025 ERA update which is presented in 2025 EP TID Vol 2.
Verification of Modelling	NA	• Project changes approved during the EP period that may change the validity of the original model assumptions;	n/a	This analysis is part of the 2025 ERA update which is presented in 2025 EP TID Vol 2.
Verification of Modelling	NA	• Timeframe modelled;	n/a	This analysis is part of the 2025 ERA update which is presented in 2025 EP TID Vol 2.
Verification of Modelling	NA	• A brief description of long term trends and deviations compared to the original modelling;	n/a	This analysis is part of the 2025 ERA update which is presented in 2025 EP TID Vol 2.
Verification of Modelling	NA	• Reasons for deviations; and	n/a	This analysis is part of the 2025 ERA update which is presented in 2025 EP TID Vol 2.
Verification of Modelling	NA	• Information regarding the accuracy/applicability of the model used.	n/a	This analysis is part of the 2025 ERA update which is presented in 2025 EP TID Vol 2.

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Verification of Modelling	NA	Information on updates/reruns of models including a discussion on the use of monitoring information for recalibration where applicable.	n/a	This analysis is part of the 2025 ERA update which is presented in 2025 EP TID Vol 2.
Verification of Modelling	NA	Information on the current relevancy of software used for modelling and any updates that may improve results. Where modelling has been updated, justification for software selection.	n/a	This analysis is part of the 2025 ERA update which is presented in 2025 EP TID Vol 2.
Verification of Modelling	NA	Where applicable, a discussion on conclusions from the previous EP reports and identification of new trends or observations.	n/a	This analysis is part of the 2025 ERA update which is presented in 2025 EP TID Vol 2.
Implication of Deviations	NA	The current state of the environment should be evaluated to determine if the impacts presented remain within the scope of those described in the original EIS or equivalent project predictions. Deviations outside the scope of the EIS or equivalent project predictions must be addressed. If significant deviations occur, regulatory action may be required and could include reassessment as per The Environmental Assessment Act.	Sections 2 to 8	n/a
Action Plan	NA	Identification of data gaps and a description of the work that will be initiated to close the gaps, including a schedule for completion of the work.	Sections 2. Physical Environment Section 3. Climate and Air Quality Section 4. Aquatic Environment Section 8. Conclusions	Additional discussion was also derived from the 2025 ERA update as presented in 2025 EP TID Vol 2
Action Plan	NA	Identification of additional monitoring that may be required including a schedule for the establishment of new monitoring sites/stations where needed.	Sections 2. Physical Environment Section 8. Conclusions	Additional recommendations was also derived from the 2025 ERA update as presented in 2025 EP TID Vol 2

Table 1.6-1 Concordance of 2025 Environmental Performance Technical Information Document to SMOE Environmental Performance Report Guideline (EPB 453, 2013)

Environmental Performance Report Guideline			2025 EP TID	
Section	**Subsection**	**Requirement**	**Volume 1 Section**	**notes**
Action Plan	NA	Identification of monitoring sites/stations that no longer provide useful information suggested for deletion from the monitoring program.	Section 4. Aquatic EnvironmentSection 8. Conclusions	Additional recommendations was also derived from the 2025 ERA update as presented in 2025 EP TID Vol 2
Action Plan	NA	Identification of monitoring sites/stations if the information gathered during the reporting period suggests that monitoring frequency should be modified, including a schedule for implementation.	Section 4. Aquatic Environment Section 8. Conclusions	Additional recommendations was also derived from the 2025 ERA update as presented in 2025 EP TID Vol 2
Action Plan	NA	A description of and schedule for any additional work that may need to be conducted as a result of identification of issues noted in the monitoring data. This would include follow up work to provide additional detail on any identified deviations beyond the scope of previous assessments and updates of models where needed.	Sections 2. Physical Environment Section 4. Aquatic Environment Section 8. Conclusions	Additional recommendations was also derived from the 2025 ERA update as presented in 2025 EP TID Vol 2

TABLE 2.2-1

Hydrostratigraphic Units

Time		Group	Formation	Member	Description	Regional Hydrostratigraphic Unit	Hydraulic Conductivity (m/s)
Quaternary	Pleistocene				Till	Aquitard/Aquifer	10^{-8} to 10^{-4}
Precambrian	Helkan	Athabasca Group	Manitou Falls Formation	MFc	Upper Sandstone	Aquifer	10^{-9} to 10^{-6}
				MFb	Lower Sandstone	Aquifer	10^{-7} to 10^{-6}
				MFa		Aquifer	
						Aquifer	
						Aquifer	
	Aphebian				Bedrock	Aquitard	10^{-10} to 10^{-5}
	Archean					Aquitard	

Note: Modified from Raemakers 2001, Sibald 1983.

TABLE 2.2-2

Summary of Hydraulic Conductivity Testing for the Local Assessment Boundary

JEB Area					
Test Type	**Hydrostratigraphic Unit**	**Overburden**	**Upper Sandstone**	**Lower Sandstone**	**Basement Rock**
Laboratory Testing	Geometric Mean (m/s)	-	$k_H = 5.4x10^{-10}$; $k_V = 5.9x10^{-10}$		-
	Number of Observations	2	14		-
	Minimum (m/s)	$1.0x10^{-6}$	$5.0x10^{-11}$		-
	Maximum (m/s)	$5.0x10^{-6}$	$1.0x10^{-7}$		-
Packer Tests	Geometric Mean (m/s)	$3.9x10^{-6}$	$3.7 x10^{-7}$	$1.5 x10^{-6}$	$1.9 x10^{-7}$
	Number of Observations	9	39	62	23
	Minimum (m/s)	$2.0 x10^{-7}$	$3.5 x10^{-8}$	$6.6 x10^{-9}$	$6.9 x10^{-9}$
	Maximum (m/s)	$5.8 x10^{-5}$	$9.7 x10^{-6}$	$3.0 x10^{-5}$	$6.4 x10^{-6}$
Monitoring Well Slug Tests	Geometric Mean (m/s)	$1.2 x10^{-6}$	$2.9 x10^{-7}$	$1.4 x10^{-6}$	$7.3 x10^{-8}$
	Number of Observations	17	10	21	5
	Minimum (m/s)	$1.2 x10^{-7}$	$3.7 x10^{-8}$	$3.7 x10^{-8}$	$2.1 x10^{-9}$
	Maximum (m/s)	$4.9 x10^{-6}$	$1.6 x10^{-6}$	$6.2 x10^{-5}$	$8.4 x10^{-7}$
Dewatering Well Slug Tests	Geometric Mean (m/s)	-	$6.8 x10^{-6}$		-
	Number of Observations	-	27		-
	Minimum (m/s)	-	$3.2 x10^{-7}$		-
	Maximum (m/s)	-	$3.9 x10^{-5}$		-
Pumping Test	Geometric Mean (m/s)	$1.0 x10^{-7}$	$1.0 x10^{-5}$		-
	Number of Observations	1	48		-
	Minimum (m/s) (m/s)	$1.0 x10^{-7}$	$4.2 x10^{-6}$		-
	Maximum	$1.0 x10^{-7}$	$3.2 x10^{-5}$		-
Pit Dewatering Response	Geometric Mean (m/s)	-	$9.3 x10^{-6}$		-
	Number of Observations	-	26		-
	Minimum (m/s)	-	$1.0 x10^{-6}$		-
	Maximum (m/s)	-	$4.3 x10^{-5}$		-
Sue Area					
Test Type	**Hydrostratigraphic Unit**	**Overburden**	**Upper Sandstone**	**Lower Sandstone**	**Basement Rock**
Packer Tests	Geometric Mean (m/s)	-	$2.5 x10^{-6}$	$2.1 x10^{-6}$	$8.8 x10^{-8}$
	Number of Observations	-	56	66	61
	Minimum (m/s)	-	$9.1 x10^{-8}$	$4.9 x10^{-9}$	$1.1 x10^{-9}$
	Maximum (m/s)	-	$3.3 x10^{-5}$	$2.1 x10^{-5}$	$1.8 x10^{-5}$
Monitoring Well Slug Tests	Geometric Mean (m/s)	$2.2 x10^{-6}$	$2.1 x10^{-5}$	$1.0 x10^{-6}$	$6.4 x10^{-8}$
	Number of Observations	9	5	50	10
	Minimum (m/s)	$5.3 x10^{-8}$	$5.7 x10^{-6}$	$6.7 x10^{-9}$	$3.7 x10^{-9}$
	Maximum (m/s)	$1.0 x10^{-4}$	$2.5 x10^{-4}$	$2.9 x10^{-4}$	$1.1 x10^{-6}$
Pumping Test	Geometric Mean (m/s)	-	$4.5 x10^{-6}$		-
	Number of Observations	-	26		-
	Minimum (m/s)	-	$6.5 x10^{-7}$		-
	Maximum (m/s)	-	$3.2 x10^{-5}$		-
Sue F (Former Caribou) Area					
Test Type	**Hydrostratigraphic Unit**	**Overburden**	**Upper Sandstone**	**Lower Sandstone**	**Basement Rock**
Packer Tests	Geometric Mean (m/s)	$1.2 x10^{-4}$	$4.7 x10^{-7}$	$1.7 x10^{-8}$	$2.5 x10^{-8}$
	Number of Observations	1	16	53	1
	Minimum (m/s)	$1.2 x10^{-4}$	$1.5 x10^{-8}$	$9.7 x10^{-10}$	$2.5 x10^{-8}$
	Maximum (m/s)	$1.2 x10^{-4}$	$6.2 x10^{-5}$	$1.2 x10^{-5}$	$2.5 x10^{-8}$
Monitoring Well Slug Tests	Geometric Mean (m/s)	$6.0 x10^{-6}$	-	$7.0 x10^{-7}$	-
	Number of Observations	6	-	17	-
	Minimum (m/s)	$8.4 x10^{-7}$	-	$2.6 x10^{-8}$	-
	Maximum (m/s)	$3.8 x10^{-5}$	-	$6.5 x10^{-6}$	-
Pumping Test	Geometric Mean (m/s)	-	$8.6 x10^{-7}$		-
	Number of Observations	-	10		-
	Minimum (m/s)	-	$1.8 x10^{-7}$		-
	Maximum (m/s)	-	$1.6 x10^{-6}$		-
McClean Mining (Former McClean Underground Mine) Area					
Test Type	**Hydrostratigraphic Unit**	**Overburden**	**Upper Sandstone**	**Lower Sandstone**	**Basement Rock**
Packer Tests	Geometric Mean (m/s)	-	$2.9 x10^{-6}$	$1.1 x10^{-6}$	$1.4 x10^{-7}$
	Number of Observations	-	118	345	51
	Minimum (m/s)	-	$1.0 x10^{-9}$	$7.2 x10^{-10}$	$2.5 x10^{-10}$
	Maximum (m/s)	-	$7.0 x10^{-5}$	$5.4 x10^{-5}$	$1.1 x10^{-5}$
Pumping Test	Geometric Mean (m/s)	-	$3.7 x10^{-6}$		-
	Number of Observations	-	34		-
	Minimum (m/s)	-	$5.7 x10^{-7}$		-
	Maximum (m/s)	-	$1.3 x10^{-5}$		-
Midwest Area					
Test Type	**Hydrostratigraphic Unit**	**Overburden**	**Upper Sandstone**	**Lower Sandstone**	**Basement Rock**
Packer Tests	Geometric Mean (m/s)	-	$7.3 x10^{-7}$	$1.4 x10^{-6}$	$6.2 x10^{-8}$
	Number of Observations	-	248	186	13
	Minimum (m/s)	-	$1.0 x10^{-9}$	$4.0 x10^{-9}$	$2.1 x10^{-9}$
	Maximum (m/s)	-	$4.0 x10^{-5}$	$2.0 x10^{-5}$	$2.0 x10^{-6}$

- = data not available.

K_H = horizontal hydraulic conductivity.

K_V = vertical hydraulic conductivity.

m/s = metres per second.

Source: AREVA 2011a

Table 2.2-3

Groundwater Monitoring Locations at the JEB Site

JEB

Well Information				Monitoring					
				Parameters		Water levels		Water quality	
Location		Completion	Number	2019 EM DD	2023 EM DD	2019 EM DD	2023 EM DD	2019 EM DD	2023 EM DD
TMF	Containment Indicator Wells	Lower Sandstone	TW08	Class B	Class B1	Continuous	N/A	Quarterly	
			95-01B						
			95-02B*						
			95-03B[1]						
			95-04B						
			95-05B[1]						
	Nearfield	Overburden	18-01D	Class B	Class B1	Bimonthly	Quarterly	Semi-Annual	
			95-02D[1]						
			95-03C						
			95-04D[1]						
			95-05D						
		Upper Sandstone	95-01C[1]	Class B	Class B1			Annual	
			95-02C*						
			95-04C						
			95-05C[1S]						
		Basement	95-01A						
			95-02A*						
			95-03A						
			95-04A						
			95-05A[1S]						
	Midfield	Overburden	96-01C[1]	Class B	Class B3	Bimonthly	Annual	Semi- Annual	Annual
			96-02C						
			96-02D						
			96-03C						
			MW20[1]	none	Class B3			None	
		Sandstone Upper	96-01B	Class B	Class B3	Bimonthly	Annual	Annual	
			96-02B						
			96-03B						
			96-09B						
		Sandstone Lower	96-01A						
			96-02A						
			96-03A	Well is Artesian and Will Be Removed					
			96-04	Class B	Class B3	Bimonthly	Annual	Annual	
			96-09A						
	Farfield	Overburden	MW18[1S]	None	Class B3	Bimonthly	Annual	None	Biennial
		Sandstone Upper	96-05B	None	Class B3	Bimonthly	Annual	None	Biennial
			96-06B[S]						
			96-07B	Well is Blocked and Will Be Removed					
		Sandstone Lower	95-06*	Class B	Class B3	Bimonthly	Annual	Annual	Biennial
			95-07					Annual	
			95-08[1S]*					Annual	Biennial
			95-09[S]*						
			96-07A[S]	None	Class B3	Bimonthly	Annual	None	Biennial
Mill Terrace		Overburden Shop Area	95-12	Class B/ Hydrocarbons	Class B4	Bimonthly	Quarterly	Semi- Annual	Semi- Annual
		CX/ Acid Plant	01-06[2]	Class B	Class B1				
		Sludge Ponds	01-07						
		SX Circuit	05-07						
		Slurry Receiving	14-03						
		SX Circuit	14-04						
		CX/ Acid Plant	14-05						
		Fuel Area	16-03[1]	Class B/ Hydrocarbons	Class B4				
		Sludge Ponds	16-07	Class B	Class B1				
		CX	16-08						
		Precipitation Circuit	19-01	None	Class B1	None	Semi- Annual	None	Semi-Annual
		Ammonia and kerosene storage	21-01		Class B4				
		Water Treatment	21-02		Class B1				
		CX & Acid Plant	21-05						
Ore Pad		Overburden	95-10	Class B	Class B1	Bimonthly	Quarterly	Semi-Annual	Semi-Annual
			14-01						
			16-01[1]						
			16-02						
			MW07A						
			21-04	None		None	Semi- Annual	None	
Clean Waste Rock Pile		Unconsolidated Waste Rock	07-08	Class B	Class B1	Semi-Annual	Biennial	Biennial	Biennial
			07-09						
			07-10						
Waste rock area		Overburden	MW11	Class B	Class B1	Bimonthly	Biennial	Semi-Annual	Biennial
			MW12						
		Lower Sandstone	96-08	Class B	Class B1	Bimonthly	Biennial	Annual	Biennial
Industrial Landfill		Overburden	95-15	Well destroyed, replaced by MW16					
			MW16	N/A	Class B1	N/A	Annual	N/A	Annual

Poor Performing Wells - Neither Groundwater Samples or Groundwater Levels were able to be taken.

Poor Performing Wells - Groundwater Level data collected, but no Groundwater Samples.

Poor Performing Wells - Reduced Groundwater Samples/Water Levels collected, below planned frequency.

1 - Some erroneous Groundwater Level data were identified and removed from the completeness dataset.

2 - 01-06 was missed in 2023 EM DD (V4) and not sampled or had water levels taken, will be addressed in future sampling. Not indicated as a problematic well.

L - Indicates Groundwater Levels were sufficient for 2022-2024

S - Indicates Groundwater Samples were sufficient for 2022-2024

*Well is used for baseline measurements

Table 2.2-4

Groundwater Monitoring Locations at the Sue Site

Sue

Well Information				Monitoring					
				Parameters		Water Levels		Water Quality	
Location		Completion	Number	2019 EM DD	2023 EM DD	2019 EM DD	2023 EM DD	2019 EM DD	2023 EM DD
Sue C/A and Sue B	Nearfield	Overburden	14-06	Well Dry and Will be Removed					
			97-01C[1]	Class B	Class B1	Bimonthly	Quarterly	Semi-Annual	Semi-Annual
			97-05C						
		Overburden/ Upper Sandstone	97-12[1]						
		Sandstone Lower	97-01B[S]	Class B	Class B1	Bimonthly	Quarterly	Semi- Annual	Semi- Annual
			97-02B						
			97-03B*						
			97-05B						
			97-6B						
			97-07B						
		Basement	97-01A						
			97-02A[1]						
			97-03A*						
			97-05A						
			97-07A						
Sue B and ore transfer pad	Nearfield	Overburden/ Upper Sandstone	97-18[S]	Class B	Class B1	Bimonthly	Quarterly	Semi-Annual	Semi-Annual
Sue E	Nearfield	Overburden	05-05B[1]	Class B	Class B1	Bimonthly	Quarterly	Semi-Annual	Semi-Annual
		Lower Sandstone	05-03	Class B	Class B1	Bimonthly	Quarterly	Annual	Annual
			05-04						
			05-05A						
Sue Pits / Waste Rock Piles	Farfield	Lower Sandstone	97-09*	Class B	Class B2	Bimonthly	Biennial	Annual	Biennial
			97-10*						
			97-11*						
Clean Waste Rock Pile	Sue C	Unconsolidated Waste Rock	07-11	Class B	Class B1	Semi-Annual	Biennial	Biennial	Biennial
			07-12						
			07-13						
	Sue E	Unconsolidated Waste Rock	07-14	Class B	Class B1	Bimonthly	Biennial	Annual	Annual
			07-15						
Sue Waste Rock Area	Sue C	Overburden	97-14[1]	Well is Dry and Will be Removed					
			97-15	Class B	Class B1	Bimonthly	Quarterly	Semi- Annual	Biennial
			97-16[1]						
			97-08B						Semi-Annual
		Lower Sandstone	97-08A					Annual	Annual
	Sue E	Overburden	05-01B[1]	Class B	Class B1	Bimonthly	Quarterly	Semi- Annual	Biennial
			05-02B					Annual	Biennial
		Lower Sandstone	05-01A						
			05-02A						

Poor Performing Well - Neither Groundwater Samples or Groundwater Levels were able to be taken.

Poor Performing Well - Groundwater Level data collected, but no Groundwater Samples.

Poor Performing Well - Reduced Groundwater Samples/Water Levels collected, below planned frequency.

1 - Some erroneous Groundwater Level data were identified and removed from the completeness dataset.

L - Indicates Groundwater Levels were sufficient for 2022-2024

S - Indicates Groundwater Samples were sufficient for 2022-2024

*Well is used for baseline measurements

Table 2.2-5

Groundwater Monitoring Locations at the Moffat Domestic Landfill

Moffat Landfill								
Well Information			**Monitoring**					
Location	**Completion**	**Number**	**Parameters**		**Water Levels**		**Water Quality**	
			2019 EM DD	**2023 EM DD**	**2019 EM DD**	**2023 EM DD**	**2019 EM DD**	**2023 EM DD**
Moffat Landfill	Overburden	97-19	Class B	Class B2	Bimonthly	Annual	Semi-Annual	Annual
		04-01						
		04-02						Semi-Annual

Table 2.2-6

Groundwater Monitoring Locations at Sink Dam

Well Information			Monitoring					
			Parameters		Water Levels		Water Quality	
Location	Completion	Number	2019 EM DD	2023 EM DD	2019 EM DD	2023 EM DD	2019 EM DD	2023 EM DD
Sink Dam	Earth Fill	95-17	None	None	Bimonthly	None	None	None
		95-18				Monthly (June-October)		
		95-19				None		

Table 2.2-7

Groundwater Monitoring Locations at the McClean Mining (SABRE) Site

McClean Mining								
Well Information			**Monitoring**					
			Parameters		**Water Levels**		**Water Quality**	
Location	**Completion**	**Number**	**2019 EM DD**	**2023 EM DD**	**2019 EM DD**	**2023 EM DD**	**2019 EM DD**	**2023 EM DD**
McClean Minig	Overburden	13-01[1]	Class B	Class B1	Monthly	Bimonthly	Annual	Semi-Annual
		13-02					Semi-Annual	
		13-03					Annual	
		13-04						
	Lower Sandstone	MED05-01*					Semi-Annual	Semi-Annual
		MED05-02*						
		MED05-03*						
		Sue03-03*[2]		Removed[2]		Removed[2]	Semi-Annual	Removed[2]

Poor Performing Well - Neither Groundwater Samples or Groundwater Levels were able to be taken.

1 - Some erroneous Groundwater Level data were identified and removed from the completeness dataset.

2 - Well was broken in 2021, unable to be sampled 2022-2024.

*Well is used for baseline measurements

Table 2.2-8

Performance Criteria for Groundwater Level Measurements with and without Poor Performing Wells

Proposed Sampling Frequency Criteria from Orano		2019 EM DD Frequencies (2022 – 2023)	2023 EM DD Frequencies (2024)	2019 EM DD		2023 EM DD
				2022	2023	2024
EM DD Target	Groundwater Elevation Measurements - Even Years[1]	**619**	**374**	**520** *84%*	-	**325** *87%*
	Groundwater Samples Elevation Measurements - Odd Years (Include biennial samples)[1]	**619**	**387**	-	**506** *82%*	-
EM DD Targets Adjusted for Poor Performing Wells[2]	Groundwater Elevation Measurements - Even Years[1]	**527**	**337**	**498** *94%*	-	**315** *94%*
	Groundwater Samples Elevation Measurements - Odd Years (Include biennial samples)[1]	**527**	**350**	-	**556** *93%*	-

Notes: Summarized sampling targets from 2019 and 2023 EM DD and collected samples from 2022-2024. Extra measurements exceeding the EM DD target and water levels that were deemed erroneous are excluded from totals. Green fill represents completeness at or over 95% of the target. The data completeness percentage is included in italics below the number of measurements taken.

[1] Biennial (every two years) samples are collected only during odd years

[2] This adjustment was requested by Orano to aid in assessing the sample completeness outside of wells known to be poorly performing (i.e. problematic).

Table 2.2-9

Performance Criteria for Groundwater Quality Monitoring with and without Poor Performing wells

Proposed Sampling Frequency Criteria from Orano		2019 EM DD	2023 EM DD	2019 EM DD		2023 EM DD
				2022	2023	2024
EM DD Targets	Groundwater Chemistry Samples - Even Years	**164**	**154**	**138** *84%*	-	**141** *92%*
	Groundwater Chemistry Samples - Odd Years (Include biennial samples)[1]	**170**	**179**	-	**142** *84%*	-
	Groundwater - QA/QC Duplicate Samples[3]	**10% of total samples**		**14** *10%*	**14** *10%*	**13** *9%*
	Groundwater - QA/QC Field Blanks[3]	**10% of total samples**		**14** *10%*	**14** *10%*	**17** *12%*
EM DD Targets Adjusted for Poor Performing Wells[2]	Groundwater Chemistry Samples - Even Years	**137**	**142**	**136** 99%	-	**141** *99%*
	Groundwater Chemistry Samples - Odd Years (Include biennial samples)[1]	**143**	**167**	-	**142** *99%*	-
	Groundwater - QA/QC Duplicate Samples[3]	**10% of total samples**		**14** *10%*	**14** *10%*	**13** 9%
	Groundwater - QA/QC Field Blanks[3]	**10% of total samples**		**14** *10%*	**14** *10%*	**17** *12%*

Notes: Summarized sampling targets from 2019 and 2023 EM DD and collected samples from 2022-2024. Extra samples taken exceeding the EM DD target are excluded from totals. Green fill represents completeness at or over 95% of the target for samples, or 10% or greater for QA/QC samples.

[1] Biennial (every two years) samples are collected only on odd years

[2] Wells that have frequent issues have been excluded to examine Orano's performance in collecting samples from functioning wells.

[3] Target of 10% of samples taken, documented in 2019 and 2023 EM DD

Table 2.2-10

Comparison of Mean Reference Groundwater Data at the McClean Lake Operation to Saskatchewan Environmental Quality Guidelines

Parameter	80% of SEQG Min Guideline	80% of SEQG Max Guideline	SEQG Guideline Minimum	SEQG Guideline Maximum[9]	Background All								Baseline JEB								Baseline SUE/Moffat								Baseline Moffat[6]		Baseline McClean Minig					
					Overburden		Upper Sandstone		Lower Sandstone		Basement		Overburden		Upper Sandstone		Lower Sandstone		Basement		Overburden		Upper Sandstone		Lower Sandstone		Basement		Overburden		Overburden		Upper Sandstone		Lower Sandstone		Basement	
					Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count
General Chemistry, Major Ions, and Field Parameters																																				
Alkalinity (as CaCO3) (mg/L)	-	-	-	-	25	8	13	9	29	20	-	0	20	35	27	31	24	120	39	30	23	2	-	0	12	230	44	25	23	2	-	0	-	0	6.4	130	-	0
Alkalinity, Phenolphthalein (mg/L)	-	-	-	-	1	5	1	9	4.7	18	-	0	1	3	1	1	1	4	1	1	-	0	-	0	1	6	-	0	-	0	-	0	-	0	1	6	-	0
pH (pH units)	-	-	6.5	8.5	7	5	**6.5**	9	7	18	-	0	7.3	35	7.6	31	6.9	120	7.4	30	8.1	2	-	0	**6.4**	230	7.4	25	8.1	2	-	0	-	0	**6.3**	130	-	0
pH, Field (pH units)	-	-	6.5	8.5	7.1	4	**6.3**	6	6.7	11	-	0	7.2	20	7.3	15	6.5	64	7.2	17	-	0	-	0	**6.2**	110	6.7	19	-	0	-	0	-	0	6.6	49	-	0
Hardness, Total (mg/L)	-	-	-	-	18	8	7.8	9	21	20	-	0	15	35	22	31	17	120	25	30	11	2	-	0	180	230	35	25	11	2	-	0	-	0	320	130	-	0
Specific Conductivity (µS/cm)	800	800	1000	1000	57	5	26	9	65	18	-	0	43	35	59	31	56	120	100	30	53	2	-	0	790	230	100	25	53	2	-	0	-	0	**1400**	130	-	0
Specific Conductivity, Field (µS/cm)	800	800	1000	1000	67	4	30	6	63	11	-	0	41	20	54	15	45	63	98	17	-	0	-	0	570	120	93	22	-	0	-	0	-	0	**1300**	51	-	0
Sum of Ions (mg/L)	-	-	-	-	45	8	22	9	46	20	-	0	36	35	48	30	42	120	74	30	36	2	-	0	370	230	76	25	36	2	-	0	-	0	650	130	-	0
Temperature, Field (°C)	-	-	-	-	4.9	4	4.3	6	4.2	11	-	0	3.8	4	7.5	2	6.8	8	7.1	2	-	0	-	0	8.7	29	13	1	-	0	-	0	-	0	9	26	-	0
Total Dissolved Solids (mg/L)	400	400	500	500	50	5	41	9	59	18	-	0	46	35	54	31	49	120	62	30	34	2	-	0	**480**	230	63	25	34	2	-	0	-	0	**850**	130	-	0
Total Suspended Solids (mg/L)	-	-	-	-	310	1	16	3	180	8	-	0	410	35	280	30	12	110	13	30	290	2	-	0	76	230	4.3	25	290	2	-	0	-	0	18	130	-	0
Turbidity (NTU)	-	-	-	-	-	-	-	-	-	-	-	0	120	7	300	7	11	25	16	8	120	2	-	0	34	17	4.1	3	120	2	-	0	-	0	60	3	-	0
Ammonia (as N) (mg/L)[4,5]	3.8	450[14]	4.7	560[14]	0.64	5	0.09	9	0.028	18	-	0	0.046	35	0.04	30	0.049	110	0.11	30	0.12	2	-	0	0.31	230	0.16	24	0.12	2	-	0	-	0	0.53	120	-	0
Nitrate (mg/L)[7]	11	11	13.27	13.27	0.29	5	0.18	9	0.26	18	-	0	0.7	4	0.04	2	0.21	8	0.04	2	-	0	-	0	0.21	39	0.04	1	-	0	-	0	-	0	0.18	36	-	0
Nitrate + Nitrite (as N) (mg/L)	80	80	100	100	0.03	1	0.04	3	0.056	8	-	0	-	0	-	0	-	0	-	0	-	0	-	0	0.018	6	-	0	-	0	-	0	-	0	0.018	6	-	0
Nitrite (mg/L)[11]	0.13	1.3	0.16	1.6	-	-	-	-	-	-	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	-	-	0	-	0	-	0	-	0	-	-	-	0
Bicarbonate (as HCO3) (mg/L)	-	-	-	-	31	8	16	9	28	20	-	0	25	35	33	31	29	120	47	30	20	2	-	0	15	230	50	25	20	2	-	0	-	0	7.6	130	-	0
Carbonate (as CO3) (mg/L)	-	-	-	-	1	8	1	9	3.5	20	-	0	1	35	1	31	1.2	120	1	30	4	2	-	0	1	230	2.8	25	4	2	-	0	-	0	1.1	130	-	0
Sulphate (mg/L)[12]	100	400	130	500	1.8	8	0.64	9	1.1	20	-	0	1.8	35	2.4	31	1.7	120	1.7	30	0.9	2	-	0	0.82	230	2.9	25	0.9	2	-	0	-	0	0.82	130	-	0
Chloride (mg/L)	80	80	100	100	0.94	8	0.11	9	2.1	20	-	0	0.34	35	0.27	31	1.3	120	5.5	30	0.3	2	-	0	**240**	230	2.6	25	0.3	2	-	0	-	0	**430**	130	-	0
Fluoride (mg/L)	0.8	0.8	1	1	0.08	5	0.039	9	0.12	18	-	0	0.02	4	0.23	2	0.13	8	0.21	2	-	0	-	0	0.14	30	0.18	1	-	0	-	0	-	0	0.16	27	-	0
Hydroxide (mg/L)	-	-	-	-	1	8	1	9	1.3	20	-	0	1	22	1	18	1	71	1	17	-	0	-	0	1	200	1	17	-	0	-	0	-	0	1	130	-	0
Calcium (mg/L)	-	-	-	-	4.6	8	2	9	5.8	20	-	0	3.8	35	4.8	31	3.9	120	5.1	30	3.9	2	-	0	38	230	9.1	25	3.9	2	-	0	-	0	66	130	-	0
Magnesium (mg/L)	-	-	-	-	1.6	8	0.66	9	1.6	20	-	0	1.4	35	2.5	31	1.9	120	2.9	30	0.3	2	-	0	22	230	3.1	25	0.3	2	-	0	-	0	38	130	-	0
Potassium (mg/L)	-	-	-	-	1.2	8	0.66	9	1.3	20	-	0	1.2	35	3.1	31	1.3	120	3	30	3.2	2	-	0	6.4	230	2.6	25	3.2	2	-	0	-	0	11	130	-	0
Sodium (mg/L)	160	160	200	200	3.3	8	2	9	3.3	20	-	0	2.6	35	2.8	31	2.9	120	8.4	30	3.5	2	-	0	54	230	3.2	25	3.5	2	-	0	-	0	97	130	-	0
Metals and Trace Elements																																				
Aluminum, dissolved (mg/L)	0.0052	0.04	0.0065	0.05	**0.068**	8	0.017	9	0.0037	20	-	0	0.011	7	0.017	6	0.0074	23	0.0047	6	-	0	-	0	0.0073	130	0.0038	3	-	0	-	0	-	0	0.0067	110	-	0
Antimony, Dissolved (mg/L)	0.0048	0.0048	0.006	0.006	0.00056	5	0.0002	9	0.00022	18	-	0	0.00058	4	0.0002	2	0.0002	8	0.0002	2	-	0	-	0	0.0018	30	0.0002	1	-	0	-	0	-	0	0.002	27	-	0
Arsenic, dissolved (ug/L)	4	4	5	5	**4.1**	8	0.78	9	**6.3**	20	-	0	0.82	33	1.9	29	1.4	110	0.72	28	0.55	2	-	0	**5.5**	230	0.58	24	0.55	2	-	0	-	0	**9.4**	130	-	0
Barium, dissolved (mg/L)	1.6	1.6	2	2	0.022	8	0.0035	9	0.026	20	-	0	0.0042	7	0.0029	6	0.013	24	0.0062	6	-	0	-	0	0.097	130	0.028	3	-	0	-	0	-	0	0.11	110	-	0
Beryllium, dissolved (mg/L)	-	-	-	-	0.00048	8	0.0001	9	0.00019	20	-	0	0.00049	7	0.0007	6	0.0007	24	0.0007	6	-	0	-	0	0.00094	45	0.0007	3	-	0	-	0	-	0	0.001	27	-	0
Bismuth, dissolved (mg/L)	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	0	-	0	0.0012	24	-	0	-	0	-	0	-	0	0.0012	24	-	0
Boron, dissolved (mg/L)	0.8	0.8	1	1	0.0084	8	0.01	9	0.014	20	-	0	0.0086	7	0.0055	6	0.015	24	0.19	6	-	0	-	0	0.11	130	0.032	3	-	0	-	0	-	0	0.13	110	-	0
Cadmium, dissolved (mg/L)[1]	0.000025	0.000031	0.000031	0.000039	**0.0004**	8	0.000018	9	**0.00011**	20	-	0	**0.00082**	32	**0.0009**	28	**0.00089**	110	**0.00089**	27	**0.001**	2	-	0	**0.00085**	230	**0.00092**	24	**0.001**	2	-	0	-	0	**0.00077**	130	-	0
Chromium, dissolved (mg/L)	0.04	0.04	0.05	0.05	0.0012	8	0.00061	9	0.00067	20	-	0	0.00071	7	0.00083	6	0.00083	24	0.00083	6	-	0	-	0	0.0022	130	0.00083	3	-	0	-	0	-	0	0.0024	110	-	0
Copper, dissolved (mg/L)	0.0056	0.0056	0.007	0.007	**0.0071**	8	0.00053	9	0.0006	20	-	0	0.0015	33	0.0011	29	0.0011	110	0.0011	28	0.005	2	-	0	0.0017	230	0.0012	24	0.005	2	-	0	-	0	0.0018	130	-	0
Iron, dissolved (mg/L)	0.24	0.24	0.3	0.3	**0.62**	8	**1.4**	9	**0.92**	20	-	0	0.019	33	0.014	29	**0.37**	110	**1.2**	28	0.042	2	-	0	**19**	230	**0.92**	24	0.042	2	-	0	-	0	**34**	130	-	0
Lead, dissolved (mg/L)[2]	0.00064	0.0079	0.0008	0.0099	**0.012**	8	0.00017	9	0.00031	20	-	0	**0.0017**	33	**0.0018**	29	**0.0018**	110	**0.0018**	28	**0.002**	2	-	0	**0.0018**	230	**0.0019**	24	**0.002**	2	-	0	-	0	0.0018	130	-	0
Manganese, dissolved (mg/L)	0.016	0.016	0.02	0.02	**0.1**	8	**0.021**	9	**0.3**	20	-	0	0.0033	33	0.0012	29	**0.19**	110	**0.15**	28	**0.043**	2	-	0	**0.86**	230	**2**	24	**0.043**	2	-	0	-	0	**1.5**	130	-	0
Molybdenum, dissolved (mg/L)	-	-	-	-	0.00084	8	0.00017	9	0.0007	20	-	0	0.0009	33	0.0014	29	0.0013	110	0.0014	28	0.001	2	-	0	0.007	230	0.001	24	0.001	2	-	0	-	0	0.012	130	-	0
Nickel, dissolved (mg/L)[3]	0.0026	0.082	0.0033	0.1	0.0047	8	0.0002	9	0.0019	20	-	0	0.001	33	0.0011	29	0.0011	110	0.0011	28	**0.014**	2	-	0	0.0025	230	0.0039	24	**0.014**	2	-	0	-	0	0.0011	130	-	0
Phosphorus, dissolved (mg/L)	-	-	-	-	0.01	3	-	-	0.015	2	-	0	0.017	3	0.068	4	0.033	16	0.028	4	-	0	-	0	0.016	100	0.04	2	-	0	-	0	-	0	0.016	85	-	0
Phosphorus, Total (mg/L)	-	-	-	-	-	-	-	-	0.02	2	-	0	-	-	-	-	-	-	-	-	-	0	-	0	0.06	1	0.06	1	-	0	-	0	-	0	-	-	-	0
Selenium, dissolved (mg/L)	0.0016	0.0016	0.002	0.002	0.00016	5	0.0001	9	0.00012	18	-	0	0.00013	4	0.0001	2	0.00014	8	0.0001	2	-	0	-	0	0.00033	120	0.0001	1	-	0	-	0	-	0	0.00034	110	-	0
Silicon, soluble, dissolved (mg/L)	-	-	-	-	4.9	3	-	-	7.7	2	-	0	5.9	3	7.9	4	8.8	16	5.1	4	-	0	-	0	6.8	15	5.6	2	-	0	-	0	-	0	-	-	-	0
Silver, dissolved (mg/L)	0.0002	0.0002	0.00025	0.00025	**0.00041**	8	0.00005	9	0.00015	20	-	0	**0.00045**	7	**0.00068**	6	**0.00072**	24	**0.00068**	6	-	0	-	0	**0.00039**	45	**0.00067**	3	-	0	-	0	-	0	0.0001	27	-	0
Strontium, dissolved (mg/L)	-	-	-	-	0.027	8	0.015	9	0.035	20	-	0	0.019	7	0.023	6	0.028	24	0.094	6	-	0	-	0	0.75	45	0.083	3	-	0	-	0	-	0	1.2	27	-	0
Thallium, Dissolved (mg/L)	-	-	-	-	0.0002	5	0.0002	9	0.0002	18	-	0	0.0002	4	0.0002	2	0.0002	8	0.0002	2	-	0	-	0	0.0018	30	0.0002	1	-	0	-	0	-	0	0.002	27	-	0
Tin, Dissolved (mg/L)	-	-	-	-	0.00018	5	0.0001	9	0.00011	18	-	0	0.0001	4	0.0001	2	0.0001	8	0.0001	2	-	0	-	0	0.00091	30	0.0001	1	-	0	-	0	-	0	0.001	27	-	0
Titanium, dissolved (mg/L)	-	-	-	-	0.002	8	0.00038	9	0.0003	20	-	0	0.0006	7	0.0008	6	0.00079	24	0.00073	6	-	0	-	0	0.0016	45	0.00073	3	-	0	-	0	-	0	0.002	27	-	0
Uranium, dissolved (µg/L)	8	8	10	10	0.58	8	0.1	9	0.12	20	-	0	0.31	33	0.28	29	0.3	110	0.31	28	1.9	2	-	0	0.32	230	0.31	23	1.9	2	-	0	-	0	0.24	130	-	0
Vanadium, dissolved (mg/L)	-	-	-	-	0.00083	8	0.0011	9	0.0038	20	-	0	0.0012	7	0.0028	6	0.00074	24	0.0007	6	-	0	-	0	0.00098	130	0.0007	3	-	0	-	0	-	0	0.001	110	-	0
Zinc, dissolved (mg/L)	0.024	0.024	0.03	0.03	0.021	8	0.0015	9	0.003	20	-	0	0.0059	33	0.0052	29	0.0048	110	0.0055	28	**0.031**	2	-	0	**0.026**	230	0.012	24	**0.031**	2	-	0	-	0	**0.043**	130	-	0
Radionuclides																																				
Lead-210, dissolved (Bq/L)	0.16	0.16	0.2	0.2	0.1	5	0.036	9	0.091	18	-	0	0.024	33	0.058	29	0.037	110	0.037	28	0.02	2	-	0	**1.3**	230	0.037	24	0.02	2	-	0	-	0	**2.2**	130	-	0
Polonium-210, dissolved (Bq/L)	0.16	0.16	0.2	0.2	0.019	5	0.014	9	0.0094	18	-	0	0.0062	33	0.0059	29	0.0096	110	0.0061	28	0.005	2	-	0	0.061	230	0.0058	24	0.005	2	-	0	-	0	0.1	130	-	0
Radium-226, dissolved (Bq/L)	0.4	0.4	0.5	0.5	0.12	5	0.0068	9	0.018	18	-	0	0.0057	33	0.0072	29	0.013	110	0.0058	28	0.006	2	-	0	**3.7**	220	0.014	24	0.006	2	-	0	-	0	**6.9**	120	-	0
Thorium-230, dissolved (Bq/L)	0.32	0.32	0.4	0.4	0.012	5	0.01	9	0.01	18	-	0	0.01	33	0.01	29	0.01	110	0.01	28	0.01	2	-	0	0.03	230	0.01	24	0.01	2	-	0	-	0	0.045	130	-	0

Table notes:

Presented parameters are those which have been analyzed as part of ongoing monitoring between 2022 and 2024. Not exclusive to the B1 to B4 classes. Hydrocarbons are analyzed in the current monitoring program but were not analyzed in baseline data period.

Guidelines were provided by Saskachewan Environmental Quality Guidelines (SEQG), which is based on the Alberta Tier 1 Guidelines and other referenced documents therein.

For non-variable guidelines, where multiple guideline values exist for different coarse or fine land uses, the lowest value from those uses is applied for each parameter. Guidelines were converted into the same units that parameters are reported in within Orano's database.

Light shading indicates reference value is over 80% of the SEQG but not exceeding.

Dark shading indcates reference value is over the SEQG Guideline.

Datasets for baseline data was defined in communications from Orano (2025).

"-" Indicates that there is no baseline data or guideline for these parameters.

The 25th percentile for hardness was calculated for each site and geologic unit based on 2022-2024 monitoring data.

The 25th percentile chloride and pH and the 75th percentile of pH and temperature (°C) were calculated based on 2022-2024 monitoring data. The percentile which provides a more conservative guideline was utilized, which varied for the different formula (see SEQG table and references therein for variable guidelines).

Variable parameters are shaded green, individual guidelines were calculated for each site and geologic unit based on the 2022-2024 monitoring data.

[1] Cd long-term mg/L formula: 10^[0.83(log10(hardness))-2.46]; When hardness value is <17 mg/L, guideline is 0.00004 mg/L.

[2] Pb long-term mg/L formula forMcClean Minig Lower Sandstone: e^[1.273(ln(hardness))-4.705]; if hardness is <65 mg/L guideline is 0.001 mg/L; if hardness is >180 mg/L, guideline is 0.007 mg/L.

[3] Ni long-term mg/L formula: e^[0.846(ln(hardness))+0.0584].

[4] Ammonia (Total) formula is: (0.019/(1/(10^((0.0901821+2729.92/K°)-pH)+1)))*0.8224; when calculated for pH <6 and >9, use value with caution. 25th Percentile of pH for SUE and McClean Minig overburden were generally below 6 pH.

[5] The high Ammonia value for maximum SEQG guideline is due to the low P75 for Sue Overburden (5.2) which has a major effect on the guideline concentration. Note a guideline concentration derived from a pH outside the range of 6-9 should be viewed with caution as per SEQG.

[6] Moffat Overburden included as 2022-2024 hardness varied between Sue and Moffat, leading to minor differences in calculated guidelines; all other guideline values for Moffat are same as SUE Overburden. The same parameters exceed SEQG guidelines using both Moffat Overburden and Sue Overburden calculated guidelines for Moffat Overbuden.

[7] Nitrate SEQG guideline comes from Table 1.2 in Environmental Quality Guidelines for Alberta Surface waters, which was the most conservative (see SEQG table and notes therein). Guideline converted from (as N) to nitrate (NO3-N*4.42569).

[8] Sulphate guidelines for aquatic health provide guidelines up to a hardness of 250 mg/L. After this concentration, the table notes that the sulphate guideline needs to be determined based on site water. Since a site specific determination is not currently available, the potable groundwater guideline (500 mg/L) was used. Only the McClean Minig site had P25 hardness >250 mg/L.

[9] Maximum SEQG is the highest value utilized for the comparison, which for non-calculated parameters is the minimum value for all coarse or fine land uses. For calculated parameters, the maximum is the maximum guideline applicable among the sites.

[10] Ammonia (Total) formula is: (0.019/(1/(10^((0.0901821+2729.92/K°)-pH)+1)))*0.8224; when calculated for pH <6 and >9, use value with caution. 25th Percentile of pH for SUE and McClean Minig overburden were generally below 6 pH.

[11] Nitrite SEQG guideline comes from Table 1.4 in Environmental Quality Guidelines for Alberta Surface waters, which was the most conservative applicable guideline. Guideline converted from Nitrate "as N" to Nitrate (NO2-N*3.28443).

[12] Sulphate SEQG guideline comes from Table 1.7 in Environmental Quality Guidelines for Alberta Surface waters, which was the most conservative applicable guideline (see SEQG Guidelines and notes therein).

Table 2.2-11

COPC Selection Screening results for Groundwater at the JEB Site for 2022 to 2024

Parameter	Identified as COPC in MLO Documentation[1]	COPC Selection based on 2022 to 2024 data			Available Guideline (SEQG) (EC4)[4]
		less than 90% of data below RDL (EC1)[2]	Above Reference Dataset (EC2)[3]	Selected as COPC for JEB Site	
General Chemistry, Major Ions, and Field Parameters					
Total Alkalinity (as CaCO3)	No	Yes	Yes	**Yes**	-
Bicarbonate (as HCO3)	No	Yes	Yes	**Yes**	-
Carbonate (as CO3)	No	No	No	No	-
Hydroxide	No	No	No	No	-
Alkalinity, Phenolphthalein	No	No	No	No	-
Ammonia (as N)	Yes	Yes	Yes	**Yes**	*Varies* [6]
Nitrate	No	Yes	Yes	**Yes**	13.27 mg/L (as NO_3)
Nitrite	No	No	No	No	*Varies* [6]
Nitrate + Nitrite (as N)	No	Yes	Yes	**Yes**	100 mg/L (as N)
Fluoride	No	Yes	Yes	**Yes**	1 mg/L
Chloride	Yes	Yes	Yes	**Yes**	80 mg/L
Sulphate	Yes	Yes	Yes	**Yes**	*Varies* [6]
Calcium	No	Yes	Yes	**Yes**	-
Magnesium	No	Yes	Yes	**Yes**	-
Potassium	No	Yes	Yes	**Yes**	-
Sodium	No	Yes	Yes	**Yes**	200 mg/L
Sum of ions	No	Yes	Yes	**Yes**	-
Hardness, Total [4]	No	Yes	Yes	**Yes**	-
Total Dissolved Solids	Yes	Yes	Yes	**Yes**	500 mg/L
Total Suspended Solids	Yes	Yes	Yes	**Yes**	-
pH, Field [4, 5]	No	Yes	Yes	**Yes**	6.5-8.5
Specific Conductivity, Field [5]	No	Yes	Yes	**Yes**	1000 (µS/cm)
Metals and Trace Elements					
Aluminum, Dissolved	No	Yes	Yes	**Yes**	*Varies* [6]
Antimony, Dissolved	No	No	No	No	0.006 mg/L
Arsenic, Dissolved	Yes	Yes	Yes	**Yes**	5 µg/L
Barium, Dissolved	Yes	Yes	Yes	**Yes**	2 mg/L
Beryllium, Dissolved	No	No	No	No	-
Boron, Dissolved	No	Yes	Yes	**Yes**	1 mg/L
Cadmium, Dissolved	Yes	Yes	Yes	**Yes**	*Varies* [6]
Chromium, Dissolved	Yes	Yes	Yes	**Yes**	0.05 mg/L
Cobalt, Dissolved	Yes	Yes	Yes	**Yes**	-
Copper, Dissolved	Yes	Yes	Yes	**Yes**	0.007 mg/L
Iron, Dissolved	Yes	Yes	Yes	**Yes**	0.3 mg/L
Lead, Dissolved	Yes	Yes	Yes	**Yes**	*Varies* [6]
Manganese, Dissolved	No	Yes	Yes	**Yes**	0.02 mg/L
Molybdenum, Dissolved	Yes	Yes	Yes	**Yes**	-
Nickel, Dissolved	Yes	Yes	Yes	**Yes**	*Varies* [6]
Selenium, Dissolved	Yes	Yes	Yes	**Yes**	0.002 mg/L
Silver, Dissolved	Yes	No	No	**Yes**	0.00025 mg/L
Strontium, Dissolved	No	Yes	Yes	**Yes**	-
Thallium, Dissolved	No	No	No	No	-
Tin, Dissolved	No	No	No	No	-
Titanium, Dissolved	No	Yes	Yes	**Yes**	-
Uranium, Dissolved	Yes	Yes	Yes	**Yes**	10 µg/L
Vanadium, Dissolved	Yes	Yes	Yes	**Yes**	-
Zinc, Dissolved	Yes	Yes	Yes	**Yes**	0.03 mg/L
Radionuclides					
Lead-210, Dissolved	Yes	Yes	Yes	**Yes**	0.2 Bq/L
Polonium-210, Dissolved	Yes	Yes	Yes	**Yes**	0.2 Bq/L
Radium-226, Dissolved	Yes	Yes	Yes	**Yes**	0.5 Bq/L
Thorium-230, Dissolved	Yes	No	No	**Yes**	0.4 Bq/L

Table notes:

Phosphorus and Mercury were historically listed as COPC (1995 Midwest EIS), but are not included in regular groundwater sampling

Hydrocarbons are not considered in COPC screening as they are sampled at a limited number of locations

[1] COPCs identified in 1991 EIS, 1995 EIS, 2025 Tailings TID or 2025 WR TID

[2] If less than 90% of the measured values within the monitoring period for all monitoring stations at the site were below the detection limit, the parameter met this criterion.

[3] If any measured values within the monitoing period in at least one monitoring location within the site was more than two reference standard deviations (SDs) above the mean reference dataset OR if any reference data was >80% of the Saskatchewan Environmental Quality Guideline (SEQG), the parameter met this criterion. The applicable reference dataset refers to both McClean Lake Operation background monitoring data from wells out of the zones of influence of the operation (Table 2.2-15) and JEB baseline data (Tabl 2.2-17).

[4] pH and Total Hardness included as a modifying factor for calculated guidelines

[5] Field pH and specific conductivity (rather than lab measured values) are used as they are considered more representative.

[6] Guideline for parameter varies depending on modifying factors such as pH, hardness and/or temprature. See Table 2.2-10.

Table 2.2-12

COPC Selection Screening results for Groundwater at the Sue Site for 2022 to 2024

Parameter	Identified as COPC in MLO Documentation[1]	COPC Selection based on 2022 to 2024 data			Available Guideline (SEQG) (EC4)[4]
		less than 90% of data below RDL (EC1)[2]	Above Reference Dataset (EC2)[3]	Selected as COPC for Sue Site	
General Chemistry, Major Ions, and Field Parameters					
Total Alkalinity (as CaCO3)	No	Yes	Yes	**Yes**	-
Bicarbonate (as HCO3)	No	Yes	Yes	**Yes**	-
Carbonate (as CO3)	No	No	No	No	-
Hydroxide	No	No	No	No	-
Alkalinity, Phenolphthalein	No	No	No	No	-
Ammonia (as N)	Yes	Yes	Yes	**Yes**	*Varies*[7]
Nitrate	No	Yes	Yes	**Yes**	13.27 mg/L (as NO3)
Nitrite	No	Yes	No	No	*Varies*[7]
Nitrate + Nitrite (as N)	No	Yes	Yes	**Yes**	100 mg/L (as N)
Fluoride	No	Yes	Yes	**Yes**	1 mg/L
Chloride	Yes	Yes	Yes	**Yes**	80 mg/L
Sulphate	Yes	Yes	Yes	**Yes**	*Varies*[7]
Calcium	No	Yes	Yes	**Yes**	-
Magnesium	No	Yes	Yes	**Yes**	-
Potassium	No	Yes	Yes	**Yes**	-
Sodium	No	Yes	Yes	**Yes**	200 mg/L
Sum of ions	No	Yes	Yes	**Yes**	-
Hardness, Total [4]	No	Yes	Yes	**Yes**	-
Total Dissolved Solids	Yes	Yes	Yes	**Yes**	500 mg/L
Total Suspended Solids	Yes	Yes	Yes	**Yes**	-
pH, Field [4, 5]	No	Yes	Yes	**Yes**	6.5-8.5
Specific Conductivity, Field [5]	No	Yes	Yes	**Yes**	1000 (µS/cm)
Metals and Trace Elements					
Aluminum, Dissolved	No	Yes	Yes	**Yes**	*Varies*[7]
Antimony, Dissolved	No	No	No	No	0.006 mg/L
Arsenic, Dissolved	Yes	Yes	Yes	**Yes**	5 µg/L
Barium, Dissolved	Yes	Yes	Yes	**Yes**	2 mg/L
Beryllium, Dissolved	No	Yes	Yes	**Yes**	-
Boron, Dissolved	No	Yes	Yes	**Yes**	1 mg/L
Cadmium, Dissolved	Yes	Yes	Yes	**Yes**	*Varies*[7]
Chromium, Dissolved	Yes	Yes	Yes	**Yes**	0.05 mg/L
Cobalt, Dissolved	Yes	Yes	Yes	**Yes**	-
Copper, Dissolved	Yes	Yes	Yes	**Yes**	0.007 mg/L
Iron, Dissolved	Yes	Yes	Yes	**Yes**	0.3 mg/L
Lead, Dissolved	Yes	No	No	**Yes**	*Varies*[7]
Manganese, Dissolved	No	Yes	Yes	**Yes**	0.02 mg/L
Molybdenum, Dissolved	Yes	Yes	No	**Yes**	-
Nickel, Dissolved	Yes	Yes	Yes	**Yes**	*Varies*[7]
Selenium, Dissolved	Yes	Yes	Yes	**Yes**	0.002 mg/L
Silver, Dissolved	Yes	Yes	Yes	**Yes**	0.00025 mg/L
Strontium, Dissolved	No	Yes	Yes	**Yes**	-
Thallium, Dissolved	No	No	No	No	-
Tin, Dissolved	No	No	No	No	-
Titanium, Dissolved	No	Yes	Yes	**Yes**[6]	-
Uranium, Dissolved	Yes	Yes	Yes	**Yes**	10 µg/L
Vanadium, Dissolved	Yes	Yes	No	**Yes**	-
Zinc, Dissolved	Yes	Yes	Yes	**Yes**	0.03 mg/L
Radionuclides					
Lead-210, Dissolved	Yes	Yes	Yes	**Yes**	0.2 Bq/L
Polonium-210, Dissolved	Yes	Yes	Yes	**Yes**	0.2 Bq/L
Radium-226, Dissolved	Yes	Yes	Yes	**Yes**	0.5 Bq/L
Thorium-230, Dissolved	Yes	No	No	**Yes**	0.4 Bq/L

Table notes:

Phosphorus and Mercury were historically listed as COPC (1995 Midwest EIS), but are not included in regular groundwater sampling

Hydrocarbons are not considered in COPC screening as they are sampled at a limited number of locations

[1] COPCs identified in 1991 EIS, 1995 EIS, 2025 Tailings TID or 2025 WR TID

[2] If less than 90% of the measured values within the monitoring period for all monitoring stations at the site were below the detection limit, the parameter met this criterion.

[3] If any measured values within the monitoing period in at least one monitoring location within the site was more than two reference standard deviations (SDs) above the mean reference dataset OR if any reference data was >80% of the Saskatchewan Environmental Quality Guideline (SEQG), the parameter met this criterion. The applicable referenc dataset refers to both McClean Lake Operation background monitoring data from wells out of the zones of influence of the operation (Table 2.2-15) and Sue baseline data (Tabl 2.2-22).

[4] pH and Total Hardness included as a modifying factor for calculated guidelines

[5] Field pH and specific conductivity (rather than lab measured values) are used as they are considered more representative.

[6] Considered a COPC based on waste rock concentrations being above reference values (but not other lithologies)

[7] Guideline for parameter varies depending on modifying factors such as pH, hardness and/or temprature. See Table 2.2-10.

Table 2.2-13

COPC Selection Screening results for Groundwater at the Moffat Site for 2022 to 2024

Parameter	Identified as COPC in MLO Documentation[1]	COPC Selection based on 2022 to 2024 data			Available Guideline (SEQG) (EC4)[4]
		less than 90% of data below RDL (EC1)[2]	Above Reference Dataset (EC2)[3]	Selected as COPC for Moffat Site	
General Chemistry, Major Ions, and Field Parameters					
Total Alkalinity (as CaCO3)	No	Yes	Yes	**Yes**	**-**
Bicarbonate (as HCO3)	No	Yes	Yes	**Yes**	-
Carbonate (as CO3)	No	No	No	No	-
Hydroxide	No	No	No	No	-
Alkalinity, Phenolphthalein	No	No	No	No	-
Ammonia (as N)	Yes	Yes	Yes	**Yes**	*Varies*[7]
Nitrate	No	Yes	Yes	**Yes**	13.27 mg/L (as NO3)
Nitrite	No	No	No	No	*Varies*[7]
Nitrate + Nitrite (as N)	No	Yes	No	**Yes**[6]	100 mg/L (as N)
Fluoride	No	Yes	No	No	1 mg/L
Chloride	Yes	Yes	Yes	**Yes**	80 mg/L
Sulphate	Yes	Yes	Yes	**Yes**	*Varies*[7]
Calcium	No	Yes	Yes	**Yes**	-
Magnesium	No	Yes	Yes	**Yes**	-
Potassium	No	Yes	Yes	**Yes**	-
Sodium	No	Yes	Yes	**Yes**	200 mg/L
Sum of ions	No	Yes	Yes	**Yes**	-
Hardness, Total [4]	No	Yes	Yes	**Yes**	-
Total Dissolved Solids	Yes	Yes	Yes	**Yes**	500 mg/L
Total Suspended Solids	Yes	Yes	No	**Yes**	-
pH, Field [4, 5]	No	Yes	No	**Yes**	6.5-8.5
Specific Conductivity, Field [5]	No	Yes	Yes	**Yes**	1000 (µS/cm)
Metals and Trace Elements					
Aluminum, Dissolved	No	Yes	Yes	**Yes**	*Varies*[7]
Antimony, Dissolved	No	No	No	No	0.006 mg/L
Arsenic, Dissolved	Yes	Yes	Yes	**Yes**	5 µg/L
Barium, Dissolved	Yes	Yes	No	**Yes**	2 mg/L
Beryllium, Dissolved	No	No	No	No	-
Boron, Dissolved	No	Yes	Yes	**Yes**	1 mg/L
Cadmium, Dissolved	Yes	Yes	Yes	**Yes**	*Varies*[7]
Chromium, Dissolved	Yes	Yes	No	**Yes**	0.05 mg/L
Cobalt, Dissolved	Yes	Yes	No	**Yes**	-
Copper, Dissolved	Yes	Yes	Yes	**Yes**	0.007 mg/L
Iron, Dissolved	Yes	Yes	Yes	**Yes**	0.3 mg/L
Lead, Dissolved	Yes	No	No	**Yes**	*Varies*[7]
Manganese, Dissolved	No	Yes	Yes	**Yes**	0.02 mg/L
Molybdenum, Dissolved	Yes	Yes	No	**Yes**	-
Nickel, Dissolved	Yes	Yes	Yes	**Yes**	*Varies*[7]
Selenium, Dissolved	Yes	No	No	**Yes**	0.002 mg/L
Silver, Dissolved	Yes	No	No	**Yes**	0.00025 mg/L
Strontium, Dissolved	No	Yes	Yes	**Yes**	-
Thallium, Dissolved	No	No	No	No	-
Tin, Dissolved	No	No	No	No	-
Titanium, Dissolved	No	Yes	No	No	-
Uranium, Dissolved	Yes	Yes	Yes	**Yes**	10 µg/L
Vanadium, Dissolved	Yes	Yes	No	**Yes**	-
Zinc, Dissolved	Yes	Yes	Yes	**Yes**	0.03 mg/L
Radionuclides					
Lead-210, Dissolved	Yes	Yes	Yes	**Yes**	0.2 Bq/L
Polonium-210, Dissolved	Yes	No	No	**Yes**	0.2 Bq/L
Radium-226, Dissolved	Yes	Yes	Yes	**Yes**	0.5 Bq/L
Thorium-230, Dissolved	Yes	No	No	**Yes**	0.4 Bq/L

Table notes:

Phosphorus and Mercury were historically listed as COPC (1995 Midwest EIS), but are not included in regular groundwater sampling

Hydrocarbons are not considered in COPC screening as they are sampled at a limited number of locations

[1] COPCs identified in 1991 EIS, 1995 EIS, 2025 Tailings TID or 2025 WR TID

[2] If less than 90% of the measured values within the monitoring period for all monitoring stations at the site were below the detection limit, the parameter met this criterion.

[3] If any measured values within the monitoing period in at least one monitoring location within the site was more than two reference standard deviations (SDs) above the mean reference dataset OR if any reference data was >80% of the Saskatchewan Environmental Quality Guideline (SEQG), the parameter met this criterion. The applicable referenc dataset refers to both McClean Lake Operation background monitoring data from wells out of the zones of influence of the operation (Table 2.2-15) and Sue baseline data (Tabl 2.2-22).

[4] pH and Total Hardness included as a modifying factor.

[5] Field pH and specific conductivity (rather than lab measured values) are used as they are considered more representative.

[6] Applicable background and baseline datasets for this location and parameter are limited. Considered a COPC based on comparison to single background sample.

[7] Guideline for parameter varies depending on modifying factors such as pH, hardness and/or temprature. See Table 2.2-10.

Table 2.2-14

COPC Selection Screening results for Groundwater at the McClean Mining (SABRE) Site for 2022 to 2024

Parameter	Identified as COPC in McClean Lake Operation Documentation[1]	COPC Selection based on 2022 to 2024 data			Available Guideline (SEQG) (EC4)[4]
		less than 90% of data below RDL (EC1)[2]	Above Reference Dataset (EC2)[3]	Selected as COPC for McClean Mining (SABRE) Site	
General Chemistry, Major Ions, and Field Parameters					
Total Alkalinity (as CaCO3)	No	Yes	Yes	**Yes**	**-**
Bicarbonate (as HCO3)	No	Yes	Yes	**Yes**	-
Carbonate (as CO3)	No	No	No	No	-
Hydroxide	No	No	No	No	-
Alkalinity, Phenolphthalein	No	No	No	No	-
Ammonia (as N)	Yes	Yes	Yes	**Yes**	*Varies*[6]
Nitrate	No	No	No	No	13.27 mg/L (as NO3)
Nitrite	No	No	No	No	*Varies*[6]
Nitrate + Nitrite (as N)	No	No	No	No	100 mg/L (as N)
Fluoride	No	Yes	Yes	**Yes**	1 mg/L
Chloride	Yes	Yes	Yes	**Yes**	80 mg/L
Sulphate	Yes	Yes	Yes	**Yes**	*Varies*[6]
Calcium	No	Yes	Yes	**Yes**	-
Magnesium	No	Yes	Yes	**Yes**	-
Potassium	No	Yes	Yes	**Yes**	-
Sodium	No	Yes	Yes	**Yes**	200 mg/L
Sum of ions	No	Yes	Yes	**Yes**	-
Hardness, Total [4]	No	Yes	Yes	**Yes**	-
Total Dissolved Solids	Yes	Yes	Yes	**Yes**	500 mg/L
Total Suspended Solids	Yes	Yes	No	**Yes**	-
pH, Field [4, 5]	No	Yes	Yes	**Yes**	6.5-8.5
Specific Conductivity, Field [5]	No	Yes	Yes	**Yes**	1000 (µS/cm)
Metals and Trace Elements					
Aluminum, Dissolved	No	Yes	Yes	**Yes**	*Varies*[6]
Antimony, Dissolved	No	No	No	No	0.006 mg/L
Arsenic, Dissolved	Yes	Yes	Yes	**Yes**	5 µg/L
Barium, Dissolved	Yes	Yes	Yes	**Yes**	2 mg/L
Beryllium, Dissolved	No	No	No	No	-
Boron, Dissolved	No	Yes	Yes	**Yes**	1 mg/L
Cadmium, Dissolved	Yes	Yes	Yes	**Yes**	*Varies*[6]
Chromium, Dissolved	Yes	Yes	Yes	**Yes**	0.05 mg/L
Cobalt, Dissolved	Yes	Yes	Yes	**Yes**	-
Copper, Dissolved	Yes	Yes	Yes	**Yes**	0.007 mg/L
Iron, Dissolved	Yes	Yes	Yes	**Yes**	0.3 mg/L
Lead, Dissolved	Yes	Yes	Yes	**Yes**	*Varies*[6]
Manganese, Dissolved	No	Yes	Yes	**Yes**	0.02 mg/L
Molybdenum, Dissolved	Yes	Yes	Yes	**Yes**	-
Nickel, Dissolved	Yes	Yes	Yes	**Yes**	*Varies*[6]
Selenium, Dissolved	Yes	Yes	Yes	**Yes**	0.002 mg/L
Silver, Dissolved	Yes	No	No	**Yes**	0.00025 mg/L
Strontium, Dissolved	No	Yes	Yes	**Yes**	-
Thallium, Dissolved	No	No	No	No	-
Tin, Dissolved	No	Yes	Yes	**Yes**	-
Titanium, Dissolved	No	Yes	Yes	**Yes**	-
Uranium, Dissolved	Yes	Yes	Yes	**Yes**	10 µg/L
Vanadium, Dissolved	Yes	Yes	Yes	**Yes**	-
Zinc, Dissolved	Yes	Yes	Yes	**Yes**	0.03 mg/L
Radionuclides					
Lead-210, Dissolved	Yes	Yes	Yes	**Yes**	0.2 Bq/L
Polonium-210, Dissolved	Yes	Yes	Yes	**Yes**	**0.2 Bq/L**
Radium-226, Dissolved	Yes	Yes	Yes	**Yes**	0.5 Bq/L
Thorium-230, Dissolved	Yes	Yes	Yes	**Yes**	0.4 Bq/L

Table notes:

Phosphorus and Mercury were historically listed as COPC (1995 Midwest EIS), but are not included in regular groundwater sampling

Hydrocarbons are not considered in COPC screening as they are sampled at a limited number of locations

[1] COPCs identified in 1991 EIS, 1995 EIS, 2025 Tailings TID or 2025 WR TID

[2] If less than 90% of the measured values within the monitoring period for all monitoring stations at the site were below the detection limit, the parameter met this criterion.

[3] If any measured values within the monitoing period in at least one monitoring location within the site was more than two reference standard deviations (SDs) above the mean reference dataset OR if any reference data was >80% of the Saskatchewan Environmental Quality Guideline (SEQG), the parameter met this criterion. The applicable reference dataset refers to both McClean Lake Operation background monitoring data from wells out of the zones of influence of the operation (Table 2.2-15) and McClean Mining (SABRE) baseline data (Table 2.2-26).

[4] pH and Total Hardness included as a modifying factor for calculated guidelines.

[5] Field pH and specific conductivity (rather than lab measured values) are used as they are considered more representative.

[6] Guideline for parameter varies depending on modifying factors such as pH, hardness and/or temprature. See Table 2.2-10.

Table 2.2-15

Summary Statistics for Background Monitoring Locations at the McClean Lake Operation

Parameter (Units)[1]	Background														
	Lower Sandstone					Upper Sandstone					Overburden				
	Count	Min	Max	Mean	Std.Dev	Count	Min	Max	Mean	Std.Dev	Count	Min	Max	Mean	Std.Dev
General Chemistry, Major Ions, and Field Parameters															
Alkalinity (as CaCO3) (mg/L)	20	11	56	29	15	9	7	25	13	6.8	8	17	54	25	13
Alkalinity, Phenolphthalein (mg/L)	18	1	36	4.7	11	9	1	1	1	-	5	1	1	1	-
pH (pH units)	18	6.3	9.8	7	1.1	9	6.1	6.8	6.5	0.24	5	6.8	7.2	7	0.2
pH, Field (pH units)	11	6.1	10	6.7	1.2	6	6.1	6.7	6.3	0.26	4	6.8	7.5	7.1	0.3
Hardness, Total (mg/L)	20	5	48	21	12	9	4	15	7.8	4.1	8	12	36	18	7.8
Specific Conductivity (µS/cm)	18	29	100	65	23	9	15	44	26	11	5	35	120	57	35
Specific Conductivity, Field (µS/cm)	11	38	110	63	22	6	21	45	30	9.9	4	39	140	67	48
Sum of Ions (mg/L)	20	21	87	46	17	9	12	40	22	10	8	29	93	45	21
Total Dissolved Solids (mg/L)	18	29	110	59	22	9	9	73	41	19	5	38	76	50	16
Total Suspended Solids (mg/L)	8	1	1200	180	430	3	12	23	16	6.1	1	310	310	310	-
Ammonia (as N) (mg/L)	18	0.01	0.06	0.028	0.019	9	0.01	0.23	0.09	0.088	5	0.02	3	0.64	1.3
Ammonia, Un-ionized (as N) (mg/L)	2	0.01	0.01	0.01	-	1	0.01	0.01	0.01	-	0	-	-	-	-
Nitrate (mg/L)	18	0.04	0.46	0.26	0.16	9	0.04	0.4	0.18	0.14	5	0.13	0.4	0.29	0.12
Nitrate + Nitrite (as N) (mg/L)	8	0.01	0.09	0.056	0.031	3	0.01	0.07	0.04	0.03	1	0.03	0.03	0.03	-
Bicarbonate (as HCO3) (mg/L)	20	1	68	28	17	9	8	30	16	8.1	8	21	66	31	16
Carbonate (as CO3) (mg/L)	20	1	28	3.5	7.7	9	1	1	1	-	8	1	1	1	-
Sulfate (mg/L)	20	0.4	2.4	1.1	0.62	9	0.5	0.9	0.64	0.15	8	0.6	2.9	1.8	0.81
Chloride (mg/L)	20	0.1	6.9	2.1	2.5	9	0.1	0.2	0.11	0.033	8	0.1	4.3	0.94	1.4
Fluoride (mg/L)	18	0.01	0.32	0.12	0.078	9	0.02	0.06	0.039	0.016	5	0.04	0.24	0.08	0.089
Hydroxide (mg/L)	20	1	5	1.3	0.98	9	1	1	1	-	8	1	1	1	-
Calcium (mg/L)	20	1.2	19	5.8	5	9	1.1	3.9	2	1.1	8	3.3	8.5	4.6	1.7
Magnesium (mg/L)	20	0.1	2.9	1.6	0.84	9	0.3	1.3	0.66	0.37	8	0.8	3.7	1.6	0.9
Potassium (mg/L)	20	0.6	1.8	1.3	0.37	9	0.2	1.4	0.66	0.41	8	0.7	2.5	1.2	0.57
Sodium (mg/L)	20	1.3	4.8	3.3	0.96	9	1	3.4	2	0.93	8	2.3	5	3.3	1.1
Metals and Trace Elements															
Aluminum, dissolved (mg/L)	20	0.0005	0.017	0.0037	0.0049	9	0.001	0.045	0.017	0.021	8	0.0014	0.46	0.068	0.16
Antimony, Dissolved (mg/L)	18	0.0002	0.0005	0.00022	0.000071	9	0.0002	0.0002	0.0002	-	5	0.0002	0.002	0.00056	0.0008
Arsenic, dissolved (µg/L)	20	0.1	51	6.3	15	9	0.1	1.7	0.78	0.68	8	0.1	27	4.1	9.3
Barium, dissolved (mg/L)	20	0.005	0.085	0.026	0.026	9	0.0019	0.0056	0.0035	0.0015	8	0.003	0.067	0.022	0.027
Beryllium, dissolved (mg/L)	20	0.0001	0.001	0.00019	0.00028	9	0.0001	0.0001	0.0001	-	8	0.0001	0.001	0.00048	0.00045
Boron, dissolved (mg/L)	20	0.008	0.03	0.014	0.0061	9	0.01	0.01	0.01	-	8	0.002	0.02	0.0084	0.006
Cadmium, dissolved (mg/L)	20	0.00001	0.001	0.00011	0.0003	9	0.00001	0.00008	0.000018	0.000023	8	0.00001	0.001	0.0004	0.0005
Chromium, dissolved (mg/L)	20	0.0005	0.0012	0.00067	0.00025	9	0.0005	0.0013	0.00061	0.00026	8	0.0005	0.0029	0.0012	0.00077
Cobalt, dissolved (mg/L)	20	0.0001	0.013	0.0024	0.0046	9	0.0001	0.0002	0.00013	0.00005	8	0.0001	0.009	0.0017	0.003
Copper, dissolved (mg/L)	20	0.0002	0.0035	0.0006	0.00083	9	0.0002	0.0015	0.00053	0.00055	8	0.0002	0.043	0.0071	0.015
Iron, dissolved (mg/L)	20	0.0012	4.8	0.92	1.7	9	0.0013	4.7	1.4	2.1	8	0.005	4	0.62	1.4
Lead, dissolved (mg/L)	20	0.0001	0.002	0.00031	0.00058	9	0.0001	0.0006	0.00017	0.00017	8	0.0001	0.088	0.012	0.031
Manganese, dissolved (mg/L)	20	0.0005	1.8	0.3	0.63	9	0.0005	0.07	0.021	0.031	8	0.0057	0.47	0.10	0.16
Molybdenum, dissolved (mg/L)	20	0.0001	0.003	0.0007	0.00081	9	0.0001	0.0005	0.00017	0.00014	8	0.0002	0.0023	0.00084	0.0007
Nickel, dissolved (mg/L)	20	0.0001	0.008	0.0019	0.0027	9	0.0001	0.0005	0.0002	0.00015	8	0.0001	0.024	0.0047	0.0081
Selenium, dissolved (mg/L)	18	0.0001	0.0003	0.00012	0.000055	9	0.0001	0.0001	0.0001	-	5	0.0001	0.0004	0.00016	0.00013
Silver, dissolved (mg/L)	20	0.00005	0.001	0.00015	0.00029	9	0.00005	0.00005	0.00005	-	8	0.00005	0.001	0.00041	0.00049
Strontium, dissolved (mg/L)	20	0.011	0.052	0.035	0.015	9	0.011	0.023	0.015	0.0045	8	0.005	0.09	0.027	0.026
Thallium, Dissolved (mg/L)	18	0.0002	0.0002	0.0002	-	9	0.0002	0.0002	0.0002	-	5	0.0002	0.0002	0.0002	-
Tin, Dissolved (mg/L)	18	0.0001	0.0002	0.00011	0.000024	9	0.0001	0.0001	0.0001	-	5	0.0001	0.0004	0.00018	0.00013
Titanium, dissolved (mg/L)	20	0.0002	0.001	0.0003	0.00025	9	0.0002	0.0008	0.00038	0.00023	8	0.0002	0.0096	0.002	0.0032
Uranium, dissolved (µg/L)	20	0.1	0.3	0.12	0.052	9	0.1	0.1	0.1	-	8	0.1	3.2	0.58	1.1
Vanadium, dissolved (mg/L)	20	0.0001	0.036	0.0038	0.011	9	0.0004	0.0017	0.0011	0.00049	8	0.0001	0.0025	0.00083	0.00078
Zinc, dissolved (mg/L)	20	0.0005	0.0084	0.003	0.0026	9	0.0005	0.0053	0.0015	0.0016	8	0.0005	0.077	0.021	0.029
Radionuclides															
Lead-210, dissolved (Bq/L)	18	0.02	0.23	0.091	0.061	9	0.02	0.07	0.036	0.021	5	0.02	0.38	0.1	0.16
Polonium-210, dissolved (Bq/L)	18	0.005	0.06	0.0094	0.013	9	0.005	0.04	0.014	0.013	5	0.005	0.07	0.019	0.029
Radium-226, dissolved (Bq/L)	18	0.005	0.04	0.018	0.012	9	0.005	0.01	0.0068	0.0022	5	0.005	0.57	0.12	0.25
Thorium-230, dissolved (Bq/L)	18	0.01	0.01	0.01	-	9	0.01	0.01	0.01	-	5	0.01	0.02	0.012	0.0045

Note: "-" Indicates No Data or Standard Deviation. Standard deviations that are below x1000 the minimum concentration were replaced with "-".

[1] Presented parameters are those which have been analyzed as part of ongoing monitoring between 2022 and 2024. Not exclusive to the B1 to B4 classes.

Background monitoring began in 2001/2002 and includes data through 2024.

Background monitoring locations are 01-01A, 01-01B, 01-01C, 01-04A, 01-04B, 01-04C, 01-05A, 01-05B, 01-05C, 02-01A, 02-01B, 02-02A, 02-02B, 02-05B

TABLE 2.2-16

JEB Site Groundwater Levels - Pre-Development (1995) and Current Operations

Purpose	Monitoring Well ID	Hydrostratigraphic Unit	Predevelopment		Operations	
			Date	Groundwater Elevation (mASL)[a]	Date	Groundwater Elevation (mASL)[a]
TMF Nearfield	95-01A	Basement	29-Dec-95	451.798	13-Dec-24	451.242
TMF Nearfield	95-02A	Basement	29-Dec-95	446.931	13-Dec-24	446.408
TMF Nearfield	95-03A	Basement	29-Dec-95	446.958	13-Dec-24	446.733
TMF Nearfield	95-04A	Basement	29-Dec-95	448.964	13-Dec-24	446.549
TMF Nearfield	95-05A	Basement	29-Dec-95	449.954	8-Oct-23	447.434
CWRP	96-08	Lower Sandstone	-[b]	-[b]	10-Dec-23	445.762
TMF Containment Indicator	95-01B	Lower Sandstone	29-Dec-95	452.588	13-Dec-24	451.566
TMF Containment Indicator	95-02B	Lower Sandstone	29-Dec-95	446.929	13-Dec-24	446.219
TMF Containment Indicator	95-03B	Lower Sandstone	29-Dec-95	448.168	1-Nov-24	446.765
TMF Containment Indicator	95-04B	Lower Sandstone	29-Dec-95	449.253	13-Dec-24	446.703
TMF Containment Indicator	95-05B	Lower Sandstone	29-Dec-95	448.442	17-Oct-24	447.366
TMF Containment Indicator	TW08	Lower Sandstone	-	-	13-Dec-24	448.618
TMF Farfield	95-06	Lower Sandstone	29-Dec-95	456.547	10-Sep-24	455.411
TMF Farfield	95-07	Lower Sandstone	29-Dec-95	446.665	11-Aug-24	446.139
TMF Farfield	95-08	Lower Sandstone	29-Dec-95	445.127	10-Sep-24	444.76
TMF Farfield	95-09	Lower Sandstone	29-Dec-95	452.207	10-Sep-24	451.388
TMF Farfield	96-07A	Lower Sandstone	-	-	3-Oct-22	449.146
TMF Midfield	96-01A	Lower Sandstone	-	-	14-Jul-24	446.389
TMF Midfield	96-02A	Lower Sandstone	-	-	3-Aug-24	446.852
TMF Midfield	96-03A	Lower Sandstone	-	-	13-Aug-20	446.775
TMF Midfield	96-04	Lower Sandstone	-	-	11-Aug-24	452.757
TMF Midfield	96-09A	Lower Sandstone	-	-	10-Aug-24	445.906
CWRP	MW11	Overburden	-	-	10-Dec-23	451.712
CWRP	MW12	Overburden	-	-	10-Dec-23	456.912
CWRP	MW16	Overburden	-	-	28-Aug-24	452.719
Industrial Landfill	95-15	Overburden	29-Dec-95	453.019	4-Jun-21	451.304
Mill Terrace	21-01	Overburden	-	-	10-Oct-24	451.874
Mill Terrace	21-02	Overburden	-	-	30-Aug-24	450.171
Mill Terrace	21-04	Overburden	-	-	13-Oct-24	450.861
Mill Terrace	21-05	Overburden	-	-	30-Aug-24	450.526
Mill Terrace (CX/Acid Plant)	01-06	Overburden	-	-	7-Dec-21	449.829
Mill Terrace (CX/Acid Plant)	14-05	Overburden	-	-	13-Dec-24	450.316
Mill Terrace (CX/Acid Plant)	16-08	Overburden	-	-	5-Dec-24	449.251
Mill Terrace (Fuel Area)	16-03	Overburden	-	-	5-Dec-24	447.537
Mill Terrace (Precipitation Circuit)	19-01	Overburden	-	-	13-Oct-24	450.431
Mill Terrace (Shop Area)	95-12	Overburden	29-Dec-95	447.483	6-Dec-24	446.85
Mill Terrace (Sludge Ponds)	01-07	Overburden	-	-	5-Dec-24	448.898
Mill Terrace (Sludge Ponds)	16-07	Overburden	-	-	5-Dec-24	447.106
Mill Terrace (Slurry receiving)	14-03	Overburden	-	-	6-Dec-24	449.952
Mill Terrace (SX circuit)	05-07	Overburden	-	-	5-Dec-24	450.738
Mill Terrace (SX circuit)	14-04	Overburden	-	-	13-Dec-24	450.792
Ore Pad	14-01	Overburden	-	-	13-Dec-24	452.46
Ore Pad	16-01	Overburden	-	-	13-Dec-24	451.806
Ore Pad	16-02	Overburden	-	-	13-Dec-24	451.543
Ore Pad	95-10	Overburden	29-Dec-95	451.796	6-Dec-24	449.452
Ore Pad	MW07A	Overburden	-	-	13-Dec-24	449.547
TMF Farfield	MW18	Overburden	-	-	10-Sep-24	445.31
TMF Midfield	96-01C	Overburden	-	-	14-Jul-24	446.476
TMF Midfield	96-02C	Overburden	-	-	10-Jul-24	446.081
TMF Midfield	96-02D	Overburden	-	-	3-Aug-24	446.025
TMF Midfield	96-03C	Overburden	-	-	16-Jul-24	445.664
TMF Midfield	MW20	Overburden	-	-	8-Sep-24	450.032
TMF Nearfield	18-01D	Overburden	-	-	13-Dec-24	452.935
TMF Nearfield	95-02D	Overburden	29-Dec-95	455.296	11-Oct-24	451.208
TMF Nearfield	95-03C	Overburden	29-Dec-95	447.079	13-Dec-24	446.097
TMF Nearfield	95-04D	Overburden	29-Dec-95	447.233	7-Aug-21	447.006
TMF Nearfield	95-05D	Overburden	29-Dec-95	447.286	13-Dec-24	445.589
CWRP	07-08	Unconsolidated Waste Rock	-	-	13-Dec-23	453.283
CWRP	07-09	Unconsolidated Waste Rock	-	-	13-Dec-23	458.642
CWRP	07-10	Unconsolidated Waste Rock	-	-	13-Dec-23	458.303
TMF Farfield	96-05B	Upper Sandstone	-	-	10-Sep-24	447.046
TMF Farfield	96-06B	Upper Sandstone	-	-	10-Sep-24	447.579
TMF Midfield	96-01B	Upper Sandstone	-	-	9-Sep-24	446.298
TMF Midfield	96-02B	Upper Sandstone	-	-	10-Jul-24	447.088
TMF Midfield	96-03B	Upper Sandstone	-	-	2-Aug-23	445.575
TMF Midfield	96-09B	Upper Sandstone	-	-	10-Aug-24	446.179
TMF Nearfield	95-01C	Upper Sandstone	29-Dec-95	453.244	13-Dec-24	452.502
TMF Nearfield	95-02C	Upper Sandstone	29-Dec-95	449.85	13-Dec-24	448.034
TMF Nearfield	95-04C	Upper Sandstone	29-Dec-95	448.159	13-Dec-24	446.121
TMF Nearfield	95-05C	Upper Sandstone	29-Dec-95	446.865	27-Jun-24	447.174

[a]mASL = metres above sea level.

[b]no data.

Source: Orano 2025 (EQUIS)

Table 2.2-17

Summary Statistics for JEB Site Baseline Groundwater Chemistry

Parameter (Units)[1]	JEB Site																			
	Basement					Lower Sandstone					Upper Sandstone					Overburden				
	Count	Min	Max	Mean	Std.Dev	Count	Min	Max	Mean	Std.Dev	Count	Min	Max	Mean	Std.Dev	Count	Min	Max	Mean	Std.Dev
General Chemistry, Major Ions, and Field Parameters																				
Alkalinity (as CaCO3) (mg/L)	30	36	46	39	2.5	116	3	52	24	9.2	31	21	38	27	4.3	35	10	32	20	6.4
Alkalinity, Phenolphthalein (mg/L)	1	1	1	1	-	4	1	1	1	-	1	1	1	1	-	3	1	1	1	-
pH (pH units)	30	6.9	7.9	7.4	0.2	116	6	9.6	6.9	0.62	31	7.1	8.2	7.6	0.17	35	6.5	7.8	7.3	0.24
pH, Field (pH units)	17	6.4	8.4	7.2	0.54	64	5.4	8.2	6.5	0.72	15	6.6	8.4	7.3	0.48	20	6.3	8.1	7.2	0.41
Hardness, Total (mg/L)	30	22	37	25	2.5	116	4	39	17	8.5	31	17	41	22	4.1	35	6	28	15	6.3
Specific Conductivity (µS/cm)	30	89	130	100	8.1	116	19	120	56	21	31	51	73	59	5.3	35	23	77	43	14
Specific Conductivity, Field (µS/cm)	17	73	120	98	10	63	11	75	45	18	15	38	68	54	6.8	20	24	54	41	8.6
Sum of Ions (mg/L)	30	67	96	74	5.6	116	9	75	42	15	30	38	62	48	5.8	35	17	56	36	12
Total Dissolved Solids (mg/L)	30	45	85	62	8.5	116	3	91	49	16	31	32	99	54	14	35	21	120	46	19
Total Suspended Solids (mg/L)	30	1	150	13	31	112	1	480	12	48	30	1	3700	280	700	35	1	2200	410	480
Ammonia (as N) (mg/L)	30	0.03	0.23	0.11	0.044	112	0.01	0.22	0.049	0.038	30	0.01	0.15	0.04	0.041	35	0.01	0.12	0.046	0.03
Ammonia, Un-ionized (as N) (mg/L)	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
Nitrate (mg/L)	2	0.04	0.04	0.04	-	8	0.04	0.62	0.21	0.19	2	0.04	0.04	0.04	-	4	0.4	1.1	0.7	0.31
Nitrate + Nitrite (as N) (mg/L)	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
Bicarbonate (as HCO3) (mg/L)	30	44	56	47	3.1	116	4	51	29	11	31	26	46	33	5.2	35	12	39	25	7.9
Carbonate (as CO3) (mg/L)	30	1	1	1	-	116	1	19	1.2	1.7	31	1	1	1	-	35	1	1	1	-
Sulfate (mg/L)	30	1.1	5.1	1.7	0.68	116	0.3	4.8	1.7	1.2	31	1.8	2.9	2.4	0.28	35	0.7	7.2	1.8	1.4
Chloride (mg/L)	30	2.4	7.5	5.5	1.6	116	0.1	4.1	1.3	1.4	31	0.1	3.8	0.27	0.67	35	0.1	0.8	0.34	0.2
Fluoride (mg/L)	2	0.15	0.26	0.21	0.078	8	0.08	0.23	0.13	0.057	2	0.21	0.25	0.23	0.028	4	0.01	0.03	0.02	0.0082
Hydroxide (mg/L)	17	1	1	1	-	71	1	1	1	-	18	1	1	1	-	22	1	1	1	-
Calcium (mg/L)	30	4.5	9.2	5.1	0.81	116	0.8	12	3.9	1.9	31	3.8	7	4.8	0.64	35	1.6	6.8	3.8	1.5
Magnesium (mg/L)	30	2.6	3.3	2.9	0.15	116	0.4	3.3	1.9	0.93	31	1.8	5.8	2.5	0.71	35	0.4	2.9	1.4	0.64
Potassium (mg/L)	30	1.8	4.6	3	0.48	116	0.1	6.9	1.3	0.67	31	1	17	3.1	3.3	35	0.1	3.7	1.2	0.71
Sodium (mg/L)	30	7.6	9.8	8.4	0.44	116	1.4	6.2	2.9	0.91	31	2.3	6.1	2.8	0.64	35	1.4	4.8	2.6	0.74
Metals and Trace Elements																				
Aluminum, dissolved (mg/L)	6	0.0012	0.0069	0.0047	0.0019	23	0.0005	0.024	0.0074	0.0063	6	0.007	0.03	0.017	0.01	7	0.006	0.019	0.011	0.0042
Antimony, Dissolved (mg/L)	2	0.0002	0.0002	0.0002	-	8	0.0002	0.0002	0.0002	2.9E-20	2	0.0002	0.0002	0.0002	-	4	0.0002	0.0017	0.00058	0.00075
Arsenic, dissolved (µg/L)	28	0.2	3.3	0.72	0.8	110	0.2	7.5	1.4	1.2	29	1.2	5.1	1.9	0.88	33	0.1	6.7	0.82	1.2
Barium, dissolved (mg/L)	6	0.0039	0.009	0.0062	0.0021	24	0.0036	0.018	0.013	0.0053	6	0.0019	0.004	0.0029	0.00074	7	0.0032	0.006	0.0042	0.0011
Beryllium, dissolved (mg/L)	6	0.0001	0.001	0.0007	0.00046	24	0.0001	0.001	0.0007	0.00043	6	0.0001	0.001	0.0007	0.00046	7	0.0001	0.001	0.00049	0.00048
Boron, dissolved (mg/L)	6	0.17	0.2	0.19	0.012	24	0.003	0.033	0.015	0.01	6	0.003	0.01	0.0055	0.0035	7	0.003	0.013	0.0086	0.0036
Cadmium, dissolved (mg/L)	27	0.00001	0.001	0.00089	0.00031	106	0.00001	0.001	0.00089	0.00031	28	0.00001	0.001	0.0009	0.0003	32	0.00001	0.001	0.00082	0.00038
Chromium, dissolved (mg/L)	6	0.0005	0.001	0.00083	0.00026	24	0.0005	0.001	0.00083	0.00024	6	0.0005	0.001	0.00083	0.00026	7	0.0005	0.001	0.00071	0.00027
Cobalt, dissolved (mg/L)	6	0.0001	0.001	0.0007	0.00046	24	0.0001	0.001	0.00081	0.00031	6	0.0001	0.001	0.0007	0.00046	7	0.0001	0.001	0.00049	0.00048
Copper, dissolved (mg/L)	28	0.0002	0.004	0.0011	0.00084	110	0.0002	0.005	0.0011	0.00075	29	0.0002	0.005	0.0011	0.00083	33	0.0002	0.006	0.0015	0.0011
Iron, dissolved (mg/L)	28	0.015	1.4	1.2	0.3	110	0.009	3.8	0.37	0.46	29	0.0018	0.045	0.014	0.011	33	0.0032	0.12	0.019	0.024
Lead, dissolved (mg/L)	28	0.0001	0.002	0.0018	0.0006	110	0.0001	0.002	0.0018	0.00058	29	0.0001	0.002	0.0018	0.00059	33	0.00002	0.003	0.0017	0.00081
Manganese, dissolved (mg/L)	28	0.092	0.32	0.15	0.062	110	0.005	1	0.19	0.17	29	0.0006	0.002	0.0012	0.00044	33	0.0001	0.067	0.0033	0.012
Molybdenum, dissolved (mg/L)	28	0.0007	0.01	0.0014	0.0018	110	0.0001	0.019	0.0013	0.0022	29	0.001	0.004	0.0014	0.00079	33	0.0001	0.003	0.0009	0.00051
Nickel, dissolved (mg/L)	28	0.0001	0.004	0.0011	0.00074	110	0.0001	0.006	0.0011	0.00064	29	0.0001	0.003	0.0011	0.00054	33	0.0001	0.004	0.001	0.00071
Selenium, dissolved (mg/L)	2	0.0001	0.0001	0.0001	-	8	0.0001	0.0003	0.00014	0.000074	2	0.0001	0.0001	0.0001	-	4	0.0001	0.0002	0.00013	0.00005
Silver, dissolved (mg/L)	6	0.00001	0.001	0.00068	0.0005	24	0.00001	0.002	0.00072	0.00054	6	0.00001	0.001	0.00068	0.0005	7	0.00001	0.001	0.00045	0.00052
Strontium, dissolved (mg/L)	6	0.089	0.1	0.094	0.0039	24	0.008	0.047	0.028	0.012	6	0.021	0.024	0.023	0.0011	7	0.016	0.022	0.019	0.0019
Thallium, Dissolved (mg/L)	2	0.0002	0.0002	0.0002	-	8	0.0002	0.0002	0.0002	-	2	0.0002	0.0002	0.0002	-	4	0.0002	0.0002	0.0002	-
Tin, Dissolved (mg/L)	2	0.0001	0.0001	0.0001	-	8	0.0001	0.0001	0.0001	-	2	0.0001	0.0001	0.0001	-	4	0.0001	0.0001	0.0001	-
Titanium, dissolved (mg/L)	6	0.0002	0.001	0.00073	0.00041	24	0.0002	0.0011	0.00079	0.00035	6	0.0004	0.001	0.0008	0.00031	7	0.0002	0.001	0.0006	0.00038
Uranium, dissolved (µg/L)	28	0.1	1.4	0.31	0.29	110	0.1	3.4	0.3	0.37	29	0.1	1.4	0.28	0.28	33	0.1	1	0.31	0.23
Vanadium, dissolved (mg/L)	6	0.0001	0.001	0.0007	0.00046	24	0.0001	0.001	0.00074	0.00038	6	0.002	0.004	0.0028	0.00071	7	0.001	0.0014	0.0012	0.00021
Zinc, dissolved (mg/L)	28	0.0005	0.013	0.0055	0.0028	110	0.0005	0.014	0.0048	0.0019	29	0.0005	0.012	0.0052	0.0021	33	0.0017	0.016	0.0059	0.0027
Radionuclides																				
Lead-210, dissolved (Bq/L)	28	0.02	0.1	0.037	0.02	110	0.02	0.15	0.037	0.025	29	0.02	0.11	0.058	0.022	33	0.02	0.1	0.024	0.015
Polonium-210, dissolved (Bq/L)	28	0.005	0.02	0.0061	0.003	110	0.005	0.19	0.0096	0.018	29	0.005	0.01	0.0059	0.0016	33	0.005	0.03	0.0062	0.0044
Radium-226, dissolved (Bq/L)	28	0.005	0.01	0.0058	0.0014	110	0.005	0.08	0.013	0.011	29	0.005	0.02	0.0072	0.0041	33	0.005	0.02	0.0057	0.0027
Thorium-230, dissolved (Bq/L)	28	0.01	0.01	0.01	-	110	0.01	0.025	0.01	0.0019	29	0.01	0.02	0.01	0.0019	33	0.01	0.01	0.01	-

Note: "-" Indicates No Data or Standard Deviation

[1] Presented parameters are those which have been analyzed as part of ongoing monitoring between 2022 and 2024. Not exclusive to the B1 to B4 classes.

Baseline monitoring for the JEB site occurred between 1996 and 2011

Baseline monitoring locations for the JEB site were 95-02A, 95-02B, 95-02C, 95-02D, 95-06, 95-08, 95-09

Table 2.2-18

Summary of Mean Groundwater Chemistry data for 2022 to 2024 and Statistical Trend Analysis results for 2011-2024 at JEB Mill and Ore Pad Wells

| Location | Sub-Location | Completion | Well | Count | General Chemistry, Major Ions, and Field Parameters | | | | | | | | | | | | | | | | | | | Metals and Trace Elements | | | | | | | | | | | | | | | | | | |

Table 2.2-19

Summary of Mean Groundwater Chemistry data for 2022 to 2024 and Statistical Trend Analysis for 2011-2024 at JEB TMF Area Wells

| Location | Sub-Location | Completion | Well | Count | General Chemistry, Major Ions, and Field Parameters | | | | | | | | | | | | | | | | | | | Metals and Trace Elements | | | | | | | | | | | | | | | | | | |

Table 2.2-20

Summary of Mean Groundwater Chemistry data for 2022 to 2024 and Statistical Trend Analysis for 2011-2024 at JEB Clean Waste Rock and Landfill Wells

| Location | Sub-Location | Completion | Well | Count | General Chemistry, Major Ions, and Field Parameters | | | | | | | | | | | | | | | | | | Metals and Trace Elements | | | | | | | | | | | | | | | | | |

TABLE 2.2-21

Sue Site Groundwater Levels - Pre-Development (1997) and Current Operations

Purpose	Monitoring Well ID	Hydrostratigraphic Unit	Predevelopment		Operations	
			Date	Groundwater Elevation (mASL)[a]	Date	Groundwater Elevation (mASL)[a]
Sue C/A and Sue B Pits, Nearfield	97-01A	Basement	25-May-97	452.903	6-Dec-24	444.907
Sue C/A and Sue B Pits, Nearfield	97-02A	Basement	25-May-97	452.417	6-Dec-24	443.178
Sue C/A and Sue B Pits, Nearfield	97-03A	Basement	25-May-97	449.693	6-Dec-24	440.671
Sue C/A and Sue B Pits, Nearfield	97-05A	Basement	25-May-97	444.231	14-Dec-24	439.82
Sue C/A and Sue B Pits, Nearfield	97-07A	Basement	25-May-97	448.377	14-Dec-24	438.169
Sue E CWRP	05-01A	Lower sandstone	-[b]	-[b]	7-Dec-24	439.911
Sue E CWRP	05-02A	Lower sandstone	-	-	7-Dec-24	441.217
Sue E Pit, Nearfield	05-03	Lower sandstone	-	-	14-Dec-24	446.766
Sue E Pit, Nearfield	05-04	Lower sandstone	-	-	14-Dec-24	445.568
Sue E Pit, Nearfield	05-05A	Lower sandstone	-	-	7-Dec-24	446.898
Sue C/A and Sue B Pits, Nearfield	97-01B	Lower sandstone	25-May-97	453.771	29-Sep-24	448.76
Sue C/A and Sue B Pits, Nearfield	97-02B	Lower sandstone	25-May-97	452.486	6-Dec-24	443.361
Sue C/A and Sue B Pits, Nearfield	97-03B	Lower sandstone	25-May-97	450.838	6-Dec-24	440.448
Sue C/A and Sue B Pits, Nearfield	97-05B	Lower sandstone	25-May-97	445.784	7-Dec-24	437.876
Sue C/A and Sue B Pits, Nearfield	97-06B	Lower sandstone	25-May-97	446.451	14-Dec-24	437.921
Sue C/A and Sue B Pits, Nearfield	97-07B	Lower sandstone	25-May-97	449.145	14-Dec-24	438.757
Sue C CWRP	97-08A	Lower sandstone	25-May-97	451.886	14-Dec-24	451.588
Sue Pits and CWRP, Farfield	97-09	Lower sandstone	25-May-97	452.645	18-Dec-23	446.759
Sue Pits and CWRP, Farfield	97-10	Lower sandstone	25-May-97	450.781	18-Dec-23	448.161
Sue Pits and CWRP, Farfield	97-11	Lower sandstone	25-May-97	441.077	17-Dec-23	439.713
Sue E CWRP	05-01B	Overburden	-	-	7-Dec-24	442.24
Sue E CWRP	05-02B	Overburden	-	-	6-Aug-24	441.634
Sue E Pit, Nearfield	05-05B	Overburden	-	-	3-Aug-21	450.691
Sue C/A and Sue B Pits, Nearfield	97-01C	Overburden	25-May-97	454.495	25-Oct-21	451.761
Sue C/A and Sue B Pits, Nearfield	97-05C	Overburden	25-May-97	451.308	9-Jun-24	445.868
Sue C CWRP	97-08B	Overburden	25-May-97	455.819	14-Dec-24	454.877
Sue C CWRP	97-15	Overburden	25-May-97	462.772	7-Dec-24	459.574
Sue C CWRP	97-16	Overburden	25-May-97	463.82	9-Jun-24	463.828
Sue C/A and Sue B Pits, Nearfield	97-12	Overburden/Upper sandstone	-	-	16-Oct-18	454.598
Sue C CWRP	97-14	Overburden/Upper sandstone	-	-	16-Oct-18	456.126
Sue B Pit and Ore Transfer Pad, Nearfield	97-18	Overburden/Upper sandstone	25-May-97	451.106	14-Oct-24	450.062
Sue C CWRP	07-11	Unconsolidated Waste Rock	-	-	18-Dec-23	455.963
Sue C CWRP	07-12	Unconsolidated Waste Rock	-	-	10-Oct-23	455.249
Sue C CWRP	07-13	Unconsolidated Waste Rock	-	-	11-May-23	462.013
Sue E CWRP	07-14	Unconsolidated Waste Rock	-	-	26-Aug-24	448.502
Sue E CWRP	07-15	Unconsolidated Waste Rock	-	-	6-Aug-24	447.271

[a]mASL = metres above sea level.

[b]no data.

Source: Orano 2025 (EQUIS)

Table 2.2-22

Summary Statistics for Sue Baseline Monitoring

Parameter (Units)[1]	Sue Site														
	Basement					Lower Sandstone					Overburden				
	Count	Min	Max	Mean	Std.Dev	Count	Min	Max	Mean	Std.Dev	Count	Min	Max	Mean	Std.Dev
General Chemistry, Major Ions, and Field Parameters															
Alkalinity (as CaCO3) (mg/L)	25	32	70	44	10	232	1	53	12	8	2	14	31	23	12
Alkalinity, Phenolphthalein (mg/L)	0	-	-	-	-	6	1	1	1	-	0	-	-	-	-
pH (pH units)	25	6.5	9.7	7.4	0.78	232	4.6	8.7	6.4	0.39	2	7	9.2	8.1	1.6
pH, Field (pH units)	19	6.1	8.7	6.7	0.55	111	5.2	8.1	6.2	0.53	0	-	-	-	-
Hardness, Total (mg/L)	25	25	65	35	9.3	232	10	480	180	170	2	6	15	11	6.4
Specific Conductivity (µS/cm)	25	84	200	100	25	232	30	1900	790	750	2	34	71	53	26
Specific Conductivity, Field (µS/cm)	22	64	140	93	17	118	19	1900	570	680	0	-	-	-	-
Sum of Ions (mg/L)	25	58	120	76	14	232	21	930	370	350	2	24	47	36	16
Total Dissolved Solids (mg/L)	25	49	110	63	13	232	15	1500	480	460	2	17	50	34	23
Total Suspended Solids (mg/L)	25	1	18	4.3	4.2	232	1	2700	76	280	2	190	390	290	140
Ammonia (as N) (mg/L)	24	0.01	0.29	0.16	0.059	225	0.01	0.94	0.31	0.3	2	0.04	0.2	0.12	0.11
Ammonia, Un-ionized (as N) (mg/L)	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
Nitrate (mg/L)	1	0.04	0.04	0.04	-	39	0.04	4.4	0.21	0.72	0	-	-	-	-
Nitrate + Nitrite (as N) (mg/L)	0	-	-	-	-	6	0.01	0.05	0.018	0.016	0	-	-	-	-
Bicarbonate (as HCO3) (mg/L)	25	24	70	50	12	231	1	45	15	9.5	2	17	23	20	4.2
Carbonate (as CO3) (mg/L)	25	1	24	2.8	6.2	232	1	10	1	0.59	2	1	7	4	4.2
Sulfate (mg/L)	25	0.4	7	2.9	2	232	0.2	8.7	0.82	1	2	0.2	1.6	0.9	0.99
Chloride (mg/L)	25	0.3	17	2.6	4.6	232	0.1	630	240	240	2	0.2	0.4	0.3	0.14
Fluoride (mg/L)	1	0.18	0.18	0.18	-	30	0.02	0.28	0.14	0.061	0	-	-	-	-
Hydroxide (mg/L)	17	1	1	1	-	198	1	1	1	-	0	-	-	-	-
Calcium (mg/L)	25	5.8	17	9.1	3.1	232	2.4	110	38	35	2	2.1	5.6	3.9	2.5
Magnesium (mg/L)	25	2.4	5.5	3.1	0.7	232	0.7	55	22	21	2	0.3	0.3	0.3	-
Potassium (mg/L)	25	1.8	7.6	2.6	1.5	232	0.1	18	6.4	5.8	2	1.3	5	3.2	2.6
Sodium (mg/L)	25	2.6	8.2	3.2	1.3	232	1	170	54	54	2	2.9	4.1	3.5	0.85
Metals and Trace Elements															
Aluminum, dissolved (mg/L)	3	0.0013	0.005	0.0038	0.0021	130	0.0014	0.035	0.0073	0.0056	0	-	-	-	-
Antimony, Dissolved (mg/L)	1	0.0002	0.0002	0.0002	-	30	0.0002	0.002	0.0018	0.00055	0	-	-	-	-
Arsenic, dissolved (µg/L)	24	0.4	1.2	0.58	0.2	231	0.1	400	5.5	27	2	0.5	0.6	0.55	0.071
Barium, dissolved (mg/L)	3	0.026	0.03	0.028	0.002	130	0.006	0.16	0.097	0.04	0	-	-	-	-
Beryllium, dissolved (mg/L)	3	0.0001	0.001	0.0007	0.00052	45	0.0001	0.001	0.00094	0.00023	0	-	-	-	-
Boron, dissolved (mg/L)	3	0.03	0.036	0.032	0.0035	130	0.002	0.3	0.11	0.07	0	-	-	-	-
Cadmium, dissolved (mg/L)	24	0.00001	0.001	0.00092	0.00027	231	0.00001	0.005	0.00085	0.00044	2	0.001	0.001	0.001	-
Chromium, dissolved (mg/L)	3	0.0005	0.001	0.00083	0.00029	130	0.0005	0.005	0.0022	0.0019	0	-	-	-	-
Cobalt, dissolved (mg/L)	3	0.005	0.0063	0.0058	0.00068	130	0.0001	0.002	0.00099	0.00015	0	-	-	-	-
Copper, dissolved (mg/L)	24	0.0002	0.005	0.0012	0.00089	231	0.0002	0.013	0.0017	0.0017	2	0.003	0.007	0.005	0.0028
Iron, dissolved (mg/L)	24	0.003	4.7	0.92	1	230	0.0005	46	19	18	2	0.005	0.078	0.042	0.052
Lead, dissolved (mg/L)	24	0.0001	0.002	0.0019	0.00048	231	0.0001	0.006	0.0018	0.00065	2	0.002	0.002	0.002	-
Manganese, dissolved (mg/L)	24	0.017	3.6	2	1.1	231	0.0005	2.1	0.86	0.8	2	0.001	0.084	0.043	0.059
Molybdenum, dissolved (mg/L)	24	0.0004	0.002	0.001	0.00025	231	0.0001	0.99	0.007	0.065	2	0.001	0.001	0.001	-
Nickel, dissolved (mg/L)	24	0.001	0.015	0.0039	0.0035	231	0.0002	0.087	0.0025	0.0079	2	0.001	0.027	0.014	0.018
Selenium, dissolved (mg/L)	1	0.0001	0.0001	0.0001	-	115	0.0001	0.002	0.00033	0.00045	0	-	-	-	-
Silver, dissolved (mg/L)	3	0.00001	0.001	0.00067	0.00057	45	0.00001	0.001	0.00039	0.00043	0	-	-	-	-
Strontium, dissolved (mg/L)	3	0.075	0.097	0.083	0.012	45	0.022	1.7	0.75	0.7	0	-	-	-	-
Thallium, Dissolved (mg/L)	1	0.0002	0.0002	0.0002	-	30	0.0002	0.002	0.0018	0.00055	0	-	-	-	-
Tin, Dissolved (mg/L)	1	0.0001	0.0001	0.0001	-	30	0.0001	0.001	0.00091	0.00027	0	-	-	-	-
Titanium, dissolved (mg/L)	3	0.0002	0.001	0.00073	0.00046	45	0.0002	0.003	0.0016	0.00062	0	-	-	-	-
Uranium, dissolved (µg/L)	23	0.1	1.2	0.31	0.27	228	0.1	5.7	0.32	0.57	2	0.1	3.7	1.9	2.5
Vanadium, dissolved (mg/L)	3	0.0001	0.001	0.0007	0.00052	129	0.0001	0.001	0.00098	0.00011	0	-	-	-	-
Zinc, dissolved (mg/L)	24	0.005	0.04	0.012	0.0097	231	0.0005	1.1	0.026	0.098	2	0.005	0.057	0.031	0.037
Radionuclides															
Lead-210, dissolved (Bq/L)	24	0.02	0.13	0.037	0.026	230	0.02	40	1.3	3.9	2	0.02	0.02	0.02	-
Polonium-210, dissolved (Bq/L)	24	0.005	0.01	0.0058	0.0017	231	0.005	1.6	0.061	0.19	2	0.005	0.005	0.005	-
Radium-226, dissolved (Bq/L)	24	0.005	0.11	0.014	0.023	222	0.005	32	3.7	8.1	2	0.005	0.007	0.006	0.0014
Thorium-230, dissolved (Bq/L)	24	0.01	0.02	0.01	0.002	231	0.01	0.38	0.03	0.054	2	0.01	0.01	0.01	-

Note: "-" Indicates No Data or Standard Deviation. Standard deviation that are below x1000 the minimum concentration were replaced with "-".

[1] Presented parameters are those which have been analyzed as part of ongoing monitoring between 2022 and 2024. Not exclusive to the B1 to B4 classes.

Baseline monitoring for the Sue site occurred between 1997 and 2010

Baseline monitoring was not completed in the upper sandstone layer

Baseline Monitoring Locations for Sue Site were 97-03A, 97-03B, 97-03C, 97-09, 97-10, 97-11, 03-03, MED05-01, MED05-02, MED05-03

Table 2.2-23

Summary of Mean Groundwater Chemistry data for 2022 to 2024 and Statistical Trend Analysis for 2011-2024 at the Sue Site

| Location | | Completion | Well | Count | General Chemistry, Major Ions, and Field Parameters | | | | | | | | | | | | | | | | | Metals and Trace Elements | | | | | | | | | | | | | | | | |

Table 2.2-24

Moffat Domestic Landfill Groundwater Levels - Pre-Development and Current Operations

Monitoring Well ID	Hydrostratigraphic Unit	Pre-Development		2024	
		Date	Groundwater Elevation (mASL)[a]	Date	Groundwater Elevation (mASL)
04-01	Overburden	05-Dec-04	443.869	29-Jun-24	442.897
04-02	Overburden	05-Dec-04	443.326	31-Aug-24	443.130
97-19	Overburden	16-Dec-98	446.546	29-Jun-24	445.806

[a]metres above sea level.

Source: Orano EQUIS database and Orano 2025.

Table 2.2-25

Summary of Mean Groundwater Chemistry data and Statistical Trend Anlaysis for 2011-2024 at Moffat Domestic Landfill

Location	Completion	Well	Count	General Chemistry, Major Ions, and Field Parameters																	Metals and Trace Elements																					Radionuclides			
				Alkalinity (as CaCO3)	Bicarbonate (as HCO3)	Ammonia (as N)	Nitrate	Nitrate + Nitrite (as N)	Chloride	Sulfate	Calcium, Total	Magnesium, Total	Potassium	Sodium, Total	Sum Of Ions	Hardness, Total	Total Dissolved Solids	Total Suspended Solids	pH, Field	Specific Conductivity, Field	Aluminum, Dissolved	Arsenic, Dissolved	Barium, Dissolved	Boron, Dissolved	Cadmium, Dissolved	Chromium, Dissolved	Cobalt, Dissolved	Copper, Dissolved	Iron, Dissolved	Lead, Dissolved	Manganese, Dissolved	Molybdenum, Dissolved	Nickel, Dissolved	Selenium, Dissolved	Silver, Dissolved	Strontium, Dissolved	Uranium, Dissolved	Vanadium, Dissolved	Zinc, Dissolved	Lead-210, Dissolved	Polonium-210, Dissolved	Radium-226, Dissolved	Thorium-230, Dissolved
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	s.u.	µS/cm	µg/l	µg/l	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/l	mg/L	mg/L	bq/L	bq/L	bq/L	bq/L
SEQG (Min-Max)				*-*	*-*	*19*	*13*	*3.0*	*100*	*130*	*-*	*-*	*-*	*200*	*-*	*-*	*500*	*-*	*-*	*1000*	*0.050*	*5.0*	*2.0*	*1.0*	*0.000041*	*0.05*	*-*	*0.0070*	*0.30*	*0.000001*	*0.020*	*-*	*0.013*	*0.002*	*0.00025*	*-*	*10*	*-*	*0.030*	*0.20*	*0.20*	*0.50*	*0.40*
80% of SEQG				*-*	*-*	*15*	*11*	*2.4*	*80*	*100*	*-*	*-*	*-*	*160*	*-*	*-*	*400*	*-*	*-*	*800*	*0.040*	*4.0*	*1.6*	*0.80*	*0.000033*	*0.04*	*-*	*0.0056*	*0.24*	*0.0000008*	*0.016*	*-*	*0.011*	*0.0016*	*0.0002*	*-*	*8.0*	*-*	*0.024*	*0.16*	*0.16*	*0.40*	*0.32*
Moffat Landfill	Overburden	04-01	*5*	45	55	0.17	5.4	1.2	0.26	2.2	10	3.0	1.2	4.5	82	37	75	85	6.7	100	0.0021	0.10	0.0069	0.010	0.00001	0.00062	0.00026	0.0024	0.014	0.0001	0.010	0.00012	0.0055	0.0001	0.00005	0.051	0.18	0.0001	**0.033**	0.023	0.0050	0.0075	0.010
		04-02	*6*	140	170	0.045	7.8	1.7	10	17	35	14	2.7	12	270	150	210	35	6.7	310	0.0015	0.10	0.018	0.11	0.000013	0.00077	0.00018	0.0012	0.0031	0.0001	0.0023	0.00027	0.0018	0.0001	0.00005	0.13	**15**	0.00038	0.0056	0.025	0.0050	0.0075	0.010
		97-19	*5*	26	31	0.018	4.4	1.0	0.26	0.62	5.1	1.3	1.0	3.0	47	18	45	220	6.9	55	0.011	0.10	0.0037	0.010	0.000012	0.0006	0.00010	0.00068	0.0086	0.0001	0.0023	0.0001	0.00016	0.0001	0.00005	0.027	0.12	0.00028	0.0015	0.020	0.0050	0.0053	0.010

Note: Value shown is mean value for reporting period 2022 to 2024

For detailed trend analysis results see Appendix II.2-9.

For SEQG values dependent on toxicity-modifying factors, the 25th percentile of hardness values and the 75th percentiles of field pH and temperature values were used

- SEQG values listed along the top of the table were calculated based site-wide statistics for Moffat for the reporting period
- SEQG values used to determine bold formatting were calculated based on statistics for the individual station for the reporting period

LEGEND:

Increasing Trend
Decreasing Trend
No Trend
Insufficient data for trend analysis (i.e.,more than 40% of results were below detection limits)
Recent mean greater than 80% of SEQG

Table 2.2-26

Summary of Baseline Groundwater Chemistry for the McClean Mining (SABRE) Site

McClean Mining					
Parameter (Units)[1]	Lower Sandstone				
	Count	Min	Max	Mean	Std.Dev
General Chemistry, Major Ions, and Field Parameters					
Alkalinity (as CaCO3) (mg/L)	128	1	53	6.4	5.7
Alkalinity, Phenolphthalein (mg/L)	6	1	1	1	-
pH (pH units)	128	4.6	8.7	6.3	0.44
pH, Field (pH units)	49	6	7	6.6	0.2
Hardness, Total (mg/L)	128	120	480	320	110
Specific Conductivity (µS/cm)	128	540	1900	1400	450
Specific Conductivity, Field (µS/cm)	51	470	1900	1300	440
Sum of Ions (mg/L)	128	240	930	650	220
Total Dissolved Solids (mg/L)	128	260	1500	850	300
Total Suspended Solids (mg/L)	128	1	110	18	14
Ammonia (as N) (mg/L)	124	0.05	0.94	0.53	0.24
Ammonia, Un-ionized (as N) (mg/L)	0	-	-	-	-
Nitrate (mg/L)	36	0.04	4.4	0.18	0.73
Nitrate + Nitrite (as N) (mg/L)	6	0.01	0.05	0.018	0.016
Bicarbonate (as HCO3) (mg/L)	127	1	45	7.6	5.9
Carbonate (as CO3) (mg/L)	128	1	10	1.1	0.8
Sulfate (mg/L)	128	0.2	8.7	0.82	1.2
Chloride (mg/L)	128	150	630	430	150
Fluoride (mg/L)	27	0.07	0.28	0.16	0.051
Hydroxide (mg/L)	128	1	1	1	-
Calcium (mg/L)	128	26	110	66	22
Magnesium (mg/L)	128	13	55	38	13
Potassium (mg/L)	128	3.8	18	11	4.3
Sodium (mg/L)	128	38	170	97	33
Metals and Trace Elements					
Aluminum, dissolved (mg/L)	112	0.005	0.026	0.0067	0.0041
Antimony, Dissolved (mg/L)	27	0.002	0.002	0.002	-
Arsenic, dissolved (µg/L)	128	0.1	400	9.4	35
Barium, dissolved (mg/L)	112	0.073	0.16	0.11	0.026
Beryllium, dissolved (mg/L)	27	0.001	0.001	0.001	-
Boron, dissolved (mg/L)	112	0.057	0.3	0.13	0.06
Cadmium, dissolved (mg/L)	128	0.0001	0.001	0.00077	0.00039
Chromium, dissolved (mg/L)	112	0.001	0.005	0.0024	0.0019
Cobalt, dissolved (mg/L)	112	0.001	0.001	0.001	-
Copper, dissolved (mg/L)	128	0.001	0.013	0.0018	0.0019
Iron, dissolved (mg/L)	127	0.36	46	34	11
Lead, dissolved (mg/L)	128	0.001	0.006	0.0018	0.00063
Manganese, dissolved (mg/L)	128	0.074	2.1	1.5	0.49
Molybdenum, dissolved (mg/L)	128	0.001	0.99	0.012	0.088
Nickel, dissolved (mg/L)	128	0.001	0.003	0.0011	0.00034
Selenium, dissolved (mg/L)	112	0.0001	0.002	0.00034	0.00045
Silver, dissolved (mg/L)	27	0.0001	0.0001	0.0001	-
Strontium, dissolved (mg/L)	27	0.38	1.7	1.2	0.5
Thallium, Dissolved (mg/L)	27	0.002	0.002	0.002	-
Tin, Dissolved (mg/L)	27	0.001	0.001	0.001	-
Titanium, dissolved (mg/L)	27	0.002	0.003	0.002	0.00019
Uranium, dissolved (µg/L)	127	0.1	5.7	0.24	0.53
Vanadium, dissolved (mg/L)	111	0.001	0.001	0.001	-
Zinc, dissolved (mg/L)	128	0.005	1.1	0.043	0.13
Radionuclides					
Lead-210, dissolved (Bq/L)	127	0.02	40	2.2	5
Polonium-210, dissolved (Bq/L)	128	0.005	1.6	0.1	0.24
Radium-226, dissolved (Bq/L)	119	0.005	32	6.9	10
Thorium-230, dissolved (Bq/L)	128	0.01	0.38	0.045	0.069

Note: "-" Indicates No Data or Standard Deviation. Standard deviations that are below x1000 the minimum concentration were replaced with "-".

[1] Presented parameters are those which have been analyzed as part of ongoing monitoring between 2022 and 2024. Not exclusive to the B1 to B4 classes.

Baseline monitoring for the Sue site occurred between 1997 and 2010

Baseline monitoring was not completed in the basement, upper sandstone, or overburden layers

Baseline Monitoring Locations for McClean Mining site were 03-03, MED05-01, MED05-02, MED05-03,.

Table 2.2-27

Summary of Mean Value for Reporting Period and Statistical Trend Analysis for 2011-2024 for the McClean Mining (SABRE) Site

Location	Completion	Well	Count	General Chemistry, Major Ions, and Field Parameters																	Metals and Trace Elements																											Radionuclides			
				Alkalinity (as CaCO3)	Bicarbonate (as HCO3)	Ammonia (as N)	Chloride	Fluoride	Sulfate	Calcium, Total	Magnesium, Total	Potassium	Sodium, Total	Sum Of Ions	Hardness, Total	Total Dissolved Solids	Total Suspended Solids	pH, Field	Specific Conductivity, Field	Aluminum, Dissolved	Arsenic, Dissolved	Barium, Dissolved	Boron, Dissolved	Cadmium, Dissolved	Chromium, Dissolved	Cobalt, Dissolved	Copper, Dissolved	Iron, Dissolved	Lead, Dissolved	Manganese, Dissolved	Molybdenum, Dissolved	Nickel, Dissolved	Selenium, Dissolved	Silver, Dissolved	Strontium, Dissolved	Tin, Dissolved	Titanium, Dissolved	Uranium, Dissolved	Vanadium, Dissolved	Zinc, Dissolved	Lead-210, Dissolved	Polonium-210, Dissolved	Radium-226, Dissolved	Thorium-230, Dissolved
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	s.u.	µS/cm	mg/L	µg/l	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/l	mg/L	mg/L	bq/L	bq/L	bq/L	bq/L
SEQG (Min-Max)				-	-	*22*	*100*	*1.0*	*220*	-	-	-	*200*	-	-	*500*	-	-	*1000*	*0.050*	*5.0*	*2.0*	*1.0*	*0.000067*	*0.050*	-	*0.0070*	*0.30*	*0.000001*	*0.020*	-	*0.022*	*0.002*	*0.00025*	-	-	-	*10*	-	*0.030*	*0.20*	*0.20*	*0.50*	*0.40*
80% of SEQG				-	-	*18*	*80*	*0.80*	*170*	-	-	-	*160*	-	-	*400*	-	-	*800*	*0.040*	*4.0*	*1.6*	*0.8*	*0.000054*	*0.040*	-	*0.0056*	*0.24*	*0.0000008*	*0.016*	-	*0.017*	*0.0016*	*0.0002*	-	-	-	*8.0*	-	*0.024*	*0.16*	*0.16*	*0.40*	*0.32*
McClean Minig	Overburden	13-01	*4*	46	56	0.040	10	0.038	1.5	13	2.9	1.0	5.3	90	44	85	75	**6.1**	130	0.0094	0.15	0.013	0.010	**0.000063**	0.0005	0.0025	0.0010	0.15	0.00013	**1.1**	0.00013	0.0044	0.0001	0.00005	0.089	0.0001	0.00045	0.40	0.00010	0.011	0.023	0.015	0.028	0.010
		13-02	*6*	31	38	0.22	9.6	0.053	3.3	9.2	2.3	1.7	4.9	69	32	95	52	**5.9**	130	**0.22**	**19**	0.036	0.015	0.000027	0.0016	0.0022	0.0007	**10**	0.00027	**0.18**	0.036	0.0053	0.0002	0.00005	0.067	0.0001	0.0044	6.2	0.0043	0.0087	0.038	0.032	0.023	0.018
		13-03	*4*	25	31	1.0	2.2	0.060	1.8	7.5	1.6	2.5	2.0	50	26	120	66	**5.8**	110	**1.1**	**40**	0.045	0.013	**0.000048**	0.0065	0.0052	0.0039	**6.9**	**0.022**	**0.31**	0.0023	**0.040**	0.00013	0.00005	0.049	0.00013	0.024	**16**	0.020	0.017	**0.23**	**0.24**	0.30	0.21
		13-04	*4*	44	54	0.52	9.9	0.063	0.23	13	3.1	0.93	3.0	84	44	110	240	**6.1**	160	**0.19**	2.0	0.030	0.010	0.000013	0.0017	0.0020	0.0022	**15**	0.00023	**0.42**	0.00038	0.0018	0.0001	0.00005	0.074	0.0001	0.0060	0.20	0.0039	0.0049	0.023	0.0075	0.0088	0.010
	Lower Sandstone	MED05-01	*6*	5.3	6.7	0.51	**540**	0.23	0.20	81	48	9.5	120	810	400	**930**	13	6.7	**1800**	0.0082	0.63	0.11	0.10	0.0001	0.0050	0.0010	0.0020	**43**	**0.001**	**1.9**	0.0017	0.0010	0.0001	**0.0005**	1.6	0.001	0.0020	0.12	0.0010	0.0075	0.028	0.0055	**0.98**	0.010
		MED05-02	*6*	9.0	11	0.35	**360**	0.12	7.4	55	35	14	79	560	280	**660**	24	**6.5**	**1300**	0.011	**10**	0.074	0.22	0.0001	0.0050	0.0010	0.0020	**37**	**0.001**	**1.5**	0.0067	0.0010	0.0001	**0.0005**	1.3	0.001	0.0020	1.2	0.0010	0.0072	**6.0**	**0.58**	**20**	0.12
		MED05-03	*6*	4.7	5.7	0.59	**530**	0.21	0.20	80	48	11	120	800	400	**940**	13	6.8	**1800**	0.0050	0.47	0.14	0.10	0.0001	0.0050	0.0010	0.0028	**44**	**0.001**	**1.7**	0.0010	0.0010	0.00025	**0.0005**	1.6	0.001	0.0020	0.25	0.0010	0.0050	0.023	0.0053	**1.1**	0.010

Note: Value shown is mean value for reporting period 2022-2024.

For details on trend analysis and evaluation criteria refer to Section 2.2.6

For SEQG values dependent on toxicity-modifying factors, the 25th percentile of hardness values and the 75th percentiles of field pH and temperature values were used

- SEQG values listed along the top of the table were calculated based site-wide statistics for McClean Minig for the reporting period
- SEQG values used to determine bold formatting were calculated based on statistics for the individual station for the reporting period

LEGEND:

Increasing Trend
Decreasing Trend
No Trend
Insufficient data for trend analysis (i.e.,more than 40% of results were below detection limits)
Recent mean greater than 80% of SEQG

TABLE 2.3-1

Annual Mean and Extreme Lake Elevation Values for Lakes in the McClean Lake Operation LSA (1995 to 2024)

Waterbody	Staff Gauge No.	UTM Coordinates		Unit	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020 [3]	2021	2022	2023	2024	Mean	SD	Extreme Max	Extreme Min
		Northing	Easting																																		
Mallen Lake	SG01C	6474650	566297	masl	454.84	454.76	454.75	454.71	454.67	454.69	454.69	454.73	454.80	454.55	454.59	454.58	454.55	454.57	454.68	454.54	454.54	454.56	454.59	454.54	454.48	454.63	454.59	454.64	454.60	454.64	454.73	454.55	454.47	454.53	454.58	0.06	454.80	454.40
Fox Lake	SG02E	6468025	567724	masl	445.65	445.60	445.65	445.47	445.55	445.55	445.02	445.06	445.71	445.57	445.62	445.59	445.57	445.51	445.74	445.76	445.79	445.64	445.63	445.66	445.62	445.68	445.63	445.72	445.66	445.65	445.66	445.62	445.64	445.68	445.65	0.06	445.88	445.05
Pat Lake	SG03E	6467090	567487	masl	443.47	443.41	443.41	443.35	443.33	443.34	443.34	443.43	443.48	443.49	443.55	443.47	443.47	443.71	443.63	443.48	443.49	443.51	443.47	443.49	443.40	443.56	443.49	443.61	443.55	443.60	443.56	443.51	443.60	443.59	443.53	0.07	443.76	443.31
Sue Lake	SG04E	6457972	570473	masl	456.36	456.55	456.57	456.39	456.34	456.46	456.15	457.33	457.35	457.40	457.52	457.38	457.39	457.36	457.58	457.32	457.21	457.41	457.41	457.28	457.12	457.42	457.34	457.40	457.45	-	457.30	457.30	457.22	457.27	457.35	0.10	457.78	456.96
Johannes Lake	SG05E	6465757	568734	masl	442.65	442.57	442.59	442.55	442.53	442.55	442.57	442.63	442.65	442.71	442.76	442.73	442.69	442.68	442.86	442.70	442.67	442.69	442.66	442.63	442.55	442.76	442.68	442.73	442.68	442.75	442.70	442.69	442.57	-	442.69	0.07	442.92	442.51
Sink Reservoir	SG06E	6461435	568386	masl	-	440.11	440.17	440.50	439.70	439.83	439.87	440.27	440.48	440.97	440.31	440.16	440.30	440.17	440.93	440.18	440.15	440.21	440.21	439.98	440.03	440.37	440.53	441.14	441.05	440.91	441.11	440.82	440.87	440.65	440.53	0.38	442.02	439.37
Vulture Lake	SG07E	6461336	568328	masl	-	438.12	438.13	437.91	438.04	437.98	437.96	437.80	438.03	438.08	438.23	437.93	438.06	438.10	438.29	438.20	438.45	438.14	437.92	437.92	437.96	438.05	437.98	437.68	437.97	438.02	437.59	437.72	437.49	437.50	437.97	0.25	438.68	437.25
McClean Lake	SG09E	6458932	566413	masl	433.96	433.93	433.93	433.93	433.95	433.96	433.96	433.99	434.01	433.96	434.04	433.96	433.98	434.00	434.14	433.98	433.99	434.06	434.00	434.04	433.95	434.17	434.08	434.11	434.12	434.19	434.17	434.05	433.99	434.00	434.05	0.07	434.57	433.79
Candy Lake	SG10E	6458266	567817	masl	438.46	438.52	438.63	438.50	438.56	438.64	438.65	438.72	438.91	438.89	438.73	438.58	438.60	438.70	439.06	438.53	438.51	438.89	438.86	438.91	438.78	438.93	438.71	438.98	438.99	-	439.05	439.00	439.00	438.97	438.83	0.17	434.43	433.81
Isis Lake	SG11E	6468548	569082	masl	462.44	462.46	462.44	462.35	462.11	461.98	461.71	461.74	462.03	462.30	462.38	462.39	462.34	462.41	462.63	462.51	462.49	462.67	462.49	462.67	462.25	462.33	462.54	462.56	462.56	-	462.58	462.55	462.55	462.51	462.49	0.12	439.19	438.41
Osiris Lake	SG12E	6468637	569510	masl	459.60	459.53	459.17	459.06	459.05	459.11	459.03	459.22	459.24	459.29	459.34	459.32	459.26	459.31	459.39	459.32	459.29	459.29	459.23	459.26	459.20	459.35	459.35	459.40	459.33	-	459.32	459.27	459.22	-	459.30	0.05	462.73	461.80
Tail Lake	SG13E	6468715	568186	masl	447.48	447.42	447.41	447.37	447.36	447.36	447.51	447.55	447.52	447.50	447.60	447.58	447.59	447.57	447.63	447.56	447.56	447.57	447.56	447.53	447.53	447.52	447.54	447.55	447.51	-	447.53	447.50	447.49	-	447.55	0.04	447.66	447.30
Moffat Lake	SG14E	6460933	569038	masl	441.80	441.84	441.87	441.80	441.88	441.81	441.69	441.74	441.85	442.00	442.03	442.02	442.00	441.99	442.10	441.90	441.89	441.96	441.75	441.79	441.70	441.81	441.72	441.78	441.68	-	441.70	441.53	441.44	441.90	441.84	0.17	442.13	441.40
Tut Lake	SG15E	6459927	571939	masl	457.54	457.73	457.42	457.34	457.34	457.36	457.33	458.08	458.05	457.37	457.42	457.37	457.35	457.32	457.39	457.30	457.14	457.16	457.14	457.08	457.13	457.14	457.28	457.15	457.07	-	457.19	456.96	457.09	457.01	457.20	0.13	457.91	456.92
Esto Lake	SG16E	6459940	572072	masl	458.35	458.42	458.41	458.31	458.37	458.34	458.40	458.36	458.37	458.37	458.40	458.34	458.29	458.32	458.41	458.29	458.23	458.30	458.26	458.25	458.25	458.31	458.25	458.30	458.26	-	458.27	458.18	458.21	-	458.29	0.06	458.56	458.12
Kewen Lake	SG17E	6450466	568725	masl	425.16	425.13	425.07	425.03	425.05	425.03	425.01	425.10	425.09	425.00	424.96	424.96	424.90	425.00	425.14	424.92	424.93	424.98	424.85	424.86	424.72	424.97	424.85	424.97	424.87	-	424.82	424.76	424.66	424.68	424.89	0.12	425.23	424.55
Sils Lake	SG18E	6457431	570196	masl	453.60	453.45	454.23	453.29	453.12	453.89	453.58	453.67	453.09	453.17	453.16	452.66	452.52	452.37	452.63	452.68	452.49	452.76	452.77	452.57	452.33	452.73	453.05	452.94	453.09	-	453.18	452.95	452.67	452.46	452.76	0.26	454.50	452.23
Indigo Lake	SG19C	6459214	560025	masl	435.20	435.18	435.29	435.37	435.21	435.20	435.24	435.37	435.41	434.98	435.08	434.96	434.95	435.05	435.24	435.00	435.13	435.07	435.04	435.02	434.92	435.21	435.21	435.23	435.13	435.25	435.07	435.03	434.88	434.95	435.07	0.11	435.47	434.77
Bena Lake[1]	SG20E	6457663	568906	masl	-	-	-	438.84	438.86	438.88	438.83	438.93	438.94	438.91	439.00	438.90	438.85	438.89	439.09	438.95	438.96	438.97	438.98	438.89	438.95	439.05	439.05	439.10	439.11	-	439.17	439.12	439.11	439.11	439.01	0.09	439.31	438.79
Sharp Lake[2]	SG21E	6454742	569502	masl	-	-	-	-	-	-	-	-	438.24	438.32	438.36	438.27	438.24	438.27	438.39	438.26	438.29	438.32	438.27	438.33	438.24	438.26	438.32	438.39	438.35	-	438.42	438.29	438.27	-	438.31	0.05	438.53	438.15
Telephone Lake	SG22E	6456745	567700	masl	-	-	-	-	-	-	-	-	435.48	-	435.52	435.22	435.41	435.36	435.52	435.32	435.31	435.39	435.29	435.31	435.23	435.40	435.31	435.39	435.35	-	435.39	435.31	435.25	-	435.35	0.08	435.60	435.13

Note: All data prior to 2004 should be interpreted with caution due to potential survey errors.

[1]Bena Lake was not measured prior to 1998.

[2]Sharp and Telephone Lakes were not measured prior to 2003.

[3]Program in 2020 was reduced due to COVID-19.

No. = Number; masl = meters above sea level; SD= Standard Deviation; Max = Maximun; Min = Minimum.

UTM Coordinates provided in NAD83, Zone 13; Dash indicates no data is available.

Source of 1995-2024: Orano Equis database.

TABLE 2.3-2

Performance Criteria for Surface Water Hydrology Measurements - Data Availability in 2022 - 2024

Type of monitoring	Stations	2022	2023	2024
Surface Water Elevations	SG01 to SG22	99%	99%	96%
Stream Discharge Monitoring	SG08E, CM03, CM04	100%	100%	99%
Effluent Discharge Volumes	CM01B, SC01	100%	100%	100%

TABLE 2.3-3

Mean and standard deviation of the Collins Creek rating curves' residuals

Equation	Mean (m^3/s)	Standard Deviation (m^3/s)
Eq. 4 (1997 – 2000)	-7%	5%
Eq. 5 (2001 – 2013)	-16%	13%
Eq. 6 (2014 – 2023)	11%	12%
Eq. 7 (2024)	2%	10%

Note: Rating curve's Equations (Eq.) 4 to 7 as defined in the 2025 EP TID Volume 1, Section 2.3

TABLE 2.3-4

Annual Inputs to Collins Creek (2011 to 2024)

Year	Annual Withdrawal from Pat Lake (m3)	Annual Input (m3) (JEB WTP plus SUE WTP)	Input - Withdrawal (m3)	Annual Inputs (m3/s)
2011	58,663	1,648,844	1,590,181	0.050
2012	144,840	2,156,984	2,012,144	0.064
2013	221,398	1,515,057	1,293,659	0.041
2014	199,321	1,453,611	1,254,290	0.040
2015	383,445	1,637,336	1,253,891	0.040
2016	450,010	2,023,673	1,573,663	0.050
2017	467,820	1,879,029	1,411,209	0.045
2018	537,860	2,140,981	1,603,121	0.051
2019	527,462	1,735,617	1,208,155	0.038
2020	307,825	1,559,320	1,251,495	0.040
2021	442,930	1,709,399	1,266,469	0.040
2022	491,820	1,630,692	1,138,872	0.036
2023	562,419	1,147,926	585,507	0.019
2024	730,698	1,258,972	528,274	0.017
Average (2011 - 2021)	340,143	1,769,077	1,428,934	0.045
Average (2022 - 2024)	594,979	1,345,863	750,884	0.024

Source: Orano Equis database.

TABLE 2.3-5

Monthly and Annual Mean Flow (m³/s) at Sink Reservoir Outflow, Station CM03 (1999 to 2024)

Month	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
January	-	0.112	0.098	0.190	0.103	0.065	0.131	0.162	0.094	0.098	0.069	0.088	0.045	0.052	0.035	0.018	0.008	0.053	0.070	0.013	0.063	0.048	0.056	0.044	0.035	0.060
February	-	0.101	0.107	0.146	0.093	0.049	0.136	0.141	0.077	0.043	0.059	0.073	0.045	0.040	0.027	0.018	0.005	0.069	0.049	0.013	0.066	0.052	0.038	0.107	0.038	0.057
March	-	0.100	0.124	0.117	0.087	0.026	0.164	0.123	0.068	0.042	0.041	0.077	0.036	0.038	0.022	0.023	0.008	0.066	0.049	0.064	0.066	0.128	0.067	0.158	0.115	0.051
April	-	0.113	0.134	0.175	0.094	0.070	0.185	0.112	0.076	0.091	0.066	0.096	0.022	0.039	0.013	0.022	0.044	0.101	0.050	0.117	0.087	0.126	0.121	0.104	0.129	0.046
May	-	0.167	0.172	0.171	0.127	0.129	0.225	0.103	0.109	0.127	0.066	0.121	0.067	0.055	0.011	0.053	0.087	0.176	0.054	0.110	0.086	0.134	0.180	0.030	0.101	0.054
June	0.203	0.191	0.156	0.056	0.267	0.256	0.244	0.068	0.102	0.122	0.135	0.102	0.059	0.187	0.038	0.071	0.076	0.094	0.154	0.139	0.033	0.000	0.000	0.078	0.008	0.018
July	0.198	0.180	0.15	0.042	0.215	0.306	0.199	0.039	0.075	0.094	0.104	0.051	0.051	0.135	0.069	0.062	0.166	0.112	0.183	0.138	0.113	0.243	0.282	0.192	0.074	0.072
August	0.192	0.151	0.158	0.046	0.151	0.180	0.201	0.110	0.089	0.082	0.197	0.031	0.074	0.091	0.078	0.050	0.162	0.159	0.057	0.238	0.179	0.212	0.300	0.040	0.137	0.119
September	0.295	0.158	0.163	0.108	0.119	0.174	0.173	0.072	0.163	0.130	0.126	0.121	0.060	0.104	0.065	0.044	0.085	0.240	0.064	0.175	0.401	0.154	0.223	0.191	0.059	0.141
October	0.156	0.164	0.159	0.220	0.135	0.220	0.218	0.042	0.106	0.123	0.277	0.135	0.081	0.116	0.057	0.057	0.078	0.145	0.153	0.152	0.149	0.174	0.129	0.173	0.074	0.137
November	0.095	0.154	0.170	0.123	0.119	0.192	0.217	0.074	0.109	0.122	0.211	0.071	0.100	0.091	0.045	0.065	0.037	0.122	0.095	0.090	0.094	0.182	0.129	0.059	0.075	0.095
December	0.096	0.120	0.185	0.114	0.086	0.154	0.178	0.104	0.101	0.115	0.098	0.047	0.068	0.043	0.019	0.029	0.032	0.104	0.037	0.056	0.059	0.127	0.094	0.035	0.070	0.051
Mean	0.1764	0.1426	0.148	0.1257	0.1329	0.1519	0.1893	0.096	0.097	0.099	0.121	0.084	0.059	0.083	0.040	0.043	0.066	0.120	0.085	0.109	0.116	0.132	0.135	0.101	0.076	0.075

Dash indicates no data is available.
Source: Orano Equis database.

TABLE 2.3-6

Monthly and Annual Mean Flow (m^3/s) at Vulture Lake Outflow, Station CM04 (1997 to 2024)

Month	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
January	0.183	0.231	0.129	0.151	0.116	0.183	0.140	0.114	0.194	0.233	0.156	0.160	0.144	0.114	0.076	0.093	0.043	0.033	0.053	0.058	0.106	0.035	0.108	0.074	0.099	0.066	0.049	0.072
February	0.16	0.168	0.162	0.161	0.172	0.170	0.131	0.103	0.217	0.210	0.129	0.109	0.131	0.099	0.074	0.077	0.041	0.029	0.031	0.086	0.084	0.035	0.109	0.072	0.062	0.086	0.062	0.074
March	0.154	0.231	0.158	0.162	0.227	0.134	0.128	0.071	0.226	0.191	0.125	0.089	0.137	0.098	0.079	0.077	0.038	0.038	0.030	0.082	0.076	0.104	0.087	0.126	0.078	0.147	0.106	0.063
April	0.179	0.195	0.179	0.181	0.205	0.189	0.149	0.104	0.255	0.190	0.133	0.128	0.127	0.137	0.078	0.080	0.024	0.045	0.083	0.097	0.073	0.162	0.109	0.185	0.156	0.192	0.137	0.073
May	0.271	0.201	0.427	0.253	0.258	0.221	0.188	0.187	0.308	0.191	0.185	0.197	0.164	0.150	0.109	0.104	0.074	0.110	0.130	0.178	0.108	0.145	0.142	0.208	0.225	0.136	0.141	0.081
June	0.305	0.263	0.261	0.271	0.219	0.137	0.254	0.237	0.270	0.139	0.150	0.191	0.122	0.119	0.089	0.161	0.038	0.125	0.109	0.138	0.139	0.159	0.083	0.131	0.172	0.071	0.069	0.127
July	0.197	0.168	0.197	0.226	0.221	0.126	0.282	0.322	0.289	0.079	0.133	0.149	0.139	0.054	0.094	0.180	0.052	0.088	0.203	0.131	0.201	0.211	0.080	0.208	0.074	0.161	0.075	0.065
August	0.167	0.101	0.122	0.198	0.231	0.104	0.221	0.251	0.274	0.153	0.140	0.142	0.206	0.048	0.110	0.108	0.071	0.071	0.176	0.143	0.102	0.231	0.180	0.248	0.225	0.169	0.128	0.108
September	0.036	0.185	0.309	0.191	0.234	0.124	0.184	0.227	0.240	0.133	0.208	0.193	0.150	0.136	0.097	0.150	0.074	0.051	0.132	0.260	0.076	0.252	0.235	0.197	0.248	0.053	0.077	0.142
October	0.116	0.221	0.23	0.207	0.226	0.229	0.184	0.261	0.275	0.090	0.203	0.194	0.225	0.179	0.121	0.144	0.076	0.171	0.111	0.177	0.171	0.224	0.222	0.199	0.148	0.145	0.067	0.144
November	0.451	0.222	0.148	0.209	0.216	0.169	0.178	0.266	0.274	0.119	0.172	0.196	0.276	0.118	0.140	0.123	0.068	0.142	0.077	0.151	0.148	0.169	0.133	0.205	0.142	0.101	0.084	0.117
December	0.355	0.240	0.139	0.18	0.194	0.154	0.145	0.222	0.249	0.163	0.158	0.187	0.153	0.084	0.114	0.064	0.032	0.093	0.053	0.133	0.066	0.103	0.091	0.157	0.129	0.049	0.080	0.064
Mean	0.214	0.202	0.205	0.199	0.213	0.162	0.182	0.197	0.256	0.158	0.158	0.161	0.164	0.111	0.098	0.113	0.053	0.083	0.099	0.136	0.112	0.152	0.132	0.168	0.146	0.115	0.089	0.094

Dash indicates no data is available.
Source: Orano Equis database.

TABLE 2.3-7

Estimated Monthly and Annual Mean Discharge and Extreme Values for Collins Creek Below McClean Lake (SG08E), (1979 to 2024)

Month	1979 (m^3/s)	1980 (m^3/s)	1981 (m^3/s)	1982 (m^3/s)	1983 (m^3/s)	1984 (m^3/s)	1985 (m^3/s)	1986 (m^3/s)	1987 (m^3/s)	1988 (m^3/s)	1989 (m^3/s)	1990 (m^3/s)	1991 (m^3/s)	1992 (m^3/s)	1993 (m^3/s)	1994 (m^3/s)	Mean '79-'94
January	0.743	0.708	0.947	0.568	0.657	1.037	0.715	0.852	0.771	0.800	1.035	0.933	0.994	1.018	0.906	0.856	0.846
February	0.583	0.560	0.790	0.466	0.570	0.853	0.634	0.765	0.649	0.635	0.826	0.843	0.805	0.867	0.704	0.636	0.699
March	0.496	0.527	0.672	0.418	0.535	0.723	0.623	0.657	0.603	0.548	0.688	0.740	0.727	0.847	0.668	0.564	0.627
April	0.475	0.816	0.642	0.407	0.571	1.368	0.685	0.744	0.794	0.538	0.647	0.669	0.737	0.801	0.708	0.527	0.696
May	1.344	1.682	2.444	2.058	1.350	2.832	4.213	4.639	2.432	2.891	3.931	1.851	3.054	3.151	1.284	3.598	2.672
June	2.560	1.064	2.496	2.107	2.725	2.097	2.381	4.121	2.325	3.958	3.228	3.131	3.052	2.530	1.151	3.615	2.659
July	2.207	1.379	1.595	1.561	2.067	1.427	1.500	2.585	1.416	2.746	3.170	2.536	2.128	1.437	0.936	1.649	1.896
August	1.532	2.436	1.024	1.313	2.659	1.111	1.077	2.231	0.751	1.736	2.009	1.850	1.820	1.063	1.555	0.912	1.567
September	1.187	2.290	0.727	1.429	4.379	0.841	2.842	1.598	0.726	1.411	1.349	1.552	2.125	2.141	1.612	0.603	1.676
October	1.944	2.338	0.718	1.192	3.201	0.832	2.266	1.361	0.894	1.396	1.237	1.491	2.037	2.802	1.398	0.592	1.606
November	1.617	1.819	0.765	0.929	2.210	0.966	1.726	1.202	1.141	1.366	1.275	1.512	1.702	1.985	1.336	0.699	1.391
December	1.043	1.214	0.712	0.765	1.529	0.899	1.129	0.923	1.017	1.269	1.158	1.342	1.260	1.392	1.181	0.720	1.097
Mean	1.315	1.406	1.130	1.105	1.875	1.250	1.655	1.814	1.129	1.611	1.721	1.541	1.709	1.672	1.122	1.252	1.457
Daily Maximum	3.071	2.731	3.531	2.514	5.637	3.416	6.096	7.034	2.731	4.641	6.261	3.566	4.854	4.237	1.918	5.540	4.236
Daily Minimum	0.438	0.516	0.626	0.386	0.508	0.661	0.609	0.631	0.587	0.517	0.629	0.619	0.674	0.777	0.643	0.519	0.584
Annual Total (dam^3)	41,477	44,348	35,641	34,848	59,140	39,425	52,180	57,201	35,613	50,802	54,272	48,608	53,884	52,720	35,398	39,470	45,939

Month	1997 (m^3/s)	1998 (m^3/s)	1999 (m^3/s)	2000 (m^3/s)	2001 (m^3/s)	2002 (m^3/s)	2003 (m^3/s)	2004 (m^3/s)	2005 (m^3/s)	2006 (m^3/s)	2007 (m^3/s)	2008 (m^3/s)	2009 (m^3/s)	2010 (m^3/s)	2011 (m^3/s)	2012 (m^3/s)	2013 (m^3/s)
January	na	1.669	0.678	1.035	0.674	0.977	1.269	1.612	0.987	1.277	0.931	0.983	1.107	1.397	1.180	0.889	1.084
February	0.973	1.523	0.784	0.753	0.674	0.786	0.963	1.112	1.097	1.248	0.907	0.690	1.068	1.412	1.200	1.069	1.052
March	1.057	1.305	0.722	0.975	0.723	0.613	0.812	1.201	0.872	1.034	0.917	0.946	0.944	1.114	1.007	0.854	0.718
April	2.428	2.856	1.280	1.349	0.838	0.806	1.055	2.474	1.066	1.174	0.966	0.840	0.893	1.636	0.907	1.192	0.892
May	1.768	3.464	2.423	2.795	1.700	2.072	3.594	1.101	4.025	2.040	2.827	1.319	1.729	2.258	1.318	3.913	4.106
June	1.467	1.191	1.414	2.300	0.943	1.778	4.029	1.727	2.688	2.592	1.448	1.939	3.737	1.275	0.678	1.536	2.374
July	1.076	0.924	0.774	1.011	0.913	1.359	2.553	1.640	1.853	1.254	0.874	1.520	4.019	0.446	1.588	1.878	0.952
August	0.979	0.598	0.845	0.957	1.393	2.593	2.205	0.886	2.143	1.429	0.961	0.992	3.719	0.372	1.647	0.708	0.631
September	5.045	0.887	1.258	0.646	1.687	2.672	2.676	0.766	1.724	1.226	1.271	2.192	4.104	1.992	1.354	1.912	0.744
October	4.978	1.031	1.063	0.950	1.555	2.162	2.622	0.768	2.535	1.041	2.255	1.824	3.077	2.244	1.681	1.399	0.966
November	2.513	1.064	1.297	1.046	1.312	1.742	3.925	2.591	2.114	1.007	2.687	1.805	2.643	1.891	1.605	1.689	1.239
December	1.905	0.977	1.241	0.622	1.101	1.631	1.793	2.442	1.724	0.992	1.708	1.597	1.668	1.397	1.417	1.506	0.807
Mean	2.195	1.435	1.228	1.227	1.129	1.604	2.295	1.525	1.909	1.359	1.483	1.388	2.398	1.450	1.301	1.545	1.297
Daily Maximum	9.032	5.914	3.333	3.346	2.553	4.324	5.395	4.215	4.682	3.552	4.076	2.603	5.005	2.871	2.070	4.542	5.298
Daily Minimum	0.454	0.348	0.466	0.306	0.701	0.568	0.797	0.795	0.980	0.733	0.626	0.765	0.925	0.195	0.514	0.465	0.485
Annual Total (dam^3)	69,222	45,254	38,726	38,695	35,607	50,591	72,388	48,224	60,203	42,851	46,761	43,880	75,627	45,740	41,034	48,723	40,902

Month	2014 (m^3/s)	2015 (m^3/s)	2016 (m^3/s)	2017 (m^3/s)	2018 (m^3/s)	2019 (m^3/s)	2020 (m^3/s)	2021 (m^3/s)	2022 (m^3/s)	2023 (m^3/s)	2024 (m^3/s)	Mean '97-'21	Mean '97-'24	Mean '22-'24
January	0.704	0.600	0.925	1.880	1.593	1.278	1.470	1.840	1.648	0.864	0.680	1.168	1.157	1.064
February	0.818	0.688	0.997	1.535	1.310	0.873	1.360	1.280	1.279	1.136	0.586	1.047	1.042	1.000
March	0.642	0.512	1.011	1.240	2.265	0.902	1.420	1.722	1.264	1.066	0.751	1.021	1.022	1.027
April	0.672	1.421	1.232	1.328	1.770	1.841	1.350	1.380	1.295	1.105	2.648	1.346	1.382	1.683
May	3.125	1.260	3.219	4.712	438.84	2.990	4.247	7.044	5.249	1.788	2.268	20.315	18.471	3.102
June	3.181	1.024	3.465	3.139	3.539	3.505	5.183	10.092	3.142	1.707	5.279	2.650	2.728	3.376
July	2.092	1.253	3.059	1.980	5.103	3.457	3.410	3.274	2.158	1.500	2.643	1.931	1.949	2.100
August	1.272	1.649	3.525	1.040	4.507	3.529	2.996	2.138	2.102	0.877	1.730	1.749	1.729	1.570
September	1.058	1.466	3.965	1.450	3.365	4.031	3.302	2.188	1.655	0.652	1.766	2.119	2.038	1.358
October	1.475	1.647	4.322	2.104	2.710	2.868	3.475	2.098	1.525	0.740	1.996	2.114	2.040	1.420
November	2.031	1.470	3.145	2.722	2.153	1.690	2.540	1.770	0.839	0.822	1.272	1.988	1.879	0.978
December	1.284	1.150	1.657	1.694	1.458	1.515	2.190	1.750	1.009	0.859	1.126	1.489	1.436	0.998
Mean	1.529	1.178	2.543	2.069	39.051	2.373	2.745	3.048	1.930	1.093	1.895	3.252	3.079	1.640
Daily Maximum	4.079	2.248	4.679	6.506	8.137	5.137	6.890	15.985	9.640	2.530	6.628	5.059	5.188	6.266
Daily Minimum	0.642	0.308	0.837	0.800	1.142	0.638	1.280	1.280	0.850	0.615	0.560	0.682	0.681	0.675
Annual Total (dam^3)	48,219	37,149	80,196	65,248	90,792	74,834	86,566	96,122	62,000	35,068	60,557	56,942	56,471	52,542

Source of 1979 to 2000: AREVA 2009a.

Source of 2001-2024: Orano Equis database.

Note: (2001-2024) Mean monthly flow, mean annual flow, and total annual flow have been adjusted for the addition of Sue and JEB water treatment plant discharge, JEB dewatering well discharge, and Pat Lake pumphouse withdrawal (except for December 2011).

Note: (2001-2024) Daily max and min flow is based on Collins Creek discharge data only (SG08E in the Equis database) and has not been adjusted for additional discharges or withdrawals.

Table 3.1-1 Temperature Values, McClean Lake, Saskatchewan, 2000 to 2021

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Mean Temperature (°C)	-21.9	-19.9	-13.2	-3.8	4.6	12.8	16.5	14.0	7.7	-0.6	-11.5	-20.0	-3.0
Mean Daily Maximum Temperature (°C)	-17.4	-14.4	-6.8	2.4	10.6	18.6	22.1	19.1	12.4	2.5	-8.0	-16.1	2.1
Mean Daily Minimum Temperature (°C)	-26.4	-25.5	-19.7	-10.5	-1.6	6.9	10.9	9.2	3.6	-3.5	-15.6	-24.2	-8.0
Extreme Maximum Temperature (°C)	4.7	23.0	13.8	23.2	31.3	**36.8**	36.3	30.8	29.1	23.2	9.3	3.9	36.8
Year of Extreme Maximum Temperature	2003	2013	2021	2001	2018	2021	2021	2021	2006	2003	2021	2020	2021
Extreme Minimum Temperature (°C)	**-45.0**	-42.8	-38.6	-35.1	-19.3	-4.5	2.3	-0.2	-10.8	-19.0	-34.8	-42.7	-45.0
Year of Extreme Minimum Temperature	2004	2008	2017	2018	2021	2009	2004	2000	2018	2003	2018	2009	2004

Note: Bolded values represent the extreme temperature conditions.
Data in this table was collected at the Moffat Lake meteorological station from 2000 to October of 2014, after which the data is from the JEB site.

Table 3.1-2 Temperature Values, McClean Lake, Saskatchewan, 2022 to 2024

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Mean Temperature (°C)	-21.5	-22.7	-15.2	-1.9	7.2	12.7	16.7	15.4	11.1	1.0	-10.1	-17.8	-2.1
Mean Daily Maximum Temperature (°C)	-17.6	-16.3	-8.3	4.5	13.7	19.0	23.1	21.7	17.0	5.5	-7.1	-14.0	3.4
Mean Daily Minimum Temperature (°C)	-25.7	-28.6	-21.7	-8.5	1.0	6.7	10.6	9.9	6.0	-3.0	-13.5	-21.9	-7.4
Extreme Maximum Temperature (°C)	3.2	0.2	11.2	18.8	27.8	30.6	**33.4**	30.5	29.4	19.8	4.8	2.5	33.4
Year of Extreme Maximum Temperature	2024	2022	2022	2024	2023	2023	2024	2024	2022	2022	2024	2023	2024
Extreme Minimum Temperature (°C)	-41.3	**-41.5**	-35.4	-35.1	-11.7	-0.7	4.1	4.1	-2.9	-16.9	-37.4	-39.2	-41.5
Year of Extreme Minimum Temperature	2024	2022	2023	2024	2022	2022	2022	2022	2022	2024	2022	2024	2022

Note: Bolded values represent the extreme temperature conditions.
Data in this table was collected at the JEB site meteorological station.

Table 3.1-3 Temperature Values, Collins Bay, Saskatchewan, 2022 to 2024

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Mean Temperature (°C)	-21.7	-23.5	-16.7	-3.2	6.1	11.7	15.5	14.7	10.8	1.0	-10.0	-18.1	-2.8
Mean Daily Maximum Temperature (°C)	-17.3	-16.8	-9.2	3.3	12.5	18.0	22.0	20.9	16.8	5.5	-6.6	-13.5	3.0
Mean Daily Minimum Temperature (°C)	-26.2	-30.2	-24.2	-9.6	-0.3	5.5	9.1	8.4	4.8	-3.6	-13.5	-22.8	-8.5
Extreme Maximum Temperature (°C)	4.4	0.7	10.3	12.5	27.1	**30.7**	30.6	30.6	27.9	20.8	4.7	3.9	30.7
Year of Extreme Maximum Temperature	2024	2022	2022	2023	2023	2023	2024	2022	2022	2022	2024	2023	2023
Extreme Minimum Temperature (°C)	-41.7	**-43.5**	-39.1	-29.8	-13.9	-2.3	0.7	0.7	-4.6	-20.1	-38.0	-40.2	-43.5
Year of Extreme Minimum Temperature	2024	2022	2023	2023	2022	2024	2022	2022	2023	2024	2022	2024	2022

Note: Bolded values represent the extreme temperature conditions.
Data in this table was collected at the Collins Bay ECCC meteorological station (Climate ID 4061620).
Source: ECCC 2025a.

Table 3.1-4 Temperature Normals, Key Lake, Saskatchewan, 1991 to 2020

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Mean Temperature (°C)	-22.1	-19.4	-12.7	-2.6	6.1	13.3	16.1	14.5	8.1	-0.1	-11.2	-19.1	-2.4
Mean Daily Maximum Temperature (°C)	-16.4	-12.5	-4.9	4.4	13.0	19.9	22.5	20.3	13.1	3.6	-6.8	-13.8	3.5
Mean Daily Minimum Temperature (°C)	-27.7	-26.3	-20.5	-9.9	-0.9	6.6	9.8	8.6	3.1	-3.8	-15.4	-24.7	-8.4
Extreme Maximum Temperature (°C)	10.0	8.0	15.0	25.0	31.5	34.0	32.8	**36.0**	30.5	24.5	10.0	5.2	36.0
Extreme Minimum Temperature (°C)	**-52.5**	-49.0	-50.5	-40.2	-24.6	-7.0	-1.0	-3.0	-8.5	-28.0	-43.0	-48.3	-52.5

Note: Bolded values represent the extreme temperature conditions.
Source: ECCC 2025b.

Table 3.1-5 Precipitation Values, McClean Lake, Saskatchewan, 2000 to 2021

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Mean Monthly Precipitation (mm)	17.8	13.1	23.1	20.8	36.3	57.5	52.8	65.4	56.7	57.8	14.9	17.3	433.6
Greatest Precipitation in 24 hrs (mm)	30.7	17.8	31.2	53.8	31.9	89.2	**108.3**	53.8	40.4	61.0	14.3	17.5	108.3
Number of days with measurable precipitation	6.8	5.7	6.9	6.8	9.4	10.9	12.0	13.1	15.1	14.9	7.9	6.4	115.9

Note: Bolded value shows the month in which the greatest precipitation occurred.
Data in this table was collected at the Moffat Lake meteorological station from 2000 to October of 2014, after which the data is from the JEB site.

Table 3.1-6 Precipitation Values, McClean Lake, Saskatchewan, 2022 to 2024

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Mean Monthly Precipitation (mm)	19.4	38.0	27.9	22.4	42.4	62.6	56.7	34.7	36.2	15.5	39.3	24.4	419.6
Greatest Precipitation in 24 hrs (mm)	8.7	9.7	12.8	9.1	**30.3**	35.4	25.4	12.6	18.3	6.9	13.9	6.4	35.4
Number of days with measurable precipitation	10.7	13.7	12.0	10.7	9.0	13.7	12.0	15.0	11.7	11.3	19.7	13.3	152.7

Note: Bolded value shows the month in which the greatest precipitation occurred.
Data in this table was collected at the JEB site meteorological station.

Table 3.1-7 Precipitation Values, Collins Bay, Saskatchewan, 2022 to 2024

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Mean Monthly Precipitation (mm)	15.4	20.6	15.7	20.4	42.3	64.0	64.9	47.6	31.6	15.8	32.3	23.9	394.5
Greatest Precipitation in 24 hrs (mm)	8.5	8.8	13.4	8.8	29.0	**37.1**	28.4	30.5	9.9	8.1	12.9	7.8	37.1
Number of days with measurable precipitation	10.7	8.3	4.7	9.7	9.3	12.3	12.7	9.7	10.7	9.7	15.0	11.0	123.7

Note: Bolded value shows the month in which the greatest precipitation occurred.
Data in this table was collected at the Collins Bay ECCC meteorological station (Climate ID 4061620).
Source: ECCC 2025a.

Table 3.1-8 Precipitation Normals for Key Lake, Saskatchewan, 1991 to 2020

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Mean Monthly Precipitation (mm)	22.4	15.4	23.7	21.1	35.0	57.2	88.0	70.9	56.3	35.5	26.8	19.0	471.4
Greatest Precipitation in 24 hrs (mm)	25.2	13.4	26.0	26.2	21.9	47.2	**72.0**	52.7	33.6	31.2	25.3	16.0	72.0
Number of days with measurable precipitation	12.5	11.2	10.7	7.6	10.3	12.3	15.7	16.3	15.9	15.0	14.7	12.7	154.8

Note: Bolded value shows the month in which the greatest precipitation occurred.
Source: ECCC 2025b.

TABLE 3.2-1 Air Quality Monitoring Stations at the McClean Lake Operation

Station	Easting	Northing	Station	Easting	Northing
TRACK-ETCH CUPS			**HIGH VOLUME AIR SAMPLERS**		
TE-J1	567119	6467651	HVJ1A	567990	6467418
TE-J2	566766	6465713	HVJ2	568499	6466917
TE-J3	569705	6469174	HVJ3	567827	6466314
TE-J4	568247	6466370	HVJ4	566649	6459495
TE-J5[1]	567816	6465851	HVS1A	570459	6458278
TE-J6	570091	6467350	SO_2 MONITOR		
TE-J7	569374	6465744	JM02	568519	6466774
TE-J8[1]	570499	6466243	Stack Emissions		
TE-M1	567120	6460160	SE01	568245	6467025
TE-M2	567365	6458058	SE02	568203	6466978
TE-M3	568570	6459063	SE03	568312	6467200
TE-M4	567857	6457277	SE04	568284	6467127
TE-M5A[1]	568244	6458110	SE05	568295	6467123
TE-M6	568916	6458693	SE07	567780	6466369
TE-M8	569825	6458210			
TE-S1	570589	6458365			
TE-S2	569937	6458690			
TE-S3	571286	6458809			
TE-S5[1]	570761	6457778			
TE-S6	571175	6457291			
TE-S7[1]	571725	6457920			
TE-S8	569620	6456527			
TE-S9	569100	6457386			
TE-C1	566019	6474415			

Notes: [1]Removed from sampling program in 2024.

TABLE 3.2-2 Predicted Concentrations of Select Ambient Air Quality Parameters in the McClean Lake Operation LSA

Parameter	Units	1991 EIS	2016 ERA Predictions[1]		
			McClean Lake Operation	JEB Camp	Ambient SO_2 Monitor Location (JM02)
Total Suspended Particulate	µg/m³	40 to 50	13.3	19.5	-
Metals and Trace Elements in TSP					
Arsenic (µg/m³)	µg/m³	-	0.10	0.11	-
Cadmium (µg/m³)	µg/m³	-	-	-	-
Cobalt (µg/m³)	µg/m³	-	0.01	0.01	-
Copper (µg/m³)	µg/m³	-	0.06	0.06	-
Lead (µg/m³)	µg/m³	-	0.030	0.031	-
Molybdenum (µg/m³)	µg/m³	-	0.01	0.01	-
Nickel (µg/m³)	µg/m³	-	0.06	0.06	-
Selenium (µg/m³)	µg/m³	-	0.005	0.01	-
Uranium (µg/m³)	µg/m³	-	0.050	0.054	-
Zinc[3] (µg/m³)	µg/m³	-	0.55	0.55	-
Radionuclides in TSP					
Thorium-230 (Bq/g)	Bq/m³	-	0.00062	0.00067	-
Radium-226 (Bq/g)	Bq/m³	-	0.00062	0.00067	-
Lead-210 (Bq/g)	Bq/m³	-	0.012	0.012	-
Polonium-210 (Bq/g)	Bq/m³	-	0.012	0.012	-
Radon	Bq/m³	30 to 45	23	26	-
SO_2					
Maximum 1-hour Average	µg/m³	-	5.2	74.6	91.0
Maximum 24-hour Average	µg/m³	-	1.5	17.0	53.0
Annual Average	µg/m³	2 to 3	0.1	1.2	2.5

Sources: Minatco 1991; AREVA 2016b.

Notes: [1]Unless otherwise stated, predictions are annual average ambient concentrations (including background) for Operational Period 2 (2022-2030) from the 2016 ERA (AREVA 2016b)

TABLE 3.2-3 COPC Selection Screening Results for Metals and Radionuclides in Total Suspended Particulate (TSP) Matter at the McClean Lake Operation, 2022 to 2024

Parameter	COPC Selection based on 2022 to 2024 Data			Available Predictions in 2016 EP TID (EvC3)[3]	Available Guideline (AAQC) (EvC4)[4]	Selected as COPC
	Less than 90% of data below RDL (EvC1)[1]	Above Reference Dataset (EvC2)[2]	Selected as COPC			
Arsenic	Y	Y	Y	Y	Y	Y
Cadmium	Y	Y	Y	N	Y	Y
Copper	Y	N	N	Y	Y	Y
Molybdenum	Y	N	N	Y	Y	Y
Nickel	Y	N	N	Y	Y	Y
Lead	Y	Y	Y	Y	Y	Y
Zinc	Y	N	N	Y	Y	Y
Lead-210	Y	N	N	Y	N	Y
Polonium-210	Y	N	N	Y	N	Y
Radium-226	Y	Y	Y	Y	N	Y
Thorium-230	Y	Y	Y	Y	N	Y
Uranium	Y	Y	Y	Y	Y	Y
Selenium	Y	Y	Y	Y	Y	Y
Manganese	Y	N	N	N	Y	N
Cobalt	Y	N	N	Y	Y	Y
Thallium	N	N	N	N	N	N
Vanadium	Y	Y	Y	N	Y	Y

Notes:

[1]EvC1: Recent monitoring data (2022 to 2024) for all monitoring parameters were screened against laboratory DLs (used as the first evaluation criteria). If more than 90% of a parameter concentration was below the DL, it was considered heavily censored and was not selected as a COPC.

[2]EvC2: Parameters considered un-censored (after EC1) were compared to the applicable background (reference) or baseline data (used as the second evaluation criteria). If mean concentrations in at least one of the exposure monitoring locations were more than two reference standard deviations (SDs) above the reference mean, then they were selected as a COPC. Parameters with concentrations lower than the screening criteria were dropped from further assessment.

[3]EvC3: If the parameter was included in the 2016 EP TID with an available prediction, it was selected as a COPC regardless of the outcome of EC1 and EC2.

[4]EvC4: Identifies whether an ambient air quality criteria value is available for the parameter for comparison.

TABLE 3.2-4 Total Suspended Particulate (TSP) Concentrations at Reference and Exposure Monitoring Stations at the McClean Lake Operation, 2022 to 2024

Station	Station ID	No. of Samples (N)	N >SAAQS of 100 µg/m^3	TSP Concentration (µg/m^3)								Predicted Annual Arithmetic Mean Concentrations in 2016 ERA	
				Arithmetic Mean	Standard Deviation	Minimum	Maximum	95th Percentile	Geomean				
									(2022-24)	Max. (2022-24)	(2000-21)	McClean Lake Operation Area	JEB Camp
Exposure													
JEB TMF	HVJ1A	153	5	19.6	34.0	0.30	226.9	77.6	8.5	10.9	8.9	13.3	19.5
Mill Site	HVJ2	154	1	11.4	18.0	0.12	146.6	38.7	4.9	6.6	11.2		
JEB Camp	HVJ3	152	3	12.3	20.8	0.04	133.8	53.1	5.0	5.4	8.4		
Sue C Pit	HVS1A	154	0	10.9	16.6	0.03	98.3	48.7	4.0	4.8	8.9		
Reference													
Vulture Lake	HVJ4	153	2	9.7	19.8	0.04	138.8	39.6	3.4	4.3	5.0		

TABLE 3.2-5 Metal and Radionuclide Concentrations at Reference and Exposure Monitoring Stations at the McClean Lake Operation, 2022 to 2024

Station	Metal Species	Units	AAQC[1,2] (µg/m^3)	No. Samples	No. Samples <MDL	Mean	St. Dev.	Min	95th Percentile	Max
Exposure HVJ1A	Arsenic	µg/m^3	0.06	12	0	0.00031	0.00024	0.000049	0.00072	0.0009
	Cadmium	µg/m^3	0.005	11	1	0.000075	0.000064	0	0.00018	0.00022
	Cobalt	µg/m^3	0.02	10	0	0.000043	0.000028	0	0.000077	0.000083
	Copper	µg/m^3	9.6	12	0	0.11	0.078	0.027	0.24	0.25
	Lead	µg/m^3	0.1	11	0	0.00033	0.00018	0.000074	0.00064	0.00065
	Molybdenum	µg/m^3	23	12	0	0.0059	0.0044	0.002	0.012	0.013
	Nickel	µg/m^3	0.02 [3]	11	0	0.00030	0.00021	0.000095	0.00065	0.00074
	Selenium	µg/m^3	1.92	12	1	0.000034	0.000025	0.000009	0.000079	0.000081
	Uranium	µg/m^3	0.03 [3]	12	0	0.0029	0.0040	0.00055	0.0092	0.015
	Vanadium	µg/m^3	0.4	12	0	0.00013	0.00010	0.000023	0.00030	0.00032
	Zinc	µg/m^3	23	12	0	0.0031	0.0020	0.00047	0.0056	0.006
	Lead-210	Bq/m^3	-	12	0	0.00040	0.00015	0.00017	0.00062	0.00064
	Polonium-210	Bq/m^3	-	12	0	0.00014	0.000045	0.000069	0.00019	0.0002
	Radium-226	Bq/m^3	-	11	1	0.000025	0.000042	0	0.00010	0.00015
	Thorium-230	Bq/m^3	-	12	3	0.0000079	0.0000051	0.000003	0.000015	0.000022
Exposure HVJ2	Arsenic	µg/m^3	0.06	12	0	0.00029	0.00016	0.00011	0.00054	0.00058
	Cadmium	µg/m^3	0.005	11	1	0.000038	0.000034	0	0.000093	0.00013
	Cobalt	µg/m^3	0.02	11	0	0.000028	0.000019	0	0.000054	0.000057
	Copper	µg/m^3	9.6	12	0	0.085	0.10	0.0053	0.25	0.31
	Lead	µg/m^3	0.1	12	0	0.00013	0.000072	0.000019	0.00024	0.00027
	Molybdenum	µg/m^3	23	12	0	0.0033	0.0030	0.00046	0.0080	0.0088
	Nickel	µg/m^3	0.02 [3]	12	0	0.00022	0.00014	0.000057	0.00044	0.00049
	Selenium	µg/m^3	1.92	12	2	0.000034	0.000020	0.000006	0.000063	0.000071
	Uranium	µg/m^3	0.03 [3]	12	0	0.0052	0.0040	0.0014	0.012	0.016
	Vanadium	µg/m^3	0.4	12	1	0.00013	0.00010	0.00002	0.00029	0.00035
	Zinc	µg/m^3	23	11	0	0.0032	0.0027	0.00061	0.0081	0.0089
	Lead-210	Bq/m^3	-	12	0	0.00027	0.00018	0.00013	0.00061	0.00074
	Polonium-210	Bq/m^3	-	12	0	0.00010	0.000046	0.000057	0.00018	0.00023
	Radium-226	Bq/m^3	-	12	0	0.000012	0.0000072	0.000003	0.00002	0.00002
	Thorium-230	Bq/m^3	-	11	1	0.000016	0.000015	0	0.000040	0.000052
Exposure HVJ3	Arsenic	µg/m^3	0.06	12	0	0.000080	0.000053	0.000005	0.00016	0.00017
	Cadmium	µg/m^3	0.005	11	2	0.00012	0.00017	0	0.00039	0.00064
	Cobalt	µg/m^3	0.02	10	0	0.000031	0.000039	0.000003	0.000098	0.00012
	Copper	µg/m^3	9.6	12	0	0.14	0.12	0.025	0.32	0.40
	Lead	µg/m^3	0.1	11	0	0.00024	0.00016	0.000034	0.00048	0.00062
	Molybdenum	µg/m^3	23	12	0	0.0060	0.0043	0.00097	0.012	0.014
	Nickel	µg/m^3	0.02 [3]	8	0	0.00022	0.00018	0	0.00049	0.00049
	Selenium	µg/m^3	1.92	12	2	0.000019	0.000014	0.000004	0.000044	0.000051
	Uranium	µg/m^3	0.03 [3]	11	0	0.00041	0.00047	0	0.0013	0.0015
	Vanadium	µg/m^3	0.4	11	1	0.000072	0.000063	0.0000031	0.00017	0.00024
	Zinc	µg/m^3	23	11	0	0.0060	0.0022	0.0032	0.0098	0.011
	Lead-210	Bq/m^3	-	12	0	0.00037	0.00018	0.000088	0.00062	0.00069
	Polonium-210	Bq/m^3	-	12	0	0.00012	0.000042	0.000071	0.00018	0.00019
	Radium-226	Bq/m^3	-	10	3	0.0000035	0.0000019	0	0.0000055	0.000006
	Thorium-230	Bq/m^3	-	11	11	0.0000073	0.0000026	0	0.0000095	0.00001
Exposure HVS1A	Arsenic	µg/m^3	0.06	12	0	0.00054	0.00031	0.000094	0.0010	0.0011
	Cadmium	µg/m^3	0.005	12	2	0.000055	0.000043	0.000013	0.00013	0.00013
	Cobalt	µg/m^3	0.02	10	0	0.000024	0.000019	0	0.000052	0.000059
	Copper	µg/m^3	9.6	12	0	0.031	0.048	0.0021	0.12	0.16
	Lead	µg/m^3	0.1	12	0	0.00024	0.00014	0.000047	0.00045	0.00048
	Molybdenum	µg/m^3	23	12	0	0.0019	0.0028	0.000092	0.0066	0.009
	Nickel	µg/m^3	0.02 [3]	8	0	0.00041	0.00038	0.00012	0.0010	0.0013

Station	Metal Species	Units	AAQC[1,2] (µg/m^3)	No. Samples	No. Samples <MDL	Mean	St. Dev.	Min	95th Percentile	Max
	Selenium	µg/m^3	1.92	11	5	0.000018	0.000010	0	0.000031	0.000033
	Uranium	µg/m^3	0.03 [3]	12	0	0.00062	0.00077	0.00018	0.0017	0.003
	Vanadium	µg/m^3	0.4	11	1	0.000068	0.000042	0.00001	0.00013	0.00013
	Zinc	µg/m^3	23	11	0	0.0029	0.0025	0	0.0071	0.0094
	Lead-210	Bq/m^3	-	12	0	0.00030	0.00016	0.00014	0.00060	0.00069
	Polonium-210	Bq/m^3	-	12	0	0.00010	0.000046	0.000064	0.00017	0.00024
	Radium-226	Bq/m^3	-	9	6	0.0000033	0.0000021	0	0.000005	0.000005
	Thorium-230	Bq/m^3	-	9	9	0.0000055	0.0000037	0	0.0000095	0.00001
Reference HVJ4	Arsenic	µg/m^3	0.06	11	0	0.000038	0.000022	0.000009	0.00007	0.00007
	Cadmium	µg/m^3	0.005	12	4	0.000024	0.000015	0.000002	0.000043	0.000048
	Cobalt	µg/m^3	0.02	7	1	0.000020	0.000027	0	0.000066	0.000077
	Copper	µg/m^3	9.6	12	0	0.082	0.087	0.012	0.23	0.27
	Lead	µg/m^3	0.1	10	0	0.00013	0.000087	0.0000087	0.00027	0.00028
	Molybdenum	µg/m^3	23	12	0	0.0046	0.0044	0.00035	0.011	0.013
	Nickel	µg/m^3	0.02 [3]	8	0	0.00018	0.00023	0.0000098	0.00055	0.0007
	Selenium	µg/m^3	1.92	10	3	0.000012	0.0000082	0	0.00002	0.00002
	Uranium	µg/m^3	0.03 [3]	8	0	0.00029	0.00029	0.000021	0.00076	0.00085
	Vanadium	µg/m^3	0.4	10	2	0.000040	0.000021	0.000013	0.000071	0.000082
	Zinc	µg/m^3	23	12	0	0.0033	0.0030	0.0008	0.0082	0.012
	Lead-210	Bq/m^3	-	12	0	0.00033	0.00018	0.0001	0.00062	0.00074
	Polonium-210	Bq/m^3	-	12	0	0.00010	0.000034	0.000054	0.00015	0.00016
	Radium-226	Bq/m^3	-	8	6	0.0000023	0.0000020	0	0.000005	0.000005
	Thorium-230	Bq/m^3	-	12	12	0.0000071	0.0000020	0.000004	0.0000095	0.00001

Notes:
Samples less than the minimum reportable detection limit were assumed to be equal to the detection limit for calculation of summary statistics.
[1]Metals criteria based on Ontario Ambient Air Quality Criteria (AAQC) (OMECP 2022).
[2]Except for cadmium, nickel, and uranium, the annual AAQC for metals is derived from the 24-hour Ontario AAQC using the conversion method outlined in the Saskatchewan Air Dispersion Modelling Guideline (GS 2012).
[3]Annual Ontario AAQC for nickel and uranium in PM_{10}.

TABLE 3.2-6 Average Metal and Radionuclide Concentrations at the McClean Lake Operation, 2022 to 2024 Compared to Historical Data and ERA Predictions

Metal Species	Units	Average, 2022-2024			Average, 2000-2021			Predicted Annual Concentrations in 2016 ERA	
		Reference	Exposure Mean		Reference	Exposure Station Mean			
		Vulture Lake (HVJ4)	All Stations (HVJ1, HVJ2, HVJ3, HVS1)	JEB Camp (HVJ3)	Vulture Lake (HVJ4)	All Stations (HVJ1, HVJ2, HVJ3, HVS1)	JEB Camp (HVJ3)	McClean Lake Operation Area	JEB Camp
Arsenic	µg/m^3	0.000038	0.00031	0.000080	0.00024	0.0012	0.00046	0.1	0.1
Cadmium	µg/m^3	0.000024	0.000071	0.00012	0.000065	0.00014	0.00016	N/A	N/A
Cobalt	µg/m^3	0.000020	0.000032	0.000031	0.000019	0.000038	0.000033	0.01	0.01
Copper	µg/m^3	0.082	0.089	0.14	0.040	0.058	0.061	0.06	0.06
Lead	µg/m^3	0.00013	0.00023	0.00024	0.00098	0.035	0.0014	0.03	0.031
Molybdenum	µg/m^3	0.0046	0.0043	0.0060	0.00044	0.00077	0.00063	0.01	0.01
Nickel	µg/m^3	0.00018	0.00029	0.00022	0.00027	0.00084	0.00037	0.06	0.06
Selenium	µg/m^3	0.000012	0.000026	0.000019	0.000018	0.000026	0.000025	0.005	0.01
Uranium	µg/m^3	0.00029	0.0023	0.00041	0.00073	0.0037	0.0017	0.05	0.054
Vanadium	µg/m^3	0.000040	0.00010	0.000072	0.000076	0.00015	0.00013	N/A	N/A
Zinc[1]	µg/m^3	0.0033	0.0038	0.0060	0.0047	0.0056	0.0069	0.55	0.55
Lead-210	Bq/m^3	0.00033	0.00034	0.00037	0.00038	0.00042	0.00041	0.012	0.012
Polonium-210	Bq/m^3	9.68E-05	0.00012	0.00012	0.00011	0.00014	0.00013	0.012	0.012
Radium-226	Bq/m^3	0.0000023	0.000011	0.0000035	0.0000045	0.000024	0.000013	0.00062	0.00067
Thorium-230	Bq/m^3	0.0000071	0.0000091	0.0000073	0.0000063	0.000025	0.000012	0.00062	0.00067

Notes:
N/A - not available.
Samples less than the minimum reportable detection limit were assumed to be equal to the detection limit for presentation purposes.
[1]Data prior to 2008 are not presented because of unrealistic values provided due to high zinc content in filter paper (Orano 2024b).

TABLE 3.2-7 Special Projects Comparison of Total Suspended Particulate (TSP) Concentrations from New and Old HVAS Units

Station	Unit	Sample Count (N)	TSP Concentration (µg/m³)						
			Arithmetic Mean	Standard Deviation	Minimum	Maximum	Median	95th Percentile	Geomean
HVJ1A	Old (HV-9739)	26	37.5	52.9	0.0	226.9	15.1	131.1	12.6
	New (HV-3000234)	26	43.0	61.3	0.3	221.5	13.2	193.3	17.3
HVJ2	Old (HV-9534)	13	22.8	25.0	0.9	84.5	15.6	72.3	12.1
	New (HV-3000236)	13	38.3	37.5	2.6	120.0	29.7	113.6	23.5
HVJ3	Old (HV-9535)	25	19.5	28.8	0.3	115.3	8.2	78.5	7.4
	New (HV-3000237)	25	19.7	28.2	0.0	106.1	8.7	83.3	9.0
HVS1A	Old (HV-2600)	13	27.3	24.6	5.3	98.3	23.1	66.8	19.8
	New (HV-3000235)	13	33.5	33.6	2.5	113.2	27.3	102.2	20.9
HVJ4	Old (HV-9539)	26	15.5	23.3	0.2	81.1	6.5	73.1	6.1
	New (HV-3000233)	26	20.5	28.7	0.0	103.9	9.1	90.7	8.4

TABLE 3.2-8 Baseline Ambient Radon Concentrations at Reference and Exposure Areas for the McClean Lake Operation, 1988 to 1990

Station Location		Annual Mean Values			
		1988 (Bq/m³)	1989 (Bq/m³)	1990 (Bq/m³)	1988 to 1990 Mean (Bq/m³)
Reference	Far Field	13.6	12.3	72.2	32.7
JEB Exposure Stations	JEB 1	11.1	14.8	41.6	22.5
	JEB 2	19.7	14.8	54.6	29.7
	JEB 3	18.5	13.6	49.0	27.0
	JEB 4	16.0	14.8	72.2	34.3
	JEB 5	16.0	14.8	26.8	19.2
	Mean	**16.3**	**14.6**	**48.8**	**26.6**
McClean Lake Exposure Stations	M1	9.9	17.3	17.6	14.9
	M2	12.3	28.4	21.3	20.7
	M3	8.6	19.7	22.2	16.9
	M4	37.0	23.4	30.5	30.3
	M5	38.2	29.6	21.3	29.7
	Mean	**21.2**	**23.7**	**22.6**	**22.5**
Sue Exposure Stations	Sue 1	–	16.7	28.7	22.7
	Sue 2	–	22.2	16.7	19.4
	Sue 3	–	13.0	13.0	13.0
	Sue 4	–	9.3	16.7	13.0
	Sue 5	–	20.4	9.3	14.8
	Mean	**–**	**16.3**	**16.8**	**16.6**

Notes:

Dash indicates no data is available.

Table 3.2-9 Radon Concentrations at Reference and Exposure Stations at the McClean Lake Operation, 2022 to 2024

Stations		Radon Concentration (Bq/m³)							Average Geometric Mean (2000-2021)	Annual Arithmetic Average Concentrations Predicted in 2016 ERA
		No. Samples	No. Samples > MDL	Arithmetic Average	St. Dev.	Min	Max	Geometric Mean		McClean Lake Operation Area
Reference	TE-C1	6	1	18.8	30.1	12.0	26.0	20.6	12.6	23
JEB Exposure Stations	TE-J1	5	0	20.6	6.2	14.0	29.0	19.9	18.2	
	TE-J2	5	3	16.6	4.7	10.0	21.0	16.0	15.9	
	TE-J3	5	1	14.6	4.4	9.0	20.0	14.8	16.5	
	TE-J4	5	2	16.8	5.0	10.0	21.0	16.1	15.3	
	TE-J5	3	0	26.3	14.5	17.0	43.0	24.0	13.6	
	TE-J6	6	1	17.5	4.9	12.0	23.0	16.9	16.5	
	TE-J7	6	2	14.5	3.2	11.0	19.0	14.2	15.2	
	TE-J8	4	1	16.3	4.6	12.0	22.0	15.8	16.0	
	All Stations	**39**	**10**	**17.9**	**3.5**	**9.0**	**43.0**	**17.2**	**15.9**	
McClean Mining Area and Sue Exposure Stations	TE-M1	5	1	17.4	3.0	13.0	21.0	17.2	14.2	
	TE-M2	4	2	12.8	1.9	10.0	14.0	12.6	13.6	
	TE-M3	6	2	15.3	4.5	8.0	21.0	14.7	13.2	
	TE-M4	6	2	17.8	4.6	14.0	26.0	17.4	14.0	
	TE-M5A	3	1	14.7	1.2	14.0	16.0	14.6	13.5	
	TE-M6	6	1	19.3	5.5	14.0	27.0	18.7	18.8	
	TE-M8	6	0	27.2	3.5	22.0	30.0	27.0	27.8	
	TE-S1	5	1	18.0	3.4	14.0	22.0	17.7	24.8	
	TE-S2	6	0	210.7	90.3	128.0	358.0	218.2	200.2	
	TE-S3	7	1	17.4	2.6	14.0	20.0	17.3	16.5	
	TE-S5	4	1	20.5	14.3	13.0	42.0	17.8	17.8	
	TE-S6	5	2	19.2	8.7	10.0	33.0	17.7	21.2	
	TE-S7	4	1	16.3	4.6	13.0	23.0	15.8	16.8	
	TE-S8*	6	0	17.5	4.1	13.0	25.0	17.1	15.9	
	TE-S9**	6	1	25.2	7.4	14.0	37.0	24.2	14.6	
	All Stations	**73**	**16**	**18.5**	**3.4**	**8.0**	**42.0**	**17.8**	**17.8**	

Notes:

Grey cells indicate exceedances over the 2016 ERA prediction for the McClean Lake Operation Area.

Samples less than the minimum reportable detection limit were assumed to be equal to the detection limit for presentation purposes.

'All Stations' calculations for the McClean Mining Area and Sue Exposure stations do not include TE-S2 as per CNSC methodology (CNSC 2017).

*TE-S8 replaced TE-S4 in 2006 therefore 2000-21 Average Geometric Mean presented here includes data from both TE-S8 and TE-S4.

**TE-S9 replaced TE-M7 in 2006, therefore 2000-21 Average Geometric Mean presented here includes data from both TE-S9 and TE-M7.

TABLE 3.2-10 Monthly Acid Precipitation Monitoring at the McClean Lake Operation Meteorological Station, AR02, 2022 to 2024

Month	2022		2023		2024	
	pH	Precip.	pH	Precip.	pH	Precip.
Jan	5.83	Snow	5.95	Snow	5.44	Snow
Feb	6.62	Snow	6.11	Snow	5.89	Snow
Mar	7.70	Snow	6.38	Snow	5.93	Snow
Apr	6.75	Snow	5.33	Snow	5.09	Snow
May	5.12	Rain	5.49	Rain	5.45	Rain
Jun	4.83	Rain	6.49	Rain	5.24	Rain
Jul	5.73	Rain	4.72	Rain	4.67	Rain
Aug	4.86	Rain	6.20	Rain	5.64	Rain
Sep	5.25	Rain	NS	NS	5.99	Rain
Oct	7.22	Rain	4.63	Rain	5.71	Rain/Snow
Nov	5.74	Snow	5.69	Snow	5.89	Snow
Dec	5.47	Snow	5.77	Snow	5.27	Snow

Notes:

NS - no sample taken due to insufficient rain

Table 3.2-11 Summary of the Ambient Hourly SO2 Concentrations (ppb) at the McClean Lake Operation, 2000 to 2024

Year	Number of Samples	Obs.>172 ppb		Arithmetic Mean	Minimum	Maximum	Maximum Predicted 1-hour Concentrations in 2016 ERA (ppb)
		Number	Percentage				
2000	8362	6	0.07%	2.3	0	476	34.7
2001	8360	3	0.04%	2.1	0	290	
2002	7200	0	0.00%	1.1	0	16	
2003	8373	0	0.00%	1.1	0	72	
2004	8342	0	0.00%	0.3	0	33	
2005	7366	1	0.01%	0.9	0	403	
2006	7092	3	0.04%	3.5	0	1212	
2007	8203	4	0.05%	5.7	0	389	
2008	8373	23	0.27%	3.1	0	578	
2009	7708	12	0.16%	3	0	1069	
2010	6398	7	0.11%	1.9	0	957	
2011	0	0	0.00%	0	0	0	
2012	0	0	0.00%	0	0	0	
2013	0	0	0.00%	0	0	0	
2014	52	6	11.50%	-	3.1	7937	
2015	8384	4	0.04%	2.5	0	213	
2016	8405	4	0.05%	1.2	0	695	
2017	8375	40	0.48%	8.1	0	1925	
2018	7907	0	0.00%	0.9	0	235	
2019	8164	1	0.01%	0.9	0	1027	
2020	4399	0	0.00%	0.5	0	23	
2021	8218	0	0.00%	0.6	0	236	
2022	8742	0	0.00%	0.5	0	94	
2023	8737	0	0.00%	0.8	0	100	
2024	8746	0	0.00%	0.9	0	141	

Notes:
Grey cells indicate exceedances of maximum 1-hour concentration over the 2016 ERA prediction.

Table 3.2-12 Summary of the Ambient 24-Hour SO_2 Concentrations (ppb) at the McClean Lake Operation, 2000 to 2024

Year	Number of Samples	Obs.>48 ppb		Arithmetic Mean	Minimum	Maximum	Maximum Predicted 24-hour Concentrations in 2016 ERA (ppb)
		Number	Percentage				
2000	366	1	0.27%	2.4	0	63.9	20.2
2001	365	0	0.00%	2.1	0	33.4	
2002	318	0	0.00%	1.1	0	5.5	
2003	365	0	0.00%	1.1	0	12.7	
2004	365	0	0.00%	0.4	0	9.7	
2005	323	0	0.00%	0.9	0	30.6	
2006	310	1	0.32%	3.9	0	238.6	
2007	360	0	0.00%	5.7	0	51.5	
2008	366	2	0.55%	3.1	0	351.6	
2009	336	3	0.89%	3.0	0	100.7	
2010	280	0	0.00%	1.9	0	42.3	
2011	0	0	0.00%	0	0	0	
2012	0	0	0.00%	0	0	0	
2013	0	0	0.00%	0	0	0	
2014	5	2	40.00%	2.4	0	733	
2015	365	4	1.09%	2.6	0	69	
2016	366	0	0.00%	1.9	0	44.5	
2017	365	9	2.47%	14.9	0	1907.8	
2018	345	0	0.00%	1.5	0	33.1	
2019	357	2	0.56%	1.6	0	87.9	
2020	192	0	0.00%	0.7	0	10.7	
2021	354	0	0.00%	1.0	0	15.7	
2022	365	0	0.00%	0.5	0	9.6	
2023	365	0	0.00%	0.8	0	13.1	
2024	366	0	0.00%	0.9	0	16.7	

Notes:

Grey cells indicate exceedances of maximum 24-hour concentration over the 2016 ERA prediction.

Table 3.2-13 Acid Plant Stack Emissions of SO2, 2022 to 2024

Year	Month	Operating Hours	Maximum Estimated Emission Rates in 2016 ERA[1] (g/h)	Sulphuric Acid Plant Emission Rate[2] (g/h)
		SE01	**SE01**	**SE01**
2022	January	744	12,440	2,880
	February	670		2,015
	March	744		2,055
	April	720		3,270
	May	509		6,319
	June	657		4,649
	July	120		3,485
	August	311		17,614
	September	718		10,922
	October	739		7,669
	November	696		8,817
	December	730		4,721
	Average	**7356**	**-**	**6,201**
2023	January	719	12,440	3,300
	February	672		3,057
	March	742		3,901
	April	720		4,311
	May	744		3,044
	June	696		9,415
	July	738		18,464
	August	717		21,158
	September	120		41,525
	October	659		19,651
	November	706		13,609
	December	717		5,096
	Average	**7948**	**-**	**12,211**
2024	January	742	12,440	5,177
	February	696		3,016
	March	719		19,844

Year	Month	Operating Hours	Maximum Estimated Emission Rates in 2016 ERA[1] (g/h)	Sulphuric Acid Plant Emission Rate[2] (g/h)
		SE01	SE01	SE01
	April	719		5,445
	May	739		3,973
	June	720		6,732
	July	717		8,422
	August	575		6,590
	September	7		NR
	October	584		4,783
	November	714		4,221
	December	736		5,349
	Average	**7667**	**-**	**6,129**

Notes:
NR - Not required
Grey cells indicate exceedances over the 2016 ERA emission rate estimate.
[1]Emission rate estimate is for the Maximum Operations Scenario from the 2016 ERA (AREVA 2016b).
[2]Calculated based on the daily sulphur consumption rate and average monthly conversion efficiency and operating hours of the acid plant.

TABLE 3.2-14 SRC Stack Testing Results, 2022 to 2024

Pollutant	Units	Estimated Emission Rates in 2016 ERA[1]	2022		2023		2024		2022-24 Average	2022-24 Max	2016-21 Average
			Test 1 - Aug. 2022	Test 2 - Oct. 2022	Test 1 - Apr. 2023	Test 2 - Oct. 2023	Test 1 - Apr. 2024	Test 1 - Oct. 2024			
Crystallizer - SE02											
TSP	kg/h	0.9	0.16	0.13	0.33	0.28	0.67	0.16	0.29	0.67	0.83
Calciner Stack - SE04											
TSP	kg/h	12.60	1.63	2.60	2.20	4.36	2.70	2.05	2.59	4.36	4.50
SO_2	kg/h	0.72	0.11	-	0.028	-	0.62	-	0.25	0.62	1.47
U	g/h	10.8	8.2	-	29	-	35.8	-	24.3	35.8	16.9
As	g/h	0.065	0.19	-	0.27	-	0.30	-	0.25	0.30	0.09
Ni	g/h	0.036	0.078	-	0.035	-	0.051	-	0.055	0.078	0.026
Cu	g/h	0.054	0.042	-	0.039	-	0.053	-	0.045	0.053	0.032
Ra-226	Bq/h	-	649	-	208	-	479	-	445	649	373
Pb-210	Bq/h	-	1,113	-	1,120	-	1,180	-	1,138	1,180	4,623
Th-230	Bq/h	-	557	-	416	-	590	-	521	590	455
Packaging Stack - SE05											
TSP	kg/h	0.058	0.017	0.013	0.076	0.056	0.059	0.064	0.047	0.076	0.062
U	g/h	0.68	0.36	-	0.21	-	0.42	-	0.33	0.42	0.47
As	g/h	0.20	0.0015	-	0.0012	-	0.0027	-	0.0018	0.0027	0.0014
Ni	g/h	0.036	0.031	-	0.010	-	0.023	-	0.021	0.031	0.016
Cu	g/h	0.072	0.027	-	0.016	-	0.032	-	0.025	0.032	0.029
Ra-226	Bq/h	-	346	-	130	-	143	-	206	346	251
Pb-210	Bq/h	-	576	-	521	-	572	-	556	576	988
Th-230	Bq/h	-	288	-	261	-	286	-	278	288	357
Incinerator - SE07											
TSP	kg/h	0.079	-	-	-	-	0.19	-	0.19	0.19	0.29

Notes:

Grey cells indicate values higher than the 2016 ERA emission rate estimate.

[1]Estimated emission rates for Operational Period 2 (2022-2030) from the 2016 ERA (AREVA 2016b).

TABLE 3.2-15 Summary of NPRI Releases to Air for the McClean Lake Operation, 2022 to 2024

Substance	Unit	2022	2023	2024
Criteria Air Contaminants				
Nitrogen oxides (expressed as nitrogen dioxide)	tonnes	55.4	33.0	40.2
Total particulate matter	tonnes	219	279	167
PM10 - Particulate Matter <= 10 Micrometers	tonnes	42.1	48.2	25.5
PM2.5 - Particulate Matter <= 2.5 Micrometers	tonnes	5.59	4.96	3.12
Sulphur dioxide	tonnes	44.6	80.3	56.2
Volatile Organic Compounds (Total)	tonnes	198	253	243
Metals				
Arsenic (and its compounds)	kg	1.23	1.47	1.90
Cadmium (and its compounds)	kg	0.0515	0.0411	0.0349
Cobalt (and its compounds)	kg	0.00197	0.00193	0.000800
Copper (and its compounds)	tonnes	0.000394	0.000312	0.000400
Lead (and its compounds)	kg	0.0485	0.0435	0.0526
Manganese (and its compounds)	tonnes	0.00212	0.00204	0.00170
Nickel (and its compounds)	tonnes	0.000675	0.000472	0.000400
Selenium (and its compounds)	kg	0.644	0.619	0.631
Thallium (and its compounds)	kg	N/A	0.000007	N/A
Vanadium (and its compounds)	tonnes	0.000005	0.000005	N/A
Zinc (and its compounds)	tonnes	0.00415	0.00395	0.00300
Other				
Ammonia (total)	tonnes	23.6	37.8	40.9
Dioxins and furans - total	g TEQ	0.00137	0.00137	0.00130

Notes:

N/A - not applicable (i.e., releases were below the reporting threshold).

TABLE 4.3-1

A History of Baseline Surface Water Quality Sampling Programs.

Area	Station Code	1979		1980		1983		1987	1988			1989	1990	1993			1994		1995
		Sept	Mar	June	Aug	July	Oct	n/a	June	Aug	Oct	Apr	Apr	May	Aug	Oct/Dec	Apr	June	Aug
Reference Area																			
Mallen Lake	W1 (WQ1C)	x	x	x	x														x
Collins Creek upstream of Nadia Lake	W9 (WQ2C)					x	x												x
Collins Creek downstream of Nadia Lake	W10					x	x												
Collins Creek upstream McClean Lake	W16/W17	x	x	x	x			x	x	x	x								
McClean Lake West Basin	W36 (WQ15C)													x	x	x	x	x	
Sink/Vulture Treated Effluent Management System																			
Sink Lake	W18 (WQ9E; CM03)			x					x	x	x	x		x	x	x	x	x	x
Vulture Lake	W19 (WQ10E; CM04)	x	x	x	x				x	x	x	x		x	x	x	x	x	x
Primary Exposure Area																			
McClean Lake	W20	x	x	x	x	x	x		x	x	x	x							
McClean Lake East Basin	W35 (WQ11E)													x	x	x	x	x	x
Collins Creek site 1 - CC1	W37													x	x		x	x	
Collins Creek site 2 - CC2	W38 (WQ12E)													x	x	x	x	x	
Collins Creek site 3 - CC3	W39 (WQ13E)													x	x	x	x	x	
Collins Creek upstream of Kewen Lake - CC4	W29			x	x														
Kewen Lake	W25 (WQ14E)	x		x	x									x	x	x	x	x	x
Secondary Exposure Area																			
Geneva Lake	W2								x	x	x								
Tail Lake	W3 (WQ3E)									x	x	x		x	x	x	x	x	x
Fox Lake	W4/W5 (WQ4E)					x	x		x	x	x	x		x	x	x	x	x	x
Pat Lake	W6/W7 (WQ5E)					x	x		x	x	x	x		x	x	x	x	x	x
Nadia Lake	W8					x	x		x	x	x								
Torwalt Lake	W11/W12	x	x	x	x					x	x								x
Emperor Lake	W13			x															x
Armand Lake	W14			x															
Kismet Lake	W15			x															
Candy Lake	W21 (WQ18E)	x	x	x	x	x	x		x	x	x	x							
Collins Creek upstream of Candy Creek	W22					x	x	x	x	x	x	x							
Candy Creek	W23							x	x	x	x	x							
Collins Creek downstream of Candy Creek	W24	x	x	x	x	x	x	x	x	x	x	x							
Esto Lake	W26								x	x	x								
Tut Lake	W27			x					x	x	x								
Moffat Lake	W28	x	x	x	x				x	x	x								
Isis Lake	W30												x	x	x	x	x	x	x
Osiris Lake	W31 (WQ7E)												x	x	x	x	x	x	x
Dwarf Lake	W32												x						
Johannes Lake	W33 (WQ8E)												x	x	x	x	x	x	x
Unnamed Lake	W34												x						

Station codes as presented in the 1991 and 1995 environmental assessments. Station codes in brackets represent the stations named and identified in the McClean Lake Operation Environmental Monitoring Program. Station codes for Sink Reservoir and Vulture Lake were updated during the Operational Period to CM03 and CM04, respectively.

TABLE 4.3-2

Summary of Baseline Surface Water Limnology from 1993 to 1995.

Parameter	Units	Mallen Lake (WQ1C)		Collins Creek (WQ2C)		McClean Lake West (WQ15C)	
		Mean	SD[1]	Mean	SD	Mean	SD
Specific conductivity	µS/cm	23.3	0.6	20.7	3.2	19.4	3
Total alkalinity	mg/L	-[2]	-	7.8	1.7	7.6	1.8
Total dissolved solids	mg/L	23.3	3.1	24.3	3.6	24.9	5.7
Total hardness	mg/L	7	-[3]	6.2	1	5.7	1.1
Total suspended solids	mg/L	1.3	0.6	2.5	1.5	2.3	1.4

Parameter	Units	Sink Lake (WQ9E; CM03)		Vulture Lake (WQ10E; CM04)	
		Mean	SD	Mean	SD
Specific conductivity	µS/cm	23.4	9.1	25.7	5.5
Total alkalinity	mg/L	8.9	4.6	9.3	2.1
Total dissolved solids	mg/L	24.1	9.9	23	5
Total hardness	mg/L	6.9	3.1	7.6	2.1
Total suspended solids	mg/L	4.1	5.7	3	0.7

Parameter	Units	McClean Lake (WQ11E)		Collins Creek 2 (WQ12E)		Collins Creek 3 (WQ13E)		Collins Creek 4 (W29)		Kewen Lake (WQ14E)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Specific conductivity	µS/cm	20.9	4.8	20.6	5.2	20.9	4.9	30	-	23.8	5.3
Total alkalinity	mg/L	7.6	2.1	7.1	2.2	7.1	2.2	-	-	8.1	2.3
Total dissolved solids	mg/L	26.6	5.4	27.4	9.2	27.5	8	31	1.4	25	5.3
Total hardness	mg/L	6.4	1.6	6	1.7	6.1	1.6	9	-	6.9	1.6
Total suspended solids	mg/L	2.1	0.6	1.9	0.8	2.1	0.8	2	-	1.8	0.9

Parameter	Units	Fox Lake (WQ4E)		Isis Lake (W30)		Johannes Lake (WQ8E)		Osiris Lake (WQ7E)		Pat Lake (WQ5E)		Tail Lake (WQ3E)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Specific conductivity	µS/cm	24.8	9	10.5	6.8	21.2	3	17.1	2.7	22.4	2.2	31.3	9.5
Total alkalinity	mg/L	8.5	2.4	3.7	1.3	7.6	2.1	5.1	1.5	8.4	1.6	12.3	4.8
Total dissolved solids	mg/L	24.6	8.1	12.6	4.8	24.8	3.2	18.6	3.2	23.9	4.4	31.3	7.8
Total hardness	mg/L	7.7	3.4	1.6	0.5	6.6	1.2	3.9	0.6	6.5	0.7	9.8	3.7
Total suspended solids	mg/L	2	0.7	1.9	1.1	2.2	1.1	1.6	0.7	1.5	0.7	3.9	5

[1]SD = standard deviation.

[2]No data.

[3]Only one sample collected.

TABLE 4.3-3

Summary of Baseline Surface Water Major Ion Concentrations from 1993 to 1995.

Parameter	Units	Mallen Lake (WQ1C)		Collins Creek (WQ2C)		McClean Lake West (WQ15C)	
		Mean	SD[1]	Mean	SD	Mean	SD
Calcium	mg/L	1.97	0.06	1.58	0.31	1.46	0.25
Chloride	mg/L	0.13	0.06	0.15	0.08	0.19	0.12
Fluoride	mg/L	-[2]	-	0.03	0.02	0.02	0.01
Magnesium	mg/L	0.60	<0.001	0.53	0.08	0.49	0.09
Potassium	mg/L	0.47	0.06	0.37	0.14	0.39	0.09
Silica	mg/L	4.00	0.10	2.45	0.80	2.67	0.80
Sodium	mg/L	1.40	<0.001	1.22	0.26	1.14	0.22
Sulphate	mg/L	0.57	0.06	0.50	0.16	0.51	0.16

Parameter	Units	Sink Lake (WQ9E; CM03)		Vulture Lake (WQ10E; CM04)	
		Mean	SD	Mean	SD
Calcium	mg/L	1.79	0.90	1.90	0.49
Chloride	mg/L	0.29	0.13	0.22	0.08
Fluoride	mg/L	0.04	0.05	0.03	0.02
Magnesium	mg/L	0.59	0.25	0.71	0.18
Potassium	mg/L	0.41	0.16	0.50	0.16
Silica	mg/L	3.26	1.49	1.86	0.39
Sodium	mg/L	1.45	0.35	1.44	0.27
Sulphate	mg/L	0.63	0.16	0.54	0.10

Parameter	Units	McClean Lake (WQ11E)		Collins Creek 2 (WQ12E)		Collins Creek 3 (WQ13E)		Collins Creek 4 (W29)		Kewen Lake (WQ14E)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Calcium	mg/L	1.59	0.42	1.55	0.46	1.56	0.46	2.50	0.14	1.75	0.45
Chloride	mg/L	0.18	0.10	0.21	0.10	0.20	0.11	0.20	-[3]	0.33	0.263
Fluoride	mg/L	0.03	0.011	0.03	0.014	0.04	0.028	-	-	0.04	0.036
Magnesium	mg/L	0.54	0.119	0.54	0.141	0.54	0.119	0.70	-	0.60	0.141
Potassium	mg/L	0.43	0.089	0.38	0.128	0.41	0.136	0.50	-	0.42	0.14
Silica	mg/L	2.94	1.115	2.65	1.094	2.70	1.112	4.95	0.071	3.08	0.968
Sodium	mg/L	1.21	0.242	1.23	0.238	1.24	0.25	1.75	0.071	1.34	0.237
Sulphate	mg/L	0.55	0.177	0.58	0.175	0.55	0.193	0.50	-	0.75	0.217

Parameter	Units	Fox Lake (WQ4E)		Isis Lake (W30)		Johannes Lake (WQ8E)		Osiris Lake (WQ7E)		Pat Lake (WQ5E)		Tail Lake (WQ3E)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Calcium	mg/L	1.87	0.886	0.34	0.074	1.70	0.254	1.00	0.169	1.69	0.179	2.31	0.894
Chloride	mg/L	0.13	0.05	0.50	1.092	0.12	0.042	0.14	0.106	0.12	0.042	0.10	<0.001
Fluoride	mg/L	0.05	0.02	0.02	0.013	0.03	0.018	0.03	0.02	0.04	0.033	0.04	0.023
Magnesium	mg/L	0.69	0.337	0.16	0.052	0.57	0.106	0.38	0.071	0.59	0.057	0.98	0.324
Potassium	mg/L	0.47	0.141	0.39	0.295	0.47	0.106	0.33	0.104	0.43	0.067	0.63	0.104
Silica	mg/L	2.38	1.261	0.20	0.004	2.73	0.587	0.74	0.233	2.57	0.34	3.84	2.73
Sodium	mg/L	1.38	0.468	0.71	0.579	1.13	0.206	0.94	0.151	1.34	0.255	1.73	0.167
Sulphate	mg/L	0.63	0.173	0.94	0.475	0.57	0.082	0.56	0.074	0.71	0.099	0.68	0.183

[1]SD = standard deviation.

[2]No data.

[3]Only one sample collected.

TABLE 4.3-4

Summary of Baseline Surface Water Nutrient Concentrations from 1993 to 1995.

Parameter	Units	Mallen Lake (WQ1C)		Collins Creek (WQ2C)		McClean Lake West (WQ15C)	
		Mean	SD[1]	Mean	SD	Mean	SD
Ammonia	mg/L	-[2]	-	0.017	0.012	0.013	0.005
Nitrate + Nitrite	mg/L	0.083	0.057	0.015	0.012	0.02	0.022
Total Kjeldahl nitrogen	mg/L	0.13	0.03	0.18	0.04	0.241	0.104
Total phosphorus	mg/L	0.01	<0.001	0.017	0.012	0.014	0.005

Parameter	Units	Sink Lake (WQ9E; CM03)		Vulture Lake (WQ10E; CM04)	
		Mean	SD	Mean	SD
Ammonia	mg/L	0.016	0.008	0.011	0.004
Nitrate + Nitrite	mg/L	0.01	<0.001	0.038	0.054
Total Kjeldahl nitrogen	mg/L	0.2	0.108	0.22	0.088
Total phosphorus	mg/L	0.019	0.014	0.017	0.01

Parameter	Units	McClean Lake (WQ11E)		Collins Creek 2 (WQ12E)		Collins Creek 3 (WQ13E)		Collins Creek 4 (W29)		Kewen Lake (WQ14E)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Ammonia	mg/L	0.02	0.014	0.014	0.008	0.014	0.005	-	-	0.016	0.011
Nitrate + Nitrite	mg/L	0.035	0.042	0.014	0.011	0.023	0.022	0.095	0.007	0.055	0.053
Total Kjeldahl nitrogen	mg/L	0.234	0.084	0.211	0.063	0.185	0.058	0.145	0.021	0.279	0.119
Total phosphorus	mg/L	0.013	0.005	0.013	0.005	0.023	0.032	0.01	-[3]	0.016	0.013

Parameter	Units	Fox Lake (WQ4E)		Isis Lake (W30)		Johannes Lake (WQ8E)		Osiris Lake (WQ7E)		Pat Lake (WQ5E)		Tail Lake (WQ3E)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Ammonia	mg/L	0.021	0.018	0.06	0.115	0.01	-	0.019	0.015	0.014	0.008	0.024	0.015
Nitrate + Nitrite	mg/L	0.027	0.027	0.026	0.042	0.046	0.056	0.016	0.012	0.041	0.048	0.024	0.021
Total Kjeldahl nitrogen	mg/L	0.227	0.069	0.971	2.073	0.182	0.098	0.234	0.089	0.13	0.06	0.339	0.158
Total phosphorus	mg/L	0.011	0.003	0.055	0.111	0.017	0.011	0.015	0.005	0.013	0.005	0.025	0.017

[1]SD = standard deviation.

[2]No data.

[3]Only one sample collected.

TABLE 4.3-5

Summary of Baseline Surface Water Metals Concentrations from 1993 to 1995.

Parameter	Units	Mallen Lake (WQ1C)		Collins Creek (WQ2C)		McClean Lake West (WQ15C)	
		Mean	SD[1]	Mean	SD	Mean	SD
Arsenic	µg/L	0.5	-[2]	0.6	0.08	0.6	0.2
Cadmium	mg/L	0.001	-	0.001	-	0.001	-
Cobalt	mg/L	0.001	<0.001	0.001	<0.001	0.001	<0.001
Copper	mg/L	0.002	0.002	0.001	<0.001	0.001	-
Lead	mg/L	0.005	<0.001	0.005	-	0.005	0.001
Molybdenum	mg/L	0.005	<0.001	0.005	-	0.007	0.005
Nickel	mg/L	0.001	-	0.005	0.003	0.005	0.003
Selenium	mg/L	0.001	-	0.001	-	0.001	-
Vanadium	mg/L	0.01	<0.001	0.01	-	0.01	-
Zinc	mg/L	0.005	<0.001	0.005	-	0.005	0.001

Parameter	Units	Sink Lake (WQ9E; CM03)		Vulture Lake (WQ10E; CM04)	
		Mean	SD	Mean	SD
Arsenic	µg/L	0.7	0.3	0.7	0.5
Cadmium	mg/L	0.001	-	0.001	-
Cobalt	mg/L	0.001	<0.001	0.001	0.001
Copper	mg/L	0.002	0.002	0.002	0.002
Lead	mg/L	0.006	0.002	0.005	<0.001
Molybdenum	mg/L	0.005	<0.001	0.005	<0.001
Nickel	mg/L	0.003	0.003	0.002	0.001
Selenium	mg/L	0.001	-	0.001	-
Vanadium	mg/L	0.01	<0.001	0.01	<0.001
Zinc	mg/L	0.009	0.008	0.006	0.002

Parameter	Units	McClean Lake (WQ11E)		Collins Creek 2 (WQ12E)		Collins Creek 3 (WQ13E)		Collins Creek 4 (W29)		Kewen Lake (WQ14E)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Arsenic	µg/L	0.7	0.5	0.6	0.1	0.5	0.1	0.5	-	0.6	0.2
Cadmium	mg/L	0.001	-	0.001	-	0.001	-	0.001	-	0.001	-
Cobalt	mg/L	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	0	0.001	<0.001
Copper	mg/L	0.001	0.001	0.007	0.012	0.002	0.002	0.003	0.002	0.001	0.001
Lead	mg/L	0.005	0.001	0.007	0.004	0.007	0.003	0.005	-	0.005	<0.001
Molybdenum	mg/L	0.005	<0.001	0.007	0.006	0.006	0.001	0.005	-	0.005	<0.001
Nickel	mg/L	0.002	0.001	0.004	0.002	0.003	0.003	0.001	-	0.003	0.002
Selenium	mg/L	0.001	-	0.001	-	0.001	-	0.001	-	0.001	-
Vanadium	mg/L	0.01	<0.001	0.01	<0.001	0.01	<0.001	0.01	-	0.01	<0.001
Zinc	mg/L	0.006	0.001	0.005	<0.001	0.005	<0.001	0.005	-	0.007	0.004

Parameter	Units	Fox Lake (WQ4E)		Isis Lake (W30)		Johannes Lake (WQ8E)		Osiris Lake (WQ7E)		Pat Lake (WQ5E)		Tail Lake (WQ3E)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Arsenic	µg/L	0.5	0.1	0.7	0.5	0.6	0.2	0.5	-	0.7	0.5	0.7	0.5
Cadmium	mg/L	0.001	-	0.001	-	0.001	-	0.001	-	0.001	-	0.001	-
Cobalt	mg/L	0.001	0.001	0.001	<0.001	0.001	0.001	0.001	0.001	0.001	0	0.001	<0.001
Copper	mg/L	0.002	0.002	0.002	0.001	0.002	0.001	0.004	0.006	0.002	0.001	0.001	<0.001
Lead	mg/L	0.005	<0.001	0.005	<0.001	0.006	0.004	0.005	<0.001	0.006	0.002	0.005	<0.001
Molybdenum	mg/L	0.011	0.017	0.006	0.002	0.005	0.001	0.005	<0.001	0.005	<0.001	0.006	0.002
Nickel	mg/L	0.003	0.003	0.003	0.003	0.002	0.002	0.005	0.005	0.003	0.002	0.003	0.003
Selenium	mg/L	0.001	-	0.001	-	0.001	-	0.001	-	0.001	-	0.001	-
Vanadium	mg/L	0.01	<0.001	0.01	<0.001	0.01	<0.001	0.01	<0.001	0.01	<0.001	0.01	<0.001
Zinc	mg/L	0.006	0.002	0.005	<0.001	0.005	<0.001	0.005	<0.001	0.006	0.002	0.006	0.001

[1]SD = standard deviation.

[2]Only one sample collected.

Highlighted means exceed either Provincial or Federal guideline for the protection of freshwater aquatic life.

TABLE 4.3-6

Summary of Baseline Surface Water Radionuclide Concentrations from 1993 to 1995.

Reference Area							
Parameter	Units	Mallen Lake (WQ1C)		Collins Creek (WQ2C)		McClean Lake West (WQ15C)	
		Mean	SD[a]1	Mean	SD	Mean	SD
Lead-210	Bq/L	0.02	<0.001	0.02	-[2]	0.02	-
Radium-226	Bq/L	0.005	<0.001	0.005	-	0.005	-
Polonium-210	Bq/L	0.005	<0.001	0.007	0.003	0.006	0.002
Thorium-230	Bq/L	0.023	0.006	0.01	-	0.01	-
Uranium	µg/L	0.5	-	0.6	0.2	0.5	-

Sink/Vulture Treated Effluent Management System					
Parameter	Units	Sink Lake (WQ9E; CM03)		Vulture Lake (WQ10E; CM04)	
		Mean	SD	Mean	SD
Lead-210	Bq/L	0.02	<0.001	0.02	<0.001
Radium-226	Bq/L	0.005	<0.001	0.005	<0.001
Polonium-210	Bq/L	0.008	0.005	0.007	0.003
Thorium-230	Bq/L	0.013	0.007	0.011	0.003
Uranium	µg/L	0.5	-	0.6	0.2

Primary Exposure Area											
Parameter	Units	McClean Lake (WQ11E)		Collins Creek 2 (WQ12E)		Collins Creek 3 (WQ13E)		Collins Creek 4 (W29)		Kewen Lake (WQ14E)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Lead-210	Bq/L	0.02	<0.001	0.021	0.004	0.02	<0.001	0.02	-	0.02	<0.001
Radium-226	Bq/L	0.005	<0.001	0.006	0.002	0.006	0.002	0.005	-	0.006	0.002
Polonium-210	Bq/L	0.007	0.003	0.007	0.003	0.009	0.005	0.005	0	0.013	0.017
Thorium-230	Bq/L	0.01	<0.001	0.01	<0.001	0.01	<0.001	0.04	<0.001	0.012	0.006
Uranium	µg/L	0.7	0.2	0.6	0.1	0.6	0.2	0.5	-	0.6	0.1

Secondary Exposure Area													
Parameter	Units	Fox Lake (WQ4E)		Isis Lake (W30)		Johannes Lake (WQ8E)		Osiris Lake (WQ7E)		Pat Lake (WQ5E)		Tail Lake (WQ3E)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Lead-210	Bq/L	0.022	0.007	0.024	0.011	0.021	0.003	0.023	0.007	0.02	<0.001	0.02	<0.001
Radium-226	Bq/L	0.005	<0.001	0.006	0.002	0.006	0.002	0.005	<0.001	0.006	0.002	0.007	0.005
Polonium-210	Bq/L	0.008	0.008	0.008	0.003	0.008	0.005	0.007	0.003	0.006	0.002	0.013	0.011
Thorium-230	Bq/L	0.012	0.007	0.013	0.007	0.017	0.012	0.016	0.015	0.013	0.005	0.01	<0.01
Uranium	µg/L	0.6	0.4	0.6	0.3	0.5	0.1	0.8	0.7	0.6	0.2	0.5	-

[1]SD = standard deviation.

[2]Only one sample collected.

TABLE 4.3-7

Waterbodies Sampled in the McClean Lake Operation LSA for the Water Quality Monitoring Program.

Reference			Primary Exposure			Secondary Exposure		
Stations	**Northing**	**Easting**	**Stations**	**Northing**	**Easting**	**Stations**	**Northing**	**Easting**
Mallen Lake (WQ01C)	6474726	565117	Sink Reservoir Outlet (CM03)	6461364	568310	Fox Lake (WQ04E)	6468110	567283
Collins Creek Upstream (WQ02C)	6459721	560346	Vulture Lake Outlet (CM04)	6459347	566518	Pat Lake (WQ05E)	6466094	566918
McClean Lake West Basin (WQ15C)	6457400	564700	McClean Lake East Basin (WQ11E)	6458556	566492	Johannes Lake (WQ08E)	6466401	568500
Henday Lake (WQ20C)	6464885	551600	McClean Lake Outlet (WQ12E)	6456662	566307	Sue Lake (WQ16E)	6457632	570648
			Collins Creek Downstream (WQ13E)	6451178	563625	Sils Lake (WQ17E)	6456658	570721
			Kewen Lake (WQ14E)	6450021	567386	Candy Lake (WQ18E)	6458447	568400
						Bena Lake (WQ19E)	6457818	568726
						Mink Arm (South McMahon Lake)[1] (M1; WQ31E)	6462767	553633

UTM coordinates are provided in NAD83, Zone13.
[1]WQ31E was monitored until 2020.

TABLE 4.3-8

Predicted Maximum Mean and 95th Percentile Water Quality Concentrations of Modelled Constituents.

Parameter	Units	Sink Reservoir Outlet (CM03)						Vulture Lake Outlet (CM04)						McClean Lake Outlet (WQ12E)						Kewen Lake (WQ14E)				
		1991	1995	2016		2018		1991	1995	2016		2018		1991	1995	2016		2018		1991	2016		2018	
		Max Mean	Max Mean	Max Mean	95th Percentile	Max Mean	95th Percentile	Max Mean	Max Mean	Max Mean	95th Percentile	Max Mean	95th Percentile	Max Mean	Max Mean	Max Mean	95th Percentile	Max Mean	95th Percentile	Max Mean	Max Mean	95th Percentile	Max Mean	95th Percentile
Nutrients																								
Ammonia as N	mg/L	5.3	7.3	4.3	5.3	-	-	4.8	6.0	1.4	1.7	-	-	0.91	0.94	0.22	0.28	-	-	0.47	0.10	0.11	-	-
Major Ions																								
Chloride	mg/L	-	-	290	330	-	-	-	-	210	240	-	-	-	-	22	30	-	-	-	10	14	-	-
Fluoride	mg/L	-	-	0.52	0.57	-	-	-	-	0.42	0.46	-	-	-	-	0.09	0.10	-	-		0.068	0.074	-	-
Potassium	mg/L	-	-	46	55	-	-	-	-	34	39	-	-	-	-	3.9	5.3	-	-		2	2.5	-	-
Sulphate	mg/L	1590	1440	1400	1600	-	-	1156	1244	1100	1200	-	-	177	170	110	140	-	-	72	48	65	-	-
Total Dissolved Solids	mg/L	2250	2005	2500	2900	-	-	1695	1770	1900	2200	-	-	282	264	190	260	-	-	129	87	120	-	-
Metals and Trace Elements																								
Arsenic	µg/L	88	81	11	16	-	-	51	42	5.2	7.7	-	-	6	5	1.0	1.4	-	-	3	0.71	0.84	-	-
Cadmium	mg/L	0.0065	0.0070			-	-	0.005	0.004			-	-	0.0010	0.0009			-	-	0.0007			-	-
Cobalt	mg/L	-	-	0.0043	0.0060	-	-	-	-	0.0010	0.0017	-	-	-	-	0.0002	0.0003	-	-	-	0.0001	0.0002	-	-
Copper	mg/L	0.055	0.051	0.0043	0.0060	-	-	0.036	0.029	0.0028	0.0035	-	-	0.0077	0.0060	0.0004	0.0005	-	-	0.005	0.0002	0.0003	-	-
Lead	mg/L	0.014	0.015	0.0008	0.0014	-	-	0.007	0.008	0.0003	0.0005	-	-	0.0035	0.0030	0.0001	0.0001	-	-	0.0035	0.0001	0.0001	-	-
Molybdenum	mg/L	3.57	3.36	0.120	0.150	-	-	2.62	1.99	0.066	0.090	-	-	0.390	0.277	0.009	0.012	-	-	0.180	0.004	0.006	-	-
Nickel	mg/L	0.12	0.12	0.027	0.035	-	-	0.090	0.080	0.012	0.016	-	-	0.02	0.01	0.001	0.002	-	-	0.008	0.0006	0.0009	-	-
Selenium	mg/L	0.019	0.019	0.041	0.055	0.0031	0.0051	0.012	0.010	0.021	0.027	0.0022	0.0027	0.0019	0.0020	0.0022	0.0033	0.0003	0.0004	0.000001	0.0010	0.0014	0.0001	0.0002
Uranium	µg/L	542	582	3.5	6.2	-	-	332	316	1.5	2.4	-	-	44	40	0.21	0.33	-	-	19	0.11	0.16	-	-
Vanadium	mg/L	0.015	0.012			-	-	0.0055	0.0050			-	-	0.0032	0.0030			-	-	0.0031			-	-
Zinc	mg/L	0.084	0.088	0.005	0.007	-	-	0.058	0.055	0.0033	0.0043	-	-	0.012	0.012	0.0013	0.0015	-	-	0.008	0.0011	0.0012	-	-
Radionuclides																								
Lead-210	Bq/L	0.33	0.11	0.03	0.037	-	-	0.18	0.06	0.017	0.021	-	-	0.05	0.04	0.01	0.011	-	-	0.04	0.0096	0.01	-	-
Polonium-210	Bq/L	-	-	0.02	0.03	-	-	-	-	0.01	0.02	-	-	-	-	0.0041	0.0052	-	-	-	0.0034	0.0041	-	-
Radium-226	Bq/L	0.09	0.09	0.013	0.019	-	-	0.06	0.05	0.008	0.011	-	-	0.01	0.009	0.0028	0.0032	-	-	0.006	0.0024	0.0026	-	-
Thorium-230	Bq/L	0.04	0.03	0.016	0.022	-	-	0.02	0.02	0.01	0.013	-	-	0.01	0.01	0.0022	0.0027	-	-	0.01	0.0015	0.0017	-	-

Source: Minatco (1991); COGEMA (1995); AREVA (2016b); Orano 2018a.

Max Mean = represents maximum predicted monthly concentrations assessed in the the 1991 EIS and 1995 EIS and maximum mean annual predictions for the 2016 and 2018 ERAs.

The 2016 predictions presented in AREVA 2016b and 2018 predictions presented in Orano 2018 were for the period of 2016 to 2100. Here, the predictions are presented for the EP TID period (2022 to 2024) only.

TABLE 4.3-9

Environmental Quality Guidelines for Surface Water COPCs.

COPC	Available Guideline				Selected Guideline		
	SEQG	CEQG	FEQG	B.C. WQG	Type	Value	Formula
Nutrients							
Ammonia (as N)	0.035 mg/L to 190 mg/L	0.035 mg/L to 190 mg/L	-	-	SEQG	Variable	Varies with pH and temperature. The equation along with reference tables are available from the CCME website. For example, at 15°C and pH of 8.0, the total ammonia as N guideline is 0.59 mg/L.
Nitrate (as N)	3.0 mg/L	-	-	-	SEQG	3.0 mg/L	-
General Chemistry and Major Ions							
Chloride	120 mg/L	120 mg/L	-	-	SEQG	120 mg/L	-
Dissolved Oxygen	-	6.5 mg/L/ 9.5 mg/L	-	-	CEQG	6.5 mg/L pr 9.5 mg/L depending on life stage	9.5 mg/L for cold-water biota in early life stages; 6.5 mg/L for cold-water biota in other life stages.
pH	6.5 to 9.0	6.5 to 9.0	-	-	SEQG	Greater than 6.5 and less than 9.0	
Sulphate	128 to 429 mg/L	-	-	-	SEQG	128 to 429 mg/L	Varies with hardness. Hardness of 0-30 mg/L = guideline of 128 mg/L, hardness of 31-75 mg/L = guideline of 218 mg/L, hardness of 76-180 mg/L = guidelines of 309 mg/L, hardness of 181-250 = guidelines of 429 mg/L, hardness >250 needs to determine based on site water.
Metals and Trace Elements							
Aluminum	0.005 mg/L to 0.05 mg/L	0.005 mg/L to 0.1 mg/L	0.01 mg/L to 2.4 mg/L	0.047 mg/L to 0.478 mg/L	B.C. WQG	Variable	Varies with pH, hardness, and dissolved organic carbon (DOC). The B.C. WQG is $e^{\{[0.645 * \ln(DOC)]+[2.255 * \ln(hardness)]+[1.995 * pH]+[-0.284 \ (\ln(hardness) * ph)]-9.898\} / 3}$. This equation is valid for hardness from 10 mg/L to 430 mg/L, pH from 6.0 and 8.7, and DOC between 0.08 and 12.3 mg/L. Values outside of these ranges must be adjusted to the upper or lower bounds of these ranges to ensure the equation is accurate and the B.C. WQG is protective.
Arsenic	5 µg/L	5 µg/L	-	-	SEQG	5 µg/L	-
Boron	-	1.5 mg/L	-	-	CEQG	1.5 mg/L	-
Cadmium	0.00004 mg/L to 0.00037 mg/L	0.00004 mg/L to 0.00037 mg/L	-	-	SEQG	Variable	Varies with hardness. At hardness ≥17 mg/L and ≤280 mg/L, long-term equation is $10^{(0.83[\log10(hardness) - 2.46))}$. For example, a hardness of 5-20 mg/L relates to a guideline of 0.00004 mg/L.
Chromium	0.0089 mg/L	0.0089 mg/L	-	-	SEQG	Chromium, trivalent	-
Cobalt	-	-	0.00078 mg/L to 0.0018 mg/L	-	FEQG	Variable	Calculated assuming a hardness = 100 mg/L. For other hardness values the guideline was derived using the formula: FEQG=EXP(0.414*(LN(Hardness))-1.887).
Fluoride	-	0.12	-	-	CEQG	0.12	-
Mercury	0.005 µg/L	0.026 µg/L	-	-	SEQG	0.005 µg/L	-
Molybdenum	31 mg/L	0.073 mg/L	-	-	SEQG	31 mg/L	-
Nickel	0.0058 mg/L to 0.729 mg/L	0.025 mg/L to 0.15 mg/L	-	-	SEQG	Variable	Varies with hardness. Long-term equation is $e^{[0.846[\ln(hardness)]+0.0584]}/1000$. For example, a hardness of <60 mg/L relates to a guideline of 0.034 mg/L.
Selenium	0.002 mg/L	0.001 mg/L	-	-	SEQG	0.002 mg/L	-
Silver	0.0001 mg/L	-	-	-	SEQG	0.0001 mg/L	-
Strontium	-	-	2.5 mg/L	-	FEQG	2.5 mg/L	-
Thallium	-	0.8 µg/L	-	-	CEQG	0.8 µg/L	-
Uranium	15 µg/L	15 µg/L	-	-	SEQG	15 µg/L	-
Radionuclides							
Radium-226	0.11 Bq/L	-	-	-	SEQG	0.11 Bq/L	SEQG based on EPB#602

SEQG = Saskatchewan Environmental Quality Guidelines (SEQG; GS 2025); Canadian Environmental Quality Guidelines (CEQG; CCME 2025);Federal Environmental Quality Guidelines (FEQG; GC 2024); B.C. Water Quality Guideline
For guidelines that are variable, comparisons were made using the modifying factor and associated equation.
EPB#602 = Radium-226 in Surface Water Environmental Quality Guideline published by the Government of Saskatchewan July 2016.

TABLE 4.3-10

COPC Selection Screening Results for the 2022 to 2024 EP TID Period.

Parameter	Units	McClean Lake Operation Monitoring Program[1]		COPC Selection based on 2022 to 2024 data			Available Predictions (EC3)[5]	Available Guideline (EC4)			
		2019	2023	less than 90% of data below RDL (EC1)[2]	Exceeded Reference Range (EC2)[3]	Selected as COPC[4]		SEQG	CCME CEQG	FEQG	B.C. WQG
Nutrients											
Ammonia (as N)	mg/L	Y	Y	Y	Y	Y	Y	✓	-	-	-
Ammonia, Un-ionized (as N)	mg/L	N	Y	N	N	N	N	-	✓	-	-
Carbon, Inorganic	mg/L	N	N	Y	Y	Y	N	-	-	-	-
Carbon, Organic	mg/L	Y	Y	Y	Y	Y	N	-	-	-	-
Carbon, Organic dissolved	mg/L	Y	Y	Y	Y	Y	N	-	-	-	-
Carbon, Total	mg/L	N	N	Y	Y	Y	N	-	-	-	-
Nitrate[6]	mg/L	Y	Y	Y	Y	N	N	-	✓	-	-
Nitrate (as N)	mg/L	Y	Y	Y	Y	Y	N	✓	-	-	-
Nitrite	mg/L	N	N	N	N	N	N	-	✓	-	-
Nitrogen, Total	mg/L	Y	Y	Y	Y	Y	N	-	-	-	-
Nitrogen, Total Kjeldahl	mg/L	Y	Y	Y	Y	Y	N	-	-	-	-
Phosphorus, Total	mg/L	Y	Y	Y	Y	Y	N	-	-	-	-
General Chemistry and Major Ions											
Alkalinity (as CaCO3)	mg/L	N	Y	Y	Y	Y	N	-	-	-	-
Alkalinity, Phenolphthalein	mg/L	N	Y	N	N	N	N	-	-	-	-
Bicarbonate (as HCO3)	mg/L	N	N	Y	Y	Y	N	-	-	-	-
Bicarbonate/Carbonate (HCO3/CO3)	-	Y	Y	N	N	N	N	-	-	-	-
Calcium	mg/L	Y	Y	Y	Y	Y	N	-	-	-	-
Carbonate (as CO3)	mg/L	N	N	N	N	N	N	-	-	-	-
Carbonate/Bicarbonate (CO3/HCO3)	-	Y	Y	N	N	N	N	-	-	-	-
Chloride	mg/L	Y	Y	Y	Y	Y	Y	✓	-	-	-
Dissolved Oxygen (Field)	mg/L	N	Y	Y	Y	Y	N	-	✓	-	-
Fluoride	mg/L	N	N	Y	Y	Y	Y	-	✓	-	-
Hardness, Total	mg/L	Y	Y	Y	Y	Y	N	-	-	-	-
Hydroxide	mg/L	N	N	N	N	N	N	-	-	-	-
Magnesium	mg/L	Y	Y	Y	Y	Y	N	-	-	-	-
pH, Laboratory[7]	pH units	Y	Y	Y	N	Y	N	✓	-	-	-
pH, Field	pH units	Y	Y	Y	N	N	N	✓	-	-	-
Potassium	mg/L	Y	Y	Y	Y	Y	Y	-	-	-	-
Sodium	mg/L	Y	Y	Y	Y	Y	N	-	-	-	-
Specific Conductivity	µS/cm	Y	Y	Y	Y	Y	N	-	-	-	-
Specific Conductivity, Field	µS/cm	Y	Y	Y	Y	Y	N	-	-	-	-
Sulphate	mg/L	Y	Y	Y	Y	Y	Y	✓	-		-
Sum of Ions	mg/L	Y	Y	Y	Y	Y	N	-	-	-	-
Temperature, Field	°C	Y	Y	Y	N	N	N	-	-	-	-
Total Dissolved Solids	mg/L	Y	Y	Y	Y	Y	Y	-	-	-	-
Total Suspended Solids	mg/L	Y	Y	Y	N	N	N	-	-	-	-
Turbidity	NTU	Y	Y	Y	N	N	N	-	-	-	-
Metals and Trace Elements											
Aluminum	mg/L	Y	Y	Y	Y	Y	N	✓	-	-	✓
Antimony	mg/L	N	N	N	N	N	N	-	-	-	-
Arsenic	µg/L	Y	Y	Y	Y	Y	Y	✓	-	-	-
Barium	mg/L	Y	Y	Y	Y	Y	N	-	-	-	-
Beryllium	mg/L	N	N	N	N	N	N	-	-	-	-
Bismuth	mg/L	Y	N	N	N	N	N	-	-	-	-
Boron	mg/L	Y	Y	Y	Y	Y	N	✓	-	-	-
Cadmium	mg/L	Y	Y	Y	Y	Y	Y	✓	-	-	-
Chromium	mg/L	Y	Y	Y	Y	Y	N	✓	-	-	-
Cobalt	mg/L	Y	Y	Y	Y	Y	Y	-	-	✓	-
Copper	mg/L	Y	Y	Y	N	N	Y	✓	-	-	-
Iron	mg/L	Y	Y	Y	N	N	N	✓	-	-	-
Lead	mg/L	Y	Y	N	N	N	Y	-	✓	-	-
Manganese	mg/L	Y	Y	Y	N	N	N	-	✓	-	-
Mercury	µg/L	Y	Y	Y	Y	Y	N	✓	-	-	-
Molybdenum	mg/L	Y	Y	Y	Y	Y	Y	✓	-	-	-
Nickel	mg/L	Y	Y	Y	Y	Y	Y	✓	-	-	-
Selenium	mg/L	Y	Y	Y	Y	Y	Y	✓	-	-	-
Silver	mg/L	N	N	Y	Y	Y	N	✓	-	-	-
Strontium	mg/L	N	N	Y	Y	N	N	-	-	✓	-
Thallium	mg/L	N	Y	Y	Y	Y	N	-	✓	-	-
Tin	mg/L	N	N	N	Y	N	N	-	-	-	-
Titanium	mg/L	N	N	Y	Y	Y	N	-	-	-	-
Uranium	µg/L	Y	Y	Y	Y	Y	Y	✓	-	-	-
Vanadium	mg/L	Y	Y	Y	N	N	Y	-	-	✓	-
Zinc	mg/L	Y	Y	Y	N	N	Y	✓	-	-	-
Radionuclides											
Lead-210	Bq/L	Y	Y	Y	Y	Y	Y	-	-	-	-
Polonium-210	Bq/L	Y	Y	Y	Y	Y	Y	-	-	-	-
Radium-226	Bq/L	Y	Y	Y	Y	Y	Y	✓	-	-	-
Thorium-230	Bq/L	Y	Y	N	N	N	Y	-	-	-	-

[1]Includes MDMER requirements.

[2]If at least one exposure station had less than 90% of the values measured below the detection limit (<RDL) during the 2022 to 2024 assessment period, the parameter met this criterion. See Appendix IV.3, Table IV.3-2 for detailed results.

[3]If at least one exposure station had a mean concentration outside the reference range during the 2022 to 2024 assessment period, the parameter met this criterion. For each parameter, the upper reference range is the 2022 to 2024 average of the reference station data plus 2 reference standard deviation, as per Kilgour et al. (2017). See Appendix IV.3 Table IV.3-3 for detailed results.

[4]To be selected as a COPC, a parameter had to meet both EC1 and EC2 criteria.

[5]Available impact predictions included 1991 (Minatco 1991), 1995 (COGEMA 1995), 2016 (AREVA 2016), and 2018 (Orano 2018) impact predictions.

[6] Nitrate as N was used in lieu of Nitrate because it is measured more consistently throughout the study period.

[7]Laboratory pH was included as a COPC as a modifying factor for evaluating data against guidelines.

Y = yes; N = no; EC = Evaluation Criteria; Shaded parameters selected as COPCs.

TABLE 4.3-11

Time Periods for Surface Water Data Analysis.

Monitoring Purpose	Waterbody	Station ID	Time Period of Observation	Time Period 1	Time Period 2
Primary Exposure	Sink Reservoir Outlet	CM03	1996-2024	2015-2024 (Cigar Lake ore processing)	2000-2024 (entire JEB Mill operation)
	Vulture Lake Outlet	CM04			
	McClean Lake East Basin	WQ11E			
	McClean Lake Outlet	WQ12E			
	Collins Creek Downstream	WQ13E			
	Kewen Lake	WQ14E			
JEB Secondary Exposure	Fox Lake	WQ04E	1996-2024	2000-2024 (JEB TMF operation)	1996-2024 (since JEB Pit development)
	Pat Lake	WQ05E			
	Johannes Lake	WQ08E			
Sue Secondary Exposure	Sue Lake	WQ16E	1998-2024	2009-2024 (after mining activities completed at Sue Site)	1998-2024 (entire Sue Site operation)
	Sils Lake	WQ17E			
	Candy Lake	WQ18E			
	Bena Lake	WQ19E			
Reference	Mallen Lake	WQ01C	1996-2024	2015-2024 (Cigar Lake ore processing)	1996-2024 (entire McClean Lake Operation)
	Collins Creek Upstream	WQ02C			
	McClean Lake West Basin	WQ15C			
	Henday Lake	WQ20C			

TABLE 4.3-12

Summary of Water Chemistry Data from Primary Exposure Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Parameter	Units	Sink Reservoir Outlet (CM03)															Reference Range Upper Limit	Guidelines[1]	2016/2018 ERA Predictions	
		2022					2023					2024								
		n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference			Max Mean	95th Percentile
Nutrients																				
Ammonia (as N)	mg/L	12	0	0.85	0.47	exc	12	0	1.1	0.80	exc	12	1	0.12	0.08	exc	0.08	36 to 67	4.3	5.3
Carbon, Inorganic	mg/L	12	5	2.5	2.07	no	12	9	1.3	0.65	no	12	2	1.6	1.00	no	0.08	-	-	-
Carbon, Organic	mg/L	12	0	2.0	0.24	no	12	0	1.6	0.24	no	12	0	2.0	0.53	no	5.6	-	-	-
Carbon, Organic dissolved	mg/L	12	0	2.0	0.20	no	12	0	1.7	0.25	no	12	0	2.0	0.53	no	5.5	-	-	-
Carbon, Total	mg/L	12	0	4.2	2.44	no	12	0	2.3	1.36	no	12	0	3.3	1.07	no	7.8	-	-	-
Nitrate (as N)	mg/L	12	0	1.3	0.43	exc	12	0	1.3	0.34	exc	12	0	0.8	0.38	exc	0.10	3.0	-	-
Nitrogen, Total	mg/L	12	0	2.4	0.32	exc	12	0	2.7	0.61	exc	12	0	1.3	0.37	exc	0.42	-	-	-
Nitrogen, Total Kjeldahl	mg/L	12	0	1.1	0.48	exc	12	0	1.4	0.85	exc	12	0	0.5	0.05	exc	0.40	-	-	-
Phosphorus	mg/L	12	12	0.01	0	no	12	12	0.01	0	no	12	12	0.01	0	no	0.01	-	-	-
General Chemistry and Major Ions																				
Alkalinity	mg/L	12	0	10	9.1	no	12	3	4.2	4.1	no	12	0	7.8	4.3	no	14	-	-	-
Bicarbonate	mg/L	12	0	12	11	no	12	3	5.0	5.1	no	12	0	9.4	5.3	no	17	-	-	-
Calcium	mg/L	12	0	252	44	exc	12	0	265	40	exc	12	0	213	28	exc	2.3	-	-	-
Chloride	mg/L	12	0	46	7.9	exc	12	0	54	7.1	exc	12	0	41	7.9	exc	0.64	120	290	330
Dissolved Oxygen (Field)	mg/L	1	0	11	-	no	2	0	10	2.7	no	1	0	13	-	exc	13	6.5	-	-
Hardness	mg/L	12	0	653	119	exc	12	0	691	100	exc	12	0	554	76	exc	8.9	-	-	-
Magnesium	mg/L	12	0	5.9	2.6	exc	12	0	7.5	1.5	exc	12	0	5.6	1.8	exc	0.81	-	-	-
pH (Lab)	pH Units	12	0	6.5	0.21	no	12	0	**6.1**	0.31	no	12	0	**6.4**	0.14	no	7.0	6.5 to 9.0	-	-
Potassium	mg/L	12	0	11	1.5	exc	12	0	14	1.9	exc	12	0	11	2.2	exc	0.71	-	46	55
Sodium	mg/L	12	0	102	20	exc	12	0	126	18	exc	12	0	98	17	exc	1.7	-	-	-
Specific Conductance (Field)	µS/cm	12	0	1596	237	exc	12	0	1823	221	exc	12	0	1483	211	exc	34	-	-	-
Specific Conductance (Lab)	µS/cm	12	0	1588	233	exc	12	0	1758	194	exc	12	0	1453	172	exc	26	-	-	-
Sulphate	mg/L	12	0	**766**	142	exc	12	0	**857**	120	exc	12	0	**673**	103	exc	0.94	429	1400	1600
Sum of ions	mg/L	12	0	1202	223	exc	12	0	1335	185	exc	12	0	1054	161	exc	24	-	-	-
Solids, Total dissolved	mg/L	12	0	1272	233	exc	12	0	1353	182	exc	12	0	1118	162	exc	39	-	2500	2900
Metals and Trace Elements																				
Aluminum	mg/L	12	0	0.063	0.049	exc	12	0	0.076	0.040	exc	12	0	0.032	0.019	exc	0.018	0.401 to 0.431	-	-
Arsenic	µg/L	12	0	5.0	1.7	exc	12	0	4.9	0.8	exc	12	0	3.93	0.569	exc	0.29	5	11	16
Barium	mg/L	12	0	0.04	0.01	exc	12	0	0.041	0.011	exc	12	0	0.04	0.01	exc	0.007	-	-	-
Boron	mg/L	12	0	0.27	0.040	exc	12	0	0.33	0.035	exc	12	0	0.28	0.049	exc	0.01	1.5	-	-
Cadmium	mg/L	12	0	0.000013	0.000006	exc	12	0	0.000021	0.00001	exc	12	4	0.000012	0.000004	exc	0.00001	0.00037	-	-
Chromium	mg/L	12	12	0.0005	0	no	12	12	0.0005	0	no	12	12	0.0005	0	no	0.0005	0.0089	-	-
Cobalt	mg/L	12	0	0.0017	0.0012	exc	12	0	0.0017	0.0009	exc	12	0	0.0010	0.0010	exc	0.0001	0.00207 to 0.00226	0.0043	0.0060
Fluoride	mg/L	12	0	**0.38**	0.033	exc	12	0	**0.37**	0.062	exc	12	0	**0.29**	0.045	exc	0.06	0.12	0.52	0.57
Mercury	µg/L	4	4	0.001	0	no	4	3	0.0013	0.0005	no	4	3	0.001	0	no	0.00136	0.005	-	-
Molybdenum	mg/L	12	0	0.012	0.0024	exc	12	0	0.010	0.0031	exc	12	0	0.014	0.0035	exc	0.0002	31	0.12	0.15
Nickel	mg/L	12	0	0.016	0.0048	exc	12	0	0.015	0.0034	exc	12	0	0.011	0.0040	exc	0.0002	0.586 to 0.729	0.027	0.035
Selenium	mg/L	12	0	**0.0021**	0.0007	exc	12	0	0.0017	0.0005	exc	12	0	0.0008	0.0001	exc	0.0001	0.002	0.0031	0.0051
Silver	mg/L	12	12	0.00005	0	no	12	12	0.00005	0	no	12	11	0.00005	0	no	0.00005	0.0001	-	-
Strontium	mg/L	12	0	0.17	0.022	exc	12	0	0.21	0.030	exc	12	0	0.17	0.034	exc	0.0166	2.5	-	-
Thallium	mg/L	12	4	0.0002	0	no	12	0	0.0002	0.00005	exc	12	10	0.0002	0	no	0.0002	0.0008	-	-
Titanium	mg/L	12	9	0.0002	0.00007	no	12	12	0.0002	0	no	12	9	0.0003	0.0004	no	0.00049	-	-	-
Uranium	µg/L	12	0	0.22	0.15	exc	12	3	0.17	0.08	exc	12	2	0.20	0.07	exc	0.10	15	3.5	6.2
Radionuclides																				
Lead-210	Bq/L	12	12	0.02	0.006	no	12	12	0.02	0	no	12	11	0.02	0.006	no	0.03	-	0.03	0.037
Polonium-210	Bq/L	12	11	0.005	0	no	12	12	0.005	0	no	12	12	0.005	0	no	0.007	-	0.019	0.028
Radium-226	Bq/L	12	2	0.008	0.002	exc	12	2	0.008	0.002	exc	12	7	0.006	0.002	no	0.007	0.11	0.013	0.019

TABLE 4.3-12

Summary of Water Chemistry Data from Primary Exposure Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Parameter	Units	Vulture Lake Outlet (CM04)															Reference Range Upper Limit	Guidelines[1]	2016/2018 ERA Predictions	
		2022					2023					2024								
		n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference			Max Mean	95th Percentile
Nutrients																				
Ammonia (as N)	mg/L	11	1	0.34	0.32	exc	12	0	0.37	0.22	exc	12	3	0.21	0.29	exc	0.08	17 to 41	1.4	1.7
Carbon, Inorganic	mg/L	11	1	4.27	1.90	exc	12	0	3.2	1.64	no	12	0	3.4	1.38	exc	0.08	-	-	-
Carbon, Organic	mg/L	11	0	3.1	0.29	no	12	0	3.0	0.37	no	12	0	2.6	0.41	no	5.6	-	-	-
Carbon, Organic dissolved	mg/L	11	0	3.1	0.37	no	12	0	3.0	0.42	no	12	0	2.7	0.48	no	5.5	-	-	-
Carbon, Total	mg/L	11	0	7.2	2.09	no	12	0	6.3	1.48	no	12	0	6.0	1.41	no	7.8	-	-	-
Nitrate (as N)	mg/L	11	0	0.3	0.23	exc	12	0	0.3	0.17	exc	12	5	0.2	0.23	exc	0.10	3	-	-
Nitrogen, Total	mg/L	11	0	1.0	0.49	exc	12	0	1.0	0.28	exc	12	0	0.7	0.47	exc	0.42	-	-	-
Nitrogen, Total Kjeldahl	mg/L	11	0	0.6	0.28	exc	12	0	0.7	0.15	exc	12	0	0.5	0.26	exc	0.40	-	-	-
Phosphorus	mg/L	11	11	0.01	0	no	12	10	0.01	0	exc	12	12	0.01	0	no	0.01	-	-	-
General Chemistry and Major Ions																				
Alkalinity	mg/L	11	0	18	8.5	exc	12	0	13	6.9	no	12	0	15	4.9	exc	14	-	-	-
Bicarbonate	mg/L	11	0	22	10	exc	12	0	16	8.6	no	12	0	18	6.0	exc	17	-	-	-
Calcium	mg/L	11	0	173	34	exc	12	0	196	20	exc	12	0	178	42	exc	2.3	-	-	-
Chloride	mg/L	11	0	32	6.3	exc	12	0	39	4.3	exc	12	0	37	9.3	exc	0.64	120	210	240
Dissolved Oxygen (Field)	mg/L	-	0	-	-	-	2	0	10	2.3	no	3	0	12	2.0	no	13	6.5	-	-
Hardness	mg/L	11	0	451	89	exc	12	0	510	53	exc	12	0	466	111	exc	8.9	-	-	-
Magnesium	mg/L	11	0	4.6	1.0	exc	12	0	5.1	0.8	exc	12	0	5.4	1.4	exc	0.81	-	-	-
pH (Lab)	pH Units	11	0	6.9	0.11	no	12	0	6.7	0.17	no	12	0	6.5	0.13	no	7.0	6.5 to 9.0	-	-
Potassium	mg/L	11	0	7.7	1.6	exc	12	0	10	1.1	exc	12	0	9.5	2.3	exc	0.71	-	34	39
Sodium	mg/L	11	0	69	14	exc	12	0	87	9.4	exc	12	0	85	21	exc	1.7	-	-	-
Specific Conductance (Field)	µS/cm	11	0	1149	189	exc	12	0	1334	143	exc	12	0	1232	333	exc	34	-	-	-
Specific Conductance (Lab)	µS/cm	11	0	1148	200	exc	12	0	1326	121	exc	12	0	1257	262	exc	26	-	-	-
Sulphate	mg/L	11	0	**517**	101	exc	12	0	**611**	60	exc	12	0	**563**	137	exc	0.94	429	1100	1200
Sum of ions	mg/L	11	0	828	166	exc	12	0	965	99	exc	12	0	895	218	exc	24	-	-	-
Solids, Total dissolved	mg/L	11	0	878	170	exc	12	0	980	105	exc	12	0	950	232	exc	39	-	1900	2200
Metals and Trace Elements																				
Aluminum	mg/L	11	0	0.016	0.010	no	12	0	0.012	0.006	no	12	0	0.012	0.006	no	0.018	0.420 to 0.478	-	-
Arsenic	µg/L	11	0	3.2	0.6	exc	12	0	3.3	0.5	exc	12	0	3.2	0.64	exc	0.29	5	5.2	7.7
Barium	mg/L	11	0	0.040	0.007	exc	12	0	0.041	0.008	exc	12	0	0.037	0.011	exc	0.007	-	-	-
Boron	mg/L	11	0	0.18	0.040	exc	12	0	0.22	0.028	exc	12	0	0.23	0.060	exc	0.01	1.5	-	-
Cadmium	mg/L	11	7	0.000010	0	no	12	8	0.000010	0	no	12	8	0.00001	0	no	0.00001	0.00037	-	-
Chromium	mg/L	11	11	0.0005	0	no	12	12	0.0005	0	no	12	12	0.0005	0	no	0.0005	0.0089	-	-
Cobalt	mg/L	11	0	0.0007	0.0005	exc	12	0	0.0005	0.0002	exc	12	0	0.0005	0.0004	exc	0.0001	0.00189 to 0.0020	0.0010	0.0017
Fluoride	mg/L	11	0	**0.29**	0.044	exc	12	0	**0.30**	0.037	exc	12	0	**0.28**	0.047	exc	0.06	0.12	0.42	0.46
Mercury	µg/L	-	0	-	-	-	-	0	-	-	-	-	0	-	-	-	0.00136	0.005	-	-
Molybdenum	mg/L	11	0	0.013	0.0019	exc	12	0	0.012	0.0027	exc	12	0	0.012	0.0018	exc	0.0002	31	0.066	0.090
Nickel	mg/L	11	0	0.010	0.0042	exc	12	0	0.009	0.0028	exc	12	0	0.007	0.0045	exc	0.0002	0.476 to 0.492	0.012	0.016
Selenium	mg/L	11	0	0.0014	0.0003	exc	12	0	0.0009	0.0001	exc	12	0	0.0007	0.0002	exc	0.0001	0.002	0.0022	0.0027
Silver	mg/L	11	11	0.00005	0	no	12	12	0.00005	0	no	12	12	0.00005	0	no	0.00005	0.0001	-	-
Strontium	mg/L	11	0	0.1240	0.0240	exc	12	0	0.1525	0.0182	exc	12	0	0.1498	0.0376	exc	0.0166	2.5	-	-
Thallium	mg/L	11	11	0.0002	0	no	12	11	0.0002	0	no	12	12	0.0002	0	no	0.0002	0.0008	-	-
Titanium	mg/L	11	8	0.00023	0.00006	no	12	11	0.0002	0	no	12	9	0.0002	0.0001	no	0.00049	-	-	-
Uranium	µg/L	11	2	0.16	0.07	exc	12	6	0.12	0.04	exc	12	1	0.15	0.05	exc	0.10	15	1.5	2.4
Radionuclides																				
Lead-210	Bq/L	11	11	*0.02*	0	no	12	10	*0.02*	0.004	no	12	12	*0.02*	0	no	0.03	-	0.017	0.021
Polonium-210	Bq/L	11	10	0.005	0.0006	no	12	12	0.005	0	no	12	12	0.005	0	no	0.007	-	0.013	0.018
Radium-226	Bq/L	11	3	0.006	0.001	exc	12	3	0.008	0.002	exc	12	4	0.007	0.002	exc	0.007	0.11	0.008	0.011

TABLE 4.3-12

Summary of Water Chemistry Data from Primary Exposure Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Parameter	Units	McClean Lake East Basin (WQ11E)															Reference Range Upper Limit	Guidelines[1]	2016/2018 ERA Predictions	
		2022					2023					2024								
		n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference			Max Mean	95th Percentile
Nutrients																				
Ammonia (as N)	mg/L	12	1	0.10	0.09	exc	12	1	0.08	0.04	no	12	1	0.10	0.07	exc	0.08	26 to 36	-	-
Carbon, Inorganic	mg/L	12	2	2.5	1.73	no	12	1	2.5	1.09	no	12	0	2.3	0.87	no	0.08	-	-	-
Carbon, Organic	mg/L	12	0	4.5	0.44	no	12	0	4.1	0.62	no	12	0	4.0	0.74	no	5.6	-	-	-
Carbon, Organic dissolved	mg/L	12	0	4.4	0.38	no	12	0	4.1	0.53	no	12	0	4.1	0.73	no	5.5	-	-	-
Carbon, Total	mg/L	12	0	6.8	2.12	no	12	0	6.5	1.38	no	12	0	6.3	1.07	no	7.8	-	-	-
Nitrate (as N)	mg/L	12	5	0.1	0.11	no	12	5	0.03	0.03	no	12	8	0.05	0.06	no	0.10	3	-	-
Nitrogen, Total	mg/L	12	0	0.4	0.21	no	12	0	0.3	0.06	no	12	0	0.4	0.11	no	0.42	-	-	-
Nitrogen, Total Kjeldahl	mg/L	12	0	0.3	0.12	no	12	0	0.3	0.06	no	12	0	0.3	0.07	no	0.40	-	-	-
Phosphorus	mg/L	12	11	0.01	0	no	12	11	0.01	0	no	12	12	0.01	0	no	0.01	-	-	-
General Chemistry and Major Ions																				
Alkalinity	mg/L	12	0	11	7.5	no	12	0	10	4.5	no	12	0	10	3.2	no	14	-	-	-
Bicarbonate	mg/L	12	0	13	9.2	no	12	0	13	5.6	no	12	0	12	4.1	no	17	-	-	-
Calcium	mg/L	12	0	19	22	exc	12	0	13	8.2	exc	12	0	14	7.6	exc	2.3	-	-	-
Chloride	mg/L	12	0	3.5	4.0	exc	12	0	2.7	1.6	exc	12	0	3.1	1.7	exc	0.64	120	-	-
Dissolved Oxygen (Field)	mg/L	4	0	10	2	no	5	0	9.2	2.2	no	4	0	11	1.7	no	13	6.5	-	-
Hardness	mg/L	12	0	51	58	exc	12	0	37	21	exc	12	0	39	20	exc	8.9	-	-	-
Magnesium	mg/L	12	0	1.1	0.7	exc	12	0	0.9	0.2	exc	12	0	1.0	0.2	exc	0.81	-	-	-
pH (Lab)	pH Units	12	0	6.7	0.17	no	12	0	6.6	0.12	no	12	0	**6.4**	0.18	no	7.0	6.5 to 9.0	-	-
Potassium	mg/L	12	0	1.2	1.0	exc	12	0	1.1	0.4	exc	12	0	1.1	0.4	exc	0.71	-	-	-
Sodium	mg/L	12	0	8.3	9.1	exc	12	0	6.6	3.7	exc	12	0	7.4	3.6	exc	1.7	-	-	-
Specific Conductance (Field)	µS/cm	11	0	134	92	exc	12	0	107	80	exc	12	0	135	66	exc	34	-	-	-
Specific Conductance (Lab)	µS/cm	12	0	156	163	exc	12	0	119	71	exc	12	0	131	68	exc	26	-	-	-
Sulphate	mg/L	12	0	51	66	exc	12	0	36	27	exc	12	0	39	24	exc	0.94	198	-	-
Sum of ions	mg/L	12	0	97	108	exc	12	0	73	38	exc	12	0	79	37	exc	24	-	-	-
Solids, Total dissolved	mg/L	12	0	113	111	exc	12	0	85	39	exc	12	0	97	41	exc	39	-	-	-
Metals and Trace Elements																				
Aluminum	mg/L	12	0	0.015	0.004	no	12	0	0.011	0.003	no	12	0	0.011	0.003	no	0.018	0.152 to 0.204	-	-
Arsenic	µg/L	12	0	0.5	0.3	exc	12	0	0.4	0.2	exc	12	0	0.5	0.2	exc	0.29	5	-	-
Barium	mg/L	12	0	0.007	0.005	exc	12	0	0.007	0.002	no	12	0	0.006	0.002	no	0.007	-	-	-
Boron	mg/L	12	4	0.02	0.022	exc	12	5	0.02	0.009	exc	12	3	0.02	0.009	exc	0.01	1.5	-	-
Cadmium	mg/L	12	10	0.00002	0.00002	exc	12	11	0.00001	0	no	12	11	0.00001	0	no	0.00001	0.00007 to 0.00009	-	-
Chromium	mg/L	12	11	0.00051	0.00003	exc	12	10	0.00052	0.00006	exc	12	12	0.0005	0	no	0.0005	0.0089	-	-
Cobalt	mg/L	12	9	0.0002	0.0001	exc	12	11	0.0001	0	no	12	9	0.0001	0	no	0.0001	0.00079 to 0.00085	-	-
Fluoride	mg/L	12	0	0.071	0.031	exc	12	0	0.058	0.010	no	12	0	0.067	0.011	exc	0.06	0.12	-	-
Mercury	µg/L	4	2	0.0013	0.0005	no	4	4	0.0010	0	no	4	4	0.001	0	no	0.0014	0.005	-	-
Molybdenum	mg/L	12	1	0.002	0.0015	exc	12	0	0.002	0.0013	exc	12	2	0.002	0.0014	exc	0.0002	31	-	-
Nickel	mg/L	12	0	0.001	0.0016	exc	12	0	0.001	0.0002	exc	12	1	0.001	0.0004	exc	0.0002	0.038 to 0.054	-	-
Selenium	mg/L	12	5	0.0002	0.0001	exc	12	9	0.0001	0	no	12	10	0.0001	0	no	0.0001	0.002	-	-
Silver	mg/L	12	12	0.00005	0	no	12	12	0.00005	0	no	12	12	0.00005	0	no	0.00005	0.0001	-	-
Strontium	mg/L	12	0	0.0239	0.0142	exc	12	0	0.0233	0.0055	exc	12	0	0.0245	0.0075	exc	0.0166	2.5	-	-
Thallium	mg/L	12	12	0.0002	0	no	12	12	0.0002	0	no	12	12	0.0002	0	no	0.0002	0.0008	-	-
Titanium	mg/L	12	2	0.00029	0.00008	no	12	0	0.0004	0.0001	no	12	1	0.0003	0.0001	no	0.00049	-	-	-
Uranium	µg/L	12	11	0.11	0.03	exc	12	12	0.10	0	no	12	12	0.10	0	no	0.10	15	-	-
Radionuclides																				
Lead-210	Bq/L	12	12	0.02	0	no	12	11	0.02	0	no	12	12	0.020	0.000	no	0.03	-	-	-
Polonium-210	Bq/L	12	12	0.005	0	no	12	10	0.005	0.001	no	12	11	0.0051667	0.0005774	no	0.007	-	-	-
Radium-226	Bq/L	12	11	0.005	0.001	no	12	9	0.005	0.001	no	12	8	0.0058333	0.002	no	0.007	0.11	-	-

TABLE 4.3-12

Summary of Water Chemistry Data from Primary Exposure Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Parameter	Units	McClean Lake Outlet (WQ12E)															Reference Range Upper Limit	Guidelines[1]	2016/2018 ERA Predictions	
		2022					2023					2024								
		n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference			Max Mean	95th Percentile
Nutrients																				
Ammonia (as N)	mg/L	12	0	0.07	0.06	no	12	0	0.08	0.05	no	12	1	0.08	0.08	exc	0.08	28 to 45	0.22	0.28
Carbon, Inorganic	mg/L	12	2	2.4	1.08	no	12	0	2.2	0.72	no	12	0	2.3	0.78	no	0.08	-	-	-
Carbon, Organic	mg/L	12	0	4.3	0.50	no	12	0	4.4	0.98	no	12	0	4.1	0.75	no	5.6	-	-	-
Carbon, Organic dissolved	mg/L	12	0	4.3	0.40	no	12	0	4.3	0.91	no	12	0	4.1	0.83	no	5.5	-	-	-
Carbon, Total	mg/L	12	0	6.6	1.38	no	12	0	6.4	1.00	no	12	0	6.4	0.67	no	7.8	-	-	-
Nitrate (as N)	mg/L	12	5	0.04	0.04	no	12	6	0.04	0.04	no	12	7	0.05	0.06	no	0.10	3	-	-
Nitrogen, Total	mg/L	12	0	0.31	0.12	no	12	0	0.28	0.06	no	12	0	0.33	0.10	no	0.42	-	-	-
Nitrogen, Total Kjeldahl	mg/L	12	0	0.27	0.10	no	12	0	0.25	0.04	no	12	0	0.29	0.07	no	0.40	-	-	-
Phosphorus	mg/L	12	12	0.01	0	no	12	12	0.01	0	no	12	12	0.01	0	no	0.01	-	-	-
General Chemistry and Major Ions																				
Alkalinity	mg/L	12	0	11	4.5	no	12	0	9	2.5	no	12	0	10	2.9	no	14	-	-	-
Bicarbonate	mg/L	12	0	13	5.6	no	12	0	11	3.1	no	12	0	12	3.7	no	17	-	-	-
Calcium	mg/L	12	0	10	4.0	exc	12	0	12	4.5	exc	12	0	14	6.3	exc	2.3	-	-	-
Chloride	mg/L	12	0	2.0	0.73	exc	12	0	2.5	1.0	exc	12	0	3.1	1.4	exc	0.64	120	22	30
Dissolved Oxygen (Field)	mg/L	7	0	10	2.3	no	7	0	9	1.3	no	9	0	10	1.2	no	13	6.5	-	-
Hardness	mg/L	12	0	28	11	exc	12	0	33	12	exc	12	0	39	17	exc	8.9	-	-	-
Magnesium	mg/L	12	0	0.78	0.21	no	12	0	0.85	0.14	exc	12	0	1.00	0.27	exc	0.81	-	-	-
pH (Lab)	pH Units	12	0	6.7	0.15	no	12	0	6.6	0.12	no	12	0	6.5	0.14	no	7.0	6.5 to 9.0	-	-
Potassium	mg/L	12	0	0.77	0.22	exc	12	0	0.97	0.23	exc	12	0	1.1	0.40	exc	0.71	-	3.9	5.3
Sodium	mg/L	12	0	4.7	1.6	exc	12	0	5.9	2.0	exc	12	0	7.3	3.0	exc	1.7	-	-	-
Specific Conductance (Field)	µS/cm	11	0	87	49	exc	11	0	107	43	exc	11	0	131	62	exc	34	-	-	-
Specific Conductance (Lab)	µS/cm	12	0	92	33	exc	12	0	109	37	exc	12	0	132	56	exc	26	-	-	-
Sulphate	mg/L	12	0	26	11	exc	12	0	31	15	exc	12	0	39	19	exc	0.94	158	110	140
Sum of ions	mg/L	12	0	57	23	exc	12	0	64	23	exc	12	0	78	34	exc	24	-	-	-
Solids, Total dissolved	mg/L	12	0	71	20	exc	12	0	77	23	exc	12	0	93	38	exc	39	-	190	260
Metals and Trace Elements																				
Aluminum	mg/L	12	0	0.014	0.004	no	12	0	0.011	0.005	no	12	0	0.011	0.005	no	0.018	0.156 to 0.181	-	-
Arsenic	µg/L	12	0	0.3	0.1	exc	12	0	0.3	0.1	exc	12	0	0.4	0.1	exc	0.29	5	1.0	1.4
Barium	mg/L	12	0	0.006	0.002	no	12	0	0.006	0.002	no	12	0	0.007	0.003	no	0.007	-	-	-
Boron	mg/L	12	6	0.01	0.003	exc	12	4	0.01	0.005	exc	12	2	0.02	0.008	exc	0.01	1.5	-	-
Cadmium	mg/L	12	11	0.00001	0	no	12	11	0.00001	0	no	12	12	0.00001	0	no	0.00001	0.00006 to 0.00007	-	-
Chromium	mg/L	12	10	0.0005	0.0001	exc	12	11	0.0005	0.00003	exc	12	12	0.0005	0	no	0.0005	0.0089	-	-
Cobalt	mg/L	12	9	0.0001	0	no	12	10	0.0001	0	no	12	8	0.0001	0	no	0.0001	0.00078 to 0.00079	0.0002	0.0003
Fluoride	mg/L	12	0	0.056	0.008	no	12	0	0.058	0.007	no	12	0	0.065	0.011	exc	0.06	0.12	0.09	0.10
Mercury	µg/L	4	3	0.001	0.0005	no	4	4	0.001	0	no	4	3	0.001	0	no	0.00136	0.005	-	-
Molybdenum	mg/L	12	0	0.001	0.0007	exc	12	0	0.001	0.0012	exc	12	0	0.001	0.001	exc	0.0002	31	0.009	0.012
Nickel	mg/L	12	0	0.001	0.0003	exc	12	0	0.000	0.0002	exc	12	0	0.001	0.0003	exc	0.0002	0.30 to 0.042	0.0014	0.0020
Selenium	mg/L	12	10	0.0001	0	no	12	11	0.0001	0	no	12	12	0.0001	0	no	0.0001	0.002	0.0003	0.0004
Silver	mg/L	12	12	0.00005	0	no	12	12	0.00005	0	no	12	12	0.00005	0	no	0.00005	0.0001	-	-
Strontium	mg/L	12	0	0.0186	0.0046	exc	12	0	0.0215	0.0047	exc	12	0	0.0238	0.0078	exc	0.0166	2.5	-	-
Thallium	mg/L	12	12	0.0002	0	no	12	12	0.0002	0	no	12	12	0.0002	0	no	0.0002	0.0008	-	-
Titanium	mg/L	12	2	0.00034	0.00009	no	12	2	0.0003	0.0001	no	12	1	0.00031	0.00008	no	0.00049	-	-	-
Uranium	µg/L	12	12	0.10	0	no	12	12	0.10	0	no	12	11	0.10	0	no	0.10	15	0.21	0.33
Radionuclides																				
Lead-210	Bq/L	12	11	*0.02*	0.003	no	12	12	*0.02*	0	no	12	12	*0.02*	0	no	0.03	-	0.01	0.011
Polonium-210	Bq/L	12	11	*0.005*	0.0003	no	12	11	*0.005*	0.0003	no	12	12	*0.005*	0	no	0.007	-	0.0041	0.0052
Radium-226	Bq/L	12	10	*0.005*	0.001	no	12	9	*0.006*	0.001	no	12	11	*0.005*	0.001	no	0.007	0.11	0.0030	0.0030

TABLE 4.3-12

Summary of Water Chemistry Data from Primary Exposure Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Parameter	Units	Collins Creek Downstream (WQ13E)															Reference Range Upper Limit	Guidelines[1]	2016/2018 ERA Predictions	
		2022					2023					2024								
		n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference			Max Mean	95th Percentile
Nutrients																				
Ammonia (as N)	mg/L	4	1	0.06	0.06	no	4	0	0.09	0.06	exc	2	1	0.09	0.11	exc	0.08	37 to 44	-	-
Carbon, Inorganic	mg/L	4	0	1.8	0.96	no	4	0	1.8	0.50	no	2	0	2.5	0.71	no	0.08	-	-	-
Carbon, Organic	mg/L	4	0	4.4	0.47	no	4	0	4.3	1.23	no	2	0	4.3	1.91	no	5.6	-	-	-
Carbon, Organic dissolved	mg/L	4	0	4.4	0.36	no	4	0	4.2	1.09	no	2	0	4.4	1.84	no	5.5	-	-	-
Carbon, Total	mg/L	4	0	6.3	0.96	no	4	0	6.0	1.41	no	2	0	7.0	1.41	no	7.8	-	-	-
Nitrate (as N)	mg/L	4	2	0.05	0.07	no	4	2	0.05	0.06	no	2	1	0.10	0.12	no	0.10	3	-	-
Nitrogen, Total	mg/L	4	0	0.34	0.088	no	4	0	0.30	0.030	no	2	0	0.36	0.028	no	0.42	-	-	-
Nitrogen, Total Kjeldahl	mg/L	4	0	0.29	0.051	no	4	0	0.25	0.042	no	2	0	0.27	0.099	no	0.40	-	-	-
Phosphorus	mg/L	4	4	0.01	0	no	4	4	0.01	0	no	2	2	0.01	0	no	0.01	-	-	-
General Chemistry and Major Ions																				
Alkalinity	mg/L	4	0	8.8	4.5	no	4	0	8.0	2.2	no	2	0	10.5	3.5	no	14	-	-	-
Bicarbonate	mg/L	4	0	11	5.4	no	4	0	10	2.6	no	2	0	13	4.2	no	17	-	-	-
Calcium	mg/L	4	0	11	7.7	exc	4	0	12	5.4	exc	2	0	14	12.3	exc	2.3	-	-	-
Chloride	mg/L	4	0	2.1	1.3	exc	4	0	2.5	1.2	exc	2	0	3.2	3.2	exc	0.64	120	-	-
Dissolved Oxygen (Field)	mg/L	3	0	8.2	1.4	no	3	0	11.0	2.3	no	2	0	8.2	1.0	no	13	6.5	-	-
Hardness	mg/L	4	0	30	20	exc	4	0	34	14	exc	2	0	40	33	exc	8.9	-	-	-
Magnesium	mg/L	4	0	0.80	0.28	no	4	0	0.88	0.15	exc	2	0	1.05	0.49	exc	0.81	-	-	-
pH (Lab)	pH Units	4	0	6.7	0.25	no	4	0	6.6	0.17	no	2	0	6.4	0.07	no	7.0	6.5 to 9.0	-	-
Potassium	mg/L	4	0	0.80	0.36	exc	4	0	0.85	0.34	exc	2	0	1.05	0.78	exc	0.71	-	-	-
Sodium	mg/L	4	0	4.9	3.2	exc	4	0	5.8	2.3	exc	2	0	7.5	6.4	exc	1.7	-	-	-
Specific Conductance (Field)	µS/cm	4	0	90	59	exc	4	0	102	49	exc	2	0	132	120	exc	34	-	-	-
Specific Conductance (Lab)	µS/cm	4	0	94	63	exc	4	0	107	44	exc	2	0	133	117	exc	26	-	-	-
Sulphate	mg/L	4	0	27	22	exc	4	0	31	17	exc	2	0	39	41	exc	0.94	151	-	-
Sum of ions	mg/L	4	0	57	40	exc	4	0	63	29	exc	2	0	80	69	exc	24	-	-	-
Solids, Total dissolved	mg/L	4	0	73	45	exc	4	0	79	29	exc	2	0	86	78	exc	39	-	-	-
Metals and Trace Elements																				
Aluminum	mg/L	4	0	0.015	0.004	no	4	0	0.013	0.002	no	2	0	0.011	0	no	0.018	0.143 to 0.178	-	-
Arsenic	µg/L	4	0	0.3	0.1	exc	4	0	0.3	0.1	exc	2	0	0.4	0.1	exc	0.29	5	-	-
Barium	mg/L	4	0	0.006	0.003	no	4	0	0.006	0.002	no	2	0	0.007	0.006	exc	0.007	-	-	-
Boron	mg/L	4	3	0.01	0.005	exc	4	2	0.02	0.006	exc	2	1	0.02	0.014	exc	0.01	1.5	-	-
Cadmium	mg/L	4	2	0.00001	0	no	4	4	0.00001	0	no	2	2	0.00001	0	no	0.00001	0.00006 to 0.00007	-	-
Chromium	mg/L	4	4	0.0005	0	no	4	4	0.0005	0	no	2	2	0.0005	0	no	0.0005	0.0089	-	-
Cobalt	mg/L	4	3	0.0001	0	no	4	4	0.0001	0	no	2	1	0.0001	0	no	0.0001	0.00078 to 0.00081	-	-
Fluoride	mg/L	4	0	0.05	0.005	no	4	0	0.06	0.005	exc	2	0	0.06	0.014	no	0.06	0.12	-	-
Mercury	µg/L	2	2	0.001	0	no	3	3	0.001	0	no	2	2	0.001	0	no	0.00136	0.005	-	-
Molybdenum	mg/L	4	0	0.001	0.0006	exc	4	0	0.001	0.001	exc	2	0	0.002	0.0013	exc	0.0002	31	-	-
Nickel	mg/L	4	0	0.001	0.0004	exc	4	0	0.0005	0.0002	exc	2	0	0.001	0.0005	exc	0.0002	0.031 to 0.043	-	-
Selenium	mg/L	4	3	0.0001	0	no	4	4	0.0001	0	no	2	2	0.0001	0	no	0.0001	0.002	-	-
Silver	mg/L	4	4	0.00005	0	no	4	4	0.00005	0	no	2	2	0.00005	0	no	0.00005	0.0001	-	-
Strontium	mg/L	4	0	0.0195	0.0079	exc	4	0	0.0215	0.0062	exc	2	0	0.0255	0.0148	exc	0.0166	2.5	-	-
Thallium	mg/L	4	4	0.0002	0	no	4	4	0.0002	0	no	2	2	0.0002	0	no	0.0002	0.0008	-	-
Titanium	mg/L	4	0	0.00038	0.00005	no	4	0	0.0004	0.0002	no	2	0	0.00045	0.00007	no	0.00049	-	-	-
Uranium	µg/L	4	4	0.1	0	no	4	4	0.1	0	no	2	2	0.1	0	no	0.10	15	-	-
Radionuclides																				
Lead-210	Bq/L	4	4	0.02	0	no	4	4	0.02	0	no	2	2	0.02	0	no	0.03	-	-	-
Polonium-210	Bq/L	4	4	0.005	0	no	4	4	0.005	0	no	2	2	0.005	0	no	0.007	-	-	-
Radium-226	Bq/L	4	3	0.005	0	no	4	3	0.005	0	no	2	2	0.005	0	no	0.007	0.11	-	-

TABLE 4.3-12

Summary of Water Chemistry Data from Primary Exposure Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Parameter	Units	Kewen Lake (WQ14E)															Reference Range Upper Limit	Guidelines[1]	2016/2018 ERA Predictions	
		2022					2023					2024								
		n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference			Max Mean	95th Percentile
Nutrients																				
Ammonia (as N)	mg/L	2	0	0.03	0.02	no	2	0	0.04	0.02	no	2	1	0.04	0.01	no	0.08	29 to 41	0.10	0.11
Carbon, Inorganic	mg/L	2	1	1.3	0	no	2	0	1.3	0	no	2	0	2.0	0	no	0.08	-	-	-
Carbon, Organic	mg/L	2	0	4.3	0.57	no	2	0	3.9	0.33	no	2	0	4.3	0.94	no	5.6	-	-	-
Carbon, Organic dissolved	mg/L	2	0	4.3	0.64	no	2	0	4.1	0.47	no	2	0	4.4	0.94	no	5.5	-	-	-
Carbon, Total	mg/L	2	0	5.5	1.18	no	2	0	5.3	0	no	2	0	6.5	0.71	no	7.8	-	-	-
Nitrate (as N)	mg/L	2	1	0.02	0.01	no	2	2	0.01	0	no	2	1	0.02	0.02	no	0.10	3	-	-
Nitrogen, Total	mg/L	2	0	0.17	0.08	no	2	0	0.25	0.049	no	2	0	0.28	0.038	no	0.42	-	-	-
Nitrogen, Total Kjeldahl	mg/L	2	0	0.16	0.10	no	2	0	0.25	0.049	no	2	0	0.26	0.064	no	0.40	-	-	-
Phosphorus	mg/L	2	2	0.01	0	no	2	2	0.01	0	no	2	2	0.01	0	no	0.01	-	-	-
General Chemistry and Major Ions																				
Alkalinity	mg/L	2	0	6.0	1.9	no	2	0	6.3	0	no	2	0	8.3	1.4	no	14	-	-	-
Bicarbonate	mg/L	2	0	7.2	2.1	no	2	0	7.5	0.2	no	2	0	10	1.9	no	17	-	-	-
Calcium	mg/L	2	0	4.7	1.3	exc	2	0	5.9	0.9	exc	2	0	5.8	3.7	exc	2.3	-	-	-
Chloride	mg/L	2	0	0.88	0.40	exc	2	0	0.97	0.09	exc	2	0	1.2	0.97	exc	0.64	120	10	14
Dissolved Oxygen (Field)	mg/L	2	0	9.4	2.2	no	1	0	9.1	-	no	1	0	7.3	-	no	13	6.5	-	-
Hardness	mg/L	2	0	14.3	3.8	exc	2	0	17.3	2.8	exc	2	0	18	10	exc	8.9	-	-	-
Magnesium	mg/L	2	0	0.58	0.12	no	2	0	0.70	0.09	no	2	0	0.77	0.24	no	0.81	-	-	-
pH (Lab)	pH Units	2	0	6.7	0.16	no	2	0	6.6	0.30	no	2	0	6.4	0.01	no	7.0	6.5 to 9.0	-	-
Potassium	mg/L	2	0	0.48	0.12	no	2	0	0.58	0.16	no	2	0	0.73	0.33	exc	0.71	-	2.0	2.5
Sodium	mg/L	2	0	2.5	0.5	exc	2	0	3.0	0.3	exc	2	0	3.3	1.9	exc	1.7	-	-	-
Specific Conductance (Field)	µS/cm	2	0	47	13	exc	2	0	56	1	exc	2	0	73	52	exc	34	-	-	-
Specific Conductance (Lab)	µS/cm	2	0	45	12	exc	2	0	53	8	exc	2	0	57	37	exc	26	-	-	-
Sulphate	mg/L	2	0	10	4.1	exc	2	0	13	2.4	exc	2	0	13	12	exc	0.94	128	48	65
Sum of ions	mg/L	2	0	27	5.2	exc	2	0	31	4.2	exc	2	0	35	21	exc	24	-	-	-
Solids, Total dissolved	mg/L	2	0	42	14	exc	2	0	55	3	exc	2	0	44	37	exc	39	-	87	120
Metals and Trace Elements																				
Aluminum	mg/L	2	0	0.006	0.001	no	2	0	0.006	0.001	no	2	0	0.005	0.001	no	0.018	0.104 to 0.142	-	-
Arsenic	µg/L	2	0	0.2	0.02	no	2	0	0.2	0	no	2	0	0.2	0.02	no	0.29	5	0.71	0.84
Barium	mg/L	2	0	0.004	0.002	no	2	0	0.004	0.002	no	2	0	0.004	0.003	no	0.007	-	-	-
Boron	mg/L	2	2	0.01	0	no	2	2	0.01	0	no	2	2	0.01	0	no	0.01	1.5	-	-
Cadmium	mg/L	2	2	0.00001	0	no	2	2	0.00001	0	no	2	2	0.00001	0	no	0.00001	0.00004 to 0.00005	-	-
Chromium	mg/L	2	2	0.0005	0	no	2	2	0.0005	0	no	2	2	0.0005	0	no	0.0005	0.0089	-	-
Cobalt	mg/L	2	2	0.0001	0	no	2	2	0.0001	0	no	2	2	0.0001	0	no	0.0001	0.00078	0.00014	0.00018
Fluoride	mg/L	2	0	0.05	0.007	no	2	0	0.05	0.002	no	2	0	0.06	0.007	no	0.06	0.12	0.068	0.074
Mercury	µg/L	2	1	0.001	0	no	2	1	0.0012	0.0002	no	2	2	0.0012	0.0002	no	0.00136	0.005	-	-
Molybdenum	mg/L	2	0	0.001	0.0005	exc	2	0	0.001	0.0006	exc	2	0	0.001	0.0005	exc	0.0002	31	0.0042	0.0055
Nickel	mg/L	2	0	0.0002	0.0001	no	2	0	0.0002	0	exc	2	0	0.0002	0.00002	exc	0.0002	0.015 to 0.019	0.00064	0.00089
Selenium	mg/L	2	2	0.0001	0	no	2	2	0.0001	0	no	2	2	0.0001	0	no	0.0001	0.002	0.0001	0.0002
Silver	mg/L	2	2	0.00005	0	no	2	2	0.00005	0	no	2	2	0.00005	0	no	0.00005	0.00010	-	-
Strontium	mg/L	2	0	0.0130	0.0014	no	2	0	0.0143	0.0033	no	2	0	0.0153	0.0057	no	0.0166	2.5	-	-
Thallium	mg/L	2	2	0.0002	0	no	2	2	0.0002	0	no	2	2	0.0002	0	no	0.0002	0.0008	-	-
Titanium	mg/L	2	0	0.0002	0	no	2	0	0.00025	0.00002	no	2	2	0.0002	0	no	0.00049	-	-	-
Uranium	µg/L	2	2	0.1	0	no	2	2	0.1	0	no	2	2	0.1	0	no	0.10	15	0.11	0.16
Radionuclides																				
Lead-210	Bq/L	2	2	*0.02*	0	no	2	2	*0.02*	0	no	2	2	*0.02*	0	no	0.03	-	0.0096	0.01
Polonium-210	Bq/L	2	2	*0.005*	0	no	2	2	*0.005*	0	no	2	2	*0.005*	0	no	0.007	-	0.0034	0.0041
Radium-226	Bq/L	2	2	*0.005*	0	no	2	2	*0.005*	0	no	2	2	*0.005*	0	no	0.007	0.11	0.0024	0.0026

Values below reportable detection limits (RDLs) were set to the detection limit for calculating summary statistics. Bolded values indicate higher than the preferentially selected guidelines (Table 4.3-9); italicized values exceed at least one of the available predictions outlined in Table 4.3-8.
Predictions from the 2016 ERA are provided for COPCs. Selenium predictions is from the more recent 2018 selenium update. See Table 4.3-8 for more details.
n = number of samples; RDL = reportable detection limit; SD = standard deviation; '-' indicates no associated value; exc = exceedance.

TABLE 4.3-13

Statistical Analysis and Benchmark Comparison Results for the Primary Exposure Areas at the McClean Operation, Time Period 1, 2015 to 2024.

COPC	Metric	Sink Reservoir CM03	Vulture Lake CM04	McClean Lake East Basin WQ11E	McClean Lake Outlet WQ12E	Collins Creek Downstream WQ13E	Kewen Lake WQ14E
Nutrients							
Ammonia (as N)	%<RDL	0.8	4.3	10.8	13.3	13.2	20
	Trend	no change	no change	increase	no change	no change	no change
	GL Exceedance	no	no	no	no	no	no
	Prediction Exceedance	no	no	NA	no	exc	no
	Ref Range Exceedance	exc	exc	exc	no	no	no
Carbon, Inorganic	%<RDL	37.3	2.5	12.5	15.8	5.3	10
	Trend	no change	decrease	no change	no change	decrease	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	no	exc	no	no	no	no
Carbon, Organic	%<RDL	0	0	0	0	0	0
	Trend	no change	no change	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	no	no	no	no	no	no
Carbon, Organic dissolved	%<RDL	0	0	0	0	0	0
	Trend	increase	no change	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	no	no	no	no	no	no
Carbon, Total	%<RDL	0	0	0	0	0	0
	Trend	no change	decrease	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	no	no	no	no	no	no
Nitrate (as N)	%<RDL	0	10.2	37.5	35	34.2	35
	Trend	decrease	decrease	no change	no change	no change	no change
	GL Exceedance	exc	no	no	no	no	no
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	exc	exc	no	no	no	no
Nitrogen, Total	%<RDL	0	0	0.8	0.8	0	0
	Trend	decrease	decrease	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	exc	exc	no	no	no	no
Nitrogen, Total Kjeldahl	%<RDL	0	0	0.8	0.8	0	0
	Trend	no change	no change	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	exc	exc	no	no	no	no
Phosphorus	%<RDL	96.6	95.8	95.8	98.3	100	100
	Trend	NA	NA	NA	NA	NA	NA
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	no	exc	no	no	no	no
Water Chemistry and Major Ions							
Alkalinity	%<RDL	6.8	0	0	0	0	0
	Trend	no change	decrease	decrease	no change	decrease	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	no	exc	no	no	no	no
Bicarbonate	%<RDL	6.8	0	0.8	0	0	0
	Trend	no change	decrease	decrease	no change	decrease	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	no	exc	no	no	no	no
Calcium	%<RDL	0	0	0	0	0	0
	Trend	no change	increase	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	exc	exc	exc	exc	exc	exc

TABLE 4.3-13

Statistical Analysis and Benchmark Comparison Results for the Primary Exposure Areas at the McClean Operation, Time Period 1, 2015 to 2024.

COPC	Metric	Sink Reservoir CM03	Vulture Lake CM04	McClean Lake East Basin WQ11E	McClean Lake Outlet WQ12E	Collins Creek Downstream WQ13E	Kewen Lake WQ14E
Chloride	%<RDL	0	0	0.8	0	0	0
	Trend	increase	increase	increase	increase	increase	no change
	GL Exceedance	no	no	no	no	no	no
	Prediction Exceedance	no	no	NA	no	no	no
	Ref Range Exceedance	exc	exc	exc	exc	exc	exc
Dissolved Oxygen (Field)	%<RDL	0	0	0	0	0	0
	Trend	no change	no change	no change	no change	no change	no change
	GL Exceedance[1]	<9.5	<9.5	<6.5, <9.5	<9.5	<9.5	<9.5
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	no	no	no	no	no	no
Hardness	%<RDL	0	0	0.8	0	0	0
	Trend	no change	increase	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	exc	exc	exc	exc	exc	exc
Magnesium	%<RDL	0	0	0.8	0	0	0
	Trend	increase	increase	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	exc	exc	exc	exc	exc	no
pH (Lab)	%<RDL	0	0	0	0	0	0
	Trend	decrease	decrease	decrease	decrease	no change	decrease
	GL Exceedance	<6.5	<6.5	<6.5	<6.5	<6.5	<6.5
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	no	no	no	no	no	no
Potassium	%<RDL	0	0	0	0	0	0
	Trend	no change	increase	increase	increase	increase	increase
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	no	no	NA	no	no	no
	Ref Range Exceedance	exc	exc	exc	exc	exc	no
Sodium	%<RDL	0	0	0	0	0	0
	Trend	increase	increase	increase	increase	increase	increase
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	exc	exc	exc	exc	exc	exc
Specific Conductance (Field)	%<RDL	0	0	0	0	0	0
	Trend	increase	increase	increase	increase	no change	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	exc	exc	exc	exc	exc	exc
Specific Conductance (Lab)	%<RDL	0	0	0.8	0	0	0
	Trend	increase	increase	no change	increase	no change	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	exc	exc	exc	exc	exc	exc
Sulphate	%<RDL	0	0	0	0	0	0
	Trend	increase	increase	no change	increase	no change	no change
	GL Exceedance	exc	exc	exc	no	no	no
	Prediction Exceedance	no	no	NA	no	exc	no
	Ref Range Exceedance	exc	exc	exc	exc	exc	exc
Sum of ions	%<RDL	0	0	0	0	0	0
	Trend	increase	increase	no change	increase	no change	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	exc	exc	exc	exc	exc	exc
Solids, Total dissolved	%<RDL	0	0	0.8	0	0	0
	Trend	increase	increase	no change	increase	no change	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	no	no	NA	no	exc	no
	Ref Range Exceedance	exc	exc	exc	exc	exc	exc
Metals							
Aluminum	%<RDL	0	0	0	0	0	0
	Trend	no change	no change	no change	decrease	no change	no change
	GL Exceedance	no	no	no	no	no	no
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	exc	no	no	no	no	no
Arsenic	%<RDL	0	0	0	0	0	0
	Trend	increase	increase	no change	no change	no change	no change
	GL Exceedance	exc	no	no	no	no	no
	Prediction Exceedance	no	no	NA	no	no	no
	Ref Range Exceedance	exc	exc	exc	exc	exc	no

TABLE 4.3-13

Statistical Analysis and Benchmark Comparison Results for the Primary Exposure Areas at the McClean Operation, Time Period 1, 2015 to 2024.

COPC	Metric	Sink Reservoir CM03	Vulture Lake CM04	McClean Lake East Basin WQ11E	McClean Lake Outlet WQ12E	Collins Creek Downstream WQ13E	Kewen Lake WQ14E
Barium	%<RDL	0	0	0	0	0	0
	Trend	no change	decrease	no change	no change	no change	decrease
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	exc	exc	exc	no	no	no
Boron	%<RDL	0	0	47.5	46.7	60.5	95
	Trend	no change	no change	NA	NA	NA	NA
	GL Exceedance	no	no	no	no	no	no
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	exc	exc	exc	exc	exc	no
Cadmium	%<RDL	18.6	69.5	78.3	83.3	78.9	85
	Trend	no change	NA	NA	NA	NA	NA
	GL Exceedance	no	no	exc	no	no	no
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	exc	no	exc	no	no	no
Chromium	%<RDL	99.2	99.2	95.8	97.5	100	100
	Trend	NA	NA	NA	NA	NA	NA
	GL Exceedance	no	no	no	no	no	no
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	no	no	exc	exc	no	no
Cobalt	%<RDL	0	0	82.5	85.8	89.5	100
	Trend	no change	no change	NA	NA	NA	NA
	GL Exceedance	exc	exc	exc	no	no	no
	Prediction Exceedance	no	no	NA	no	no	no
	Ref Range Exceedance	exc	exc	exc	no	no	no
Fluoride	%<RDL	0	0	0	0	0	0
	Trend	increase	increase	no change	no change	no change	no change
	GL Exceedance	exc	exc	exc	no	no	exc
	Prediction Exceedance	no	no	NA	no	no	no
	Ref Range Exceedance	exc	exc	exc	no	no	no
Mercury	%<RDL	77.3	100	65.1	70.7	75	50
	Trend	NA	NA	NA	NA	NA	NA
	GL Exceedance	exc	no	exc	exc	exc	exc
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	no	NA	no	no	no	no
Molybdenum	%<RDL	0	0	8.3	0	0	0
	Trend	decrease	decrease	decrease	decrease	decrease	decrease
	GL Exceedance	no	no	no	no	no	no
	Prediction Exceedance	no	no	NA	no	no	no
	Ref Range Exceedance	exc	exc	exc	exc	exc	exc
Nickel	%<RDL	0	0	0.8	0.8	0	0
	Trend	decrease	no change	no change	no change	no change	no change
	GL Exceedance	no	no	no	no	no	no
	Prediction Exceedance	no	no	NA	no	exc	no
	Ref Range Exceedance	exc	exc	exc	exc	exc	exc
Selenium	%<RDL	0	0	59.2	67.5	65.8	95
	Trend	decrease	no change	NA	NA	NA	NA
	GL Exceedance	exc	exc	no	no	no	no
	Prediction Exceedance	no	no	NA	no	no	no
	Ref Range Exceedance	exc	exc	exc	no	no	no
Silver	%<RDL	99.2	100	100	100	100	100
	Trend	NA	NA	NA	NA	NA	NA
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	no	no	no	no	no	no
Strontium	%<RDL	0	0	0	0	0	0
	Trend	decrease	no change	no change	no change	no change	decrease
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	exc	exc	exc	exc	exc	no
Thallium	%<RDL	33.1	69.5	100	100	100	100
	Trend	no change	NA	NA	NA	NA	NA
	GL Exceedance	no	no	no	no	no	no
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	exc	no	no	no	no	no
Titanium	%<RDL	40.7	34.7	9.2	8.3	2.6	45
	Trend	NA	decrease	no change	no change	no change	NA
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	NA	NA	NA	NA	NA	NA
	Ref Range Exceedance	no	no	no	no	no	no

TABLE 4.3-13

Statistical Analysis and Benchmark Comparison Results for the Primary Exposure Areas at the McClean Operation, Time Period 1, 2015 to 2024.

COPC	Metric	Sink Reservoir CM03	Vulture Lake CM04	McClean Lake East Basin WQ11E	McClean Lake Outlet WQ12E	Collins Creek Downstream WQ13E	Kewen Lake WQ14E
Uranium	%<RDL	5.1	8.5	89.2	97.5	100	100
	Trend	decrease	decrease	NA	NA	NA	NA
	GL Exceedance	no	no	no	no	no	no
	Prediction Exceedance	no	no	NA	no	no	no
	Ref Range Exceedance	exc	exc	exc	no	no	no
Radionuclides							
Lead-210	%<RDL	96.6	94.9	91.6	97.5	97.4	95
	Trend	NA	NA	NA	NA	NA	NA
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	exc	exc	NA	exc	exc	exc
	Ref Range Exceedance	no	no	no	no	no	no
Polonium-210	%<RDL	94.9	92.4	81.7	87.5	92.1	100
	Trend	NA	NA	NA	NA	NA	NA
	GL Exceedance	NA	NA	NA	NA	NA	NA
	Prediction Exceedance	no	no	NA	exc	exc	exc
	Ref Range Exceedance	no	no	no	no	no	no
Radium-226	%<RDL	17.8	27.1	65.8	70.8	65.8	70
	Trend	decrease	decrease	NA	NA	NA	NA
	GL Exceedance	no	no	no	no	no	no
	Prediction Exceedance	no	no	NA	exc	exc	exc
	Ref Range Exceedance	exc	exc	no	no	no	no

Trend analysis was not performed on COPCs if more than 40% of values were less than the reported detection limit (RDL) during the Time Period.

Gray cells indicate exceedances over benchmarks; tan cells indicate significant increasing trend; blue cells indicate significant decreasing trend.

%<RDL: percentage of values less than the reported detection limit over the 2015-2024 period; Trend: Trend over the 2015-2024 period; GL exceedance: guideline exceedance over the 2015-2024 period; Prediction exceedance: prediction exceedance over the 2022-2024 period; Ref Range Exceedance: exceedance over the 2022-2024 period; no: does not exceed benchmark; exc: exceeds benchmark; NA: no benchmark available or no trend analysis performed.

[1]Dissolved oxygen has two guidelines: one is for early life stages (9.5 mg/L), the other is for other life stages (6.5 mg/L). Levels are only flagged in this table if they fall below the lower guideline.

TABLE 4.3-14

Statistical Analysis and Benchmark Comparison Results for the Primary Exposure Areas at the McClean Operation, Time Period 2, 2000 to 2024.

COPC	Metric	Sink Reservoir CM03	Vulture Lake CM04	McClean Lake East Basin WQ11E	McClean Lake Outlet WQ12E	Collins Creek Downstream WQ13E	Kewen Lake WQ14E
Nutrients							
Ammonia (as N)	%<RDL	1.7	3.7	12	15.7	17.3	16
	Trend	decrease	decrease	decrease	decrease	decrease	decrease
	GL Exceedance	no	no	no	no	no	no
Carbon, Inorganic	%<RDL	27.9	2.8	10.4	13.2	5.2	6.7
	Trend	no change	decrease	decrease	no change	decrease	decrease
	GL Exceedance	NA	NA	NA	NA	NA	NA
Carbon, Organic	%<RDL	0	0	0.3	0	0	0
	Trend	increase	increase	increase	no change	no change	increase
	GL Exceedance	NA	NA	NA	NA	NA	NA
Carbon, Organic dissolved	%<RDL	0	0	0	0	0	0
	Trend	no change	decrease	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
Carbon, Total	%<RDL	0.6	0	0	0	0	0
	Trend	decrease	decrease	decrease	no change	decrease	decrease
	GL Exceedance	NA	NA	NA	NA	NA	NA
Nitrate (as N)	%<RDL	2.8	18.4	38.6	37	32.9	40.8
	Trend	decrease	no change	no change	no change	no change	NA
	GL Exceedance	exc	no	no	no	no	no
Nitrogen, Total	%<RDL	0	0	0.9	0.9	0	0
	Trend	decrease	no change	decrease	decrease	no change	decrease
	GL Exceedance	NA	NA	NA	NA	NA	NA
Nitrogen, Total Kjeldahl	%<RDL	0	0	1	1	0	0
	Trend	decrease	decrease	decrease	decrease	decrease	decrease
	GL Exceedance	NA	NA	NA	NA	NA	NA
Phosphorus	%<RDL	91.2	88.9	92.6	92.3	92.8	94
	Trend	NA	NA	NA	NA	NA	NA
	GL Exceedance	NA	NA	NA	NA	NA	NA
Water Chemistry and Major Ions							
Alkalinity	%<RDL	3.8	0	0	0.3	0	0
	Trend	no change	increase	no change	no change	no change	decrease
	GL Exceedance	NA	NA	NA	NA	NA	NA
Bicarbonate	%<RDL	3.7	0	0.3	0.3	0	0
	Trend	no change	increase	no change	no change	no change	decrease
	GL Exceedance	NA	NA	NA	NA	NA	NA
Calcium	%<RDL	0	0	0	0	0	0
	Trend	increase	increase	decrease	decrease	decrease	decrease
	GL Exceedance	NA	NA	NA	NA	NA	NA
Chloride	%<RDL	0	0	1.3	0.7	0	0
	Trend	increase	increase	no change	no change	no change	no change
	GL Exceedance	no	no	no	no	no	no
Dissolved Oxygen (Field)	%<RDL	0	0	0	0	0	0
	Trend	no change	no change	no change	no change	no change	increase
	GL Exceedance[1]	<9.5	<6.5, <9.5	<6.5, <9.5	<6.5, <9.5	<6.5, <9.5	<6.5, <9.5
Hardness	%<RDL	0	0	0.3	0	0	0
	Trend	increase	increase	decrease	decrease	decrease	decrease
	GL Exceedance	NA	NA	NA	NA	NA	NA
Magnesium	%<RDL	0	0	0.3	0	0	0
	Trend	decrease	decrease	decrease	decrease	decrease	decrease
	GL Exceedance	NA	NA	NA	NA	NA	NA
pH (Lab)	%<RDL	0	0	0	0	0	0
	Trend	increase	increase	no change	no change	no change	no change
	GL Exceedance	<6.5	<6.5	<6.5	<6.5	<6.5	<6.5

TABLE 4.3-14

Statistical Analysis and Benchmark Comparison Results for the Primary Exposure Areas at the McClean Operation, Time Period 2, 2000 to 2024.

COPC	Metric	Sink Reservoir CM03	Vulture Lake CM04	McClean Lake East Basin WQ11E	McClean Lake Outlet WQ12E	Collins Creek Downstream WQ13E	Kewen Lake WQ14E
Potassium	%<RDL	0	0	0	0	0	0
	Trend	no change	no change	decrease	decrease	decrease	decrease
	GL Exceedance	NA	NA	NA	NA	NA	NA
Sodium	%<RDL	0	0	0	0	0	0
	Trend	increase	increase	no change	increase	no change	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
Specific Conductance (Field)	%<RDL	0	0	0	0	0	0
	Trend	increase	increase	decrease	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
Specific Conductance (Lab)	%<RDL	0	0	0.3	0	0	0
	Trend	increase	increase	decrease	decrease	decrease	decrease
	GL Exceedance	NA	NA	NA	NA	NA	NA
Sulphate	%<RDL	0	0	0	0	0	0
	Trend	increase	increase	decrease	decrease	decrease	decrease
	GL Exceedance	exc	exc	exc	no	no	no
Sum of ions	%<RDL	0	0	0	0	0	0
	Trend	increase	increase	decrease	decrease	decrease	NA
	GL Exceedance	NA	NA	NA	NA	NA	NA
Solids, Total dissolved	%<RDL	0	0	0.3	0	0	0
	Trend	increase	increase	decrease	decrease	decrease	no change
	GL Exceedance	NA	NA	NA	NA	NA	NA
Metals							
Aluminum	%<RDL	7.1	23.9	17.7	18	18.4	30
	Trend	no change	increase	increase	increase	increase	no change
	GL Exceedance	exc	no	no	no	no	no
Arsenic	%<RDL	0	0.3	7.7	9.3	9.2	18
	Trend	no change	increase	decrease	decrease	decrease	decrease
	GL Exceedance	exc	exc	exc	no	no	no
Barium	%<RDL	0	0	0.7	0	1	0
	Trend	decrease	no change	decrease	decrease	decrease	decrease
	GL Exceedance	NA	NA	NA	NA	NA	NA
Boron	%<RDL	0.9	0	47.1	48.9	58	72
	Trend	increase	increase	NA	NA	NA	NA
	GL Exceedance	no	no	no	no	no	no
Cadmium	%<RDL	55.6	78.1	83	86.7	83.7	88
	Trend	NA	NA	NA	NA	NA	NA
	GL Exceedance	exc	exc	exc	exc	exc	exc
Chromium	%<RDL	98.3	99.3	96.9	98.3	100	100
	Trend	NA	NA	NA	NA	NA	NA
	GL Exceedance	exc	no	no	no	no	no
Cobalt	%<RDL	11.4	29	84.7	86	88.8	100
	Trend	decrease[2]	decrease[2]	NA	NA	NA	NA
	GL Exceedance	exc	exc	exc	exc	exc	exc
Fluoride	%<RDL	0	0	1	0	1.6	0
	Trend	increase	increase	increase	no change	no change	no change
	GL Exceedance	exc	exc	exc	no	no	exc
Mercury	%<RDL	89.5	100	85	87.4	90.2	80
	Trend	NA	NA	NA	NA	NA	NA
	GL Exceedance	exc	no	exc	exc	exc	exc
Molybdenum	%<RDL	0	0.7	5.7	2.7	3.1	6
	Trend	decrease	decrease	decrease	decrease	decrease	decrease
	GL Exceedance	no	no	no	no	no	no
Nickel	%<RDL	0	0.7	21.3	21.7	22.4	36
	Trend	no change	no change	decrease	decrease	decrease	decrease
	GL Exceedance	no	no	no	no	no	no

TABLE 4.3-14

Statistical Analysis and Benchmark Comparison Results for the Primary Exposure Areas at the McClean Operation, Time Period 2, 2000 to 2024.

COPC	Metric	Sink Reservoir CM03	Vulture Lake CM04	McClean Lake East Basin WQ11E	McClean Lake Outlet WQ12E	Collins Creek Downstream WQ13E	Kewen Lake WQ14E
Selenium	%<RDL	3.4	6.7	56.7	65	69.4	82
	Trend	increase	increase	NA	NA	NA	NA
	GL Exceedance	exc	exc	no	exc	no	no
Silver	%<RDL	99.5	99.3	99.6	99.6	98.7	100
	Trend	NA	NA	NA	NA	NA	NA
	GL Exceedance	NA	NA	NA	NA	NA	NA
Strontium	%<RDL	0	0	0.4	0	0	0
	Trend	no change	decrease	decrease	decrease	decrease	decrease
	GL Exceedance	NA	NA	NA	NA	NA	NA
Thallium	%<RDL	50.8	79.9	100	100	100	100
	Trend	NA	NA	NA	NA	NA	NA
	GL Exceedance	no	no	no	no	no	no
Titanium	%<RDL	41.3	56.1	36.2	34.9	27.8	57.6
	Trend	NA	NA	decrease	decrease	decrease	NA
	GL Exceedance	NA	NA	NA	NA	NA	NA
Uranium	%<RDL	9.1	12.1	79	92.7	95.9	98
	Trend	decrease	decrease	NA	NA	NA	NA
	GL Exceedance	exc	no	no	no	no	no
Radionuclides							
Lead-210	%<RDL	96	96	93.3	96.3	93.9	96
	Trend	NA	NA	NA	NA	NA	NA
	GL Exceedance	NA	NA	NA	NA	NA	NA
Polonium-210	%<RDL	87.1	88.9	79	84	86.7	98
	Trend	NA	NA	NA	NA	NA	NA
	GL Exceedance	NA	NA	NA	NA	NA	NA
Radium-226	%<RDL	22.6	34	66.7	74	74.5	78
	Trend	no change	no change	NA	NA	NA	NA
	GL Exceedance	no	no	no	no	no	no

Trend analysis was not performed on COPCs if more than 40% of values were less than the reported detection limit (RDL) during the Time Period.

Gray cells indicate exceedances over benchmarks; tan cells indicate significant increasing trend; blue cells indicate significant decreasing trend.

%<RDL: percentage of values less than the reported detection limit over the 2000-2024 period; Trend: Trend over the 2000-2024 period; GL exceedance: guideline exceedance over the 2000-2024 period; no: does not exceed benchmark; exc: exceeds benchmark; NA: no benchmark available or no trend analysis performed.

[1]Dissolved oxygen has two guidelines: one is for early life stages (9.5 mg/L), the other is for other life stages (6.5 mg/L). Levels are only flagged in this table if they fall below the lower guideline.

[2]This trend is an artifact of decreased RDLs for cobalt in 2009.

TABLE 4.3-15

Summary of Water Chemistry Data from Secondary Exposure and Reference Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Parameter	Units	Mallen Lake (WQ01C)												Guidelines[1]
		2022				2023				2024				
		n	n<RDL	Mean	SD	n	n<RDL	Mean	SD	n	n<RDL	Mean	SD	
Nutrients														
Ammonia (as N)	mg/L	4	2	0.02	0.02	4	2	0.04	0.03	2	0	0.02	0.01	18 to 34
Carbon, Inorganic	mg/L	4	1	2.3	1.25	4	0	1.9	0.17	2	0	2.0	0	-
Carbon, Organic	mg/L	4	0	2.4	0.12	4	0	2.3	0.20	2	0	2.2	0.14	-
Carbon, Organic dissolved	mg/L	4	0	2.5	0.14	4	0	2.4	0.16	2	0	2.2	0.09	-
Carbon, Total	mg/L	4	0	4.5	1.64	4	0	4.0	0	2	0	4.0	0	-
Nitrate (as N)	mg/L	4	3	0.05	0.07	4	3	0.03	0.05	2	1	0.06	0.07	3
Nitrogen, Total	mg/L	4	0	0.23	0.056	4	0	0.19	0.076	2	0	0.23	0.057	-
Nitrogen, Total Kjeldahl	mg/L	4	0	0.18	0.049	4	0	0.17	0.063	2	0	0.18	0.016	-
Phosphorus	mg/L	4	4	0.01	0	4	4	0.01	0	2	2	0.01	0	-
General Chemistry and Major Ions														
Alkalinity	mg/L	4	0	9.5	4.8	4	0	8.2	0.6	2	0	8.0	0.9	-
Bicarbonate	mg/L	4	0	12	5.8	4	0	10	0.9	2	0	10	1.4	-
Calcium	mg/L	4	0	1.5	0.2	4	0	1.6	0.1	2	0	1.7	0.3	-
Chloride	mg/L	4	2	0.12	0.02	4	2	0.13	0.03	2	1	0.12	0.02	120
Dissolved Oxygen (Field)	mg/L	3	0	9.9	1.6	3	0	10.3	1.2	1	0	8.6	-	6.5
Hardness	mg/L	4	0	5.9	0.7	4	0	6.3	0.4	2	0	6.5	0.7	-
Magnesium	mg/L	4	0	0.53	0.09	4	0	0.58	0.03	2	0	0.55	0.07	-
pH (Lab)	pH Units	4	0	6.8	0.11	4	0	6.7	0.15	2	0	**6.4**	0.01	6.5 to 9.0
Potassium	mg/L	4	0	0.42	0.03	4	0	0.44	0.04	2	0	0.43	0	-
Sodium	mg/L	4	0	1.2	0.19	4	0	1.2	0.07	2	0	1.3	0.07	-
Specific Conductance (Field)	µS/cm	4	0	18	5.2	4	0	21	1.7	2	0	35	20.3	-
Specific Conductance (Lab)	µS/cm	4	0	17	2.8	4	0	17	1.9	2	0	17	1.6	-
Sulphate	mg/L	4	0	0.7	0.3	4	0	0.5	0.1	2	0	0.6	0.2	128
Sum of ions	mg/L	4	0	16	6.3	4	0	15	1.1	2	0	15	2.6	-
Solids, Total dissolved	mg/L	4	0	21	4.5	4	0	28	5.4	2	0	21	12	-
Metals and Trace Elements														
Aluminum	mg/L	4	0	0.002	0.001	4	0	0.001	0.0004	2	0	0.001	0.001	0.081 to 0.142
Arsenic	µg/L	4	1	0.1	0	4	2	0.1	0.05	2	0	0.2	0.1	5.0
Barium	mg/L	4	0	0.006	0.003	4	0	0.004	0.001	2	0	0.005	0.002	-
Boron	mg/L	4	4	0.01	0	4	4	0.01	0	2	2	0.01	0	1.5
Cadmium	mg/L	4	4	0.00001	0	4	4	0.00001	0	2	2	0.00001	0	0.00004
Chromium	mg/L	4	4	0.0005	0	4	4	0.0005	0	2	2	0.0005	0	0.0089
Cobalt	mg/L	4	4	0.0001	0	4	4	0.0001	0	2	2	0.0001	0	0.00078
Fluoride	mg/L	4	0	0.05	0.006	4	0	0.05	0.006	2	0	0.05	0.002	0.12
Mercury	µg/L	4	4	0.001	0	4	3	0.001	0	2	2	0.001	0	0.005
Molybdenum	mg/L	4	4	0.0001	0	4	3	0.0001	0	2	2	0.0001	0	31
Nickel	mg/L	4	4	0.0001	0	4	4	0.0001	0	2	1	0.0002	0.0001	0.0062 to 0.0069
Selenium	mg/L	4	4	0.0001	0	4	4	0.0001	0	2	2	0.0001	0	0.002
Silver	mg/L	4	4	0.00005	0	4	4	0.00005	0	2	2	0.00005	0	0.0001
Strontium	mg/L	4	0	0.0113	0	4	0	0.0112	0	2	0	0.0125	0	2.5
Thallium	mg/L	4	4	0.0002	0	4	4	0.0002	0	2	2	0.0002	0	0.0008
Titanium	mg/L	4	4	0.00021	0.00002	4	4	0.0002	0	2	2	0.0002	0	-
Uranium	µg/L	4	4	0.1	0	4	4	0.1	0	2	2	0.1	0	15
Radionuclides														
Lead-210	Bq/L	4	4	0.02	0	4	4	0.02	0	2	2	0.02	0	-
Polonium-210	Bq/L	4	4	0.005	0	4	4	0.005	0	2	2	0.005	0	-
Radium-226	Bq/L	4	4	0.005	0	4	4	0.005	0.001	2	2	0.005	0	0.11

TABLE 4.3-15

Summary of Water Chemistry Data from Secondary Exposure and Reference Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Parameter	Units	Collins Creek Near Indigo Lake (WQ02C)												Guidelines[1]
		2022				2023				2024				
		n	n<RDL	Mean	SD	n	n<RDL	Mean	SD	n	n<RDL	Mean	SD	
Nutrients														
Ammonia (as N)	mg/L	4	0	0.04	0.03	4	1	0.03	0.03	2	1	0.03	0.02	30 to 66
Carbon, Inorganic	mg/L	4	1	1.8	0.96	4	0	2.0	0.82	2	0	1.5	0.71	-
Carbon, Organic	mg/L	4	0	4.2	0.15	4	0	3.8	0.73	2	0	4.5	1.13	-
Carbon, Organic dissolved	mg/L	4	0	4.1	0.25	4	0	3.9	0.67	2	0	4.3	0.85	-
Carbon, Total	mg/L	4	0	5.5	1.29	4	0	5.8	0.96	2	0	6.0	1.41	-
Nitrate (as N)	mg/L	4	2	0.03	0.03	4	2	0.03	0.03	2	2	0.01	0	3
Nitrogen, Total	mg/L	4	0	0.25	0.10	4	0	0.27	0.07	2	0	0.20	0.06	-
Nitrogen, Total Kjeldahl	mg/L	4	0	0.22	0.083	4	0	0.25	0.044	2	0	0.20	0.064	-
Phosphorus	mg/L	4	4	0.01	0	4	4	0.01	0	2	1	0.01	0	-
General Chemistry and Major Ions														
Alkalinity	mg/L	4	0	7.5	4.2	4	0	9.0	3.2	2	0	7.5	2.1	-
Bicarbonate	mg/L	4	0	9	5.1	4	0	11	4.1	2	0	9	2.8	-
Calcium	mg/L	4	0	1.6	0.3	4	0	1.7	0.3	2	0	1.5	0.2	-
Chloride	mg/L	4	0	0.15	0.06	4	1	0.20	0.08	2	0	0.20	0	120
Dissolved Oxygen (Field)	mg/L	3	0	8.9	0.7	-	-	-	-	-	-	-	-	6.5
Hardness	mg/L	4	0	6.5	1.3	4	0	6.8	1.0	2	0	5.5	0.7	-
Magnesium	mg/L	4	0	0.58	0.10	4	0	0.60	0.08	2	0	0.55	0.07	-
pH (Lab)	pH Units	4	0	6.7	0.16	4	0	6.5	0.07	2	0	**6.4**	0.11	6.5 to 9.0
Potassium	mg/L	4	0	0.38	0.13	4	0	0.45	0.31	2	0	0.45	0.07	-
Sodium	mg/L	4	0	1.3	0.27	4	0	1.4	0.13	2	0	1.4	0.07	-
Specific Conductance (Field)	µS/cm	4	0	14	7.7	4	0	20	4.0	2	0	20	1.8	-
Specific Conductance (Lab)	µS/cm	4	0	17	4.0	4	0	19	4.6	2	0	17	2.8	-
Sulphate	mg/L	4	0	0.5	0.1	4	0	0.6	0.1	2	0	0.4	0.1	128
Sum of ions	mg/L	4	0	14	5.9	4	0	16	5.1	2	0	14	3.5	-
Solids, Total dissolved	mg/L	4	0	27	4.9	4	0	30	4.4	2	0	17	7.1	-
Metals and Trace Elements														
Aluminum	mg/L	4	0	0.013	0.002	4	0	0.011	0.001	2	0	0.014	0.004	0.077 to 0.129
Arsenic	µg/L	4	0	0.2	0.06	4	0	0.2	0.06	2	0	0.2	0	5.0
Barium	mg/L	4	0	0.004	0.001	4	0	0.003	0.0005	2	0	0.004	0.001	-
Boron	mg/L	4	4	0.01	0	4	4	0.01	0	2	2	0.01	0	1.5
Cadmium	mg/L	4	2	0.00001	0	4	4	0.00001	0	2	1	0.00001	0	0.00004
Chromium	mg/L	4	4	0.0005	0	4	4	0.0005	0	2	2	0.0005	0	0.0089
Cobalt	mg/L	4	4	0.0001	0	4	4	0.0001	0	2	2	0.0001	0	0.00078
Fluoride	mg/L	4	0	0.04	0.005	4	0	0.05	0	2	0	0.04	0	0.12
Mercury	µg/L	4	2	0.001	0	4	3	0.001	0	2	1	0.001	0	0.005
Molybdenum	mg/L	4	4	0.0001	0	4	3	0.0001	0.0001	2	2	0.0001	0	31
Nickel	mg/L	4	1	0.0001	0	4	3	0.0001	0.0001	2	2	0.0001	0	0.0058 to 0.0071
Selenium	mg/L	4	4	0.0001	0	4	4	0.0001	0	2	2	0.0001	0	0.002
Silver	mg/L	4	4	0.00005	0	4	4	0.00005	0	2	2	0.00005	0	0.0001
Strontium	mg/L	4	0	0.0112	0	4	0	0.0110	0	2	0	0.0106	0	2.5
Thallium	mg/L	4	4	0.0002	0	4	4	0.0002	0	2	2	0.0002	0	0.0008
Titanium	mg/L	4	0	0.00035	0.0001	4	0	0.0004	0.0001	2	0	0.0005	0.0001	-
Uranium	µg/L	4	4	0.1	0	4	4	0.1	0	2	2	0.1	0	15
Radionuclides														
Lead-210	Bq/L	4	4	0.03	0	4	4	0.02	0	2	2	0.02	0	-
Polonium-210	Bq/L	4	4	0.005	0	4	3	0.005	0	2	1	0.007	0.002	-
Radium-226	Bq/L	4	4	0.005	0	4	3	0.005	0	2	2	0.005	0	0.11

TABLE 4.3-15

Summary of Water Chemistry Data from Secondary Exposure and Reference Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Parameter	Units	McClean Lake West Basin (WQ15C)												Guidelines[1]
		2022				2023				2024				
		n	n<RDL	Mean	SD	n	n<RDL	Mean	SD	n	n<RDL	Mean	SD	
Nutrients														
Ammonia (as N)	mg/L	4	1	0.04	0.02	4	0	0.04	0.03	4	2	0.03	0.03	25 to 51
Carbon, Inorganic	mg/L	4	1	1.8	0.96	4	0	1.8	0.50	4	0	1.8	0.50	-
Carbon, Organic	mg/L	4	0	4.4	0.39	4	0	4.0	0.25	4	0	4.5	0.69	-
Carbon, Organic dissolved	mg/L	4	0	4.5	0.38	4	0	4.1	0.31	4	0	4.3	0.65	-
Carbon, Total	mg/L	4	0	6.0	1.41	4	0	5.8	0.50	4	0	6.0	0.82	-
Nitrate (as N)	mg/L	4	2	0.03	0.03	4	3	0.02	0.03	4	3	0.03	0.05	3
Nitrogen, Total	mg/L	4	0	0.25	0.07	4	0	0.27	0.06	4	0	0.27	0.03	-
Nitrogen, Total Kjeldahl	mg/L	4	0	0.22	0.055	4	0	0.26	0.068	4	0	0.24	0.073	-
Phosphorus	mg/L	4	4	0.01	0	4	4	0.01	0	4	4	0.01	0	-
General Chemistry and Major Ions														
Alkalinity	mg/L	4	0	7.5	4.5	4	0	8.3	1.7	4	0	8.3	2.1	-
Bicarbonate	mg/L	4	0	9	5.5	4	0	10	2.2	4	0	10	2.6	-
Calcium	mg/L	4	0	1.7	0.5	4	0	1.7	0.3	4	0	1.7	0.5	-
Chloride	mg/L	4	0	0.50	0.18	4	0	0.53	0.10	4	0	0.48	0.13	120
Dissolved Oxygen (Field)	mg/L	4	0	10.0	1.0	4	0	10.7	1.6	4	0	10.8	1.1	6.5
Hardness	mg/L	4	0	6.5	1.9	4	0	6.5	1.3	4	0	6.5	1.9	-
Magnesium	mg/L	4	0	0.58	0.15	4	0	0.60	0.08	4	0	0.63	0.17	-
pH (Lab)	pH Units	4	0	6.7	0.19	4	0	6.6	0.10	4	0	**6.4**	0.20	6.5 to 9.0
Potassium	mg/L	4	0	0.43	0.15	4	0	0.45	0.13	4	0	0.48	0.15	-
Sodium	mg/L	4	0	1.3	0.33	4	0	1.4	0.18	4	0	1.5	0.28	-
Specific Conductance (Field)	µS/cm	4	0	20	6.4	4	0	23	4.4	4	0	21	4.9	-
Specific Conductance (Lab)	µS/cm	4	0	20	5.2	4	0	19	2.2	4	0	20	5.4	-
Sulphate	mg/L	4	0	0.6	0.2	4	0	0.7	0.2	4	0	0.6	0.3	128
Sum of ions	mg/L	4	0	14	7.1	4	0	16	2.9	4	0	16	4.1	-
Solids, Total dissolved	mg/L	4	0	24	9.2	4	0	29	7.9	4	0	30	6.2	-
Metals and Trace Elements														
Aluminum	mg/L	4	0	0.013	0.002	4	0	0.009	0.002	4	0	0.009	0.003	0.089 to 0.131
Arsenic	µg/L	4	0	0.2	0.06	4	0	0.2	0.05	4	0	0.2	0.08	5.0
Barium	mg/L	4	0	0.004	0.001	4	0	0.003	0.001	4	0	0.003	0.001	-
Boron	mg/L	4	4	0.01	0	4	4	0.01	0	4	4	0.01	0	1.5
Cadmium	mg/L	4	4	0.00001	0	4	4	0.00001	0	4	4	0.00001	0	0.00004
Chromium	mg/L	4	4	0.0005	0	4	4	0.0005	0	4	4	0.0005	0	0.0089
Cobalt	mg/L	4	4	0.0001	0	4	4	0.0001	0	4	4	0.0001	0	0.00078
Fluoride	mg/L	4	0	0.04	0.005	4	0	0.04	0.008	4	0	0.05	0.010	0.12
Mercury	µg/L	4	2	0.0013	0.0005	4	4	0.001	0	4	4	0.001	0	0.005
Molybdenum	mg/L	4	3	0.0001	0.0001	4	3	0.0001	0	4	3	0.0001	0	31
Nickel	mg/L	4	4	0.0001	0	4	4	0.0001	0	4	2	0.0001	0	0.0069
Selenium	mg/L	4	4	0.0001	0	4	4	0.0001	0	4	4	0.0001	0	0.002
Silver	mg/L	4	4	0.00005	0	4	4	0.00005	0	4	4	0.00005	0	0.0001
Strontium	mg/L	4	0	0.0128	0	4	0	0.0140	0	4	0	0.0136	0	2.5
Thallium	mg/L	4	4	0.0002	0	4	4	0.0002	0	4	4	0.0002	0	0.0008
Titanium	mg/L	4	2	0.00023	0.00005	4	0	0.0004	0.0001	4	0	0.0003	0.0001	-
Uranium	µg/L	4	4	0.1	0	4	4	0.1	0	4	3	0.1	0	15
Radionuclides														
Lead-210	Bq/L	4	4	0.02	0	4	4	0.02	0	4	4	0.02	0	-
Polonium-210	Bq/L	4	3	0.005	0	4	4	0.006	0.001	4	4	0.005	0	-
Radium-226	Bq/L	4	3	0.006	0.003	4	2	0.006	0.001	4	4	0.005	0	0.11

TABLE 4.3-15

Summary of Water Chemistry Data from Secondary Exposure and Reference Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Parameter	Units	Henday Lake (WQ20C)												Guidelines[1]
		2022				2023				2024				
		n	n<RDL	Mean	SD	n	n<RDL	Mean	SD	n	n<RDL	Mean	SD	
Nutrients														
Ammonia (as N)	mg/L	2	0	0.06	0.02	2	0	0.05	0.01	1	0	0.03	-	17 to 65
Carbon, Inorganic	mg/L	2	0	2.5	0.71	2	0	2.0	0	1	0	2.0	-	-
Carbon, Organic	mg/L	2	0	4.1	0.28	2	0	4.0	1.27	1	0	4.5	-	-
Carbon, Organic dissolved	mg/L	2	0	4.0	0.35	2	0	3.9	0.99	1	0	4.4	-	-
Carbon, Total	mg/L	2	0	6.5	0.71	2	0	6.0	1.41	1	0	6.0	-	-
Nitrate (as N)	mg/L	2	1	0.02	0.01	2	2	0.01	0	1	1	0.01	-	3
Nitrogen, Total	mg/L	2	0	0.40	0.03	2	0	0.34	0.01	1	0	0.42	-	-
Nitrogen, Total Kjeldahl	mg/L	2	0	0.39	0.014	2	0	0.34	0.007	1	0	0.42	-	-
Phosphorus	mg/L	2	2	0.01	0	2	2	0.01	0	1	1	0.01	-	-
General Chemistry and Major Ions														
Alkalinity	mg/L	2	0	11.0	2.8	2	0	8.5	2.1	1	0	10.0	-	-
Bicarbonate	mg/L	2	0	14	3.5	2	0	10	2.8	1	0	12	-	-
Calcium	mg/L	2	0	1.7	0.9	2	0	1.6	0.2	1	0	1.9	-	-
Chloride	mg/L	2	1	0.15	0.07	2	1	0.10	0	1	0	0.10	-	120
Dissolved Oxygen (Field)	mg/L	2	0	11.4	3.6	1	0	8.9	-	-	-	-	-	6.5
Hardness	mg/L	2	0	6.5	3.5	2	0	6.5	0.7	1	0	8.0	-	-
Magnesium	mg/L	2	0	0.60	0.28	2	0	0.60	0.14	1	0	0.80	-	-
pH (Lab)	pH Units	2	0	6.8	0.10	2	0	6.7	0.18	1	0	6.5	-	6.5 to 9.0
Potassium	mg/L	2	0	0.50	0.14	2	0	0.50	0.00	1	0	0.60	-	-
Sodium	mg/L	2	0	1.2	0.28	2	0	1.2	0.28	1	0	1.4	-	-
Specific Conductance (Field)	µS/cm	2	0	18	5.9	2	0	19	5.5	1	0	25	-	-
Specific Conductance (Lab)	µS/cm	2	0	19	9.2	2	0	16	3.5	1	0	20	-	-
Sulphate	mg/L	2	0	0.7	0.2	2	0	0.6	0.1	1	0	0.6	-	128
Sum of ions	mg/L	2	0	18	5.7	2	0	15	3.5	1	0	17	-	-
Solids, Total dissolved	mg/L	2	0	15	2.1	2	0	21	4.2	1	0	24	-	-
Metals and Trace Elements														
Aluminum	mg/L	2	0	0.008	0.001	2	0	0.004	0.0001	1	0	0.001	-	0.088 to 0.138
Arsenic	µg/L	2	0	0.3	0.07	2	0	0.2	0	1	0	0.2	-	5
Barium	mg/L	2	0	0.004	0.002	2	0	0.003	0.001	1	0	0.004	-	-
Boron	mg/L	2	2	0.01	0	2	2	0.01	0	1	1	0.01	-	1.5
Cadmium	mg/L	2	1	0.00001	0	2	2	0.00001	0	1	1	0.00001	-	0.00004
Chromium	mg/L	2	2	0.0005	0	2	2	0.0005	0	1	1	0.0005	-	0.0089
Cobalt	mg/L	2	2	0.0001	0	2	2	0.0001	0	1	1	0.0001	-	0.0008
Fluoride	mg/L	2	0	0.05	0.014	2	0	0.06	0.007	1	0	0.06	-	0.12
Mercury	µg/L	2	1	0.0010	0	2	2	0.001	0	1	1	0.001	-	0.005
Molybdenum	mg/L	2	2	0.0001	0	2	2	0.0001	0	1	0	0.0004	-	31
Nickel	mg/L	2	0	0.0002	0.0001	2	2	0.0001	0	1	1	0.0001	-	0.0069 to 0.0084
Selenium	mg/L	2	2	0.0001	0	2	2	0.0001	0	1	1	0.0001	-	0.002
Silver	mg/L	2	2	0.00005	0	2	2	0.00005	0	1	1	0.00005	-	0.0001
Strontium	mg/L	2	0	0.0101	0	2	0	0.0088	0	1	0	0.0100	-	2.5
Thallium	mg/L	2	2	0.0002	0	2	2	0.0002	0	1	1	0.0002	-	0.0008
Titanium	mg/L	2	1	0.0002	0	2	2	0.0002	0	1	1	0.0002	-	-
Uranium	µg/L	2	2	0.1	0	2	2	0.1	0	1	1	0.1	-	15
Radionuclides														
Lead-210	Bq/L	2	2	0.04	0	2	2	0.02	0	1	1	0.02	-	-
Polonium-210	Bq/L	2	1	0.007	0.003	2	2	0.005	0	1	1	0.005	-	-
Radium-226	Bq/L	2	2	0.005	0	2	2	0.005	0	1	1	0.005	-	0.11

TABLE 4.3-15

Summary of Water Chemistry Data from Secondary Exposure and Reference Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Parameter	Units	Fox Lake (WQ04E)															Reference Range Upper Limit	Guidelines[1]
		2022					2023					2024						
		n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference		
Nutrients																		
Ammonia (as N)	mg/L	4	2	0.025	0.030	no	4	0	0.068	0.061	no	2	0	0.10	0.11	exc	0.081	22 to 45
Carbon, Inorganic	mg/L	4	1	2.0	2.0	no	4	0	2.8	0.96	no	2	0	3.5	2.1	exc	0.08	-
Carbon, Organic	mg/L	4	0	4.6	0.48	no	4	0	4.9	0.78	no	2	0	4.7	0.42	no	5.6	-
Carbon, Organic dissolved	mg/L	4	0	4.6	0.50	no	4	0	4.6	0.53	no	2	0	4.8	0.35	no	5.5	-
Carbon, Total	mg/L	4	0	6.5	1.73	no	4	0	7.8	0.50	no	2	0	8.0	1.41	exc	7.8	-
Nitrate (as N)	mg/L	4	2	0.10	0.11	no	4	2	0.03	0.02	no	2	1	0.04	0.04	no	0.10	3
Nitrogen, Total	mg/L	4	0	0.36	0.086	no	4	0	0.43	0.073	exc	2	0	0.41	0.042	no	0.42	-
Nitrogen, Total Kjeldahl	mg/L	4	0	0.26	0.098	no	4	0	0.41	0.067	exc	2	0	0.38	0.007	no	0.40	-
Phosphorus	mg/L	4	4	0.01	0	no	4	4	0.01	0	no	2	2	0.01	0	no	0.01	-
General Chemistry and Major Ions																		
Alkalinity	mg/L	4	0	8.3	8.0	no	4	0	11.3	3.8	no	2	0	14	9.2	no	14.1	-
Bicarbonate	mg/L	4	0	10	9.7	no	4	0	14	4.3	no	2	0	16	11	no	17	-
Calcium	mg/L	4	0	1.5	0.7	no	4	0	2.0	0.6	no	2	0	2.4	1.1	exc	2.3	-
Chloride	mg/L	4	2	0.1	0	no	4	2	0.13	0.05	no	2	1	0.15	0.07	no	0.6	120
Dissolved Oxygen (Field)	mg/L	3	0	11.8	1.9	no	1	0	**6.2**	-	no	2	0	9.3	6.0	no	13.1	6.5
Hardness	mg/L	4	0	6.3	2.5	no	4	0	8.3	1.9	no	2	0	10	4.2	exc	8.9	-
Magnesium	mg/L	4	0	0.63	0.25	no	4	0	0.80	0.14	no	2	0	0.95	0.35	exc	0.81	-
pH (Lab)	pH Units	4	0	6.8	0.17	no	4	0	6.7	0.11	no	2	0	6.5	0.08	no	7.0	6.5 to 9.0
Potassium	mg/L	4	0	0.43	0.13	no	4	0	0.53	0.15	no	2	0	0.65	0.07	no	0.71	-
Sodium	mg/L	4	0	1.3	0.3	no	4	0	1.5	0.2	no	2	0	1.8	0.6	exc	1.7	-
Specific Conductance (Field)	µS/cm	4	0	18	8	no	4	0	27	6.1	no	2	0	28	12.7	no	34	-
Specific Conductance (Lab)	µS/cm	4	0	18	7	no	4	0	25	7.1	no	2	0	28	12.0	exc	26	-
Sulphate	mg/L	4	0	0.65	0.06	no	4	0	0.68	0.05	no	2	0	0.60	0.28	no	0.94	128
Sum of ions	mg/L	4	0	15	12	no	4	0	20	5.3	no	2	0	23	14	no	24	-
Solids, Total dissolved	mg/L	4	0	24	6.2	no	4	0	31	7.8	no	2	0	42	14	exc	39	-
Metals and Trace Elements																		
Aluminum	mg/L	4	0	0.014	0.003	no	4	0	0.012	0.005	no	2	0	0.010	0.002	no	0.018	0.102 to 0.135
Arsenic	µg/L	4	0	0.2	0	no	4	0	0.2	0.1	no	2	0	0.3	0	exc	0.29	5.0
Barium	mg/L	4	0	0.005	0.003	no	4	0	0.007	0.002	exc	2	0	0.009	0.006	exc	0.007	-
Boron	mg/L	4	4	0.01	0	no	4	4	0.01	0	no	2	2	0.01	0	no	0.01	1.5
Cadmium	mg/L	4	4	0.00001	0	no	4	4	0.00001	0	no	2	2	0.00001	0	no	0.00001	0.00004
Chromium	mg/L	4	4	0.0005	0	no	4	4	0.0005	0	no	2	2	0.0005	0	no	0.0005	0.0089
Cobalt	mg/L	4	4	0.0001	0	no	4	4	0.0001	0	no	2	1	0.0001	0	no	0.0001	0.00078
Fluoride	mg/L	4	0	0.05	0.008	no	4	0	0.07	0.006	exc	2	0	0.07	0.014	exc	0.06	0.12
Mercury	µg/L	4	1	0.0015	0.0006	exc	4	1	0.001	0	no	2	2	0.001	0	no	0.0014	0.005
Molybdenum	mg/L	4	1	0.0002	0.0001	no	4	1	0.0003	0.0002	exc	2	0	0.0003	0.0001	exc	0.0002	31
Nickel	mg/L	4	2	0.0001	0.0001	no	4	1	0.0002	0.0001	no	2	1	0.0002	0.0001	no	0.0002	0.0066 to 0.011
Selenium	mg/L	4	4	0.0001	0	no	4	4	0.0001	0	no	2	2	0.0001	0	no	0.0001	0.002
Silver	mg/L	4	4	0.00005	0	no	4	4	0.00005	0	no	2	2	0.00005	0	no	0.00005	0.0001
Strontium	mg/L	4	0	0.0097	0	no	4	0	0.0112	0	no	2	0	0.0150	0	no	0.0166	2.5
Thallium	mg/L	4	4	0.0002	0	no	4	4	0.0002	0	no	2	2	0.0002	0	no	0.0002	0.0008
Titanium	mg/L	4	3	0.0002	0	no	4	3	0.00023	0.00005	no	2	2	0.0002	0	no	0.00049	-
Uranium	µg/L	4	3	0.1	0	no	4	4	0.1	0	no	2	2	0.1	0	no	0.1	15
Radionuclides																		
Lead-210	Bq/L	4	4	0.02	0	no	4	4	0.02	0	no	2	2	0.02	0	no	0.033	-
Polonium-210	Bq/L	4	4	0.005	0	no	4	3	0.006	0.002	no	2	1	0.005	0	no	0.007	-
Radium-226	Bq/L	4	4	0.005	0	no	4	4	0.005	0	no	2	2	0.005	0	no	0.007	0.11

TABLE 4.3-15

Summary of Water Chemistry Data from Secondary Exposure and Reference Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Parameter	Units	Pat Lake (WQ05E)															Reference Range Upper Limit	Guidelines[1]
		2022					2023					2024						
		n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference		
Nutrients																		
Ammonia (as N)	mg/L	2	0	0.027	0.005	no	2	0	0.032	0.012	no	1	0	0.047	-	no	0.081	17 to 41
Carbon, Inorganic	mg/L	2	0	1.2	0.24	no	2	0	1.83	0.24	no	1	0	2.3	-	no	0.08	-
Carbon, Organic	mg/L	2	0	3.1	0.05	no	2	0	2.9	0.16	no	1	0	3.1	-	no	5.6	-
Carbon, Organic dissolved	mg/L	2	0	3.1	0.05	no	2	0	3.0	0.24	no	1	0	3.2	-	no	5.5	-
Carbon, Total	mg/L	2	0	3.8	0.24	no	2	0	4.8	0.24	no	1	0	5.7	-	no	7.8	-
Nitrate (as N)	mg/L	2	1	0.02	0.01	no	2	1	0.05	0.06	no	1	0	0.06	-	no	0.10	3
Nitrogen, Total	mg/L	2	0	0.17	0.10	no	2	0	0.19	0.15	no	1	0	0.23	-	no	0.42	-
Nitrogen, Total Kjeldahl	mg/L	2	0	0.16	0.087	no	2	0	0.14	0.078	no	1	0	0.17	-	no	0.40	-
Phosphorus	mg/L	2	2	0.01	0	no	2	2	0.01	0	no	1	1	0.01	-	no	0.01	-
General Chemistry and Major Ions																		
Alkalinity	mg/L	2	0	5.0	0.94	no	2	0	9.3	1.4	no	1	0	9.3	-	no	14.1	-
Bicarbonate	mg/L	2	0	6.0	1.4	no	2	0	11.2	1.6	no	1	0	11.7	-	no	17	-
Calcium	mg/L	2	0	1.5	0.024	no	2	0	1.7	0.071	no	1	0	1.9	-	no	2.3	-
Chloride	mg/L	2	0	0.1	0.024	no	2	0	0.1	0.024	no	1	0	0.2	-	no	0.6	120
Dissolved Oxygen (Field)	mg/L	2	0	10.3	1.2	no	2	0	10	1.6	no	-	-	-	-	-	13.1	6.5
Hardness	mg/L	2	0	6.0	0	no	2	0	6.3	0.47	no	1	0	7.7	-	no	8.9	-
Magnesium	mg/L	2	0	0.53	0	no	2	0	0.62	0.02	no	1	0	0.67	-	no	0.81	-
pH (Lab)	pH Units	2	0	6.9	0.21	no	2	0	6.7	0.33	no	1	0	6.6	-	no	7.0	6.5 to 9.0
Potassium	mg/L	2	0	0.40	0	no	2	0	0.42	0.02	no	1	0	0.57	-	no	0.71	-
Sodium	mg/L	2	0	1.1	0.05	no	2	0	1.2	0.07	no	1	0	1.3	-	no	1.7	-
Specific Conductance (Field)	µS/cm	2	0	18	0.42	no	2	0	19	1.9	no	1	0	25	-	no	34	-
Specific Conductance (Lab)	µS/cm	2	0	16	0.47	no	2	0	17	0.71	no	1	0	19	-	no	26	-
Sulphate	mg/L	2	0	1	0	no	2	0	0.6	0	no	1	0	0.6	-	no	0.94	128
Sum of ions	mg/L	2	0	10	1.4	no	2	0	16	0.94	no	1	0	17	-	no	24	-
Solids, Total dissolved	mg/L	2	0	23	2.6	no	2	0	22	8.5	no	1	0	30	-	no	39	-
Metals and Trace Elements																		
Aluminum	mg/L	2	0	0.003	0.0004	no	2	0	0.002	0.0002	no	1	0	0.001	-	no	0.018	0.109 to 0.166
Arsenic	µg/L	2	0	0.1	0	no	2	0	0.2	0.02	no	1	0	0.1	-	no	0.29	5.0
Barium	mg/L	2	0	0.003	0.0004	no	2	0	0.003	0.0005	no	1	0	0.003	-	no	0.007	-
Boron	mg/L	2	2	0.01	0	no	2	2	0.01	0	no	1	1	0.01	-	no	0.01	1.5
Cadmium	mg/L	2	2	0.00001	0	no	2	2	0.00001	0	no	1	1	0.00001	-	no	0.00001	0.00004
Chromium	mg/L	2	2	0.0005	0	no	2	2	0.0005	0	no	1	1	0.0005	-	no	0.0005	0.0089
Cobalt	mg/L	2	2	0.0001	0	no	2	2	0.0001	0	no	1	1	0.0001	-	no	0.0001	0.00078
Fluoride	mg/L	2	0	0.043	0.005	no	2	0	0.042	0.002	no	1	0	0.053	-	no	0.06	0.12
Mercury	µg/L	2	2	0.001	0	no	2	1	0.001	0	no	1	1	0.001	-	no	0.0014	0.005
Molybdenum	mg/L	2	2	0.0001	0	no	2	2	0.0001	0	no	1	1	0.0001	-	no	0.000	31
Nickel	mg/L	2	2	0.0001	0	no	2	2	0.0001	0	no	1	1	0.0001	-	no	0.000	0.0063 to 0.0081
Selenium	mg/L	2	2	0.0001	0	no	2	2	0.0001	0	no	1	1	0.0001	-	no	0.0001	0.002
Silver	mg/L	2	2	0.00005	0	no	2	2	0.00005	0	no	1	1	0.00005	-	no	0.00005	0.0001
Strontium	mg/L	2	0	0.0098	0	no	2	0	0.0100	0	no	1	0	0.0110	-	no	0.0166	2.5
Thallium	mg/L	2	2	0.0002	0	no	2	2	0.0002	0	no	1	1	0.0002	-	no	0.0002	0.0008
Titanium	mg/L	2	2	0.0002	0	no	2	2	0.0002	0	no	1	1	0.0002	-	no	0.00049	-
Uranium	µg/L	2	2	0.1	0	no	2	2	0.1	0	no	1	1	0.1	-	no	0.1	15
Radionuclides																		
Lead-210	Bq/L	2	2	0.02	0	no	2	2	0.02	0	no	1	1	0.02	-	no	0.033	-
Polonium-210	Bq/L	2	2	0.005	0	no	2	2	0.005	0	no	1	1	0.005	-	no	0.007	-
Radium-226	Bq/L	2	2	0.005	0	no	2	2	0.006	0	no	1	1	0.006	-	no	0.007	0.11

TABLE 4.3-15

Summary of Water Chemistry Data from Secondary Exposure and Reference Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Parameter	Units	Johannes Lake (WQ08E)															Reference Range Upper Limit	Guidelines[1]
		2022					2023					2024						
		n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference		
Nutrients																		
Ammonia (as N)	mg/L	2	0	0.025	0.002	no	2	0	0.027	0.009	no	1	0	0.067	-	no	0.081	16 to 52
Carbon, Inorganic	mg/L	2	1	1.5	0.71	no	2	0	1.5	0.2	no	1	0	2.3	-	no	0.08	-
Carbon, Organic	mg/L	2	0	3.9	0.07	no	2	0	3.6	0.02	no	1	0	4.0	-	no	5.6	-
Carbon, Organic dissolved	mg/L	2	0	3.9	0.07	no	2	0	3.7	0	no	1	0	3.9	-	no	5.5	-
Carbon, Total	mg/L	2	0	5.2	1.18	no	2	0	5.0	0	no	1	0	6.3	-	no	7.8	-
Nitrate (as N)	mg/L	2	0	0.02	0	no	2	2	0.01	0	no	1	1	0.01	-	no	0.10	3
Nitrogen, Total	mg/L	2	0	0.23	0.04	no	2	0	0.21	0.002	no	1	0	0.28	-	no	0.42	-
Nitrogen, Total Kjeldahl	mg/L	2	0	0.22	0.04	no	2	0	0.20	0.002	no	1	0	0.27	-	no	0.40	-
Phosphorus	mg/L	2	1	0.01	0	no	2	2	0.01	0	no	1	1	0.01	-	no	0.01	-
General Chemistry and Major Ions																		
Alkalinity	mg/L	2	0	5.7	1.89	no	2	0	6.8	0.24	no	1	0	10.3	-	no	14.1	-
Bicarbonate	mg/L	2	0	6.7	1.9	no	2	0	8.2	0.2	no	1	0	12.7	-	no	17	-
Calcium	mg/L	2	0	1.3	0.024	no	2	0	1.8	0.024	no	1	0	2.1	-	no	2.3	-
Chloride	mg/L	2	0	0.1	0	no	2	0	0.1	0	no	1	0	0.2	-	no	0.6	120
Dissolved Oxygen (Field)	mg/L	2	0	9.8	2.1	no	1	0	10.8	-	no	-	-	-	-	-	13.1	6.5
Hardness	mg/L	2	0	5.2	0.24	no	2	0	7.2	0.24	no	1	0	8.7	-	no	8.9	-
Magnesium	mg/L	2	0	0.5	0	no	2	0	0.6	0.05	no	1	0	0.8	-	no	0.81	-
pH (Lab)	pH Units	2	0	6.8	0.01	no	2	0	6.9	0.02	no	1	0	6.5	-	no	7.0	6.5 to 9.0
Potassium	mg/L	2	0	0.35	0.071	no	2	0	0.43	0	no	1	0	0.63	-	no	0.71	-
Sodium	mg/L	2	0	1.0	0.05	no	2	0	1.2	0.05	no	1	0	1.5	-	no	1.7	-
Specific Conductance (Field)	µS/cm	2	0	17	1.07	no	2	0	22	1.4	no	1	0	27	-	no	34	-
Specific Conductance (Lab)	µS/cm	2	0	16	4.24	no	2	0	18	0.24	no	1	0	21	-	no	26	-
Sulphate	mg/L	2	0	0.57	0.047	no	2	0	0.68	0.024	no	1	0	0.67	-	no	0.94	128
Sum of ions	mg/L	2	0	11	2.1	no	2	0	13	0.24	no	1	0	19	-	no	24	-
Solids, Total dissolved	mg/L	2	0	24	0.5	no	2	0	24	7.8	no	1	0	29	-	no	39	-
Metals and Trace Elements																		
Aluminum	mg/L	2	0	0.011	0.0013	no	2	0	0.006	0.002	no	1	0	0.003	-	no	0.018	0.091 to 0.149
Arsenic	µg/L	2	0	0.1	0	no	2	0	0.2	0	no	1	0	0.3	-	exc	0.29	5.0
Barium	mg/L	2	0	0.003	0.0001	no	2	0	0.003	0.0001	no	1	0	0.003	-	no	0.007	-
Boron	mg/L	2	2	0.01	0	no	2	2	0.01	0	no	1	1	0.01	-	no	0.01	1.5
Cadmium	mg/L	2	2	0.00001	0	no	2	2	0.00001	0	no	1	1	0.00001	-	no	0.00001	0.00004
Chromium	mg/L	2	2	0.0005	0	no	2	2	0.0005	0	no	1	1	0.0005	-	no	0.0005	0.0089
Cobalt	mg/L	2	2	0.0001	0	no	2	2	0.0001	0	no	1	1	0.0001	-	no	0.0001	0.00078
Fluoride	mg/L	2	0	0.048	0.007	no	2	0	0.052	0.002	no	1	0	0.060	-	no	0.06	0.12
Mercury	µg/L	2	1	0.001	0	no	2	1	0.001	0	no	1	1	0.001	-	no	0.0014	0.005
Molybdenum	mg/L	2	2	0.0001	0	no	2	1	0.0001	0	no	1	0	0.0004	-	exc	0.0002	31
Nickel	mg/L	2	2	0.0001	0	no	2	1	0.0001	0	no	1	1	0.0003	-	exc	0.000	0.0055 to 0.0092
Selenium	mg/L	2	2	0.0001	0	no	2	2	0.0001	0	no	1	1	0.0001	-	no	0.0001	0.002
Silver	mg/L	2	2	0.00005	0	no	2	2	0.00005	0	no	1	1	0.00005	-	no	0.00005	0.0001
Strontium	mg/L	2	0	0.0089	0	no	2	0	0.0101	0	no	1	0	0.0117	-	no	0.0166	2.5
Thallium	mg/L	2	2	0.0002	0	no	2	2	0.0002	0	no	1	1	0.0002	-	no	0.0002	0.0008
Titanium	mg/L	2	2	0.0002	0	no	2	1	0.0003	0.0001	no	1	1	0.0002	-	no	0.00049	-
Uranium	µg/L	2	0	0.1	0	no	2	2	0.1	0	no	1	0	0.2	-	exc	0.1	15
Radionuclides																		
Lead-210	Bq/L	2	2	0.02	0	no	2	2	0.02	0	no	1	1	0.02	-	no	0.033	-
Polonium-210	Bq/L	2	2	0.005	0	no	2	2	0.005	0	no	1	1	0.005	-	no	0.007	-
Radium-226	Bq/L	2	2	0.005	0.0005	no	2	1	0.005	0	no	1	1	0.005	-	no	0.007	0.11

TABLE 4.3-15

Summary of Water Chemistry Data from Secondary Exposure and Reference Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Parameter	Units	Sue Lake (WQ16E)															Reference Range Upper Limit	Guidelines[1]
		2022					2023					2024						
		n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference		
Nutrients																		
Ammonia (as N)	mg/L	2	0	0.05	0.04	no	2	0	0.07	0.06	no	1	0	0.18	-	exc	0.081	99 to 164
Carbon, Inorganic	mg/L	2	2	1.0	0	no	2	2	1.0	0	no	1	1	1.0	-	no	0.08	-
Carbon, Organic	mg/L	2	0	6.9	0.92	exc	2	0	7.7	0.42	exc	1	0	11	-	exc	5.6	-
Carbon, Organic dissolved	mg/L	2	0	6.8	1.1	exc	2	0	7.6	0.6	exc	1	0	11	-	exc	5.5	-
Carbon, Total	mg/L	2	0	7.0	1.4	no	2	0	7.5	0.7	no	1	0	11	-	exc	7.8	-
Nitrate (as N)	mg/L	2	2	0.01	0	no	2	2	0.01	0	no	1	1	0.01	-	no	0.10	3
Nitrogen, Total	mg/L	2	0	0.33	0.11	no	2	0	0.40	0.13	no	1	0	0.75	-	exc	0.42	-
Nitrogen, Total Kjeldahl	mg/L	2	0	0.33	0.11	no	2	0	0.40	0.13	no	1	0	0.75	-	exc	0.40	-
Phosphorus	mg/L	2	1	0.01	0	no	2	2	0.01	0	no	1	1	0.01	-	no	0.01	-
General Chemistry and Major Ions																		
Alkalinity	mg/L	2	1	2.0	1.4	no	2	0	2.0	1.4	no	1	0	2	-	no	14.1	-
Bicarbonate	mg/L	2	1	2.5	2.1	no	2	0	2.5	2.1	no	1	0	2	-	no	17	-
Calcium	mg/L	2	0	0.35	0.21	no	2	0	0.40	0.14	no	1	0	0.2	-	no	2.3	-
Chloride	mg/L	2	1	0.1	0	no	2	1	0.1	0	no	1	0	0.3	-	no	0.6	120
Dissolved Oxygen (Field)	mg/L	2	0	10.5	3.1	no	1	0	8.1	-	no	-	-	-	-	-	13.1	6.5
Hardness	mg/L	2	1	1.5	0.7	no	2	0	2.0	0.0	no	1	0	2	-	no	8.9	-
Magnesium	mg/L	2	0	0.15	0.07	no	2	0	0.20	0.00	no	1	0	0.3	-	no	0.81	-
pH (Lab)	pH Units	2	0	**5.9**	0.15	no	2	0	**5.9**	0.25	no	1	0	**5.5**	-	no	7.0	6.5 to 9.0
Potassium	mg/L	2	0	0.35	0.07	no	2	0	0.40	0.14	no	1	0	0.6	-	no	0.71	-
Sodium	mg/L	2	0	0.5	0.1	no	2	0	0.6	0.1	no	1	0	0.7	-	no	1.7	-
Specific Conductance (Field)	µS/cm	2	0	7	3	no	1	0	10	-	no	1	0	120	-	exc	34	-
Specific Conductance (Lab)	µS/cm	2	0	7	6	no	2	0	7	3	no	1	0	7	-	no	26	-
Sulphate	mg/L	2	0	1	0	no	2	0	1	0	no	1	0	1	-	exc	0.94	128
Sum of ions	mg/L	2	0	5	4	no	2	0	5	3	no	1	0	5	-	no	24	-
Solids, Total dissolved	mg/L	2	0	25	1	no	2	0	13	2	no	1	0	27	-	no	39	-
Metals and Trace Elements																		
Aluminum	mg/L	2	0	**0.16**	0.007	exc	2	0	**0.14**	0.042	exc	1	0	**0.18**	-	exc	0.018	0.047 to 0.049
Arsenic	µg/L	2	0	0.5	0	exc	2	0	0.6	0	exc	1	0	0.8	-	exc	0.29	5.0
Barium	mg/L	2	0	0.005	0.002	no	2	0	0.005	0.002	no	1	0	0.002	-	no	0.007	-
Boron	mg/L	2	2	0.01	0	no	2	2	0.01	0	no	1	1	0.01	-	no	0.01	1.5
Cadmium	mg/L	2	0	0.00001	0	no	2	0	0.00001	0	no	1	0	0.00001	-	no	0.00001	0.00004
Chromium	mg/L	2	2	0.0005	0	no	2	2	0.0005	0	no	1	1	0.0005	-	no	0.0005	0.0089
Cobalt	mg/L	2	2	0.0001	0	no	2	2	0.0001	0	no	1	0	0.0002	-	exc	0.0001	0.00078
Fluoride	mg/L	2	0	0.02	0	no	2	0	0.02	0	no	1	0	0.02	-	no	0.06	0.12
Mercury	µg/L	2	1	0.0015	0.0007	exc	2	0	0.0015	0.0007	exc	1	0	0.001	-	no	0.0014	0.005
Molybdenum	mg/L	2	2	0.0001	0	no	2	0	0.0003	0	exc	1	0	0.0001	-	no	0.000	31
Nickel	mg/L	2	0	0.0004	0.0001	exc	2	0	0.0003	0	exc	1	0	0.0004	-	exc	0.000	0.0021 to 0.0016
Selenium	mg/L	2	2	0.0001	0	no	2	2	0.0001	0	no	1	1	0.0001	-	no	0.0001	0.002
Silver	mg/L	2	2	0.00005	0	no	2	2	0.00005	0	no	1	1	0.00005	-	no	0.00005	0.0001
Strontium	mg/L	2	0	0.0049	0	no	2	0	0.0048	0	no	1	0	0.0022	-	no	0.0166	2.5
Thallium	mg/L	2	2	0.0002	0	no	2	2	0.0002	0	no	1	1	0.0002	-	no	0.0002	0.0008
Titanium	mg/L	2	0	0.0007	0	exc	2	0	0.0008	0.0004	exc	1	0	0.0006	-	exc	0.00049	-
Uranium	µg/L	2	0	0.2	0	exc	2	0	0.2	0	exc	1	0	0.2	-	exc	0.1	15
Radionuclides																		
Lead-210	Bq/L	2	2	0.02	0	no	2	2	0.02	0	no	1	1	0.02	-	no	0.033	-
Polonium-210	Bq/L	2	0	0.01	0	exc	2	1	0.008	0.004	exc	1	0	0.01	-	exc	0.007	-
Radium-226	Bq/L	2	2	0.005	0	no	2	2	0.005	0	no	1	0	0.006	-	no	0.007	0.11

TABLE 4.3-15

Summary of Water Chemistry Data from Secondary Exposure and Reference Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Parameter	Units	Sils Lake (WQ17E)															Reference Range Upper Limit	Guidelines[1]
		2022					2023					2024						
		n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference		
Nutrients																		
Ammonia (as N)	mg/L	2	0	0.05	0.06	no	2	0	0.09	0.11	exc	1	0	0.38	-	exc	0.081	77 to 109
Carbon, Inorganic	mg/L	2	2	1.0	0	no	2	1	1.0	0	no	1	1	1.0	-	no	0.08	-
Carbon, Organic	mg/L	2	0	4.6	1.1	no	2	0	5.4	1.5	no	1	0	7.9	-	exc	5.6	-
Carbon, Organic dissolved	mg/L	2	0	4.5	0.7	no	2	0	5.3	1.1	no	1	0	7.5	-	exc	5.5	-
Carbon, Total	mg/L	2	0	4.5	0.7	no	2	0	5.5	2.1	no	1	0	8.0	-	exc	7.8	-
Nitrate (as N)	mg/L	2	2	0.01	0	no	2	2	0.01	0	no	1	0	0.04	-	no	0.10	3
Nitrogen, Total	mg/L	2	0	0.34	0.22	no	2	0	0.48	0.08	exc	1	0	0.96	-	exc	0.42	-
Nitrogen, Total Kjeldahl	mg/L	2	0	0.34	0.22	no	2	0	0.48	0.08	exc	1	0	0.92	-	exc	0.40	-
Phosphorus	mg/L	2	2	0.01	0	no	2	2	0.01	0	no	1	1	0.01	-	no	0.01	-
General Chemistry and Major Ions																		
Alkalinity	mg/L	2	0	2.5	2.1	no	2	1	3.0	2.8	no	1	0	4.0	-	no	14.1	-
Bicarbonate	mg/L	2	0	3.0	2.8	no	2	1	3.5	3.5	no	1	0	5.0	-	no	17	-
Calcium	mg/L	2	0	0.30	0.14	no	2	0	0.40	0.14	no	1	0	0.80	-	no	2.3	-
Chloride	mg/L	2	0	0.2	0.07	no	2	1	0.1	0	no	1	0	0.3	-	no	0.6	120
Dissolved Oxygen (Field)	mg/L	2	0	8.8	0.4	no	1	0	8.4	-	no	-	-	-	-	-	13.1	6.5
Hardness	mg/L	2	1	1.5	0.71	no	2	1	1.5	0.71	no	1	0	3.0	-	no	8.9	-
Magnesium	mg/L	2	1	0.15	0.07	no	2	1	0.15	0.07	no	1	0	0.3	-	no	0.81	-
pH (Lab)	pH Units	2	0	**5.9**	0.02	no	2	0	**6.1**	0.18	no	1	0	**5.9**	-	no	7.0	6.5 to 9.0
Potassium	mg/L	2	0	0.35	0.07	no	2	0	0.35	0.21	no	1	0	0.70	-	no	0.71	-
Sodium	mg/L	2	0	0.4	0.1	no	2	0	0.5	0.2	no	1	0	0.8	-	no	1.7	-
Specific Conductance (Field)	µS/cm	2	0	6.0	2.7	no	2	0	8.4	1.6	no	1	0	23.6	-	no	34	-
Specific Conductance (Lab)	µS/cm	2	0	4.0	4.2	no	2	0	5.0	5.7	no	1	0	13.0	-	no	26	-
Sulphate	mg/L	2	0	0.7	0.1	no	2	0	0.9	0.2	no	1	0	1.5	-	exc	0.94	128
Sum of ions	mg/L	2	0	5.0	2.8	no	2	0	5.5	4.9	no	1	0	10.0	-	no	24	-
Solids, Total dissolved	mg/L	2	0	19	2.8	no	2	0	24	0.7	no	1	0	28	-	no	39	-
Metals and Trace Elements																		
Aluminum	mg/L	2	0	**0.055**	0.004	exc	2	0	**0.055**	0.008	exc	1	0	**0.067**	-	exc	0.018	0.048 to 0.054
Arsenic	µg/L	2	0	0.4	0	exc	2	0	0.5	0.1	exc	1	0	0.9	-	exc	0.29	5.0
Barium	mg/L	2	0	0.003	0.001	no	2	0	0.003	0.0001	no	1	0	0.006	-	no	0.007	-
Boron	mg/L	2	2	0.01	0	no	2	2	0.01	0	no	1	1	0.01	-	no	0.01	1.5
Cadmium	mg/L	2	0	0.00001	0	no	2	0	0.00001	0	no	1	0	0.00003	-	exc	0.00001	0.00004
Chromium	mg/L	2	2	0.0005	0	no	1	1	0.0005	-	no	1	1	0.0005	-	no	0.0005	0.0089
Cobalt	mg/L	2	2	0.0001	0	no	2	0	0.0003	0	exc	1	0	0.0004	-	exc	0.0001	0.00078
Fluoride	mg/L	2	0	0.02	0	no	2	0	0.02	0	no	1	0	0.03	-	no	0.06	0.12
Mercury	µg/L	2	1	0.0015	0.0007	exc	2	0	0.001	0	no	1	0	0.001	-	no	0.0014	0.005
Molybdenum	mg/L	2	2	0.0001	0	no	2	0	0.0008	0	exc	1	1	0.0001	-	no	0.000	31
Nickel	mg/L	2	0	0.0002	0.0001	no	2	0	**0.0048**	0.0063	exc	1	0	0.0003	-	exc	0.000	0.0016 to 0.0032
Selenium	mg/L	2	2	0.0001	0	no	2	2	0.0001	0	no	1	1	0.0001	-	no	0.0001	0.002
Silver	mg/L	2	2	0.00005	0	no	2	2	0.00005	0	no	1	1	0.00005	-	no	0.00005	0.0001
Strontium	mg/L	2	0	0.0039	0	no	2	0	0.0036	0	no	1	0	0.0085	-	no	0.0166	2.5
Thallium	mg/L	2	2	0.0002	0	no	2	2	0.0002	0	no	1	1	0.0002	-	no	0.0002	0.0008
Titanium	mg/L	2	1	0.0002	0	no	2	0	0.0003	0.0001	no	1	0	0.0003	-	no	0.00049	-
Uranium	µg/L	2	2	0.1	0	no	2	2	0.1	0	no	1	1	0.1	-	no	0.1	15
Radionuclides																		
Lead-210	Bq/L	2	2	0.02	0	no	2	2	0.02	0	no	1	1	0.02	-	no	0.033	-
Polonium-210	Bq/L	2	2	0.005	0	no	2	0	0.006	0.001	no	1	0	0.008	-	exc	0.007	-
Radium-226	Bq/L	2	1	0.007	0	no	2	2	0.005	0	no	1	0	0.007	-	no	0.007	0.11

TABLE 4.3-15

Summary of Water Chemistry Data from Secondary Exposure and Reference Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Parameter	Units	Candy Lake (WQ18E)															Reference Range Upper Limit	Guidelines[1]
		2022					2023					2024						
		n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference		
Nutrients																		
Ammonia (as N)	mg/L	2	0	0.07	0.06	no	2	0	0.05	0.04	no	2	1	0.10	0.12	exc	0.081	15 to 70
Carbon, Inorganic	mg/L	2	1	1.0	0	no	2	0	2.5	0.7	no	2	1	1.5	0.7	no	0.08	-
Carbon, Organic	mg/L	2	0	6.5	0.64	exc	2	0	6.9	1.4	exc	2	0	4.1	1.9	no	5.6	-
Carbon, Organic dissolved	mg/L	2	0	6.3	0.42	exc	2	0	6.8	1.4	exc	2	0	3.8	2.3	no	5.5	-
Carbon, Total	mg/L	2	0	7.0	0.00	no	2	0	9.5	2.1	exc	2	0	5.0	2.8	no	7.8	-
Nitrate (as N)	mg/L	2	1	0.16	0.21	exc	2	1	0.02	0.01	no	2	1	0.13	0.16	exc	0.10	3
Nitrogen, Total	mg/L	2	0	0.61	0.34	exc	2	0	0.43	0.07	exc	2	0	0.44	0.12	exc	0.42	-
Nitrogen, Total Kjeldahl	mg/L	2	0	0.46	0.12	exc	2	0	0.42	0.05	exc	2	0	0.32	0.05	no	0.40	-
Phosphorus	mg/L	2	2	0.01	0	no	2	2	0.01	0	no	2	2	0.01	0	no	0.01	-
General Chemistry and Major Ions																		
Alkalinity	mg/L	2	0	4.5	0.71	no	2	0	11	4.2	no	2	0	5.0	4.2	no	14.1	-
Bicarbonate	mg/L	2	0	5.5	0.71	no	2	0	14	4.9	no	2	0	6.0	5.7	no	17	-
Calcium	mg/L	2	0	2.3	0.21	no	2	0	3.1	0.64	exc	2	0	1.7	0.92	no	2.3	-
Chloride	mg/L	2	0	2.2	0.85	exc	2	0	3.1	0.64	exc	2	0	1.7	1.13	exc	0.6	120
Dissolved Oxygen (Field)	mg/L	1	0	8.4	-	no	2	0	11	1.3	no	2	0	12.4	1.9	no	13.1	6.5
Hardness	mg/L	2	0	9.0	1.4	exc	2	0	12	2.8	exc	2	0	6.5	3.5	no	8.9	-
Magnesium	mg/L	2	0	0.80	0.14	no	2	0	1.0	0.28	exc	2	0	0.55	0.35	no	0.81	-
pH (Lab)	pH Units	2	0	6.7	0.12	no	2	0	6.8	0.30	no	2	0	**6.4**	0.22	no	7.0	6.5 to 9.0
Potassium	mg/L	2	0	0.65	0.07	no	2	0	0.70	0.28	no	2	0	0.35	0.21	no	0.71	-
Sodium	mg/L	2	0	1.1	0.21	no	2	0	1.3	0.35	no	2	0	0.7	0.42	no	1.7	-
Specific Conductance (Field)	µS/cm	2	0	55	45	exc	2	0	30	7.7	no	2	0	32	14	no	34	-
Specific Conductance (Lab)	µS/cm	2	0	26	6.4	no	2	0	31	9.2	exc	2	0	18	12	no	26	-
Sulphate	mg/L	2	0	0.5	0.3	no	2	0	0.4	0	no	2	1	0.4	0.3	no	0.94	128
Sum of ions	mg/L	2	0	14	2.1	no	2	0	23	7.1	no	2	0	12	7.1	no	24	-
Solids, Total dissolved	mg/L	2	0	31	9.2	no	2	0	35	4.9	no	2	0	26	15.6	no	39	-
Metals and Trace Elements																		
Aluminum	mg/L	2	0	0.014	0.004	no	2	0	0.005	0.001	no	2	0	0.005	0.001	no	0.018	0.078 to 0.150
Arsenic	µg/L	2	0	0.4	0	exc	2	0	0.4	0	exc	2	0	0.3	0	exc	0.29	5.0
Barium	mg/L	2	0	0.010	0.003	exc	2	0	0.008	0.003	exc	2	0	0.006	0.001	no	0.007	-
Boron	mg/L	2	2	0.01	0	no	2	2	0.01	0	no	2	2	0.01	0	no	0.01	1.5
Cadmium	mg/L	2	2	0.00001	0	no	2	2	0.00001	0	no	2	1	0.00001	0	no	0.00001	0.00004
Chromium	mg/L	2	2	0.0005	0	no	2	2	0.0005	0	no	2	2	0.0005	0	no	0.0005	0.0089
Cobalt	mg/L	2	1	0.0001	0	no	2	2	0.0001	0	no	2	2	0.0001	0	no	0.0001	0.00078
Fluoride	mg/L	2	0	0.03	0.02	no	2	0	0.05	0.01	no	2	0	0.03	0.01	no	0.06	0.12
Mercury	µg/L	2	1	0.0015	0.0007	exc	2	1	0.001	0	no	2	1	0.002	0.0014	exc	0.0014	0.005
Molybdenum	mg/L	2	2	0.0001	0	no	2	1	0.0002	0.0001	no	2	2	0.0001	0	no	0.000	31
Nickel	mg/L	2	0	0.0003	0.0001	exc	2	0	0.0003	0.0001	exc	2	0	0.0003	0.0002	exc	0.000	0.007 to 0.013
Selenium	mg/L	2	2	0.0001	0	no	2	2	0.0001	0	no	2	2	0.0001	0	no	0.0001	0.002
Silver	mg/L	2	2	0.00005	0	no	2	2	0.00005	0	no	2	2	0.00005	0	no	0.00005	0.0001
Strontium	mg/L	2	0	0.0245	0	exc	2	0	0.0285	0	exc	2	0	0.0195	0	exc	0.0166	2.5
Thallium	mg/L	2	2	0.0002	0	no	2	2	0.0002	0	no	2	2	0.0002	0	no	0.0002	0.0008
Titanium	mg/L	2	1	0.00025	0.00007	no	2	2	0.0002	0	no	2	2	0.0002	0	no	0.00049	-
Uranium	µg/L	2	1	0.1	0	no	2	2	0.1	0	no	2	1	0.2	0	exc	0.1	15
Radionuclides																		
Lead-210	Bq/L	2	2	0.02	0	no	2	2	0.02	0	no	2	1	0.09	0	exc	0.033	-
Polonium-210	Bq/L	2	1	0.007	0.002	no	2	2	0.006	0.001	no	2	1	0.028	0.032	exc	0.007	-
Radium-226	Bq/L	2	1	0.005	0	no	2	2	0.005	0	no	2	1	0.006	0.001	no	0.007	0.11

TABLE 4.3-15

Summary of Water Chemistry Data from Secondary Exposure and Reference Areas within the McClean Lake Operation LSA, January 2022 to December 2024.

Parameter	Units	Bena Lake (WQ19E)															Reference Range Upper Limit	Guidelines[1]
		2022					2023					2024						
		n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference	n	n<RDL	Mean	SD	Exceed Reference		
Nutrients																		
Ammonia (as N)	mg/L	2	0	0.12	0.01	exc	2	0	0.15	0.02	exc	2	0	0.30	0.12	exc	0.081	7 to 36
Carbon, Inorganic	mg/L	2	0	6.0	0	exc	2	0	7.0	2.8	exc	2	0	3.5	3.5	exc	0.08	-
Carbon, Organic	mg/L	2	0	6.6	1.13	exc	2	0	8.6	0.35	exc	2	0	5.3	3.0	no	5.6	-
Carbon, Organic dissolved	mg/L	2	0	6.5	0.85	exc	2	0	8.7	0.71	exc	2	0	5.4	2.8	no	5.5	-
Carbon, Total	mg/L	2	0	12.5	0.71	exc	2	0	15.5	3.54	exc	2	0	8.5	6.4	exc	7.8	-
Nitrate (as N)	mg/L	2	0	**4.0**	1.9	exc	2	0	2.4	1.7	exc	2	0	1.0	0.3	exc	0.10	3
Nitrogen, Total	mg/L	2	0	4.6	1.9	exc	2	0	3.1	1.8	exc	2	0	1.7	0.8	exc	0.42	-
Nitrogen, Total Kjeldahl	mg/L	2	0	0.6	0.04	exc	2	0	0.7	0.17	exc	2	0	0.6	0.4	exc	0.40	-
Phosphorus	mg/L	2	2	0.01	0	no	1	1	0.01	-	no	2	2	0.01	0	no	0.01	-
General Chemistry and Major Ions																		
Alkalinity	mg/L	2	0	24	0.71	exc	2	0	28	11.3	exc	2	0	15	12	exc	14.1	-
Bicarbonate	mg/L	2	0	29	0.71	exc	2	0	34	14.1	exc	2	0	18	15	exc	17	-
Calcium	mg/L	2	0	7.4	2.5	exc	2	0	9.1	4.2	exc	2	0	4.3	2.6	exc	2.3	-
Chloride	mg/L	2	0	1.2	0.64	exc	2	0	1.1	0.42	exc	2	0	0.75	0.49	exc	0.6	120
Dissolved Oxygen (Field)	mg/L	1	0	9.4	-	no	-	-	-	-	-	2	0	13.1	0.6	exc	13.1	6.5
Hardness	mg/L	2	0	27	9.2	exc	2	0	33	15	exc	2	0	16	9.2	exc	8.9	-
Magnesium	mg/L	2	0	2.1	0.64	exc	2	0	2.4	0.99	exc	2	0	1.3	0.64	exc	0.81	-
pH (Lab)	pH Units	2	0	7.2	0.01	exc	2	0	7.0	0.12	exc	2	0	6.7	0.35	no	7.0	6.5 to 9.0
Potassium	mg/L	2	0	1.4	0.42	exc	2	0	1.5	0.71	exc	2	0	0.8	0.35	exc	0.71	-
Sodium	mg/L	2	0	1.6	0.57	no	2	0	1.9	0.71	exc	2	0	1.0	0.57	no	1.7	-
Specific Conductance (Field)	µS/cm	2	0	42	17	exc	2	0	81	34	exc	2	0	45	24	exc	34	-
Specific Conductance (Lab)	µS/cm	2	0	71	21	exc	2	0	75	33	exc	2	0	42	24	exc	26	-
Sulphate	mg/L	2	0	0.4	0.2	no	2	0	0.5	0.3	no	2	1	0.5	0.4	no	0.94	128
Sum of ions	mg/L	2	0	60	13	exc	2	0	62	29	exc	2	0	31	21	exc	24	-
Solids, Total dissolved	mg/L	2	0	59	13	exc	2	0	63	25	exc	2	0	39	23	no	39	-
Metals and Trace Elements																		
Aluminum	mg/L	2	0	0.044	0.013	exc	2	0	0.043	0.025	exc	2	0	0.02	0.01	exc	0.018	0.147 to 0.278
Arsenic	µg/L	2	0	0.4	0	exc	2	0	0.4	0.07	exc	2	0	0.3	0.1	exc	0.29	5.0
Barium	mg/L	2	0	0.036	0.016	exc	2	0	0.039	0.016	exc	2	0	0.021	0.011	exc	0.007	-
Boron	mg/L	2	1	0.01	0	no	2	2	0.01	0	no	2	2	0.01	0	no	0.01	1.5
Cadmium	mg/L	2	0	0.00001	0	no	2	2	0.00001	0	no	2	0	0.00001	0	no	0.00001	0.00005
Chromium	mg/L	2	2	0.0005	0	no	2	2	0.0005	0	no	2	2	0.0005	0	no	0.0005	0.0089
Cobalt	mg/L	2	0	0.0002	0.0001	exc	2	0	0.0002	0.0001	exc	2	1	0.0001	0	no	0.0001	0.00078
Fluoride	mg/L	2	0	0.09	0.02	exc	2	0	0.10	0.021	exc	2	0	0.05	0.04	no	0.06	0.12
Mercury	µg/L	2	1	0.0015	0.0007	exc	2	1	0.0015	0.0007	exc	2	1	0.0015	0.0007	exc	0.0014	0.005
Molybdenum	mg/L	2	2	0.0001	0	no	2	2	0.0001	0	no	2	2	0.0001	0	no	0.000	31
Nickel	mg/L	2	0	0.0007	0.0001	exc	2	0	0.0006	0.0001	exc	2	0	0.0005	0.0001	exc	0.000	0.016 to 0.034
Selenium	mg/L	2	2	0.0001	0	no	2	2	0.0001	0	no	2	2	0.0001	0	no	0.0001	0.002
Silver	mg/L	2	1	0.00006	0	exc	2	2	0.00005	0	no	2	2	0.00005	0	no	0.00005	0.0001
Strontium	mg/L	2	0	0.0805	0	exc	2	0	0.0910	0	exc	2	0	0.0480	0	exc	0.0166	2.5
Thallium	mg/L	2	2	0.0002	0	no	2	2	0.0002	0	no	2	2	0.0002	0	no	0.0002	0.0008
Titanium	mg/L	2	1	0.00025	0.00007	no	2	1	0.0002	0	no	2	0	0.00025	0.00007	no	0.00049	-
Uranium	µg/L	2	1	0.1	0	no	2	2	0.1	0	no	2	1	0.1	0	no	0.1	15
Radionuclides																		
Lead-210	Bq/L	2	2	0.02	0	no	2	2	0.02	0	no	2	1	0.09	0.1	exc	0.033	-
Polonium-210	Bq/L	2	1	0.006	0.001	no	2	1	0.007	0.003	no	2	0	0.034	0.037	exc	0.007	-
Radium-226	Bq/L	2	0	0.010	0	exc	2	0	0.009	0	exc	2	1	0.006	0.001	no	0.007	0.11

Values below reportable detection limits (RDLs) were set to the detection limit for calculating summary statistics. Bolded values indicate higher than the preferentially selected guidelines (Table 4.3-9).

n = number of samples; RDL = reportable detection limit; SD = standard deviation; '-' indicates no associated value; exc = exceedance.

TABLE 4.3-16

Statistical Analysis and Benchmark Comparison Results for the JEB Secondary Exposure Areas at the McClean Operation, Time Period 1, 2000 to 2024.

COPC	Metric	Fox Lake WQ04E	Pat Lake WQ05E	Johannes Lake WQ08E
Nutrients				
Ammonia (as N)	%<RDL	23.5	26.5	26.5
	Trend	decrease	decrease	decrease
	GL Exeedance	no	no	no
	Ref Range Exceedance	no	no	no
Carbon, Inorganic	%<RDL	13.8	6.9	17.2
	Trend	0	0	0
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Carbon, Organic	%<RDL	0	0	0
	Trend	no change	increase	no change
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Carbon, Organic dissolved	%<RDL	0	0	0
	Trend	no change	increase	no change
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Carbon, Total	%<RDL	0	0	0
	Trend	0	0	0
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Nitrate (as N)	%<RDL	42.7	39.6	52.1
	Trend	NA	no change	NA
	GL Exeedance	no	no	no
	Ref Range Exceedance	no	no	no
Nitrogen, Total	%<RDL	0	0	0
	Trend	decrease	decrease	no change
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Nitrogen, Total Kjeldahl	%<RDL	0	0	0
	Trend	decrease	decrease	no change
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Phosphorus	%<RDL	86.7	87.8	87.8
	Trend	NA	NA	NA
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Water Chemistry and Major Ions				
Alkalinity	%<RDL	0	0	0
	Trend	no change	no change	decrease
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Bicarbonate	%<RDL	0	0	0
	Trend	no change	decrease	decrease
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Calcium	%<RDL	0	0	0
	Trend	increase	decrease	no change
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no

TABLE 4.3-16

Statistical Analysis and Benchmark Comparison Results for the JEB Secondary Exposure Areas at the McClean Operation, Time Period 1, 2000 to 2024.

COPC	Metric	Fox Lake WQ04E	Pat Lake WQ05E	Johannes Lake WQ08E
Chloride	%<RDL	38.8	22.4	26.5
	Trend	no change	no change	no change
	GL Exeedance	no	no	no
	Ref Range Exceedance	no	no	no
Dissolved Oxygen (Field)	%<RDL	0	0	0
	Trend	0.22	0.050	0.040
	GL Exeedance[1]	<6.5, <9.5	<9.5	<9.5
	Ref Range Exceedance	no	no	no
Hardness	%<RDL	0	0	0
	Trend	no change	decrease	no change
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Magnesium	%<RDL	0	0	0
	Trend	no change	no change	no change
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
pH (Lab)	%<RDL	0	0	0
	Trend	no change	no change	no change
	GL Exeedance	<6.5	<6.5	<6.5
	Ref Range Exceedance	no	no	no
Potassium	%<RDL	5.1	8.2	8.2
	Trend	no change	no change	no change
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Sodium	%<RDL	0	0	0
	Trend	no change	no change	no change
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Specific Conductance (Field)	%<RDL	0	0	0
	Trend	no change	no change	no change
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Specific Conductance (Lab)	%<RDL	0	0	0
	Trend	no change	decrease	decrease
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Sulphate	%<RDL	3.1	0	0
	Trend	no change	no change	no change
	GL Exeedance	no	no	no
	Ref Range Exceedance	no	no	no
Sum of ions	%<RDL	0	0	0
	Trend	no change	decrease	decrease
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Solids, Total dissolved	%<RDL	0	2	2
	Trend	no change	increase	no change
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Metals				
Aluminum	%<RDL	7.1	32.7	12.2
	Trend	increase	decrease	increase
	GL Exeedance	no	no	no
	Ref Range Exceedance	no	no	no
Arsenic	%<RDL	15.3	16.3	14.3
	Trend	no change	decrease[2]	decrease[2]
	GL Exeedance	no	no	no
	Ref Range Exceedance	no	no	no

TABLE 4.3-16

Statistical Analysis and Benchmark Comparison Results for the JEB Secondary Exposure Areas at the McClean Operation, Time Period 1, 2000 to 2024.

COPC	Metric	Fox Lake WQ04E	Pat Lake WQ05E	Johannes Lake WQ08E
Barium	%<RDL	1	0	2
	Trend	increase	no change	decrease
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	exc	no	no
Boron	%<RDL	99	98	100
	Trend	NA	NA	NA
	GL Exeedance	no	no	no
	Ref Range Exceedance	no	no	no
Cadmium	%<RDL	85.7	91.8	85.7
	Trend	NA	NA	NA
	GL Exeedance	*	*	*
	Ref Range Exceedance	no	no	no
Chromium	%<RDL	96.9	100	100
	Trend	NA	NA	NA
	GL Exeedance	no	no	no
	Ref Range Exceedance	no	no	no
Cobalt	%<RDL	96.9	100	100
	Trend	NA	NA	NA
	GL Exeedance	*	*	*
	Ref Range Exceedance	no	no	no
Fluoride	%<RDL	0	0	3.2
	Trend	no change	no change	increase
	GL Exeedance	no	no	exc
	Ref Range Exceedance	no	no	no
Mercury	%<RDL	78.6	87.8	79.6
	Trend	NA	NA	NA
	GL Exeedance	*	exc	*
	Ref Range Exceedance	no	no	no
Molybdenum	%<RDL	56.1	79.6	89.8
	Trend	NA	NA	NA
	GL Exeedance	no	no	no
	Ref Range Exceedance	exc	no	no
Nickel	%<RDL	69.4	95.9	71.4
	Trend	NA	NA	NA
	GL Exeedance	no	no	no
	Ref Range Exceedance	no	no	no
Selenium	%<RDL	90.8	89.8	95.9
	Trend	NA	NA	NA
	GL Exeedance	no	no	no
	Ref Range Exceedance	no	no	no
Silver	%<RDL	98.8	100	100
	Trend	NA	NA	NA
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Strontium	%<RDL	0	0	0
	Trend	no change	decrease	decrease
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Thallium	%<RDL	100	100	100
	Trend	NA	NA	NA
	GL Exeedance	no	no	no
	Ref Range Exceedance	no	no	no
Titanium	%<RDL	82.1	100	93.8
	Trend	NA	NA	NA
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Uranium	%<RDL	83.5	98	69.4
	Trend	NA	NA	NA
	GL Exeedance	no	no	no
	Ref Range Exceedance	no	no	exc

TABLE 4.3-16

Statistical Analysis and Benchmark Comparison Results for the JEB Secondary Exposure Areas at the McClean Operation, Time Period 1, 2000 to 2024.

COPC	Metric	Fox Lake WQ04E	Pat Lake WQ05E	Johannes Lake WQ08E
Radionuclides				
Lead-210	%<RDL	91.8	100	100
	Trend	NA	NA	NA
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Polonium-210	%<RDL	75.5	98	93.9
	Trend	NA	NA	NA
	GL Exeedance	NA	NA	NA
	Ref Range Exceedance	no	no	no
Radium-226	%<RDL	72.4	75.5	77.6
	Trend	NA	NA	NA
	GL Exeedance	no	no	no
	Ref Range Exceedance	no	no	no

Trend analysis was not performed on COPCs if more than 40% of values were less than the reported detection limit (RDL) during the Time Period.

Gray cells indicate exceedances over benchmarks; tan cells indicate significant increasing trend; blue cells indicate significant decreasing trend.

%<RDL: percentage of values less than the reported detection limit over the 2000-2024 period; Trend: Trend over the 2000-2024 period; GL exceedance: guideline exceedance over the 2000-2024 period an * is used if an exceedance is observed as a result of the RDL being higher than the guideline during some of the sampling events; Ref Range Exceedance: exceedance over the 2022-2024 period; no: does not exceed benchmark; exc: exceeds benchmark; NA: no benchmark available or no trend analysis performed.

[1]Dissolved oxygen has two guidelines: one is for early life stages (9.5 mg/L), the other is for other life stages (6.5 mg/L). Levels are only flagged in this table if they fall below the lower guideline.

[2]This trend is an artifact of decreased RDLs for arsenic in 2003.

TABLE 4.3-17

Statistical Analysis and Benchmark Comparison Results for the JEB Secondary Exposure Areas at the McClean Operation, Time Period 2, 1996 to 2024.

COPC	Metric	Fox Lake WQ04E	Pat Lake WQ05E	Johannes Lake WQ08E
Nutrients				
Ammonia (as N)	%<RDL	21.3	25.9	24.5
	Trend	decrease	decrease	decrease
	GL Exceedance	no	no	no
Carbon, Inorganic	%<RDL	13.8	6.9	17.2
	Trend	no change	no change	no change
	GL Exceedance	NA	NA	NA
Carbon, Organic	%<RDL	0	0	0
	Trend	decrease	increase	no change
	GL Exceedance	NA	NA	NA
Carbon, Organic dissolved	%<RDL	0	0	0
	Trend	decrease	increase	no change
	GL Exceedance	NA	NA	NA
Carbon, Total	%<RDL	0	0	0
	Trend	no change	no change	no change
	GL Exceedance	NA	NA	NA
Nitrate (as N)	%<RDL	40.2	39.3	51.8
	Trend	NA	0	NA
	GL Exceedance	no	no	no
Nitrogen, Total	%<RDL	0	0	0
	Trend	decrease	decrease	decrease
	GL Exceedance	NA	NA	NA
Nitrogen, Total Kjeldahl	%<RDL	0	0	0
	Trend	decrease	decrease	decrease
	GL Exceedance	NA	NA	NA
Phosphorus	%<RDL	81.5	80.7	80.7
	Trend	NA	NA	NA
	GL Exceedance	NA	NA	NA
Water Chemistry and Major Ions				
Alkalinity	%<RDL	0	0	0
	Trend	no change	no change	decrease
	GL Exceedance	NA	NA	NA
Bicarbonate	%<RDL	0	0	0
	Trend	no change	decrease	decrease
	GL Exceedance	NA	NA	NA
Calcium	%<RDL	0	0	0
	Trend	increase	decrease	no change
	GL Exceedance	NA	NA	NA
Chloride	%<RDL	38.6	19.3	24.6
	Trend	no change	no change	no change
	GL Exceedance	no	no	no
Dissolved Oxygen (Field)	%<RDL	0	0	0
	Trend	0.22	0.050	0.035
	GL Exceedance[1]	<6.5, <9.5	<9.5	<9.5
Hardness	%<RDL	0	0	0
	Trend	increase	no change	no change
	GL Exceedance	NA	NA	NA
Magnesium	%<RDL	0	0	0
	Trend	no change	no change	no change
	GL Exceedance	NA	NA	NA
pH (Lab)	%<RDL	0	0	0
	Trend	increase	no change	no change
	GL Exceedance	<6.5	<6.5	<6.5

TABLE 4.3-17

Statistical Analysis and Benchmark Comparison Results for the JEB Secondary Exposure Areas at the McClean Operation, Time Period 2, 1996 to 2024.

COPC	Metric	Fox Lake WQ04E	Pat Lake WQ05E	Johannes Lake WQ08E
Potassium	%<RDL	11.4	10.5	12.3
	Trend	no change	no change	no change
	GL Exceedance	NA	NA	NA
Sodium	%<RDL	0	0	0
	Trend	increase	no change	no change
	GL Exceedance	NA	NA	NA
Specific Conductance (Field)	%<RDL	0	0	0
	Trend	no change	no change	no change
	GL Exceedance	NA	NA	NA
Specific Conductance (Lab)	%<RDL	0	0	0
	Trend	no change	decrease	decrease
	GL Exceedance	NA	NA	NA
Sulphate	%<RDL	2.6	0	0
	Trend	no change	no change	increase
	GL Exceedance	no	no	no
Sum of ions	%<RDL	0	0	0
	Trend	no change	decrease	decrease
	GL Exceedance	NA	NA	NA
Solids, Total dissolved	%<RDL	0	1.8	1.8
	Trend	no change	increase	no change
	GL Exceedance	NA	NA	NA
Metals				
Aluminum	%<RDL	6.5	35.2	14.8
	Trend	increase	decrease	no change
	GL Exceedance	no	no	no
Arsenic	%<RDL	22	26.3	26.3
	Trend	decrease	decrease[2]	decrease[2]
	GL Exceedance	no	no	no
Barium	%<RDL	0.9	0	1.8
	Trend	increase	increase	no change
	GL Exceedance	NA	NA	NA
Boron	%<RDL	98.2	98.2	100
	Trend	NA	NA	NA
	GL Exceedance	no	no	no
Cadmium	%<RDL	87.2	93	87.7
	Trend	NA	NA	NA
	GL Exceedance	exc	exc	exc
Chromium	%<RDL	97.2	100	100
	Trend	NA	NA	NA
	GL Exceedance	no	no	no
Cobalt	%<RDL	97.2	100	100
	Trend	NA	NA	NA
	GL Exceedance	exc	exc	exc
Fluoride	%<RDL	0	0	3.2
	Trend	no change	no change	increase
	GL Exceedance	no	no	exc
Mercury	%<RDL	80.7	89.5	82.5
	Trend	NA	NA	NA
	GL Exceedance	exc	exc	exc
Molybdenum	%<RDL	59.6	82.5	91.2
	Trend	NA	NA	NA
	GL Exceedance	no	no	no

TABLE 4.3-17

Statistical Analysis and Benchmark Comparison Results for the JEB Secondary Exposure Areas at the McClean Operation, Time Period 2, 1996 to 2024.

COPC	Metric	Fox Lake WQ04E	Pat Lake WQ05E	Johannes Lake WQ08E
Nickel	%<RDL	72.5	96.5	75.4
	Trend	NA	NA	NA
	GL Exceedance	no	no	no
Selenium	%<RDL	91.7	91.2	96.5
	Trend	NA	NA	NA
	GL Exceedance	no	no	no
Silver	%<RDL	98.8	100	100
	Trend	NA	NA	NA
	GL Exceedance	NA	NA	NA
Strontium	%<RDL	0	0	0
	Trend	increase	decrease	decrease
	GL Exceedance	NA	NA	NA
Thallium	%<RDL	100	100	100
	Trend	NA	NA	NA
	GL Exceedance	no	no	no
Titanium	%<RDL	82.1	100	93.8
	Trend	NA	NA	NA
	GL Exceedance	NA	NA	NA
Uranium	%<RDL	85.8	98.2	73.7
	Trend	NA	NA	NA
	GL Exceedance	no	no	no
Radionuclides				
Lead-210	%<RDL	90.8	100	98.2
	Trend	NA	NA	NA
	GL Exceedance	NA	NA	NA
Polonium-210	%<RDL	73.4	96.5	94.7
	Trend	NA	NA	NA
	GL Exceedance	NA	NA	NA
Radium-226	%<RDL	72.8	78.9	78.9
	Trend	NA	NA	NA
	GL Exceedance	no	no	no

Trend analysis was not performed on COPCs if more than 40% of values were less than the reported detection limit (RDL) during the Time Period.

Gray cells indicate exceedances over benchmarks; tan cells indicate significant increasing trend; blue cells indicate significant decreasing trend.

%<RDL: percentage of values less than the reported detection limit over the 1996-2024 period; Trend: Trend over the 1996-2024 period; GL exceedance: guideline exceedance over the 1996-2024 period; no: does not exceed benchmark; exc: exceeds benchmark; NA: no benchmark available or no trend analysis performed.

[1]Dissolved oxygen has two guidelines: one is for early life stages (9.5 mg/L), the other is for other life stages (6.5 mg/L). Levels are only flagged in this table if they fall below the lower guideline.

[2]This trend is an artifact of decreased RDLs for arsenic in 2003.

TABLE 4.3-18

Statistical Analysis and Benchmark Comparison Results for the Sue Secondary Exposure Areas at the McClean Operation, Time Period 1, 2009 to 2024.

COPC	Metric	Sue Lake WQ16E	Sils Lake WQ17E	Candy Lake WQ18E	Bena Lake WQ19E
Nutrients					
Ammonia (as N)	%<RDL	25.8	22.6	34.4	12.5
	Trend	no change	no change	no change	increase
	GL Exceedance	no	no	no	no
	Ref Range Exceedance	exc	exc	no	exc
Carbon, Inorganic	%<RDL	100	93.1	20	10
	Trend	NA	NA	no change	increase
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	no	no	no	exc
Carbon, Organic	%<RDL	0	0	0	0
	Trend	no change	no change	decrease	decrease
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	exc	no	exc	exc
Carbon, Organic dissolved	%<RDL	0	0	0	0
	Trend	no change	no change	decrease	decrease
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	exc	no	exc	exc
Carbon, Total	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	exc	no	no	exc
Nitrate (as N)	%<RDL	66.7	53.3	51.6	12.9
	Trend	NA	NA	NA	increase
	GL Exceedance	no	no	no	exc
	Ref Range Exceedance	no	no	no	exc
Nitrogen, Total	%<RDL	0	0	0	0
	Trend	no change	no change	no change	increase
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	exc	exc	exc	exc
Nitrogen, Total Kjeldahl	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	exc	exc	no	exc
Phosphorus	%<RDL	74.2	80.6	90.6	93.5
	Trend	NA	NA	NA	NA
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	no	no	no	no
Water Chemistry and Major Ions					
Alkalinity	%<RDL	16.1	22.6	0	0
	Trend	no change	increase	increase	increase
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	no	no	no	exc
Bicarbonate	%<RDL	16.1	22.6	0	0
	Trend	no change	increase	increase	increase
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	no	no	no	exc

TABLE 4.3-18

Statistical Analysis and Benchmark Comparison Results for the Sue Secondary Exposure Areas at the McClean Operation, Time Period 1, 2009 to 2024.

COPC	Metric	Sue Lake WQ16E	Sils Lake WQ17E	Candy Lake WQ18E	Bena Lake WQ19E
Calcium	%<RDL	6.5	0	0	0
	Trend	decrease	decrease	increase	increase
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	no	no	exc	exc
Chloride	%<RDL	29	25.8	0	0
	Trend	no change	no change	increase	increase
	GL Exceedance	no	no	no	no
	Ref Range Exceedance	no	no	exc	exc
Dissolved Oxygen (Field)	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance	<6.5, <9.5	<6.5, <9.5	<6.5, <9.5	<6.5, <9.5
	Ref Range Exceedance[1]	no	no	no	no
Hardness	%<RDL	16.1	19.4	0	0
	Trend	no change	no change	increase	increase
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	no	no	exc	exc
Magnesium	%<RDL	12.9	19.4	0	0
	Trend	no change	no change	increase	increase
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	no	no	no	exc
pH (Lab)	%<RDL	0	0	0	0
	Trend	no change	no change	no change	increase
	GL Exceedance	<6.5	<6.5	<6.5	<6.5
	Ref Range Exceedance	no	no	no	no
Potassium	%<RDL	6.5	3.2	3.1	6.2
	Trend	no change	no change	increase	increase
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	no	no	no	exc
Sodium	%<RDL	0	0	0	0
	Trend	no change	no change	increase	increase
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	no	no	no	no
Specific Conductance (Field)	%<RDL	0	0	0	0
	Trend	no change	no change	increase	increase
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	exc	no	exc	exc
Specific Conductance (Lab)	%<RDL	16.1	16.1	0	0
	Trend	decrease	decrease	increase	increase
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	no	no	no	exc
Sulphate	%<RDL	3.2	0	6.2	3.1
	Trend	decrease	decrease	decrease	decrease
	GL Exceedance	no	no	no	no
	Ref Range Exceedance	no	no	no	no
Sum of ions	%<RDL	0	0	0	0
	Trend	no change	no change	increase	increase
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	no	no	no	exc

TABLE 4.3-18

Statistical Analysis and Benchmark Comparison Results for the Sue Secondary Exposure Areas at the McClean Operation, Time Period 1, 2009 to 2024.

COPC	Metric	Sue Lake WQ16E	Sils Lake WQ17E	Candy Lake WQ18E	Bena Lake WQ19E
Solids, Total dissolved	%<RDL	9.7	3.2	0	0
	Trend	no change	no change	increase	increase
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	no	no	no	exc
Metals					
Aluminum	%<RDL	0	0	0	0
	Trend	no change	no change	decrease	decrease
	GL Exceedance	exc	exc	no	exc
	Ref Range Exceedance	exc	exc	no	exc
Arsenic	%<RDL	0	0	0	0
	Trend	decrease	decrease	decrease	decrease
	GL Exceedance	no	no	no	no
	Ref Range Exceedance	exc	exc	exc	exc
Barium	%<RDL	0	0	0	0
	Trend	no change	decrease	increase	increase
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	no	no	exc	exc
Boron	%<RDL	100	100	100	96.9
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
	Ref Range Exceedance	no	no	no	no
Cadmium	%<RDL	16.1	19.4	68.8	28.1
	Trend	no change	decrease[2]	NA	no change
	GL Exceedance	exc	exc	exc	exc
	Ref Range Exceedance	no	exc	no	no
Chromium	%<RDL	96.8	96.7	93.8	100
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
	Ref Range Exceedance	no	no	no	no
Cobalt	%<RDL	51.6	58.1	87.5	25
	Trend	NA	NA	NA	no change
	GL Exceedance	no	no	no	no
	Ref Range Exceedance	exc	exc	no	exc
Fluoride	%<RDL	6.5	9.7	0	0
	Trend	no change	no change	no change	increase
	GL Exceedance	no	no	no	no
	Ref Range Exceedance	no	no	no	exc
Mercury	%<RDL	54.8	61.3	65.6	65.6
	Trend	NA	NA	NA	NA
	GL Exceedance	exc	exc	exc	exc
	Ref Range Exceedance	exc	no	exc	exc
Molybdenum	%<RDL	83.9	83.9	93.8	93.8
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
	Ref Range Exceedance	no	exc	no	no
Nickel	%<RDL	0	0	3.1	0
	Trend	decrease	decrease	no change	increase
	GL Exceedance	no	exc	no	no
	Ref Range Exceedance	exc	exc	exc	exc

TABLE 4.3-18

Statistical Analysis and Benchmark Comparison Results for the Sue Secondary Exposure Areas at the McClean Operation, Time Period 1, 2009 to 2024.

COPC	Metric	Sue Lake WQ16E	Sils Lake WQ17E	Candy Lake WQ18E	Bena Lake WQ19E
Selenium	%<RDL	90.3	93.5	93.8	90.6
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
	Ref Range Exceedance	no	no	no	no
Silver	%<RDL	96.8	100	100	93.8
	Trend	NA	NA	NA	NA
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	no	no	no	exc
Strontium	%<RDL	0	0	0	0
	Trend	no change	decrease	increase	increase
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	no	no	exc	exc
Thallium	%<RDL	100	100	100	100
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
	Ref Range Exceedance	no	no	no	no
Titanium	%<RDL	3.2	6.5	59.4	21.9
	Trend	no change	decrease	NA	decrease
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	exc	no	no	no
Uranium	%<RDL	0	67.7	68.8	71.9
	Trend	no change	NA	NA	NA
	GL Exceedance	no	no	no	no
	Ref Range Exceedance	exc	no	exc	no
Radionuclides					
Lead-210	%<RDL	96.8	96.8	96.9	96.9
	Trend	NA	NA	NA	NA
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	no	no	exc	exc
Polonium-210	%<RDL	12.9	38.7	50	34.4
	Trend	no change	no change	NA	no change
	GL Exceedance	NA	NA	NA	NA
	Ref Range Exceedance	exc	no	exc	exc
Radium-226	%<RDL	45.2	51.6	53.1	25
	Trend	NA	NA	NA	no change
	GL Exceedance	no	no	no	no
	Ref Range Exceedance	no	no	no	exc

Trend analysis was not performed on COPCs if more than 40% of values were less than the reported detection limit (RDL) during the Time Period.

Gray cells indicate exceedances over benchmarks; tan cells indicate significant increasing trend; blue cells indicate significant decreasing trend.

%<RDL: percentage of values less than the reported detection limit over the 2009-2024 period; Trend: Trend over the 2009-2024 period; GL exceedance: guideline exceedance over the 2009-2024 period; Ref Range Exceedance: exceedance over the 2022-2024 period; no: does not exceed benchmark; exc: exceeds benchmark; NA: no benchmark available or no trend analysis performed.

[1]Dissolved oxygen has two guidelines: one is for early life stages (9.5 mg/L), the other is for other life stages (6.5 mg/L). Levels are only flagged in this table if they fall below the lower guideline.

[2]This trend is an artifact of decreased RDLs for cadmium between 2009 and 2010.

TABLE 4.3-19

Statistical Analysis and Benchmark Comparison Results for the Sue Secondary Exposure Areas at the McClean Operation, Time Period 2, 1998 to 2024.

COPC	Metric	Sue Lake WQ16E	Sils Lake WQ17E	Candy Lake WQ18E	Bena Lake WQ19E
Nutrients					
Ammonia (as N)	%<RDL	18.9	17	27.8	11.1
	Trend	decrease	no change	no change	increase
	GL Exceedance	no	no	no	no
Carbon, Inorganic	%<RDL	100	93.1	20	10
	Trend	NA	NA	no change	increase
	GL Exceedance	NA	NA	NA	NA
Carbon, Organic	%<RDL	0	0	0	0
	Trend	no change	decrease	no change	no change
	GL Exceedance	NA	NA	NA	NA
Carbon, Organic dissolved	%<RDL	0	0	0	0
	Trend	no change	no change	decrease	decrease
	GL Exceedance	NA	NA	NA	NA
Carbon, Total	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA
Nitrate (as N)	%<RDL	69.2	53.8	64.2	35.8
	Trend	NA	NA	NA	increase
	GL Exceedance	no	no	no	exc
Nitrogen, Total	%<RDL	0	0	0	0
	Trend	no change	no change	no change	increase
	GL Exceedance	NA	NA	NA	NA
Nitrogen, Total Kjeldahl	%<RDL	0	0	0	0
	Trend	no change	no change	no change	increase
	GL Exceedance	NA	NA	NA	NA
Phosphorus	%<RDL	69.8	79.2	85.2	79.2
	Trend	NA	NA	NA	NA
	GL Exceedance	NA	NA	NA	NA
Water Chemistry and Major Ions					
Alkalinity	%<RDL	18.8	18.8	0	0
	Trend	no change	no change	no change	increase
	GL Exceedance	NA	NA	NA	NA
Bicarbonate	%<RDL	17	17	0	1.9
	Trend	decrease	decrease	no change	increase
	GL Exceedance	NA	NA	NA	NA
Calcium	%<RDL	3.8	0	0	0
	Trend	decrease	no change	increase	increase
	GL Exceedance	NA	NA	NA	NA
Chloride	%<RDL	28.3	24.5	0	5.6
	Trend	0[1]	no change	increase	increase
	GL Exceedance	no	no	no	no
Dissolved Oxygen (Field)	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance[1]	<6.5, <9.5	<6.5, <9.5	<6.5, <9.5	<6.5, <9.5
Hardness	%<RDL	11.3	13.2	0	0
	Trend	no change	no change	increase	increase
	GL Exceedance	NA	NA	NA	NA
Magnesium	%<RDL	11.3	17	0	0
	Trend	no change	no change	increase	increase
	GL Exceedance	NA	NA	NA	NA
pH (Lab)	%<RDL	0	0	0	0
	Trend	no change	no change	increase	increase
	GL Exceedance	<6.5	<6.5	<6.5	<6.5

TABLE 4.3-19

Statistical Analysis and Benchmark Comparison Results for the Sue Secondary Exposure Areas at the McClean Operation, Time Period 2, 1998 to 2024.

COPC	Metric	Sue Lake WQ16E	Sils Lake WQ17E	Candy Lake WQ18E	Bena Lake WQ19E
Potassium	%<RDL	18.9	11.3	9.3	14.8
	Trend	increase	increase	increase	increase
	GL Exceedance	NA	NA	NA	NA
Sodium	%<RDL	0	0	0	0
	Trend	no change	no change	no change	increase
	GL Exceedance	NA	NA	NA	NA
Specific Conductance (Field)	%<RDL	0	0	0	0
	Trend	no change	no change	increase	increase
	GL Exceedance	NA	NA	NA	NA
Specific Conductance (Lab)	%<RDL	9.4	9.4	0	0
	Trend	decrease	decrease	increase	increase
	GL Exceedance	NA	NA	NA	NA
Sulphate	%<RDL	1.9	0	3.7	1.9
	Trend	no change	no change	no change	decrease
	GL Exceedance	no	no	no	no
Sum of ions	%<RDL	0	0	0	0
	Trend	decrease	decrease	increase	increase
	GL Exceedance	NA	NA	NA	NA
Solids, Total dissolved	%<RDL	5.7	1.9	0	0
	Trend	no change	no change	increase	increase
	GL Exceedance	NA	NA	NA	NA
Metals					
Aluminum	%<RDL	0	0	0	0
	Trend	no change	increase	decrease	decrease
	GL Exceedance	exc	exc	no	exc
Arsenic	%<RDL	13.5	17.3	15.1	18.5
	Trend	no change	no change	no change	decrease[2]
	GL Exceedance	no	no	no	no
Barium	%<RDL	1.9	0	0	0
	Trend	no change	no change	increase	increase
	GL Exceedance	NA	NA	NA	NA
Boron	%<RDL	100	98.1	98.1	96.3
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
Cadmium	%<RDL	50.9	52.8	81.5	57.4
	Trend	NA	NA	NA	NA
	GL Exceedance	exc	exc	exc	exc
Chromium	%<RDL	98.1	96.2	96.3	98.1
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
Cobalt	%<RDL	69.8	75.5	90.7	55.6
	Trend	NA	NA	NA	NA
	GL Exceedance	exc	exc	exc	exc
Fluoride	%<RDL	6.5	9.7	0	0
	Trend	no change	no change	no change	increase
	GL Exceedance	no	no	no	no
Mercury	%<RDL	73.6	77.4	79.6	79.6
	Trend	NA	NA	NA	NA
	GL Exceedance	exc	exc	exc	exc
Molybdenum	%<RDL	84.9	84.9	96.3	96.2
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
Nickel	%<RDL	34	39.6	40.7	35.8
	Trend	decrease[2]	decrease[2]	NA	decrease[2]
	GL Exceedance	exc	exc	no	no
Selenium	%<RDL	84.9	83	87	90.7
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
Silver	%<RDL	97.9	100	100	95.8
	Trend	NA	NA	NA	NA
	GL Exceedance	NA	NA	NA	NA

TABLE 4.3-19

Statistical Analysis and Benchmark Comparison Results for the Sue Secondary Exposure Areas at the McClean Operation, Time Period 2, 1998 to 2024.

COPC	Metric	Sue Lake WQ16E	Sils Lake WQ17E	Candy Lake WQ18E	Bena Lake WQ19E
Strontium	%<RDL	0	0	0	0
	Trend	no change	no change	increase	increase
	GL Exceedance	NA	NA	NA	NA
Thallium	%<RDL	100	100	100	100
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
Titanium	%<RDL	34	36.2	72.9	43.8
	Trend	decrease[2]	decrease[2]	NA	NA
	GL Exceedance	NA	NA	NA	NA
Uranium	%<RDL	17.3	67.9	74.1	68.5
	Trend	decrease[2]	NA	NA	NA
	GL Exceedance	no	no	no	no
Radionuclides					
Lead-210	%<RDL	88.7	92.5	94.4	90.7
	Trend	NA	NA	NA	NA
	GL Exceedance	NA	NA	NA	NA
Polonium-210	%<RDL	11.3	34	59.3	35.2
	Trend	no change	decrease	NA	no change
	GL Exceedance	NA	NA	NA	NA
Radium-226	%<RDL	50.9	56.6	66.7	42.6
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no

Trend analysis was not performed on COPCs if more than 40% of values were less than the reported detection limit (RDL) during the Time Period.

Gray cells indicate exceedances over benchmarks; tan cells indicate significant increasing trend; blue cells indicate significant decreasing trend.

%<RDL: percentage of values less than the reported detection limit over the 1998-2024 period; Trend: Trend over the 1998-2024 period; GL exceedance: guideline exceedance over the 1998-2024 period; no: does not exceed benchmark; exc: exceeds benchmark; NA: no benchmark available or no trend analysis performed.

[1]Dissolved oxygen has two guidelines: one is for early life stages (9.5 mg/L), the other is for other life stages (6.5 mg/L). Levels are only flagged in this table if they fall below the lower guideline.

[2]This trend is an artifact of decreased RDLs for this parameter between 2009 and 2010.

TABLE 4.3-20

Statistical Analysis and Benchmark Comparison Results for the Reference Areas at the McClean Operation, Time Period 1, 2015 to 2024.

COPC	Metric	Mallen Lake WQ01C	Collins Creek Upstream WQ02C	McClean Lake West Basin WQ15C	Henday Lake WQ20C
Nutrients					
Ammonia (as N)	%<RDL	47.4	36.8	47.5	15.8
	Trend	NA	no change	NA	no change
	GL Exceedance	no	no	no	no
Carbon, Inorganic	%<RDL	2.6	15.8	12.5	5.3
	Trend	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA
Carbon, Organic	%<RDL	0	0	0	0
	Trend	increase	no change	no change	increase
	GL Exceedance	NA	NA	NA	NA
Carbon, Organic dissolved	%<RDL	0	0	0	0
	Trend	increase	no change	no change	increase
	GL Exceedance	NA	NA	NA	NA
Carbon, Total	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA
Nitrate (as N)	%<RDL	44.7	44.7	42.5	78.9
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
Nitrogen, Total	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA
Nitrogen, Total Kjeldahl	%<RDL	0	0	0	0
	Trend	no change	decrease	no change	no change
	GL Exceedance	NA	NA	NA	NA
Phosphorus	%<RDL	97.4	94.7	100	94.7
	Trend	NA	NA	NA	NA
	GL Exceedance	NA	NA	NA	NA
General Chemistry and Major Ions					
Alkalinity	%<RDL	0	0	0	0
	Trend	decrease	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA
Bicarbonate	%<RDL	0	0	0	0
	Trend	decrease	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA
Calcium	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA
Chloride	%<RDL	18.4	15.8	0	42.1
	Trend	no change	no change	increase	NA
	GL Exceedance	no	no	no	no
Dissolved Oxygen (Field)	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance[1]	<6.5, <9.5	<9.5	<9.5	<9.5
Hardness	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA
Magnesium	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA
pH (Lab)	%<RDL	0	0	0	0
	Trend	no change	decrease	no change	decrease
	GL Exceedance	<6.5	<6.5	<6.5	<6.5

TABLE 4.3-20

Statistical Analysis and Benchmark Comparison Results for the Reference Areas at the McClean Operation, Time Period 1, 2015 to 2024.

COPC	Metric	Mallen Lake WQ01C	Collins Creek Upstream WQ02C	McClean Lake West Basin WQ15C	Henday Lake WQ20C
Potassium	%<RDL	2.6	5.3	2.5	5.3
	Trend	increase	no change	increase	increase
	GL Exceedance	NA	NA	NA	NA
Sodium	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA
Specific Conductance (Field)	%<RDL	0	0	0	0
	Trend	no change	decrease	no change	no change
	GL Exceedance	NA	NA	NA	NA
Specific Conductance (Lab)	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA
Sulphate	%<RDL	0	0	2.5	0
	Trend	no change	decrease	no change	no change
	GL Exceedance	no	no	no	no
Sum of ions	%<RDL	0	0	0	0
	Trend	decrease	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA
Solids, Total dissolved	%<RDL	0	0	0	5.3
	Trend	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA
Metals and Trace Elements					
Aluminum	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance	no	no	no	no
Arsenic	%<RDL	21.1	2.6	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance	no	no	no	no
Barium	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance	NA	NA	NA	NA
Boron	%<RDL	100	100	100	100
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
Cadmium	%<RDL	97.4	76.3	87.5	52.6
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
Chromium	%<RDL	100	100	100	100
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
Cobalt	%<RDL	100	100	100	100
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
Fluoride	%<RDL	0	2.6	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance	no	no	no	exc
Mercury	%<RDL	81.6	63.2	65	73.7
	Trend	NA	NA	NA	NA
	GL Exceedance	exc	exc	exc	exc
Molybdenum	%<RDL	97.4	86.8	85	94.7
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
Nickel	%<RDL	92.1	84.2	60	73.7
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
Selenium	%<RDL	100	100	100	100
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
Silver	%<RDL	100	100	100	100
	Trend	NA	NA	NA	NA
	GL Exceedance	NA	NA	NA	NA
Strontium	%<RDL	0	0	0	0
	Trend	decrease	no change	no change	decrease
	GL Exceedance	NA	NA	NA	NA

TABLE 4.3-20

Statistical Analysis and Benchmark Comparison Results for the Reference Areas at the McClean Operation, Time Period 1, 2015 to 2024.

COPC	Metric	Mallen Lake WQ01C	Collins Creek Upstream WQ02C	McClean Lake West Basin WQ15C	Henday Lake WQ20C
Thallium	%<RDL	100	100	100	100
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
Titanium	%<RDL	100	2.6	17.5	89.5
	Trend	NA	no change	no change	NA
	GL Exceedance	NA	NA	NA	NA
Uranium	%<RDL	100	100	95	100
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no
Radionuclides					
Lead-210	%<RDL	100	97.4	97.5	100
	Trend	NA	NA	NA	NA
	GL Exceedance	NA	NA	NA	NA
Polonium-210	%<RDL	97.4	92.1	85	89.5
	Trend	NA	NA	NA	NA
	GL Exceedance	NA	NA	NA	NA
Radium-226	%<RDL	84.2	84.2	67.5	94.7
	Trend	NA	NA	NA	NA
	GL Exceedance	no	no	no	no

Trend analysis was not performed on COPCs if more than 40% of values were less than the reported detection limit (RDL) during the Time Period.

Gray cells indicate exceedances over benchmarks; tan cells indicate significant increasing trend; blue cells indicate significant decreasing trend.

%<RDL: percentage of values less than the reported detection limit over the 2015-2024 period; Trend: Trend over the 2015-2024 period; GL exceedance: guideline exceedance over the 2015-2024 period; no: does not exceed benchmark; exc: exceeds benchmark; NA: no benchmark available or no trend analysis performed.

[1]Dissolved oxygen has two guidelines: one is for early life stages (9.5 mg/L), the other is for other life stages (6.5 mg/L). Levels are only flagged in this table if they fall below the lower guideline.

TABLE 4.3-21

Statistical Analysis and Benchmark Comparison Results for the Reference Areas at the McClean Operation, Time Period 2, 1996 to 2024.

COPC	Metric	Mallen Lake WQ01C	Collins Creek Upstream WQ02C	McClean Lake West Basin WQ15C	Henday Lake WQ20C
Nutrients					
Ammonia (as N)	%<RDL	32.1	23.9	28.7	22
	Trend	decrease	decrease	decrease	no change
	GL Exceedance	no	no	no	no
Carbon, Inorganic	%<RDL	1.7	12.1	14.8	6.9
	Trend	decrease	no change	no change	no change
	GL Exceedance	-	-	-	-
Carbon, Organic	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance	-	-	-	-
Carbon, Organic dissolved	%<RDL	0	0	0	0
	Trend	increase	no change	no change	increase
	GL Exceedance	-	-	-	-
Carbon, Total	%<RDL	0	0	0	0
	Trend	decrease	decrease	no change	no change
	GL Exceedance	-	-	-	-
Nitrate (as N)	%<RDL	48.6	48.2	49.5	73.5
	Trend	-	-	-	-
	GL Exceedance	no	no	no	no
Nitrogen, Total	%<RDL	1.8	0	0	0
	Trend	decrease	decrease	no change	-0.00051
	GL Exceedance	-	-	-	-
Nitrogen, Total Kjeldahl	%<RDL	1.8	0	0	0
	Trend	decrease	decrease	no change	no change
	GL Exceedance	-	-	-	-
Phosphorus	%<RDL	87.6	84.1	84.3	96
	Trend	-	-	-	-
	GL Exceedance	-	-	-	-
General Chemistry and Major Ions					
Alkalinity	%<RDL	0	0	0	2.1
	Trend	no change	decrease	decrease	no change
	GL Exceedance	-	-	-	-
Bicarbonate	%<RDL	0	0	0	2
	Trend	no change	decrease	decrease	no change
	GL Exceedance	-	-	-	-
Calcium	%<RDL	0	0	0	0
	Trend	decrease	decrease	no change	decrease
	GL Exceedance	-	-	-	-
Chloride	%<RDL	18.4	19.3	1.7	30
	Trend	no change	no change	increase	no change
	GL Exceedance	no	no	no	no
Dissolved Oxygen (Field)	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance[4]	<6.5, <9.5	<9.5	<6.5, <9.5	<6.5, <9.5
Hardness	%<RDL	0	0	0	0
	Trend	decrease	no change	no change	no change
	GL Exceedance	-	-	-	-
Magnesium	%<RDL	0	0	0	0
	Trend	decrease	no change	no change	no change
	GL Exceedance	-	-	-	-
pH (Lab)	%<RDL	0	0	0	0
	Trend	no change	increase	no change	no change
	GL Exceedance	<6.5	<6.5	<6.5	<6.5

TABLE 4.3-21

Statistical Analysis and Benchmark Comparison Results for the Reference Areas at the McClean Operation, Time Period 2, 1996 to 2024.

COPC	Metric	Mallen Lake WQ01C	Collins Creek Upstream WQ02C	McClean Lake West Basin WQ15C	Henday Lake WQ20C
Potassium	%<RDL	6.1	9.6	9.6	10
	Trend	decrease	no change	no change	no change
	GL Exceedance	-	-	-	-
Sodium	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance	-	-	-	-
Specific Conductance (Field)	%<RDL	0	0	0	0
	Trend	no change	no change	no change	no change
	GL Exceedance	-	-	-	-
Specific Conductance (Lab)	%<RDL	0	0	0	0
	Trend	decrease	decrease	decrease	decrease
	GL Exceedance	-	-	-	-
Sulphate	%<RDL	0	0.9	0.9	0
	Trend	no change	no change	no change	no change
	GL Exceedance	no	no	no	no
Sum of ions	%<RDL	0	0	0	0
	Trend	decrease	decrease	no change	decrease
	GL Exceedance	-	-	-	-
Solids, Total dissolved	%<RDL	0	0	0	4
	Trend	no change	no change	no change	no change
	GL Exceedance	-	-	-	-
Metals and Trace Elements					
Aluminum	%<RDL	39.4	0	3.5	18
	Trend	decrease[2]	no change	no change	decrease[2]
	GL Exceedance	no	no	no	no
Arsenic	%<RDL	40.4	21.1	23.5	18
	Trend	-	decrease[2]	decrease[2]	no change
	GL Exceedance	no	no	no	no
Barium	%<RDL	0.9	2.6	1.7	0
	Trend	decrease	no change	increase	no change
	GL Exceedance	-	-	-	-
Boron	%<RDL	99.1	96.5	97.1	100
	Trend	-	-	-	-
	GL Exceedance	no	no	no	no
Cadmium	%<RDL	94.7	86.8	90.4	74
	Trend	-	-	-	-
	GL Exceedance	exc	exc	exc	exc
Chromium	%<RDL	99.1	98.2	98.1	100
	Trend	-	-	-	-
	GL Exceedance	no	no	no	no
Cobalt	%<RDL	100	99.1	99.1	100
	Trend	-	-	-	-
	GL Exceedance	exc	exc	exc	exc
Fluoride	%<RDL	1.6	1.6	0	3.2
	Trend	no change	no change	no change	no change
	GL Exceedance	no	exc	no	exc
Mercury	%<RDL	93	87.7	86.1	90
	Trend	-	-	-	-
	GL Exceedance	exc	exc	exc	exc
Molybdenum	%<RDL	93.8	90.4	77.4	90
	Trend	-	-	-	-
	GL Exceedance	no	no	no	no
Nickel	%<RDL	94.7	86.8	68.7	86
	Trend	-	-	-	-
	GL Exceedance	no	no	no	no

TABLE 4.3-21

Statistical Analysis and Benchmark Comparison Results for the Reference Areas at the McClean Operation, Time Period 2, 1996 to 2024.

COPC	Metric	Mallen Lake WQ01C	Collins Creek Upstream WQ02C	McClean Lake West Basin WQ15C	Henday Lake WQ20C
Selenium	%<RDL	93	86.8	88.7	86
	Trend	-	-	-	-
	GL Exceedance	no	exc	no	no
Silver	%<RDL	100	98.8	98.6	97.9
	Trend	-	-	-	-
	GL Exceedance	-	-	-	-
Strontium	%<RDL	0	0	0	0
	Trend	decrease	decrease	no change	decrease
	GL Exceedance	-	-	-	-
Thallium	%<RDL	100	100	100	100
	Trend	-	-	-	-
	GL Exceedance	no	no	no	no
Titanium	%<RDL	100	33.3	27.1	93.6
	Trend	-	decrease[2]	decrease[2]	-
	GL Exceedance	-	-	-	-
Uranium	%<RDL	99.1	95.6	93.9	100
	Trend	-	-	-	-
	GL Exceedance	no	no	no	no
Radionuclides					
Lead-210	%<RDL	95.6	97.4	97.4	96
	Trend	-	-	-	-
	GL Exceedance	-	-	-	-
Polonium-210	%<RDL	96.5	83.3	86.1	87.8
	Trend	-	-	-	-
	GL Exceedance	-	-	-	-
Radium-226	%<RDL	86.8	84.2	83.5	90
	Trend	-	-	-	-
	GL Exceedance	no	no	no	no

Trend analysis was not performed on COPCs if more than 40% of values were less than the reported detection limit (RDL) during the Time Period.

Gray cells indicate exceedances over benchmarks; tan cells indicate significant increasing trend; blue cells indicate significant decreasing trend.

%<RDL: percentage of values less than the reported detection limit over the 1996-2024 period; Trend: Trend over the 1996-2024 period; GL exceedance: guideline exceedance over the 1996-2024 period; no: does not exceed benchmark; exc: exceeds benchmark; NA: no benchmark available or no trend analysis performed.

[1]Dissolved oxygen has two guidelines: one is for early life stages (9.5 mg/L), the other is for other life stages (6.5 mg/L). Levels are only flagged in this table if they fall below the lower guideline.

[2]This trend is an artifact of decreased RDLs for this parameter in 2004 or 2009, depending on the parameter.

TABLE 4.4-1

Sediment Quality Criteria.

Parameter	Unit	CEQG[1]		CNSC[2]		Sediment Quality Value[3]		Regional Toxicity Benchmarks[4]			
		ISQG	PEL	LEL	SEL	NE2	REF	NOEC	LOEC	Growth Effects	
										IC25	IC50
Metals and Trace Elements											
Arsenic	µg/g	5.9	17	9.8	346.4	522	20.8	-	39	174	342
Cadmium	µg/g	0.6	3.5	-	-	-	-	-	-	-	-
Copper	µg/g	35.7	197	22.2	268.8	-	-	-	-	-	-
Lead	µg/g	35	91.3	36.7	412.4	-	-	-	-	-	-
Mercury	µg/g	0.17	0.486	-	-	-	-	-	-	-	-
Molybdenum	µg/g	-	-	13.8	1238.5	245	22.6	3589	-	-	-
Nickel	µg/g	-	-	23.4	484	326	21.4	-	210	189	312
Selenium	µg/g	-	-	1.9	16.1	29.7	3.6	-	-	-	-
Uranium	µg/g	-	-	104.4	5874.1	2296	96.7	740	1819	964	1918
Vanadium	µg/g	-	-	35.2	160	-	-	-	-	-	-
Zinc	µg/g	123	315	-	-	-	-	-	-	-	-
Radionuclides											
Lead-210	Bq/g	-	-	0.9	20.8	-	-	-	-	-	-
Polonium-210	Bq/g	-	-	0.8	12.1	-	-	-	-	-	-
Radium-226	Bq/g	-	-	0.6	14.4	-	-	-	-	-	-

[1]Canadian Environmental Quality Guideline (CCME 2025): ISQG = Interim Sediment Quality Guidelines; PEL = Probable Effects Level.

[2]Canadian Nuclear Safety Commission Working Benchmarks (Thompson et al. 2005); LEL = Lowest Effect Level; SEL = Severe Effect Level.

[3]Burnett-Seidel and Liber 2013; NE2 = No-Effect Value REF = Reference Value.

[4]Liber et al. 2011; NOEC = No-Observed-Effect Concentration; LOEC = Lowest-Observed-Effect Concentration; IC25 and IC50 = Inhibitory Concentrations for Growth.

TABLE 4.4-2

Summary of Baseline Sediment Chemistry in the McClean Lake Operation LSA - Major Ions.

Reference Area					
Parameter	Units	Collins Creek (CC1) (BM12C)		McClean Lake West (S15C)	
		1994		1994	
		Mean	SD[1]	Mean	SD
Calcium	µg/g	1023	142	2133	116
Magnesium	µg/g	1330	95	1667	58

Sink/Vulture Treated Effluent Management System					
Parameter	Units	Sink Lake (S9E)		Vulture Lake (S10E)	
		1994		1994	
		Mean	SD	Mean	SD
Calcium	µg/g	1633	58	1533	289
Magnesium	µg/g	1133	58	603	116

Primary Exposure Area									
Parameter	Units	McClean Lake East (S11E)		Collins Creek (CC2) (BM14E)		Collins Creek (CC3)		Kewen Lake (S14E)	
		1994		1994		1994		1994	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Calcium	µg/g	1233	58	1430	493	1477	720	1900	300
Magnesium	µg/g	963	21	990	121	930	193	1300	100

Secondary Exposure Area													
Parameter	Units	Fox Lake (S4E)		Isis Lake		Johannes Lake		Osiris Lake		Pat Lake		Tail Lake	
		1994		1994		1994		1994		1994		1994	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Calcium	µg/g	2112	233	3580	147	2500	0	2267	58	3100	0	2167	58
Magnesium	µg/g	722	145	690	30	960	0	980	20	1767	58	540	10

[1]SD =standard deviation.

TABLE 4.4-3

Summary of Baseline Sediment Chemistry in the McClean Lake Operation LSA - Nutrients.

Reference Area			
Parameter	Units	McClean Lake West (S15C)	
		1994	
		Mean	SD[1]
Total Phosphorus	µg/g	1467	58
Total Kjeldahl Nitrogen	µg/g	11500	866

Sink/Vulture Treated Effluent Management System					
Parameter	Units	Sink Lake (S9E)		Vulture Lake (S10E)	
		1994		1994	
		Mean	SD	Mean	SD
Total Phosphorus	µg/g	687	42	1083	202
Total Kjeldahl Nitrogen	µg/g	12200	346	13333	3215

Primary Exposure Area									
Parameter	Units	McClean Lake East (S11E)		Collins Creek (CC2) (BM14E)		Collins Creek (CC3)		Kewen Lake (S14E)	
		1994		1994		1994		1994	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total Phosphorus	µg/g	263	15	770	360	610	85	653	61
Total Kjeldahl Nitrogen	µg/g	1733	208	2600	1136	3000	1058	8537	590

Secondary Exposure Area													
Parameter	Units	Fox Lake (S4E)		Isis Lake		Johannes Lake		Osiris Lake		Pat Lake		Tail Lake	
		1994		1994		1994		1994		1994		1994	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total Phosphorus	µg/g	1533	731	1133	58	3200	0	1023	68	4433	116	1030	61
Total Kjeldahl Nitrogen	µg/g	16000	1000	22167	4072	15100	283	10367	611	8600	520	12667	1155

[1]SD = standard deviation.

TABLE 4.4-4

Summary of Baseline Sediment Chemistry in the McClean Lake Operation LSA - Metals.

Parameter	Units	Reference Area							
		Mallen Lake (S1C)		Collins Creek (CC1) (BM12C)		McClean Lake West (S15C)			
		1996		1994		1994		1996	
		Mean	SD[1]	Mean	SD	Mean	SD	Mean	SD
Arsenic	µg/g	4.9	1.1	1.8	0.2	**14.7**	0.6	**6.9**	0.8
Cadmium	µg/g	**4.7**	0.6	1.0	-	1.0	-	3.0	-
Cobalt	µg/g	8.3	0.6	2.0	-	8.7	0.6	7.3	0.6
Copper	µg/g	11.7	0.6	1.0	-	2.0	-	6.3	1.2
Lead	µg/g	25.3	1.2	4.3	0.6	27.7	1.5	15.0	1.0
Molybdenum	µg/g	4.0	-	4.0	-	4.0	-	4.3	0.6
Nickel	µg/g	13.7	0.6	3.7	0.6	10.7	1.2	11.3	1.5
Uranium	µg/g	3.1	0.1	1.2	0.2	2.7	0.2	2.8	0.3
Vanadium	µg/g	32.3	2.5	16.3	0.6	**73.3**	3.1	**45.0**	2.0
Zinc	µg/g	87	4	13	2	76	6	65	3

Parameter	Units	Sink/Vulture Treated Effluent Management System			
		Sink Lake (S9E)		Vulture Lake (S10E)	
		1994		1994	
		Mean	SD	Mean	SD
Arsenic	µg/g	5.4	0.2	3.7	0.1
Cadmium	µg/g	1.0	-	1.0	-
Cobalt	µg/g	4.0	0.0	2.7	0.6
Copper	µg/g	4.7	0.6	4.3	1.2
Lead	µg/g	16.0	2.0	13.7	1.5
Molybdenum	µg/g	4.0	-	4.0	-
Nickel	µg/g	10.0	0.0	5.0	1.0
Uranium	µg/g	2.9	0.0	2.0	0.2
Vanadium	µg/g	**51**	1	22	4
Zinc	µg/g	54	3	36	9

Parameter	Units	Primary Exposure Area							
		McClean Lake East (S11E)		Collins Creek (CC2) (BM14E)		Collins Creek (CC3)		Kewen Lake (S14E)	
		1994		1994		1994		1994	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Arsenic	µg/g	1.7	0.1	**6.1**	3.4	4.9	1.4	4.3	0.2
Cadmium	µg/g	1.0	-	1.0	-	1.0	-	1.0	-
Cobalt	µg/g	2.0	-	3.3	1.2	4.3	0.6	4.7	1.2
Copper	µg/g	1.0	-	1.0	-	1.0	-	3.0	-
Lead	µg/g	4.7	1.2	7.0	3.6	7.3	3.1	9.7	3.2
Molybdenum	µg/g	4.0	-	8.0	6.9	4.0	0.0	4.0	-
Nickel	µg/g	3.0	-	3.7	1.2	4.3	1.5	5.7	0.6
Uranium	µg/g	0.8	0.2	1.1	0.4	1.4	0.3	2.5	0.2
Vanadium	µg/g	12.0	-	29.3	10.8	21.3	4.5	34.3	2.3
Zinc	µg/g	12	3	26	9	29	11	41.7	3

Parameter	Units	Secondary Exposure Area											
		Fox Lake (S4E)		Isis Lake		Johannes Lake		Osiris Lake		Pat Lake		Tail Lake	
		1994		1994		1994		1994		1994		1994	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Arsenic	µg/g	**6.7**	0.7	2.2	0.0	**8.2**	0.0	3.4	0.1	**21.3**	1.5	2.0	0.1
Cadmium	µg/g	1.0	-	1.0	-	1.0	-	1.0	-	1.0	-	1.0	-
Cobalt	µg/g	3.8	0.4	2.3	0.6	6.5	0.7	4.0	0.0	12.3	0.6	3.0	0.0
Copper	µg/g	6.2	2.0	11.3	0.6	8.5	0.7	7.3	1.2	1.0	0	4.3	0.6
Lead	µg/g	8.7	5.8	7.3	0.6	24.0	0	10.0	4.0	**38.0**	5.3	9.0	1.7
Molybdenu	µg/g	4.0	-	4.0	-	4.0	-	4.0	-	6.0	2.0	4.0	-
Nickel	µg/g	6.5	1.6	8.0	1.0	8.0	0.0	10.7	4.7	8.3	0.6	4.7	1.2
Uranium	µg/g	1.7	0.5	1.2	0.1	2.4	0.2	1.6	0.3	2.6	0.0	1.5	0.1
Vanadium	µg/g	29.2	2.1	12.3	0.6	**50.5**	0.7	30.0	1.0	**82.7**	1.5	12.0	0.0
Zinc	µg/g	49	9	73	21	99	2	90	15	**140**	10	16	1

Bold values indicate concentrations are greater than one of the available sediment quality guidelines.

Values below laboratory test detection limits were set to the limit when calculating means and standard deviations.

[1]SD = standard deviation.

TABLE 4.4-5

Summary of Baseline Sediment Chemistry in the McClean Lake Operation LSA - Radionuclides.

Parameter	Units	Reference Area							
		Mallen Lake (S1C)		Collins Creek (CC1) (BM12C)		McClean Lake West (S15C)			
		1996		1994		1994		1996	
		Mean	SD[1]	Mean	SD	Mean	SD	Mean	SD
Lead-210	Bq/g	**0.93**	0.12	0.05	0.01	0.42	0.20	0.50	0.05
Radium-226	Bq/g	0.16	0.01	0.03	0.01	0.08	0.01	0.08	0.01
Polonium-210	Bq/g	**0.83**	0.10	0.06	0.00	**0.85**	0.22	0.52	0.03
Thorium-230	Bq/g	0.02	0	0.02	0.01	0.04	0.01	0.03	0.01

Parameter	Units	Sink/Vulture Treated Effluent Management System			
		Sink Lake (S9E)		Vulture Lake (S10E)	
		1994		1994	
		Mean	SD	Mean	SD
Lead-210	Bq/g	0.50	0.05	0.47	0.03
Radium-226	Bq/g	0.09	0.01	0.03	0
Polonium-210	Bq/g	0.53	0.13	0.50	0.05
Thorium-230	Bq/g	0.02	0.00	0.02	-

Parameter	Units	Primary Exposure Area							
		McClean Lake East (S11E)		Collins Creek (CC2) (BM14E)		Collins Creek (CC3)		Kewen Lake (S14E)	
		1994		1994		1994		1994	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Lead-210	Bq/g	0.04	0.017	0.157	0.081	0.2	0.05	0.25	0.05
Radium-226	Bq/g	0.02	0.01	0.05	0.02	0.08	0.02	0.06	0.01
Polonium-210	Bq/g	0.06	0.02	0.17	0.11	0.19	0.05	0.28	0.06
Thorium-230	Bq/g	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00

Parameter	Units	Secondary Exposure Area											
		Fox Lake (S4E)		Isis Lake		Johannes Lake		Osiris Lake		Pat Lake		Tail Lake	
		1994		1994		1994		1994		1994		1994	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Lead-210	Bq/g	0.55	0.55	0.38	0.06	**1.20**	0.26	0.43	0.12	0.50	0.10	0.40	0.05
Radium-226	Bq/g	0.05	0.03	0.03	0.01	0.13	0.01	0.03	0.01	0.12	0.01	0.02	0
Polonium-210	Bq/g	0.66	0.67	0.62	0.06	**1.53**	0.06	0.55	0.18	0.52	0.16	0.42	0.03
Thorium-230	Bq/g	0.02	-	0.02	-	0.04	0.02	0.03	0.01	0.03	0.01	0.02	-

Bold values indicate concentrations are greater than one of the available sediment quality guidelines.

Values below laboratory test detection limits were set to the limit when calculating means and standard deviations.

[1]SD = standard deviation.

TABLE 4.4-6

Predicted Maximum Mean and 95th Percentile Concentrations of Select Parameters in the Sediment of Sink, Vulture, McClean, and Kewen Lakes.

Parameter	Sink Reservoir						Vulture Lake					
	1991 EIS Max Mean	1995 EIS Max Mean	2016 ERA Base Case[1]		2018 ERA[1]		1991 EIS Max Mean	1995 EIS Max Mean	2016 ERA Base Case[1]		2018 ERA[1]	
			Mean	95th Percentile	Mean	95th Percentile			Mean	95th Percentile	Mean	95th Percentile
Metals and Trace Elements												
Arsenic (µg/g)	700	410	57	89	-	-	300	184	24	39	-	-
Cobalt (µg/g)	-	-	11	20	-	-	-	-	10	13	-	-
Copper (µg/g)	-	172	18	32	-	-	-	91	7.0	8.6	-	-
Lead (µg/g)	-	139	11	15	-	-	-	67	6.9	8.5	-	-
Molybdenum (µg/g)	-	-	350	740	-	-	-	-	380	700	-	-
Nickel (µg/g)	250	148	64	99	-	-	150	96	63	100	-	-
Selenium (µg/g)	-	-	-	-	11	16	-	-	-	-	5.8	9.2
Uranium (µg/g)	-	-	23	38	-	-	-	-	10	14	-	-
Zinc (µg/g)	260	140	20	27	-	-	155	92	16	24	-	-
Radionuclides												
Lead-210 (Bq/g)	-	-	0.26	0.40	-	-	-	-	0.19	0.26	-	-
Polonium-210 (Bq/g)	-	-	0.53	1.30	-	-	-	-	0.26	0.49	-	-
Radium-226 (Bq/g)	0.8	0.49	0.08	0.13	-	-	0.35	0.21	0.07	0.12	-	-
Thorium-230 (Bq/g)	-	-	0.04	0.06	-	-	-	-	0.034	0.047	-	-
Parameter	**McClean Lake East Basin**						**Kewen Lake**					
	1991 EIS Max Mean	1995 EIS Max Mean	2016 ERA Base Case[1]		2018 ERA[1]		1991 EIS Max Mean	1995 EIS Max Mean	2016 ERA Base Case[1]		2018 ERA[1]	
			Mean	95th Percentile	Mean	95th Percentile			Mean	95th Percentile	Mean	95th Percentile
Metals and Trace Elements												
Arsenic (µg/g)	32	22	11	25	-	-	-	-	3.6	6.2	-	-
Cobalt (µg/g)	-	-	2.6	4.5	-	-	-	-	1.8	2.5	-	-
Copper (µg/g)	-	25	5.1	5.4	-	-	-	-	4.9	5.1	-	-
Lead (µg/g)	-	47	6.9	9.8	-	-	-	-	6.5	8.2	-	-
Molybdenum (µg/g)	-	-	89	220	-	-	-	-	14	32	-	-
Nickel (µg/g)	15	23	30	53	-	-	-	-	9.3	12	-	-
Selenium (µg/g)	-	-	-	-	2.0	4.2	-	-	-	-	0.57	0.75
Uranium (µg/g)	-	-	3.3	6.1	-	-	-	-	1.3	2.4	-	-
Zinc (µg/g)	30	19	10	13	-	-	-	-	18	25	-	-
Radionuclides												
Lead-210 (Bq/g)	-	-	0.15	0.25	-	-	-	-	0.13	0.22	-	-
Polonium-210 (Bq/g)	-	-	0.22	0.42	-	-	-	-	0.17	0.34	-	-
Radium-226 (Bq/g)	0.05	0.04	0.03	0.04	-	-	-	-	0.02	0.03	-	-
Thorium-230 (Bq/g)	-	-	0.02	0.03	-	-	-	-	0.02	0.03	-	-

Source: Minatco 1991; COGEMA 1995; AREVA 2016b; Orano 2018a.

[1]Maximum predicted annual mean and 95th percentile for the monitoring period (2022 - 2024).

TABLE 4.4-7

Sediment Sampling Areas for the McClean Lake Operation EMP, 1999 to 2024.

Zone	Designation	Area	Year	Stations	UTM Coordinates	
					Easting	Northing
Lake Depositional[1]	Reference	Henday Lake (BM11C)	1999, 2002	3	-	-
			2005, 2008, 2011, 2015	5		
		Mallen Lake (BM1C)	1999, 2002	3	-	-
			2005, 2008, 2011, 2015	5		
		McClean Lake West Basin (BM10C)	1999, 2002	3	564864	6457011
			2005, 2008, 2011, 2015, 2018, 2021, 2024	5		
		Konner Lake (BM16C)	1999, 2002	3	569819	6471417
			2005, 2008, 2011, 2015, 2018, 2021, 2024	5		
	Primary Exposure	Sink Reservoir (BM3E)	1999, 2002	3	568833	6462047
			2005, 2008, 2011, 2015, 2018, 2021, 2024	5		
		Vulture Lake (BM4E)	1999, 2002	3	567905	6461069
			2005, 2008, 2011, 2015, 2018, 2021, 2024	5		
		McClean Lake East Basin (BM5E)	1999, 2002	3	565847	6457992
			2005, 2008, 2011, 2015, 2018, 2021, 2024	5		
		Kewen Lake (BM8E)	1999, 2002	3	565771	6448598
			2005, 2008, 2011, 2015, 2018, 2021, 2024	5		
	Secondary Exposure	Fox Lake (BM13E)	2018, 2021, 2024	5	567222	6468072
Riverine Depositional	Reference	Collins Creek (BM18C)	2008, 2013, 2016, 2019, 2022	5	562386	6458340
	Exposure	Collins Creek (BM19E)	2008, 2013, 2016, 2019, 2022	5	566626	6457481

[1]Sediment samples were also collected in 1994 from the west basin of McClean Lake, Sink Reservoir, Vulture Lake, the east basin of McClean Lake, and Kewen Lake from the 0-5 cm horizon as described in Section 4.4.1.

UTM coordinates are provided in NAD83, Zone 13 for the current EP TID Period.

TABLE 4.4-8

Identification of COPC in Sediment from the Primary Exposure Area in the McClean Lake Operation LSA.

Parameter	Unit	McClean Lake Operation Monitoring Program		COPC Selection based on 2022 to 2024 data		Available Impact Prediction (EC3)?[3]	Selected as COPC[4]
		EMDD 2019	EMDD 2023	less than 90% of data below RDL (EC1)[1]	Exceeded Reference Range (EC2)[2]		
Major Ions							
Calcium	µg/g	N	N	Y	Y	N	Y
Magnesium	µg/g	N	N	Y	N	N	N
Potassium	µg/g	N	N	Y	N	N	N
Sodium	µg/g	N	N	Y	Y	N	Y
Metals and Trace Elements							
Aluminum	µg/g	Y	Y	Y	Y	N	Y
Antimony	µg/g	N	N	Y	Y	N	Y
Arsenic	µg/g	Y	Y	Y	Y	Y	Y
Barium	µg/g	N	N	Y	Y	N	Y
Beryllium	µg/g	N	N	Y	N	N	N
Boron	µg/g	N	N	Y	Y	N	Y
Cadmium	µg/g	Y	Y	Y	Y	N	Y
Chromium	µg/g	N	N	Y	N	N	N
Cobalt	µg/g	Y	Y	Y	Y	Y	Y
Copper	µg/g	Y	Y	Y	Y	Y	Y
Iron	µg/g	Y	Y	Y	Y	N	Y
Lead	µg/g	Y	Y	Y	Y	Y	Y
Manganese	µg/g	N	N	Y	Y	N	Y
Mercury	µg/g	Y	Y	Y	Y	N	Y
Molybdenum	µg/g	Y	Y	Y	Y	Y	Y
Nickel	µg/g	Y	Y	Y	Y	Y	Y
Selenium	µg/g	Y	Y	Y	Y	Y	Y
Silver	µg/g	N	N	N	N	N	N
Strontium	µg/g	N	N	Y	Y	N	Y
Thallium	µg/g	N	N	Y	Y	N	Y
Tin	µg/g	N	N	Y	N	N	N
Titanium	µg/g	N	N	Y	N	N	N
Uranium	µg/g	Y	Y	Y	Y	Y	Y
Vanadium	µg/g	Y	Y	Y	Y	N	Y
Zinc	µg/g	Y	Y	Y	N	Y	N
Nutrients							
Carbon, total organic	%	Y	Y	Y	Y	N	Y
Phosphorus	µg/g	N	N	Y	Y	N	Y
Physical Properties							
% Moisture	%	Y	Y	Y	N	N	N
Loss on ignition	%	Y	Y	Y	Y	N	Y
Radionuclides							
Lead-210	Bq/g	Y	Y	Y	Y	Y	Y
Polonium-210	Bq/g	Y	Y	Y	Y	Y	Y
Radium-226	Bq/g	Y	Y	Y	Y	Y	Y
Thorium-230	Bq/g	Y	Y	Y	Y	Y	Y

RDL = Reportable Detection Limit; Y = Yes; N = No.

[1] If at least one exposure station had less than 90% of the values measured below the detection limit (<RDL) during the 2022 to 2024 assessment period, the parameter met this criterion.

[2] If at least one exposure station had a mean concentration outside the reference range during the 2022 to 2024 assessment period, the parameter met this criterion. For each parameter, the upper reference range is the 2022 to 2024 average of the reference station data plus 2 * reference standard deviation. See Table IV.4-3.

[3] Available impact predictions included 1991 (Minatco 1991), 1995 (COGEMA 1995), 2016 (AREVA 2016), and 2018 (Orano 2018) impact predictions.

[4] To be selected as a COPC, an analyte had to meet both EC1 and EC2 criteria.

TABLE 4.4-9

Summary of Sediment Chemistry from Lake Depositional Sampling Areas in the McClean Lake Operation LSA, February/March 2024.

Parameter	Unit	Values[1]	0-2 cm							
			Reference		Pooled Reference	Primary Exposure				Secondary Exposure
			McClean West Basin (BM10C)	Konner Lake (BM16C)		Sink Reservoir (BM3E)	Vulture Lake (BM4E)	McClean East Basin (BM5E)	Kewen Lake (BM8E)	Fox Lake (BM13E)
Major ions										
Calcium	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	3020	2120	2570	10200	9320	8540	3220	2440
		SD	84	84	481	1114	1610	956	259	207
Sodium	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	266	152	209	1860	1640	664	256	120
		SD	70	16	77	251	378	98	45	19
Metals and Trace Elements										
Aluminum	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	11380	8860	10120	12300	7200	13060	5820	6360
		SD	650	351	1416	906	857	953	550	321
Antimony	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	5	5	10	0	1	0	5	4
		Mean	0.2	0.2	0.2	0.8	0.5	0.6	0.2	0.2
		SD	0	0	0	0.2	0.3	0.2	0	0
Arsenic	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	8.2	4.7	6.5	***82***	***28***	***20***	3.2	**8.5**
		SD	0.40	0.33	1.9	24	18.0	4.6	0.07	0.55
2016 ERA Prediction	µg/g	Mean	-	-	-	57	24	11	3.6	-
		95th %				89	39	25	6.2	-
Barium	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	71	49	60	526	694	71	40	53
		SD	1.7	2.3	11.3	190	661	3.6	1.9	6.1
Boron	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	11	4	7.2	23	19	27	7.2	4.4
		SD	0.45	0.55	3.8	1.5	4.7	3.4	0.84	0.89
Cadmium	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	0.4	0.5	0.4	0.5	0.6	0.4	0.2	0.4
		SD	0.04	0.09	0.07	0.05	0.2	0.11	0	0.05
Cobalt	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	5.6	4.4	5.0	*15*	*11*	*7.9*	*3.5*	3.8
		SD	0.4	1.1	1.0	4.2	4.4	0.8	0.4	0.3
2016 ERA Prediction	µg/g	Mean	-	-	-	11	10	2.6	1.8	-
		95th %				20	13	4.5	2.5	-
Copper	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	5.3	5.6	5.4	7.9	*7.3*	*8.1*	1.9	6.8
		SD	0.74	0.32	0.57	0.88	1.0	0.62	0.33	0.27
2016 ERA Prediction	µg/g	Mean	-	-	-	18	7.0	5.1	4.9	-
		95th %				32	8.6	5.4	5.1	-
Iron	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	48700	26780	37740	39040	16220	90560	25820	20860
		SD	2686	4571	12082	6033	4778	19647	2642	2783

TABLE 4.4-9

Summary of Sediment Chemistry from Lake Depositional Sampling Areas in the McClean Lake Operation LSA, February/March 2024.

Parameter	Unit	Values[1]	0-2 cm							
			Reference		Pooled Reference	Primary Exposure				Secondary Exposure
			McClean West Basin (BM10C)	Konner Lake (BM16C)		Sink Reservoir (BM3E)	Vulture Lake (BM4E)	McClean East Basin (BM5E)	Kewen Lake (BM8E)	Fox Lake (BM13E)
Lead	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	4.8	2.9	3.9	10.2	*7.2*	*9.2*	2.6	6.8
		SD	0.73	1.4	1.45	0.81	2.76	0.8	0.35	1.87
2016 ERA Prediction	µg/g	Mean	-	-	-	11	6.9	6.9	6.5	-
		95th %				15	8.5	10	8.2	-
Manganese	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	316	254	285	143	158	264	464	318
		SD	23	50	49	51	24	59	85	47
Mercury	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	4	4	0	1	0	5	0
		Mean	0.06	0.05	0.06	0.06	0.06	0.09	0.05	0.07
		SD	0.004	0.004	0.005	0	0.005	0.005	0	0.01
Molybdenum	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	1.8	5.8	3.8	***919***	**351**	***113***	7.7	6.7
		SD	0.15	1.05	2.3	177	210	11	0.9	1.0
2016 ERA Prediction	µg/g	Mean	-	-	-	350	380	89	14	-
		95th %				740	700	220	32	-
Nickel	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	9.9	6.8	8.3	***96***	***68***	***36***	6.2	7.3
		SD	0.8	0.3	1.7	25	36	6.6	0.86	0.60
2016 ERA Prediction	µg/g	Mean	-	-	-	64	63	30	9.3	-
		95th %				99	100	53	12	-
Selenium	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	0.9	0.7	0.8	***14***	***6.1***	***3.2***	0.5	0.6
		SD	0.2	0	0.2	5.1	2.5	0.6	0.10	0.1
2018 ERA Prediction	µg/g	Mean	-	-	-	11	5.8	2.0	0.6	-
		95th %				16	9.2	4.2	0.8	-
Strontium	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	30	17.8	23.9	47	31	26	18	21
		SD	1.9	0.4	6.6	4.0	13.0	1.8	1.2	1.5
Thallium	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	5	4	9	0	0	0	5	5
		Mean	0.2	0.2	0.2	1.6	0.9	0.4	0.2	0.2
		SD	0	0	0	0.55	0.4	0.1	0	0
Uranium	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	1.9	1.1	1.5	*26*	8.1	*6.0*	1.2	4.5
		SD	0.19	0.08	0.45	8.9	5.8	0.95	0.16	1.7
2016 ERA Prediction	µg/g	Mean	-	-	-	23	10	3.3	1.3	-
		95th %				38	14	6.1	2.4	-
Vanadium	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	44	30	37	37	20	52	18	26
		SD	2.6	1.6	7.5	4.0	2.2	3.4	1.3	1.7
Radionuclides										
Lead-210	Bq/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	2	2	0	0	0	1	0
		Mean	0.10	0.07	0.09	*0.36*	*0.29*	*0.55*	0.07	0.37
		SD	0.04	0.04	0.04	0.09	0.14	0.18	0.03	0.18
2016 ERA Prediction	µg/g	Mean	-	-	-	0.26	0.19	0.15	0.13	-
		95th %				0.40	0.26	0.25	0.22	-
Polonium-210	Bq/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	0.17	0.12	0.15	0.40	*0.31*	*0.57*	0.14	0.38
		SD	0.03	0.05	0.05	0.08	0.16	0.15	0.03	0.15
2016 ERA Prediction	µg/g	Mean	-	-	-	0.53	0.26	0.22	0.17	-
		95th %				1.3	0.49	0.42	0.34	-

TABLE 4.4-9

Summary of Sediment Chemistry from Lake Depositional Sampling Areas in the McClean Lake Operation LSA, February/March 2024.

Parameter	Unit	Values[1]	0-2 cm							
			Reference		Pooled Reference	Primary Exposure				Secondary Exposure
			McClean West Basin (BM10C)	Konner Lake (BM16C)		Sink Reservoir (BM3E)	Vulture Lake (BM4E)	McClean East Basin (BM5E)	Kewen Lake (BM8E)	Fox Lake (BM13E)
Radium-226	Bq/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	0.05	0.04	0.04	*0.13*	*0.07*	*0.05*	*0.03*	0.03
		SD	0.02	0.02	0.02	0.02	0.04	0.01	0.01	0.01
2016 ERA Prediction	µg/g	Mean	-	-	-	0.08	0.07	0.03	0.02	-
		95th %				0.13	0.12	0.04	0.03	-
Thorium-230	Bq/g	n	5	5	10	5	5	5	5	5
		n<RDL	1	5	6	0	1	0	3	1
		Mean	0.03	0.02	0.03	*0.05*	0.03	*0.03*	0.02	0.04
		SD	0.01	0	0.007	0.02	0.01	0.01	0	0.02
2016 ERA Prediction	µg/g	Mean	-	-	-	0.04	0.03	0.02	0.02	-
		95th %				0.06	0.05	0.03	0.03	-
Nutrients and Physical Properties										
Carbon, Total Organic	%	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	12.2	13.3	12.8	12.7	15.4	17.1	5.6	15.7
		SD	1.17	0.21	1.00	0.55	1.39	0.95	0.78	1.25
Phosphorus	µg/g	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	634	634	634	628	762	1440	554	1040
		SD	70	94	78	89	125	404	55	170
Loss on Ignition	%	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	24.4	28.5	26.5	30.4	34.3	37.5	9.1	35.9
		SD	2.40	0.65	2.72	1.50	3.58	1.90	1.08	2.99

Shaded means indicate significantly greater than both reference means ($p < 0.05$; see post hoc statstic results in Appendix IV.4, Table IV.4-4); bolded values indicate higher than at least one of the sediment quality criteria (Table 4.4-1); italicized values exceeded the most recent mean or 95th percentile prediction presented in Table 4.4-6.

Chemistry results presented on a dry weight basis. Values below laboratory test detection limits were set to the limit when calculating means and standard deviations.

[1] n = sample size; DL = detection limit; SD = standard deviation.

TABLE 4.4-10

Summary of Sediment Particle Size from Lake Depositional Sampling Areas in the McClean Lake Operation LSA, February/March 2024.

Parameter	Unit	Values[1]	0-2 cm							
			Reference		Pooled Reference	Primary Exposure				Secondary Exposure
			McClean West Basin (BM10C)	Konner Lake (BM16C)		Sink Reservoir (BM3E)	Vulture Lake (BM4E)	McClean East Basin (BM5E)	Kewen Lake (BM8E)	Fox Lake (BM13C)
Clay	vol %	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	14.04	27.62	20.83	24.18	29.84	13.18	7.24	37.32
		SD	2.13	3.41	7.64	3.43	5.19	1.64	1.24	0.75
Coarse sand	vol %	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	3.00	0.31	1.65	0.12	0.10	0.24	1.67	0.08
		SD	5.98	0.14	4.23	0.10	0.06	0.26	1.73	0.03
Fine sand	vol %	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	10.28	8.54	9.41	2.67	2.80	27.00	44.44	3.40
		SD	3.63	4.45	3.94	1.61	0.90	7.84	3.42	1.10
Gravel	vol %	n	5	5	10	5	5	5	5	5
		n<RDL	5	5	10	5	5	5	5	5
		Mean	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
		SD	0	0	0	0	0	0	0	0
Silt	vol %	n	5	5	10	5	5	5	5	5
		n<RDL	0	0	0	0	0	0	0	0
		Mean	72.70	63.54	68.12	73.04	67.30	59.62	46.64	59.20
		SD	7.61	2.84	7.25	3.20	5.41	6.71	3.70	0.70

[1] n = sample size; DL = detection limit; SD = standard deviation.

TABLE 4.5-1

Benthos Sampling Design for Primary Exposure Area.

Habitat	Method	Condition	Location	Year															
				Baseline Period		Operation Period													
				1993	1996	1998	1999	2002	2005	2008	2011	2013	2015	2016	2018	2019	2021	2022	2024
Depositional	Ekman	Reference	Henday Lake (BM11C)	-	-	-	3	3	-	5	-	-	-	-	-	-	-	-	-
			Konner Lake (BM16C)	-	-	-	3	3	5	5	5	-	5	-	5	-	5	-	5
			Mallen Lake (BM1C)	-	5	-	3	3	5	5	5	-	5	-	-	-	-	-	-
			McClean West Basin (BM10C)	5	5	-	5	5	5	5	5	-	5	-	5	-	5	-	5
		Exposure	Sink Reservoir (BM3E)	5	5	-	3	3	5	5	5	-	5	-	5	-	5	-	5
			Vulture Lake (BM4E)	5	5	-	3	3	5	5	5	-	5	-	5	-	5	-	5
			McClean East Basin (BM4E)	5	5	-	5	5	5	5	5	-	5	-	5	-	5	-	5
			Kewen Lake (BM8E)	5	5	-	3	3	5	5	5	-	5	-	5	-	5	-	5
	Modified CABIN	Reference	Collins Creek Upstream (BM18C)	-	-	-	-	-	-	5	-	5	-	5	-	5	-	5	-
		Exposure	Collins Creek Downstream (BM19E)	-	-	-	-	-	-	5	-	5	-	5	-	4	-	5	-
Erosional	Neill-Hess Cylinder	Reference	Collins Creek Upstream (BM2C)	5	5	5	-	5	5	5	5	-	5	-	-	-	-	-	-
			Collins Creek Upstream (BM17C)	-	-	-	-	-	5	5	5	-	5	-	-	-	-	-	-
		Exposure	Collins Creek Downstream (BM6E)	5	5	5	-	5	5	5	5	-	5	-	-	-	-	-	-
			Collins Creek Downstream (BM7E)	5	5	5	-	5	5	5	5	-	5	-	-	-	-	-	-

Note: Values are number of stations at which benthic samples were collected; dashes indicate no samples collected.

TABLE 4.5-2

Relative Abundances of Benthic Macroinvertebrates in the Four Reference Lakes.

Family	Henday Lake			Konner Lake									Mallen Lake							McClean Lake West									
	1999	2002	2008	1999	2002	2005	2008	2011	2015	2018	2021	2024	1996	1999	2002	2005	2008	2011	2015	1993	1996	1999	2002	2005	2008	2011	2015	2018	2021	2024
Caenidae	<1	2	3							<1								1	1	<1		1	2	<1		2	16	6	1	<1
Ceratopogonidae	<1		1	<1	<1	4	6	3	1	1	2	2			<1	1	<1	1	2	1		1	1	2	2	1	1	<1	<1	2
Chironomidae	93	83	49	43	70	39	55	39	76	81	74	87	64	76	85	82	76	69	70	62	56	51	54	76	29	73	49	77	70	45
Glossiphoniidae	<1	<1	1		<1	<1	<1	<1		<1	<1		12		<1	<1	<1	<1	<1	<1		2	4	4	5	2	6	1	3	3
Naididae	1	1		<1			<1			<1	<1			1				1	<1			1	<1	<1	<1					
Prostigmata	1	2	<1	1		<1	1	1	<1					9	4	<1	1	2	3	<1		2	2	2	1	3	4			
Valvatidae	<1		2	1	4	1	1	2	<1	1	2	1	21	<1	1	1	1	2	3	<1		2	5	2	4	2	1	3	6	5
Veneroida	5	12	30	19	13	33	16	26						14	8	15	17	19				27	18	12	48	13				
Leptoceridae			1	<1				<1									<1		<1				<1	<1	<1	<1		<1		
Sphaeriidae			13				4	14	17	13	6	9	1				3	5	16	17	38				9	3	23	9	18	44
Chaoboridae				2	3	<1	<1	1	<1	<1		<1	1		<1			<1		<1										
Corixidae				<1		<1		<1												<1						<1				
Hyalellidae				33	9	20	17	11	5	2	13	<1			<1			1	<1	13			11				<1	<1	<1	
Phryganeidae				<1		<1	<1	<1	<1	<1	<1	<1								<1			<1	<1				<1		
Molannidae					<1												<1	<1						<1				<1	<1	
Tubificinae					1	1	<1		<1	1					2	1	1	<1	1	1	6	8	1	1	2	<1	<1	1	1	
Erpobdellidae						<1	<1	<1	<1	<1	<1	<1										<1	<1				<1	<1		
Enchytraeidae								1	<1		<1															2				
Corduliidae										<1									<1				<1							
Lumbriculidae										<1	<1																		<1	
Polycentropodidae										<1	<1	<1							<1	<1			<1				<1			
Trombidiformes										<1	<1																	<1	<1	
Hydroptilidae															<1				<1	1			1			<1	<1			
Ephemeridae																<1	<1	<1	1	<1		5	<1	<1			<1	<1		1
Planorbidae																	<1	<1	<1	<1										
Sialidae																	<1	<1	<1				<1	<1						
Harpacticoida																				3										
Limnephilidae																				<1										
Limnesiidae																				<1								1	<1	<1
Trichoptera																				<1										
Baetidae																							<1							
Coenagrionidae																							1							
Dytiscidae																							<1							
Leptophlebiidae																							<1							
Haliplidae																												<1		
Unionicolidae																												1	<1	<1

TABLE 4.5-3

Relative Abundances of Benthic Macroinvertebrates in the Four Exposure Lakes.

Family	Sink Reservoir											Vulture Lake											McClean Lake East											Kewen Lake										
	1993	1996	1999	2002	2005	2008	2011	2015	2018	2021	2024	1993	1996	1999	2002	2005	2008	2011	2015	2018	2021	2024	1993	1996	1999	2002	2005	2008	2011	2015	2018	2021	2024	1993	1996	1999	2002	2005	2008	2011	2015	2018	2021	2024
Chaoboridae										<1	<1	1	3	21	1		1			<1				<1	<1	<1				<1	<1			<1	31						<1			
Chironomidae	97	91	90	83	96	34	96	44	15	25	63	92	77	56	97	90	68	82	97	4	1	12	69	51	46	51	57	48	66	65	68	40	57	65	59	59	69	58	63	69	66	84	91	74
Ephemeridae																							<1	4	1	<1	1	<1	<1		<1	1	<1	6		13	3	8	5	6	1	<1	1	4
Limnesiidae	<1											<1											<1								<1	<1	<1	1							<1	<1	<1
Sphaeriidae	1	2				11	<1	52	74	26	16	1	4				1		2	89	98	88	18	31				7	3	19	22	44	39	25	3				6	5	20	8	3	18
Prostigmata	<1			1	<1	<1	<1	<1				<1		5	1	5	4	10	1					<1	3	2	2	1	2	3				<1		3	4	<1	2	4	6			
Tubificinae	<1	5	<1	9	<1	4		1	2			2	15	15									3	12	25		5	8	2	<1	1	5		2	5	4	<1	1	<1	2	1	2	<1	
Unionicolidae	<1											<1									<1										1	<1		<1								<1	
Hydropsychidae																																			1									
Naididae	<1	1	<1									2	<1			1							1		2	1	1			<1	<1				1	1	<1		<1	<1	2	2		
Caenidae				<1	<1	2	<1	1	<1	4	<1	1		2	1	3		4				<1	<1	1	4	2	1	<1	3	3	2	<1	<1			1	<1	<1	1	1	1	1	<1	1
Ceratopogonidae	<1	1	<1	2	<1	<1	<1			<1		<1			<1	1	1	<1					<1	1	<1	<1	1	1	<1	1	<1	<1	<1			1	2	1	3	3	<1	<1	1	<1
Veneroida			9	3	3	47	2							2			16	1							13	31	25	30	21							18	16	31	18	9				
Baetidae						1		<1																													<1						
Coenagrionidae																																					<1						
Corixidae								<1											<1										<1							<1		<1	<1	<1	<1		<1
Ephemerellidae																																					<1						
Glossiphoniidae												<1											4		3	2	1	<1	<1		<1	<1				1	1	1		<1	<1	1	<1
Haliplidae																																					1						<1
Hyalellidae	<1			<1								1											2	<1													1			<1	1	1		
Hydroptilidae																																					1			<1	<1			
Leptoceridae				1		1	<1	1	2	30	1							2	<1		<1	<1	<1			<1		<1	<1		1	<1					<1						<1
Phryganeidae				<1	<1		<1		<1	<1	<1					<1	5	<1	<1	<1		<1	<1			<1	<1		<1			<1	<1				<1				<1		
Physidae																				5																	<1						
Planorbidae																				<1			<1						<1							1			<1	<1	<1		
Polycentropodidae																																					<1						
Valvatidae	<1								7	14	20					1				1			1		3	10	7	4	2	9	4	10	3				1		2	<1	<1	1	2	2
Sialidae																		1																					<1	<1	<1		<1	<1
Enchytraeidae			<1																							<1														1	<1			
Erpobdellidae																					<1										<1									<1				
Trombidiformes																																										1		
Harpacticoida																							1																					
Trichoptera																							<1																					
Leptophlebiidae								<1																				<1															
Lumbriculidae						1	<1																																					
Molannidae									<1								1																											
Lymnaeidae																				1																								

TABLE 4.5-4

Percent Composition of Major Taxa in the Riverine Erosional Benthic Invertebrate Samples from Collins Creek.

Major Group	Reference												Exposure															
	BM2C								BM17C				BM6E								BM7E							
	1993	1996	1998	2002	2005	2008	2011	2015	2005	2008	2011	2015	1993	1996	1998	2002	2005	2008	2011	2015	1993	1996	1998	2002	2005	2008	2011	2015
Nematoda	<1	<1	1	1	1	1	1	1	1	1	1	<1	1	1	1	<1	2	2	3	5	7	6	5	5	3	1	1	1
Oligochaeta	2	1	2	2	2	2	3	4	4	3	3	3	3	3	3	1	1	1	1	1	1	1	1	1	<1	<1	<1	<1
Oribatida																	<1	1	1	2	2	2	2	1	1	1	1	1
Lebertiidae																						<1	<1	<1	1	1	<1	<1
Limnesiidae																		<1	<1	<1	<1	<1	<1	<1	<1			
Sididae																					<1	<1						
Torrenticolidae																								<1	<1	<1	<1	<1
Trombidiformes	3	3	9	10	10	9	9	5	1	2	2	2	4	2	2	2	2	2	2	2	1	<1	<1	1	1	<1	<1	<1
Unionicolidae																	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1
Lymnaeidae	<1	<1							<1	<1	<1	<1																
Planorbidae						<1	<1	<1	<1				<1	<1	<1	<1												
Valvatidae	<1	<1	<1			<1	<1	<1	<1	<1	<1	<1	<1	<1														
Sphaeriidae	14	14	11	12	15	13	13	17	10	8	9	9	16	9	9	7	5	4	4	3	2	3	3	3	4	7	4	4
Hyalellidae	<1	<1	<1	<1	<1																							
Baetidae	8	8	9	10	9	8	8	7	5	5	5	8	7	6	7	7	6	5	3	2	<1	<1	1	1	2	3	2	1
Baetiscidae							<1	<1					<1	<1	<1													
Ephemerellidae	1	1	5	5	7	7	6	5	<1	1	1	1	4	2	2	2	2	2	2	2	2	1	1	1	1	1	4	4
Heptageniidae	1	1	<1	<1	1	1	1	1	<1	1	1	1	1	1	1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Leptophlebiidae	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1													
Gomphidae	<1	<1		<1	<1	<1	<1	<1				<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Capniidae																		<1	<1	<1	<1	<1	<1	<1	<1			
Plecoptera (unidentified)				<1	<1	<1	<1	1	1	<1	<1	<1	<1	1	<1	<1	2	3	6	9	11	9	8	6	4	1	1	<1
Coleoptera																				<1	<1	<1	<1					
Leuctridae	<1	<1	<1	<1				<1	<1	<1	<1	<1	<1	<1	<1	<1								<1	<1	1	1	1
Nemouridae	<1	<1								<1	<1	<1								<1	<1	<1	<1	<1		<1	1	1
Perlodidae							<1	<1					<1	<1	<1												<1	<1
Pteronarcyidae																				<1	<1	<1	<1	<1				
Trichoptera (unidentified)	<1	<1	<1	<1	1	1	1	1	<1	<1	<1	<1	2	2	2	1	1	1	1	<1	<1	<1	1	1	1	2	1	1
Brachycentridae																						<1	<1	<1	<1	1	<1	<1
Hydropsychidae	9	10	3	3	2	1	1	2	1	7	7	8	2	2	2	2	1	1	<1	<1	<1	<1	1	2	2	3	3	2
Hydroptilidae	1	1	<1	<1	<1	<1	<1	<1	1	1	1	1	<1	1	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Lepidostomatidae	<1	<1	<1	<1	1	1	1	1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	<1								<1	<1
Leptoceridae	1	1	1	1	1	1	1	1		<1	1	1	1	<1	<1	<1	<1	<1	<1	<1	<1						<1	<1
Polycentropodidae	2	2	1	1	1	<1	<1	1	1	1	1	1	1	1	1	<1	<1	<1	<1	<1					<1	<1	<1	<1
Chironomidae	57	56	56	53	50	54	54	53	73	68	68	63	56	69	69	74	74	75	72	69	68	69	69	68	68	64	69	74
Simuliidae	<1	<1	<1						<1	<1	<1	<1	<1	<1	<1	<1	<1	1	2	2	3	4	5	7	8	10	7	3
Tipulidae		<1	<1	<1	<1	<1	<1	<1						<1	<1	<1	<1	1	1	<1	<1	<1	<1	<1	<1	1	<1	1
Empididae		<1	<1	<1	<1	<1								<1	<1	<1	<1	1	1	1	1	1	2	2	2	2	2	2

TABLE 4.5-5

Results of ANOVA Testing For Significant Variations in Indices of Benthic Community Composition of Lake Depositional Areas.

Lake	Index	BACI	Variance Explained (%)	Difference in Time Trend After	Variance Explained (%)
Sink Reservoir	Log of Density	0.515	0.1	0.591	0.1
	Taxa Richness	**<0.001**	9.7	0.466	0.2
	Simpson's Diversity	**<0.001**	22.6	**0.001**	6.0
	Simpson's Evenness	0.060	2.2	**0.001**	7.0
	CA Axis 1 Scores	**<0.001**	55.4	0.635	0.1
	CA Axis 2 Scores	**<0.001**	6.3	0.119	0.6
	Bray-Curtis	**0.001**		**0.019**	
Vulture Lake	Log of Density	**<0.001**	3.6	**<0.001**	9.2
	Taxa Richness	**<0.001**	8.7	0.789	0.0
	Simpson's Diversity	**0.048**	1.0	**0.003**	2.3
	Simpson's Evenness	**0.045**	1.9	0.119	1.1
	CA Axis 1 Scores	**<0.001**	41.5	0.317	0.6
	CA Axis 2 Scores	**0.001**	2.2	0.213	0.3
	Bray-Curtis	**0.001**		0.298	
McClean East Basin	Log of Density	0.101	1.2	**<0.001**	8.1
	Taxa Richness	**0.001**	7.5	0.657	0.1
	Simpson's Diversity	**<0.001**	30.9	0.192	0.9
	Simpson's Evenness	0.418	0.5	0.373	0.7
	CA Axis 1 Scores	**<0.001**	25.1	0.731	0.1
	CA Axis 2 Scores	**0.001**	4.2	**0.011**	2.4
	Bray-Curtis	**0.001**		0.903	
Kewen Lake	Log of Density	**0.021**	2.0	**<0.001**	21.5
	Taxa Richness	0.222	0.8	0.159	1.1
	Simpson's Diversity	**<0.001**	22.1	0.172	1.1
	Simpson's Evenness	**<0.001**	13.0	0.859	0.0
	CA Axis 1 Scores	**0.002**	3.6	0.128	0.9
	CA Axis 2 Scores	**<0.001**	4.1	**0.015**	1.9
	Bray-Curtis	**0.001**		0.770	

Note: Bold values are <0.05 and are statistically significant; underlined values are "core" variables with significant p-values.

TABLE 4.5-6

Relative Abundances, Density, and Taxon Richness of Benthic Macroinvertebrates in Fox Lake.

Family		Fox Lake		
		2018	2021	2024
Caenidae		7	3	1
Ceratopogonidae		3	21	4
Chaoboridae		1	6	<1
Chironomidae		62	33	69
Erpobdellidae		<1	0	0
Glossiphoniidae		1	0	<1
Hyalellidae		7	22	12
Leptoceridae		<1	<1	<1
Limnesiidae		<1	0	<1
Phryganeidae		<1	<1	0
Sphaeriidae		15	10	13
Polycentropodidae		1	2	<1
Trombidiformes		<1	<1	0
Tubificinae		<1	<1	0
Unionicolidae		<1	<1	<1
Valvatidae		1	<1	0
Naididae		0	<1	0
Density (#/m^2)	Mean	4060	1287	6636
	Standard Deviation	2346	375	2595
Taxon Richness	Mean	29	27	25
	Standard Deviation	2	1	5

Relative abundance expressed on a % basis.

TABLE 4.5-7

Analysis of Variance Testing for Variations in Indices of Composition Between Reference and Exposure Riverine Erosional Benthic Invertebrate Samples from Collins Creek.

Area	Index	BACI	Variance Explained (%)	Difference in Time Trend After	Variance Explained (%)
BM6E	Log of Abundance	0.863	0.0	0.060	2.6
	Richness	0.097	1.5	0.838	0.0
	Simpson's Diversity	0.670	0.0	0.619	0.5
	Equitability	0.989	0.0	0.698	0.0
	Evenness	0.264	1.1	0.413	0.7
	CA Axis 1 Scores	0.851	0.0	0.883	0.0
	CA Axis 2 Scores	**0.003**	0.7	**<0.001**	2.5
	Brary-Curtis	**0.001**		**0.001**	
BM7E	Log of Abundance	0.463	0.4	0.999	0.0
	Richness	0.093	1.5	0.068	1.8
	Simpson's Diversity	0.643	0.5	**0.039**	6.4
	Equitability	0.984	0.0	0.673	0.0
	Evenness	0.171	1.8	**<0.001**	13.1
	CA Axis 1 Scores	**0.035**	0.3	0.152	0.2
	CA Axis 2 Scores	**0.001**	0.8	**0.004**	0.7
	Bray-Curtis	**0.001**		**0.001**	

Note: Bold values are <0.05 and are statistically significant; underlined values are "core" variables with significant p-values.

TABLE 4.5-8

Percent Composition of Major Taxa in the Riverine Depositional Benthic Invertebrate Samples Collected from Collins Creek.

Major Group	Family	BMC18C					BM19E				
		2008	2013	2016	2019	2022	2008	2013	2016	2019	2022
Catenulida	Catenulida								<1		
Hydrozoa	Hydridae				<1				6	5	
Oligochaeta	Enchytraeidae	2	1			<1	<1	<1	<1		
	Lumbriculidae	1	<1	<1	<1		1	1	<1	1	1
	Naididae	5	4	2	4	<1	1	2	4	3	<1
Hirudinea	Erpobdellidae	<1	<1			<1	<1	<1		<1	
	Glossiphoniidae	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Piscicolidae						<1	<1		<1	
Gastropoda	Physidae		<1		<1	<1	<1	<1		<1	
	Planorbidae	1	1	1	<1	3	2	1	2	1	1
	Lymnaeidae	<1	<1	<1			<1	<1	<1	<1	1
	Valvatidae	<1	<1	<1	<1	<1	1	<1	1		<1
	Gastropoda				<1					<1	
Bivalvia	Sphaeriidae	16	28	20	37	29	12	20	13	31	28
Amphipoda	Hyalellidae	21	10	3	1	18	30	7	8	3	15
	Gammaridae						<1				
	Amphipoda				1					3	
Ostracoda	Ostracoda	1	<1	2		1	1	<1	4		<1
Trombidiformes	Prostigmata	<1	<1				<1	<1			
	Trombidiformes			3					<1		
	Arrenuridae				<1					<1	
	Hydrodromidae				<1						
	Hygrobatidae				<1						<1
	Lebertiidae				<1	<1				<1	
	Limnesiidae									<1	
	Mideopsidae				<1					<1	
	Oxidae				<1						
	Pionidae									<1	
	Sperchontidae					<1					
	Torrenticolidae									<1	
Ephemeroptera	Baetidae	1	2	13	8	1	5	4	2	2	1
	Baetiscidae	<1	<1	<1	<1	<1					
	Caenidae						5	3	2	<1	<1
	Ephemerellidae	<1	<1	1	<1	1	<1	4	1	1	1
	Ephemeridae						1	1	1	<1	2
	Heptageniidae									<1	
	Leptophlebiidae	4	5	2	3	7	19	37	26	21	29
	Metretopodidae	2	<1		<1	<1	2	<1		<1	<1
Plecoptera	Plecoptera			<1	<1						
	Perlodidae	<1			<1	<1					
	Taeniopterygidae	<1			<1						
	Leuctridae			<1		<1					
	Pteronarcyidae			<1							
Trichoptera	Trichoptera				<1					<1	
	Brachycentridae			<1							
	Hydropsychidae							<1			
	Hydroptilidae	6	3	15	13	6	<1	1	1	3	<1
	Lepidostomatidae			1	2	<1	<1	<1	1	<1	<1
	Leptoceridae	<1	1	<1	4	9	<1	<1	<1	2	<1
	Limnephilidae	<1	<1		<1		<1	<1	<1	<1	<1
	Molannidae	<1	<1			<1	<1	<1	<1		<1
	Phryganeidae	<1	<1	<1	<1	<1	<1	<1	<1	<1	1
	Polycentropodidae	<1	<1	<1	<1	<1	2	1	6	4	1
Diptera	Ceratopogonidae	3	3	1	<1	2	1	1	<1	<1	<1
	Chironomidae	30	35	34	21	19	12	13	20	17	17
	Dolichopodidae		<1								
	Empididae	<1	<1			<1	<1				
	Simuliidae				<1				1	<1	
	Tabanidae		<1				<1	<1			<1
	Tipulidae		<1				<1		<1	<1	
Odonata	Odonata				<1					<1	
	Aeshnidae		<1				<1	<1			
	Corduliidae	<1	<1		<1	<1	<1	<1	<1	<1	<1
	Gomphidae	<1	<1	<1	1				<1		
	Coenagrionidae				<1		<1	<1	<1	<1	<1
Coleoptera	Chrysomelidae		<1			<1	<1				
	Dytiscidae	<1	<1		<1	<1	<1	<1	<1	<1	
	Gyrinidae	<1					<1		<1		
	Haliplidae	<1			<1						
Hemiptera	Corixidae	3	5	1	<1	<1	2	2	<1	<1	<1
Megaloptera	Sialidae	<1	<1	<1	<1	<1	<1				

TABLE 4.5-9

Summary of Riverine Depositional Benthic Invertebrate Biotic Indices Calculated at the Lowest Practical Level of Taxonomic Identification.

Collins Creek	Station	2008			2013			2016			2019			2022		
		Taxon Richness	Simpson's Diversity	Evenness	Taxon Richness	Simpson's Diversity	Evenness	Taxon Richness	Simpson's Diversity	Evenness	Taxon Richness	Simpson's Diversity	Evenness	Taxon Richness	Simpson's Diversity	Evenness
BM18C Reference	1	45	0.89	0.20	60	0.83	0.10	28	0.78	0.16	72	0.93	0.21	30	0.72	0.12
	2	46	0.94	0.37	42	0.80	0.12	30	0.80	0.16	67	0.89	0.13	36	0.86	0.19
	3	55	0.86	0.13	39	0.91	0.28	29	0.89	0.32	70	0.90	0.14	36	0.70	0.09
	4	43	0.88	0.19	33	0.88	0.26	39	0.85	0.18	63	0.86	0.11	38	0.83	0.16
	5	39	0.88	0.22	46	0.92	0.26	24	0.89	0.39	74	0.95	0.28	30	0.87	0.26
Total		228	4.45	1.11	220	4.35	1.03	150	4.21	1.21	346	4.53	0.87	170.00	3.99	0.83
Mean		46	0.89	0.22	44	0.87	0.21	30	0.84	0.24	69	0.91	0.17	34.00	0.80	0.17
Standard Deviation		6	0.03	0.09	10	0.05	0.09	6	0.05	0.11	4	0.04	0.07	3.74	0.08	0.07
Median		45	0.88	0.20	42	0.88	0.26	29	0.85	0.18	70	0.90	0.14	36.00	0.83	0.16
Minimum		39	0.86	0.13	33	0.80	0.10	24	0.78	0.16	63	0.86	0.11	30.00	0.70	0.09
Maximum		55	0.94	0.37	60	0.92	0.28	39	0.89	0.39	74	0.95	0.28	38.00	0.87	0.26
BM19E Exposure	1	61	0.84	0.10	70	0.89	0.12	37	0.90	0.26	69	0.92	0.18	35	0.84	0.17
	2	53	0.76	0.08	35	0.83	0.17	40	0.89	0.22	62	0.94	0.25	31	0.75	0.13
	3	65	0.82	0.08	47	0.73	0.08	37	0.81	0.14	46	0.79	0.11	20	0.80	0.25
	4	45	0.91	0.24	33	0.91	0.35	43	0.89	0.22	59	0.86	0.12	25	0.72	0.14
	5	41	0.89	0.22	28	0.79	0.17	35	0.87	0.22	57	0.87	0.14	23	0.77	0.19
Total		265	4.22	0.73	213	4.15	0.89	192	4.36	1.06	293	4.38	0.80	134.00	3.89	0.89
Mean		53	0.84	0.15	43	0.83	0.18	38	0.87	0.21	59	0.88	0.16	26.80	0.78	0.18
Standard Deviation		10	0.06	0.08	17	0.07	0.10	3	0.03	0.04	8	0.06	0.06	6.10	0.04	0.05
Median		53	0.84	0.10	35	0.83	0.17	37	0.89	0.22	59	0.87	0.14	25.00	0.77	0.17
Minimum		41	0.76	0.08	28	0.73	0.08	35	0.81	0.14	46	0.79	0.11	20.00	0.72	0.13
Maximum		65	0.91	0.24	70	0.91	0.35	43	0.90	0.26	69	0.94	0.25	35.00	0.84	0.25

TABLE 4.5-10

Analysis of Variance Testing for Variations in Indices Composition (at Lowest Practical Level) Between Reference and Exposure Riverine Depositional Benthic Invertebrate Samples from Collins Creek, 2022.

Variable	Source	SS	df	MS	*F*	*p*- Value	Area	LS Mean	SD	Difference	ES
Log of Abundance	Area	0.027	1	0.027	0.17	0.689	BM18C	3.41	0.40	0.27	0.66
	Error	1.262	8	0.158			BM19E	3.68	0.45		
Log of LPL Richness	Area	0.030	1	0.030	5.054	0.055	BM18C	1.63	0.14	-0.01	-0.06
	Error	0.048	8	0.006			BM19E	1.62	0.15		
Simpson's Evenness	Area	0.000	1	0.000	0.119	0.739	BM18C	0.20	0.08	-0.03	-0.33
	Error	0.027	8	0.003			BM19E	0.17	0.07		
Simpson's Diversity	Area	0.001	1	0.001	0.261	0.624	BM18C	0.86	0.06	-0.02	-0.35
	Error	0.033	8	0.004			BM19E	0.84	0.06		
CA Axis 1	Area	0.090	1	0.090	0.25	0.634	BM18C	0.08	0.50	-0.34	-0.69
	Error	2.934	8	0.367			BM19E	-0.27	0.69		
CA Axis 2	Area	0.027	1	0.027	0.188	0.676	BM18C	-0.36	0.41	0.51	1.25
	Error	1.147	8	0.143			BM19E	0.16	0.52		

SS = Sum of Squares, df = Degrees of Freedom, MS = Mean Square, F = F-ratio, ES= Effect size,
LS Mean = Least Squares Mean , SD = Standard Deviations
Values in bold represent p-Values that are statistically significant at p < 0. 05.

TABLE 4.5-11

Analysis of Variance Testing for Variations in Indices Composition (at Lowest Practical Level) Between Reference and Exposure Riverine Depositional Benthic Invertebrate Samples from Collins Creek, 2008, 2013, 2016, 2019, and 2022.

Variable	Source	SS	df	MS	*F* ratio	*p*-Value	Variance Explained (%)
log of Abundance	Area-Year	6.4258	9	0.714	8.945	**<0.001**	-
	H02: 2022 Differed from prior	0.0089	1	0.009	0.112	0.739	0
	H03: 2022 and 2019 Differed from prior	3.6649	1	3.665	45.915	**<0.001**	57
	H04: 2016, 2019, and 2022 Differed from prior	0.0360	1	0.036	0.451	0.506	1
	H05: 2013, 2016, 2019, and 2022 Differed from 2008	0.0005	1	0.001	0.007	0.934	0
	H06: Difference in linear trends	0.0205	1	0.020	0.256	0.615	0
	Error	3.1928	40	0.080			-
log of LPL Richness	Area-Year	0.7616	9	0.085	12.392	**<0.001**	-
	H02: 2022 Differed from prior	0.0009	1	0.001	0.128	0.723	0
	H03: 2022 and 2019 Differed from prior	0.1253	1	0.125	18.346	**<0.001**	16
	H04: 2016, 2019, and 2022 Differed from prior	0.2284	1	0.228	33.446	**<0.001**	30
	H05: 2013, 2016, 2019, and 2022 Differed from 2008	0.0388	1	0.039	5.688	**0.022**	5
	H06: Difference in linear trends	0.0536	1	0.054	7.846	**0.008**	7
	Error	0.2732	40	0.007			-
Simpson's Evenness	Area-Year	0.0430	9	0.005	0.781	0.635	-
	H02: 2022 Differed from prior	0.0017	1	0.002	0.285	0.597	4
	H03: 2022 and 2019 Differed from prior	0.0177	1	0.018	2.887	0.097	41
	H04: 2016, 2019, and 2022 Differed from prior	0.0002	1	0.000	0.027	0.871	0
	H05: 2013, 2016, 2019, and 2022 Differed from 2008	0.0012	1	0.001	0.197	0.659	3
	H06: Difference in linear trends	0.0085	1	0.009	1.390	0.245	20
	Error	0.2449	40	0.006			-
Simpson's Diversity	Area-Year	0.0738	9	0.008	2.809	**0.012**	-
	H02: 2022 Differed from prior	0.0021	1	0.002	0.706	0.406	3
	H03: 2022 and 2019 Differed from prior	0.0002	1	0.000	0.055	0.815	0
	H04: 2016, 2019, and 2022 Differed from prior	0.0183	1	0.018	6.274	**0.016**	25
	H05: 2013, 2016, 2019, and 2022 Differed from 2008	0.0108	1	0.011	3.695	0.062	15
	H06: Difference in linear trends	0.0001	1	0.000	0.047	0.829	0
	Error	0.1167	40	0.003			-
CA Axis 1	Area-Year	11.9584	9	1.329	7.641	**<0.001**	-
	H02: 2022 Differed from prior	0.0168	1	0.017	0.096	0.758	0
	H03: 2022 and 2019 Differed from prior	0.7266	1	0.727	4.178	**0.048**	6
	H04: 2016, 2019, and 2022 Differed from prior	3.4394	1	3.439	19.778	**<0.001**	29
	H05: 2013, 2016, 2019, and 2022 Differed from 2008	0.1390	1	0.139	0.799	0.377	1
	H06: Difference in linear trends	1.5797	1	1.580	9.084	0.004	13
	Error	6.9558	40	0.174			-
CA Axis 2	Area-Year	6.7240	9	0.747	4.256	**0.001**	-
	H02: 2022 Differed from prior	0.0625	1	0.063	0.356	0.554	1
	H03: 2022 and 2019 Differed from prior	1.8819	1	1.882	10.721	**0.002**	28
	H04: 2016, 2019, and 2022 Differed from prior	1.8649	1	1.865	10.624	**0.002**	28
	H05: 2013, 2016, 2019, and 2022 Differed from 2008	0.9051	1	0.905	5.156	**0.029**	13
	H06: Difference in linear trends	0.0166	1	0.017	0.094	0.760	0
	Error	7.0213	40	0.176			-

SS = Sum of Squares, df = Degrees of Freedom, MS = Mean Square, F = F-ratio

Values in bold represent *p*-Values that are statistically significant at $p < 0.05$, values in bold and Variance Explained cells shaded are significant and explain more than 20% of the variance

TABLE 4.5-12

Results of the Mantel Test for Spatial and Temporal Differences in the Bray-Curtis Index (at the Lowest Practical Level) from the Riverine Depositional Area of Collins Creek.

Test	Mantel *r*	*p*- Value
H01: Control-Impact 2022	0.147	**0.001**
H02: 2022 Differed from prior	0.003	0.486
H03: 2022 and 2019 Differed from prior	0.099	**0.004**
H04: 2016, 2019, and 2022 Differed from 2008	-0.009	0.618
H05: 2013, 2016, 2019, and 2022 Differed from 2008	-0.097	0.921
H06: Difference in linear trends	-0.053	0.889

Values in bold represent *p* -Values that are statistically significant at $p < 0.05$.

TABLE 4.6-1

Fish Species Identified During Baseline and Operational Period Fish Surveys in the McClean Lake Operation LSA and Associated Reference Areas.

Waterbody	Arctic Grayling	Burbot	Cisco	Lake Chub	Lake Trout	Lake Whitefish	Longnose Sucker	Ninespine Stickleback	Northern Pike	Round Whitefish	Slimy Sculpin	Spottail Shiner	Trout-perch	Walleye	White Sucker	Yellow Perch
Reference Area																
Collins Creek	-	✓	-	✓	-	-	-	-	✓	-	✓	-	-	-	✓	-
Henday Lake	-	✓	-	-	✓	✓	✓	-	✓	-	-	-	-	-	✓	-
Konner Lake	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	✓	-
Mallen Lake	-	x	x, ✓	x	x, ✓	x, ✓	x, ✓	x	x, ✓	x	x	x	x	-	x, ✓	-
Umpherville River	✓	✓	-	-	-	-	-	-	-	-	✓	-	-	-	✓	-
Sink/Vulture Treated Effluent Management System																
Sink Lake	-	-	-	-	-	-	-	x	x, ✓	-	-	-	-	-	x, ✓	-
Vulture Lake	-	-	-	-	-	-	-	x	x, ✓	-	-	-	-	-	x, ✓	x, ✓
Vulture Creek	-	-	-	-	-	-	-	x	x	-	x	-	-	-	-	-
Primary Exposure Area																
McClean Lake	-	x	x	-	-	x, ✓	x	x	x, ✓	-	x	-	-	x, ✓	x, ✓	x
Collins Creek	x, ✓	x, ✓	-	x, ✓	-	x	x	x, ✓	x, ✓	-	x, ✓	-	x, ✓	x	x, ✓	x, ✓
Kewen Lake	-	-	x	-	-	x, ✓	-	-	x, ✓	-	-	-	-	x, ✓	x, ✓	✓
Secondary Exposure Area																
Armand Lake	-	-	-	-	-	x	-	-	x	-	-	-	-	-	-	-
Candy Lake	-	x	-	-	-	-	-	-	x	-	-	-	-	-	x	-
Candy Creek	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dwarf Lake	-	-	-	-	-	x	-	-	x	-	-	-	-	-	x	-
Emperor Lake	-	-	-	-	-	x	-	x	x	-	-	-	-	-	x	-
Esto Lake	-	-	-	x	-		-	-	-	-	-	-	-	-	-	-
Fox Lake	-	-	-	-	-	x	-	-	x	-	-	-	-	-	x	x
Johannes Lake	-	-	-	-	x	x	-	-	x	-	-	-	-	x	x	x
Kismet Lake	-	-	-	-	-	x	-	-	x	-	-	-	-	-	-	-
Moffat Lake	-	x	-	x	-	x	-	x	x	-	-	-	-	x	x	x
Nadia Lake	-	-	-	-	-	x	-	-	x	-	-	-	-	-	-	-
Pat Lake	-	x	-	-	x	x	-	-	x	-	x	x	-	-	x	x
Tail Lake	-	-	-	-	-	x	-	-	x	-	-	-	-	-	-	-
Torwalt Lake	-	x	x	-	-	x	x	x	x	-	-	x	-	x	x	x
Tut Lake	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sue Lake	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sils Lake	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unnamed Lake	-	-	-	-	-	x	-	-	x	-	-	-	-	x	x	x

x denotes captured during baseline fish surveys.
✓ denotes fish captured during operational period fish surveys.

TABLE 4.6-2

Catch per Unit Effort of Short-length Gill Netting in the Operational Monitoring Period at the McClean Lake LSA and Associated Reference Areas.

Waterbody	Year	Duration (hours)	No. of Pannels	Species	Total Catch	CPUE
Reference Area						
Henday Lake	2005	48.0	4	Lake Trout	5	0.0260
				Lake Whitefish	5	0.0260
	2008	61.2	16	Burbot	1	0.0010
				Lake Trout	29	0.0296
				Lake Whitefish	22	0.0225
				Longnose Sucker	3	0.0031
				Northern Pike	4	0.0041
				White Sucker	5	0.0051
	2015	59.9	45	Lake Trout	21	0.0078
				Lake Whitefish	31	0.0115
				Northern Pike	13	0.0048
	2018	8.8	10	Northern Pike	8	0.0914
	2021	16.5	18	Lake Whitefish	6	0.0202
	2024	9.6	6	Lake Trout	2	0.0347
				Lake Whitefish	1	0.0173
				Northern Pike	4	0.0693
Konner Lake	2005	32.3	9	Northern Pike	12	0.0412
				White Sucker	5	0.0172
	2008	61.9	12	Northern Pike	8	0.0108
				White Sucker	1	0.0013
	2011	32.5	33	Northern Pike	3	0.0028
	2015	9.0	14	Northern Pike	2	0.0158
				White Sucker	5	0.0396
	2018	42.1	11	Northern Pike	5	0.0108
	2021	30.6	15	Northern Pike	7	0.0153
	2024	78.0	18	Northern Pike	25	0.0178
Mallen Lake	2005	26.8	4	Longnose Sucker	5	0.0466
				Northern Pike	6	0.0559
	2008	9.9	12	Northern Pike	15	0.1261
	2011	2.8	2	-	-	-
	2015	25.4	17	Lake Trout	1	0.0023
				Lake Whitefish	1	0.0023
				Northern Pike	3	0.0069
				White Sucker	6	0.0139
Sink/Vulture Treated Effluent Management System						
Sink Reservoir	2008	95.3	24	Northern Pike	28	0.0122
				White Sucker	6	0.0026
	2011	10.3	12	White Sucker	1	0.0081
	2015	21.8	9	Northern Pike	6	0.0305
	2021	60.2	36	Northern Pike	5	0.0023
	2024	56.2	12	Northern Pike	6	0.0089
Vulture Lake	1998	73.4	7	Northern Pike	11	0.0214
				White Sucker	5	0.0097
	2005	40.3	9	Northern Pike	5	0.0138
				White Sucker	8	0.0220
	2008	225.6	60	Northern Pike	40	0.0030
				White Sucker	5	0.0004
	2011	106.1	61	Northern Pike	12	0.0019
	2015	1587.0	23	Northern Pike	14	0.0004
	2018	50.1	8	Northern Pike	5	0.0125
	2021	55.9	24	Northern Pike	13	0.0097

TABLE 4.6-2

Catch per Unit Effort of Short-length Gill Netting in the Operational Monitoring Period at the McClean Lake LSA and Associated Reference Areas.

Waterbody	Year	Duration (hours)	No. of Pannels	Species	Total Catch	CPUE
Primary Exposure Area						
McClean Lake East Basin	2016	38.1	7	Lake Whitefish	12	0.0450
				Northern Pike	12	0.0450
				Walleye	7	0.0263
				White sucker	3	0.0113
	2021	39.2	6	Lake Whitefish	1	0.0043
				Northern Pike	2	0.0085
	2024	63.2	24	Lake Whitefish	7	0.0046
				Northern Pike	13	0.0086
				Walleye	4	0.0026
				White Sucker	1	0.0007
Kewen Lake	1998	330.7	14	Lake Whitefish	6	0.0013
				Northern Pike	15	0.0032
				White Sucker	2	0.0004
	2005	47.0	15	Lake Whitefish	9	0.0128
				Northern Pike	16	0.0227
				Walleye	5	0.0071
				White Sucker	3	0.0043
	2008	23.4	18	Lake Whitefish	5	0.0119
				Northern Pike	6	0.0143
				Walleye	1	0.0024
	2015	3.0	5	-	-	-
	2018	40.2	6	Lake Whitefish	7	0.0290
				Northern Pike	6	0.0249
	2021	12.0	6	Walleye	2	0.0278
				White Sucker	1	0.0139
	2024	22.1	12	Lake Whitefish	1	0.0038
				Northern Pike	8	0.0302
				Walleye	1	0.0038
				White Sucker	3	0.0113

CPUE = number of fish captured per hour of gill net set per 10 m panel.

TABLE 4.6-3

Catch per Unit Effort of Half Standard Gang Gill Netting in the Operational Monitoring Period at the McClean Lake LSA and Associated Reference Areas.

Waterbody	Year	Duration (hours)	Species	Total Catch	CPUE
Reference Area					
Henday Lake	2005	10.9	Lake Trout	12	1.10
			Lake Whitefish	10	0.92
			Longnose Sucker	1	0.09
	2008	18.8	Lake Trout	21	1.11
			Lake Whitefish	18	0.95
			Northern Pike	2	0.11
			White Sucker	9	0.48
	2011	4.2	Lake Trout	10	2.40
			Lake Whitefish	8	1.92
	2015	16.0	Lake Trout	22	1.37
			Lake Whitefish	8	0.50
			Northern Pike	3	0.19
	2018	73.6	Lake Trout	42	0.57
			Lake Whitefish	40	0.54
			Northern Pike	9	0.12
			White Sucker	2	0.03
	2021	22.8	Lake Trout	2	0.09
			Lake Whitefish	2	0.09
			Northern Pike	4	0.18
	2024	3.9	Lake Trout	6	1.55
			Lake Whitefish	13	3.35
			Northern Pike	5	1.29
Konner Lake	2005	34.8	Northern Pike	19	0.55
			White Sucker	2	0.06
	2008	21.0	Northern Pike	11	0.52
			White Sucker	9	0.43
	2011	48.8	Northern Pike	22	0.45
			White sucker	1	0.02
	2015	16.7	Northern Pike	8	0.48
	2018	122.3	Northern Pike	4	0.03
			White Sucker	16	0.13
	2021	35.3	Northern Pike	9	0.26
			White Sucker	7	0.20
	2024	51.5	Northern Pike	15	0.29
			White Sucker	4	0.08
Mallen Lake	1998	11.2	Cisco	1	0.09
			Lake Trout	1	0.09
			Lake Whitefish	8	0.72
			Longnose Sucker	2	0.18
			Northern Pike	2	0.18
			White Sucker	9	0.81
	2005	7.2	Northern Pike	1	0.14
			Lake Whitefish	1	0.14
	2008	37.3	Northern Pike	7	0.19
			White Sucker	5	0.13
	2011	9.4	Lake Trout	1	0.11
			Lake Whitefish	7	0.74
			Northern Pike	13	1.38
	2015	18.8	Lake Trout	1	0.05
			Lake Whitefish	13	0.69
			Northern Pike	8	0.43
			White Sucker	12	0.64

TABLE 4.6-3

Catch per Unit Effort of Half Standard Gang Gill Netting in the Operational Monitoring Period at the McClean Lake LSA and Associated Reference Areas.

Waterbody	Year	Duration (hours)	Species	Total Catch	CPUE
Sink/Vulture Treated Effluent Management System					
Sink Reservoir	2008	24.0	Northern Pike	1	0.04
			White Sucker	4	0.17
	2011	8.8	Northern Pike	4	0.45
			White Sucker	55	6.25
	2015	24.8	Northern Pike	13	0.52
			White Sucker	7	0.28
	2018	66.4	Northern Pike	27	0.41
			White Sucker	5	0.08
	2021	74.6	Northern Pike	5	0.07
	2024	39.5	Northern Pike	3	0.08
Vulture Lake	2005	43.4	Northern Pike	8	0.18
			White Sucker	1	0.02
	2008	89.7	Northern Pike	42	0.47
			White Sucker	1	0.01
	2011	64.6	Northern Pike	27	0.42
			Yellow Perch	1	0.02
	2015	33.2	Northern pike	20	0.60
	2024	7.8	Northern pike	1	0.13
Primary Exposure Area					
McClean Lake East Basin	2016	25.4	Lake Whitefish	22	0.87
			Northern Pike	18	0.71
			Walleye	8	0.31
			White Sucker	11	0.43
	2021	43.2	Lake Whitefish	21	0.49
			Northern Pike	8	0.19
			Walleye	7	0.16
			White Sucker	5	0.12
	2024	25.1	Cisco	4	0.16
			Lake Whitefish	30	1.19
			Northern Pike	14	0.56
			Walleye	12	0.48
			White Sucker	2	0.08
Kewen Lake	1998	6.2	Lake Whitefish	2	0.32
			Northern Pike	16	2.59
			White Sucker	3	0.49
			Yellow Perch	2	0.32
	2005	2.5	Lake Whitefish	4	1.60
	2008	6.8	Lake Whitefish	12	1.75
			Northern Pike	10	1.46
			Sucker sp.	8	1.17
			White Sucker	5	0.73
	2011	7.0	Lake Whitefish	11	1.57
			Northern Pike	3	0.43
			Walleye	1	0.14
			White Sucker	5	0.71
	2015	24.8	Lake Whitefish	41	1.66
			Northern Pike	28	1.13
			Walleye	8	0.32
			White Sucker	14	0.57
	2018	138.1	Lake Whitefish	11	0.08
			Northern Pike	31	0.22
			Walleye	12	0.09
			White Sucker	14	0.10
	2021	37.2	Northern Pike	2	0.05
			Walleye	4	0.11
	2024	5.8	Northern Pike	2	0.34
			White Sucker	6	1.03

CPUE = number of fish captured per hour of half standard gill net set.

TABLE 4.6-4

Catch per Unit Effort Electrofishing in Collins Creek and Associated Reference Areas during the Operational Monitoring Period.

Waterbody	Designation	Year	Species	Effort (min)	Total Catch	CPUE
McClean Lake East Basin	Exposure	2016	Burbot	35.8	3	0.08
			Northern Pike		16	0.45
Collins Creek (Downstream of McClean Lake)	Exposure 1	2005	Slimy Sculpin	90.35	134	1.48
		2006	Slimy Sculpin	271.65	672	2.47
		2008	Burbot	73.08	82	1.12
			Slimy Sculpin		123	1.68
			Lake Chub		4	0.05
		2013	Burbot	65.70	102	1.55
			Slimy Sculpin		106	1.61
			Lake Chub		3	0.05
		2016	Burbot	150.28	153	1.02
			Lake Chub		22	0.15
			Slimy Sculpin		213	1.42
			White Sucker		1	0.01
		2022	Burbot	122.40	178	1.45
			Lake Chub		13	0.11
			Slimy Sculpin		109	0.89
			Northern Pike		1	0.01
Collins Creek (Near Kewen Lake)	Exposure 2	2008	Burbot	38.07	7	0.18
			Slimy Sculpin		132	3.47
			Lake Chub		3	0.08
			White Sucker		2	0.05
			Trout Perch		1	0.03
			Northern Pike		2	0.05
Collins Creek (Near Collins Bay)	Exposure 3	2008	Burbot	166.97	58	0.35
			Slimy Sculpin		129	0.77
			Lake Chub		6	0.04
			Ninespine Stickleback		1	0.01
			Arctic Grayling		1	0.01
Collins Creek (Upstream of McClean Lake)	Reference 1	2005	Slimy Sculpin	370.68	147	0.40
		2006	Slimy Sculpin	117.25	142	1.21
		2008	Burbot	199.09	119	0.60
			Slimy Sculpin		112	0.56
			Lake Chub		4	0.02
			Northern Pike		1	0.01
		2013	Burbot	83.95	106	1.26
			Slimy Sculpin		73	0.87
			Lake Chub		2	0.02
		2016	Burbot	263.50	91	0.35
			Lake Chub		3	0.01
			Ninespine Stickleback		1	0.004
			Slimy Sculpin		66	0.25
			White Sucker		2	0.01
		2022	Burbot	365.40	280	0.77
			Lake Chub		5	0.01
			Slimy Sculpin		87	0.24
Umpherville River	Reference 2	2008	Burbot	169.80	88	0.52
			Slimy Sculpin		215	1.27
			Arctic Grayling		1	0.01

CPUE = catch per minute of electrofishing

Only targeted fish species (slimy sculpin) enumerated in 2005 and 2006, although other bycatch species were observed.

TABLE 4.6-5

Summary of Baseline Fish Tissue Metal Concentrations from the 1994 Surveys, McClean Lake Operation.

Area	Species	Analysis	Arsenic µg/g		Cadmium µg/g		Cobalt µg/g		Copper µg/g		Lead µg/g		Molybdenum µg/g		Nickel µg/g		Vanadium µg/g		Zinc µg/g	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Reference Area																				
McClean Lake West	Northern Pike	Bone	0.05	<0.001	0.2	<0.001	0.2	<0.001	0.24	0.055	0.1	<0.001	0.1	<0.001	0.28	0.045	2	0	40.8	4.438
		Flesh	0.024	0.005	0.1	<0.001	0.1	<0.001	0.2	0.071	0.05	<0.001	0.05	<0.001	0.02	0	1	0	4.94	1.573
	White Sucker	Bone	0.058	0.01	0.2	0	0.2	0	0.35	0.1	0.1	0	0.1	0	0.2	0	2	0	16	1.414
		Flesh	0.028	0.005	0.1	0	0.1	0	0.225	0.096	0.05	0	0.05	0	0.04	0.028	1	0	4.275	1.087
Sink/Vulture Treated Effluent Management																				
Vulture Lake	Northern Pike	Bone	0.05	<0.001	0.2	<0.001	0.2	<0.001	0.22	0.045	0.1	<0.001	0.1	<0.001	0.2	0.071	2	0	26.6	10.46
		Flesh	0.022	0.004	0.1	<0.001	0.1	<0.001	0.16	0.089	0.05	<0.001	0.05	<0.001	0.02	0	1	0	6.08	2.292
	White Sucker	Bone	0.06	0.01	0.2	<0.001	0.2	<0.001	0.24	0.089	0.1	<0.001	0.1	<0.001	0.138	0.057	2	0	13	2.55
		Flesh	0.026	0.009	0.1	<0.001	0.1	<0.001	0.24	0.055	0.05	<0.001	0.05	<0.001	0.02	0	1	0	3.96	0.937
Primary Exposure Area																				
McClean Lake	White	Bone	0.05	-	0.2	-	0.2	-	0.3	-	0.1	-	0.1	-	0.2	-	2	-	17	-
	Sucker	Flesh	0.03	-	0.1	-	0.1	-	0.6	-	0.05	-	0.05	-	0.02	-	1	-	5.4	-
McClean Lake East	Northern Pike	Bone	0.05	<0.001	0.2	<0.001	0.2	<0.001	0.2	<0.001	0.1	<0.001	0.1	<0.001	0.16	0.055	2	0	38.4	11.08
		Flesh	0.022	0.004	0.1	<0.001	0.1	<0.001	0.22	0.13	0.05	<0.001	0.05	<0.001	0.116	0.048	1	0	5.34	0.945
	White Sucker	Bone	0.05	<0.001	0.2	<0.001	0.2	<0.001	0.34	0.055	0.1	<0.001	0.1	<0.001	0.148	0.101	2	0	13.4	3.05
		Flesh	0.024	0.009	0.1	<0.001	0.1	<0.001	0.48	0.259	0.05	<0.001	0.05	<0.001	0.132	0.169	1	0	4.64	0.647
Kewen Lake	Northern Pike	Bone	0.05	<0.001	0.2	<0.001	0.2	<0.001	0.8	1.233	0.1	<0.001	0.1	<0.001	0.158	0.091	2	0	49	22.77
		Flesh	0.024	0.009	0.1	<0.001	0.1	<0.001	0.22	0.11	0.05	<0.001	0.05	<0.001	0.3	0.292	1	0	9.34	8.422
	White Sucker	Bone	0.05	<0.001	0.2	<0.001	0.2	<0.001	0.26	0.055	0.1	<0.001	0.1	<0.001	0.176	0.238	2	0	11.8	1.924
		Flesh	0.022	0.004	0.1	<0.001	0.1	<0.001	0.44	0.288	0.05	<0.001	0.05	<0.001	0.192	0.086	1	0	4.4	1.204
Secondary Exposure Area																				
Johannes Lake	Northern Pike	Bone	0.05	<0.001	0.2	<0.001	0.2	<0.001	0.22	0.045	0.1	<0.001	0.1	<0.001	0.19	0.134	2	0	47.8	8.758
		Flesh	0.028	0.013	0.1	<0.001	0.1	<0.001	0.14	0.055	0.05	<0.001	0.05	<0.001	0.06	0.037	1	0	4.46	0.483
	White Sucker	Bone	0.05	<0.001	0.2	<0.001	0.2	<0.001	0.24	0.089	0.1	<0.001	0.1	<0.001	0.09	0.065	2	0	10.4	3.38
		Flesh	0.024	0.005	0.1	<0.001	0.1	<0.001	0.32	0.13	0.05	<0.001	0.05	<0.001	0.096	0.095	1	0	4.22	0.823
Moffat Lake	Northern Pike	Bone	0.052	0.004	0.2	<0.001	0.2	<0.001	0.2	<0.001	0.1	<0.001	0.1	<0.001	0.2	0.1	2	0	27.8	8.585
		Flesh	0.02	0	0.1	<0.001	0.1	<0.001	0.3	0.122	0.05	<0.001	0.05	<0.001	0.072	0.073	1	0	5.16	1.443
	White Sucker	Bone	0.054	0.005	0.2	<0.001	0.2	<0.001	0.24	0.055	0.1	<0.001	0.1	<0.001	0.138	0.057	2	0	13.6	1.342
		Flesh	0.028	0.018	0.1	<0.001	0.1	<0.001	0.28	0.045	0.05	<0.001	0.05	<0.001	0.02	0	1	0	5.2	0.877

SD = standard deviation; Data presented on a dry weight basis.

TABLE 4.6-6

Summary of Baseline Fish Tissue Radionuclide Levels from the 1994 Surveys, McClean Lake Operation.

Area	Species	Analysis	Lead-210		Radium-226		Polonium-210		Thorium-230		Uranium	
			Bq/g		Bq/g		Bq/g		Bq/g		µg/g	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Reference Area												
McClean Lake West	Northern Pike	Bone	0.002	<0.001	0.001	0	0.001	<0.001	0.0022	<0.001	0.02	0
		Flesh	0.001	0	<0.001	0	<0.001	<0.001	<0.001	<0.001	0.001	0
	White Sucker	Bone	0.002	<0.001	0.001	0	0.002	0.002	0.002	0	0.023	0.005
		Flesh	0.001	0	<0.001	0	<0.001	<0.001	<0.001	<0.001	0.001	0
Sink/Vulture												
Vulture Lake	Northern Pike	Bone	0.003	0.001	0.001	0	0.002	0.001	0.002	0	0.02	0
		Flesh	0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	0.002	0.001
	White Sucker	Bone	0.003	<0.001	0.001	0	0.002	<0.001	0.0022	<0.001	0.022	0.004
		Flesh	0.001	0	<0.001	0	0.002	<0.001	<0.001	0	0.001	<0.001
Primary Exposure												
McClean Lake	White Sucker	Bone	0.004	-	0.001	-	0.002	-	0.002	-	0.02	-
		Flesh	0.002	-	<0.001	-	<0.001	-	<0.001	-	0.003	-
McClean Lake East	Northern Pike	Bone	0.011	0.019	0.001	0	0.001	<0.001	0.002	0	0.02	0
		Flesh	0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0	0.001	0
	White Sucker	Bone	0.013	0.021	0.001	0	0.001	<0.001	0.002	0	0.024	0.009
		Flesh	0.023	0.022	<0.001	<0.001	0.001	0.001	<0.001	<0.001	0.001	<0.001
Kewen Lake	Northern Pike	Bone	0.005	0.003	0.001	0	<0.001	<0.001	0.002	0	0.022	0.004
		Flesh	0.002	<0.001	<0.001	0	<0.001	<0.001	<0.001	0	0.001	0
	White Sucker	Bone	0.005	0.002	0.001	0	0.001	<0.001	0.002	0	0.024	0.009
		Flesh	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Secondary												
Johannes Lake	Northern Pike	Bone	0.004	0.003	0.001	0	<0.001	<0.001	0.002	0	0.02	0
		Flesh	0.001	<0.001	<0.001	<0.001	0.001	<0.001	0	0	0.001	0
	White Sucker	Bone	0.005	0.002	0.0012	<0.001	0.001	<0.001	0.002	0	0.024	0.009
		Flesh	0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0	0.001	<0.001
Moffat Lake	Northern Pike	Bone	0.005	0.004	0.001	0	0.002	<0.001	0.002	<0.001	0.02	0
		Flesh	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0	0.001	0
	White Sucker	Bone	0.003	0.002	0.001	0	0.003	0.001	0.002	0	0.02	0
		Flesh	0.004	0.006	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	0.002	0.001

SD = standard deviation; Data presented on a dry weight basis.

TABLE 4.6-7

Predicted Maximum Mean and 95th Percentile Concentrations of Select Parameters in Fish Flesh from the 2016 ERA.

Parameter	Sink Reservoir		Vulture Lake		McClean Lake East Basin		Kewen Lake	
	Max Mean	Max 95th Percentile	Max Mean	Max 95th Percentile	Max Mean	Max 95th Percentile	Max Mean	Max 95th Percentile
Metals and Trace Elements								
Arsenic (µg/g)	1.6	3.6	0.96	2.3	0.6	2.0	0.6	2.0
Cobalt (µg/g)	10	37	2.5	8.7	0.5	2.1	0.4	1.3
Copper (µg/g)	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
Lead (µg/g)	0.1	0.2	0.04	0.07	0.02	0.05	0.02	0.05
Molybdenum (µg/g)	0.1	0.3	0.1	0.2	0.1	0.2	0.1	0.2
Nickel (µg/g)	0.2	0.4	0.1	0.2	0.1	0.1	0.1	0.1
Uranium (µg/g)	0.03	0.1	0.02	0.04	0.01	0.03	0.01	0.02
Zinc (µg/g)	35	91	29	57	26	48	26	48
Radionuclides								
Thorium-230 (Bq/g)	0.004	0.012	0.002	0.008	0.001	0.002	0.001	0.001
Radium-226 (Bq/g)	0.001	0.005	0.001	0.003	0.0004	0.001	0.0003	0.001
Lead-210 (Bq/g)	0.005	0.016	0.003	0.008	0.003	0.006	0.003	0.005
Polonium-210 (Bq/g)	0.048	0.126	0.035	0.087	0.012	0.030	0.010	0.027

Maximum predicted mean and 95th percentile for the monitoring period (2022 - 2024); Dry weight concentration = wet weight concentration *(100/100-% moisture in sample); assumed 77% moisture in fish flesh.

Source: AREVA 2016b

TABLE 4.6-8

Predicted Maximum Mean and 95th Percentile Selenium Concentrations in Fish Tissue, 2018 ERA.

Predicted Selenium Concentration	Assessment	Result[1]	Sink Reservoir	Vulture Lake	McClean Lake east basin	Kewen Lake	Site Specific Benchmark[8]	Literature Based Guidelines
Fish Flesh (µg/g dry weight)	2018	Max Mean	19	14	7	2	13.0 µg/g (dry weight)	11.3 µg/g (dry weight)[5]
		Max 95th Percentile	28	22	17	4		
Fish Total Body (µg/g dry weight)[2,4]	2018	Max Mean	16	12	6	2	-	6.7 µg/g (dry weight)[6] 8.5 µg/g (dry weight)[5]
		Max 95th Percentile	22	18	14	4		
Fish Ovary (µg/g dry weight)[3,4]	2018	Max Mean	34	27	13	3.8	19.0 µg/g (dry weight)	14.7 µg/g (dry weight)[6] 15.1 µg/g (dry weight)[5] 20 µg/g (dry weight)[7]
		Max 95th Percentile	48	39	30	9.1		

[1]Maximum predicted mean and 95th percentile for the monitoring period (2022 - 2024); Dry weight concentration = wet weight concentration *(100/100-% moisture in sample); assumed 77% moisture in fish flesh.

[2]Total body selenium calculation: $[Se_{whole\text{-}body}] = \exp(0.1331+(0.8937 \times \ln[Se_{muscle}]))$

[3]Fish ovary selenium calculation: $[Se_{whole\text{-}body}] = 0.0173+(0.4634 \times [Se_{ovary}])$

[4]U.S. EPA 2004

[5]U.S. EPA 2016

[6]GC 2017 (PNEC)

[7]DeForest et al. 2011

[8]Site specific benchmark for selenium in fish tissue specific to McClean Lake East Basin.

Source: AREVA 2016b; Orano 2018a.

TABLE 4.6-9

COPC Screening in Fish Tissue from the Primary Exposure Area in the McClean Lake Operation LSA.

Parameter	Unit	McClean Lake Operation Monitoring		Available Impact Prediction?[1]	COPC Selection based on 2022 to 2024 data				
		EMDD 2019	EMDD 2023		less than 90% of data below RDL (EC1)[2]	Exceeded Reference Range (EC2)[3]	Initially Screened as COPC[4]	PCA (EC3)[5]	Selected as COPC
Inorganic Ions									
Calcium	µg/g	N	N	N	N	N	N	N	N
Magnesium	µg/g	N	N	N	N	N	N	N	N
Potassium	µg/g	N	N	N	N	N	N	N	N
Sodium	µg/g	N	N	N	N	N	N	N	N
Metals									
Aluminum	µg/g	Y	Y	N	Y	Y	Y	N	Y
Antimony	µg/g	N	N	N	Y	Y	Y	N	Y
Arsenic	µg/g	Y	Y	Y	Y	Y	Y	N	Y
Barium	µg/g	N	N	N	Y	N	N	Y	Y
Beryllium	µg/g	N	N	N	Y	Y	Y	N	Y
Boron	µg/g	N	N	N	Y	N	N	N	N
Cadmium	µg/g	Y	N	N	Y	N	N	Y	Y
Chromium	µg/g	N	N	N	Y	Y	Y	N	Y
Cobalt	µg/g	Y	Y	Y	Y	Y	Y	Y	Y
Copper	µg/g	Y	Y	Y	Y	N	N	Y	Y
Iron	µg/g	N	N	N	Y	N	N	Y	Y
Lead	µg/g	Y	Y	Y	Y	N	N	Y	Y
Manganese	µg/g	N	N	N	Y	Y	Y	N	Y
Mercury	µg/g	N	N	N	Y	N	N	N	N
Molybdenum	µg/g	Y	Y	Y	Y	Y	Y	Y	Y
Nickel	µg/g	Y	Y	Y	Y	Y	Y	Y	Y
Selenium	µg/g	Y	Y	Y	Y	Y	Y	Y	Y
Silver	µg/g	N	N	N	Y	Y	Y	Y	Y
Strontium	µg/g	N	N	N	Y	N	N	Y	Y
Thallium	µg/g	N	N	N	Y	Y	Y	N	Y
Tin	µg/g	N	N	N	N	N	N	N	N
Titanium	µg/g	N	N	N	Y	Y	Y	N	Y
Uranium	µg/g	Y	Y	Y	Y	Y	Y	N	Y
Vanadium	µg/g	N	N	N	Y	Y	Y	Y	Y
Zinc	µg/g	Y	Y	Y	Y	N	N	N	N
Nutrients									
Phosphorus	µg/g	N	N	N	N	N	N	Y	N
Radionuclides									
Lead-210	Bq/g	Y	N	Y	Y	N	N	N	N
Polonium-210	Bq/g	Y	Y	Y	Y	N	N	N	N
Radium-226	Bq/g	Y	Y	Y	N	N	N	Y	N
Thorium-230	Bq/g	Y	Y	Y	N	N	N	Y	N

RDL = Reportable Detection Limit; Y = Yes; N = No.

[1]Available impact predictions included 1991 (Minatco 1991), 1995 (COGEMA 1995), 2016 (AREVA 2016), and 2018 (Orano 2018) impact predictions.

[2]If at least one exposure station had less than 90% of the values measured below the detection limit (<RDL) during the 2022 to 2024 assessment period, the parameter met this

[3]If at least one exposure station had a mean concentration outside the reference range during the 2022 to 2024 assessment period, the parameter met this criterion. For each

[4] To be initially screened in as a COPC, a parameter had to meet both EC1 and EC2 criteria.

[5]An expanded list of chemicals were used in a PCA to understand other potential COPCs that may be driving variation in the fish tissue chemistry dataset, aside from those identified from EC 1 and 2. Chemicals that had high loadings on the main principal components and had less than 90% of concentrations below the DL (see EC 1), were included in the final list of COPCs.

TABLE 4.6-10

Correlations of Individual Analytes with Principal Component Axis Scores, Fish Tissues, All Lakes.

Variable	Principal Component				N
	Axis 1	Axis 2	Axis 3	Axis 4	
Aluminum	0.540	0.340	0.260	0.120	1976
Arsenic	0.420	0.110	-0.550	0.160	1976
Barium	0.460	**-0.760**	0.230	-0.190	1976
Beryllium	0.560	-0.530	-0.570	0.000	1976
Boron	-0.130	-0.280	0.560	0.550	1976
Cadmium	**0.830**	0.089	-0.150	0.067	1976
Chromium	0.450	-0.440	-0.0004	-0.190	1976
Cobalt	**0.840**	0.038	0.110	0.130	1976
Copper	0.360	**0.840**	0.001	-0.200	1976
Iron	0.480	**0.780**	0.120	-0.210	1976
Lead	**0.620**	-0.450	-0.560	-0.050	1976
Manganese	0.330	-0.460	0.540	-0.450	1976
Molybdenum	**0.720**	0.360	0.220	-0.065	1976
Nickel	**0.600**	-0.017	0.360	0.400	1976
Silver	**0.620**	0.024	-0.390	-0.140	1976
Strontium	0.120	**-0.890**	0.280	-0.190	1976
Titanium	0.310	-0.110	0.250	0.039	1976
Vanadium	**0.650**	-0.091	0.082	**0.610**	1976
Zinc	0.530	0.310	0.440	-0.360	1976
Uranium	0.550	-0.270	0.330	-0.094	1762
Selenium	0.380	**0.720**	-0.038	0.360	1471
Mercury	-0.089	0.300	-0.440	0.240	1246
Thallium	0.490	-0.091	0.240	0.190	1231
Lead-210	0.220	-0.240	0.200	0.038	1056
Polonium-210	-0.260	0.200	0.073	-0.072	1056
Radium-226	0.490	**-0.800**	**0.600**	-0.560	1056
Thorium-230	0.540	**-0.840**	**0.600**	-0.540	1056
Phosphorus, Total	0.250	**-0.750**	**0.640**	-0.190	745
Potassium	-0.360	0.310	-0.530	0.340	745
Eigenvalue	5.5	4.0	2.4	1.5	-
% of Variance	29.1	21.2	12.6	7.7	-

N = sample size; Bolded values were considered highly correlated with axis. Within a component, variables with positive loadings tend to increase together and are inversely related to variables with negative loadings; the absolute loading indicates strength of influence. The sign is arbitrary (flipping the axis flips all signs), so high PC scores reflect higher values of positively loaded variables and lower values of negatively loaded ones.

TABLE 4.6-11

Aluminum Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	4	5	9	3	5	5	5
			Mean	2	2	2	3	2	2	2
			SD	0.4	0	0.2	0.9	0	0	0
		Flesh	N	5	5	10	5	5	5	5
			N<DL	5	5	10	5	5	5	5
			Mean	2	2	2	2	2	2	2
			SD	0	0	0	0	0	0	0
		Gonad	N	5	4	9	2	2	4	3
			N<DL	4	1	5	1	0	4	3
			Mean	2	3	2.5	6	2	2	2
			SD	0	1	0.5	5	0.7	0	0
		Kidney	N	5	5	10	5	5	5	5
			N<DL	2	1	3	0	2	1	3
			Mean	3	8.4	5.7	42	5.2	2	5.8
			SD	2	6.6	2.3	46	5.6	0	6.5
		Liver	N	5	5	10	5	5	5	5
			N<DL	2	1	3	0	2	4	3
			Mean	6	7.4	6.7	10	5	2	3
			SD	5.9	4.3	0.8	8.7	3	0	1
	White Sucker	Bone	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		2				2	2
			SD		0				0	0
		Flesh	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		2				2	2
			SD		0				0	0
		Gonad	N	-	3	-	-	-	1	3
			N<DL		3				1	3
			Mean		2				2	2
			SD		0				-	0
		Kidney	N	-	3	-	-	-	3	5
			N<DL		0				0	5
			Mean		4				4	2
			SD		2				3	0
		Liver	N	-	3	-	-	-	3	5
			N<DL		2				1	1
			Mean		3				45	3
			SD		1				73	1

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard deviation.
Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations.
Concentrations are reported in µg/g dry weight.

TABLE 4.6-12

Antimony Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	5	5	10	5	5	5	5
			Mean	0.2	0.2	0.2	0.2	0.2	0.2	0.2
			SD	0	0	0	0	0	0	0
		Flesh	N	5	5	10	5	5	5	5
			N<DL	5	5	10	5	5	5	5
			Mean	0.01	0.01	0.01	0.01	0.01	0.01	0.01
			SD	0	0	0	0	0	0	0
		Gonad	N	5	4	9	2	2	4	3
			N<DL	5	4	9	2	2	4	3
			Mean	0.01	0.01	0.01	0.01	0.01	0.01	0.01
			SD	0	0	0	0	0	0	0
		Kidney	N	5	5	10	5	5	5	5
			N<DL	2	0	2	0	2	2	3
			Mean	0.04	0.07	0.06	0	0.04	0.02	0.02
			SD	0.05	0.06	0.002	0	0.04	0.02	0.009
		Liver	N	5	5	10	5	5	5	5
			N<DL	5	5	10	5	5	5	5
			Mean	0.01	0.01	0.01	0.01	0.01	0.01	0.01
			SD	0	0	0	0	0	0	0
	White Sucker	Bone	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.2				0.2	0.2
			SD		0				0	0
		Flesh	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.01				0.01	0.01
			SD		0				0	0
		Gonad	N	-	3	-	-	-	1	3
			N<DL		3				1	3
			Mean		0.01				0.01	0.01
			SD		0				-	0
		Kidney	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.01				0.01	0.01
			SD		0				0.006	0
		Liver	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.01				0.01	0.01
			SD		0				0	0

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard

Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight.

TABLE 4.6-13

Arsenic Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	5	5	10	0	1	4	4
			Mean	0.1	0.1	0.1	0.2	0.1	0.1	0.1
			SD	0	0	0	0.09	0.04	0	0
		Flesh	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.088	0.11	0.099	1.6	0.21	0.12	0.11
			SD	0.019	0.018	0.0005	0.17	0.073	0.03	0.022
		ERA Prediction	Mean	-	-	-	1.6	0.96	0.61	0.61
			95th %				3.6	2.3	2.0	2.0
		Gonad	N	5	4	9	2	2	4	3
			N<DL	0	0	0	0	0	0	0
			Mean	0.02	0.04	0.03	0.49	0.08	0.04	0.07
			SD	0.009	0.01	0.0005	0.071	0.007	0.006	0.02
		Kidney	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.08	0.082	0.081	2.3	0.91	0.11	0.17
			SD	0.02	0.024	0.002	1.1	0.64	0.017	0.11
		Liver	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.04	0.06	0.05	0.41	0.098	0.06	0.06
			SD	0.008	0.01	0.001	0.08	0.026	0.009	0.01
	White Sucker	Bone	N	-	3	-	-	-	3	5
			N<DL		3				1	4
			Mean		0.1				0.1	0.1
			SD		0				0	0
		Flesh	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		0.07				0.2	0.12
			SD		0.01				0.047	0.044
		ERA Prediction	Mean	-	-	-	1.6	0.96	0.61	0.61
			95th %				3.6	2.3	2.0	2.0
		Gonad	N	-	3	-	-	-	1	3
			N<DL		0				0	0
			Mean		0.05				0.07	0.13
			SD		0.006				-	0.058
		Kidney	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		0.06				0.16	0.12
			SD		0.006				0.058	0.046
		Liver	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		0.08				0.25	0.21
			SD		0				0.23	0.066

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard deviation.

Shaded values inidicate means exceed the exceeded the most recent mean or 95th percentile prediction presented in Table 4.6-7.

Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight.

TABLE 4.6-14

Barium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	13	21	17	3.6	2.2	5	3.9
			SD	6.5	5.9	0.3	1.3	1.4	2	0.65
		Flesh	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.082	0.25	0.166	0.05	0.072	0.06	0.07
			SD	0.038	0.13	0.046	0.02	0.049	0.03	0.01
		Gonad	N	5	4	9	2	2	4	3
			N<DL	0	0	0	0	0	0	0
			Mean	0.46	0.35	0.405	0.35	0.17	0.092	0.12
			SD	0.21	0.12	0.045	0.057	0.085	0.033	0.046
		Kidney	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.87	1.4	1.135	2	0.57	0.25	0.33
			SD	0.81	0.78	0.015	1.4	0.57	0.13	0.27
		Liver	N	5	5	10	5	5	5	5
			N<DL	1	0	1	0	0	0	3
			Mean	0.068	0.14	0.104	0.05	0.04	0.04	0.03
			SD	0.086	0.035	0.0255	0.02	0.005	0.02	0.01
	White Sucker	Bone	N		3				3	5
			N<DL	-	0	-	-	-	0	0
			Mean		7.9				6.2	5.4
			SD		3.1				2.6	0.32
		Flesh	N		3				3	5
			N<DL	-	0	-	-	-	0	0
			Mean		0.05				0.12	0.06
			SD		0.02				0.02	0.02
		Gonad	N		3				1	3
			N<DL	-	0	-	-	-	0	0
			Mean		0.1				0.08	0.07
			SD		0.017				-	0.006
		Kidney	N		3				3	5
			N<DL	-	0	-	-	-	0	0
			Mean		0.25				0.39	0.13
			SD		0.021				0.15	0.047
		Liver	N		3				3	5
			N<DL	-	0	-	-	-	0	0
			Mean		0.22				0.56	0.29
			SD		0.095				0.72	0.094

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard

Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight.

TABLE 4.6-15

Beryllium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	5	5	10	5	5	5	5
			Mean	0.05	0.05	0.05	0.05	0.05	0.05	0.05
			SD	0	0	0	0	0	0	0
		Flesh	N	5	5	10	5	5	5	5
			N<DL	5	5	10	5	5	5	5
			Mean	0.01	0.01	0.01	0.01	0.01	0.01	0.01
			SD	0	0	0	0	0	0	0
		Gonad	N	5	4	9	2	2	4	3
			N<DL	5	4	9	2	2	4	3
			Mean	0.01	0.01	0.01	0.01	0.01	0.01	0.01
			SD	0	0	0	0	0	0	0
		Kidney	N	5	5	10	5	5	5	5
			N<DL	5	5	10	4	5	5	5
			Mean	0.01	0.01	0.01	0.01	0.01	0.01	0.01
			SD	0	0	0	0.004	0	0	0
		Liver	N	5	5	10	5	5	5	5
			N<DL	5	5	10	5	5	5	5
			Mean	0.01	0.01	0.01	0.01	0.01	0.01	0.01
			SD	0	0	0	0	0	0	0
	White Sucker	Bone	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.05				0.05	0.05
			SD		0				0	0
		Flesh	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.01				0.01	0.01
			SD		0				0	0
		Gonad	N	-	3	-	-	-	1	3
			N<DL		3				1	3
			Mean		0.01				0.01	0.01
			SD		0				-	0
		Kidney	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.01				0.01	0.01
			SD		0				0.006	0
		Liver	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.01				0.01	0.01
			SD		0				0	0

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard
Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight.

TABLE 4.6-16

Cadmium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	5	5	10	5	5	5	5
			Mean	0.05	0.05	0.05	0.05	0.05	0.05	0.05
			SD	0	0	0	0	0	0	0
		Flesh	N	5	5	10	5	5	5	5
			N<DL	5	5	10	5	5	5	5
			Mean	0.01	0.01	0.01	0.01	0.01	0.01	0.01
			SD	0	0	0	0	0	0	0
		Gonad	N	5	4	9	2	2	4	3
			N<DL	3	0	3	1	2	3	1
			Mean	0.01	0.05	0.03	0.02	0.01	0.01	0.02
			SD	0	0.01	0.005	0.01	0	0.005	0.006
		Kidney	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.31	1	0.655	0.41	0.17	0.19	0.42
			SD	0.13	0.37	0.12	0.33	0.13	0.077	0.15
		Liver	N	5	5	10	5	5	5	5
			N<DL	0	0	0	1	2	0	0
			Mean	0.084	0.31	0.197	0.056	0.02	0.04	0.066
			SD	0.066	0.19	0.062	0.07	0.01	0.03	0.059
	White Sucker	Bone	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.05				0.05	0.05
			SD		0				0	0
		Flesh	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.01				0.01	0.01
			SD		0				0	0
		Gonad	N	-	3	-	-	-	1	3
			N<DL		3				1	3
			Mean		0.01				0.01	0.01
			SD		0				NA	0
		Kidney	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		2.2				1.4	0.92
			SD		1.1				0.5	0.49
		Liver	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		0.39				0.14	0.21
			SD		0.21				0.079	0.084

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard deviation.

Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight.

TABLE 4.6-17

Chromium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	5	5	10	5	5	5	5
			Mean	1	1	1	1	1	1	1
			SD	0	0	0	0	0	0	0
		Flesh	N	5	5	10	5	5	5	5
			N<DL	0	4	4	3	0	1	1
			Mean	0.11	0.05	0.08	0.05	0.16	0.06	0.078
			SD	0.061	0	0.031	0.004	0.04	0.01	0.03
		Gonad	N	5	4	9	2	2	4	3
			N<DL	4	3	7	2	2	2	1
			Mean	0.05	0.06	0.055	0.05	0.05	0.1	0.087
			SD	0	0.01	0.005	0	0	0.1	0.035
		Kidney	N	5	5	10	5	5	5	5
			N<DL	0	0	0	2	2	0	0
			Mean	1.5	1.4	1.45	0.06	0.17	0.19	0.53
			SD	1.4	1.1	0.15	0.01	0.27	0.12	0.41
		Liver	N	5	5	10	5	5	5	5
			N<DL	2	0	2	5	4	3	2
			Mean	0.20	0.33	0.27	0.05	0.05	0.06	0.13
			SD	0.19	0.2	0.005	0	0.004	0.01	0.078
	White Sucker	Bone	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		1				1	1
			SD		0				0	0
		Flesh	N	-	3	-	-	-	3	5
			N<DL		2				2	5
			Mean		0.05				0.05	0.05
			SD		0				0.006	0
		Gonad	N	-	3	-	-	-	1	3
			N<DL		2				1	3
			Mean		0.07				0.05	0.05
			SD		0.03				-	0
		Kidney	N	-	3	-	-	-	3	5
			N<DL		3				2	4
			Mean		0.05				0.07	0.05
			SD		0				0.03	0.004
		Liver	N	-	3	-	-	-	3	5
			N<DL		3				1	4
			Mean		0.05				0.17	0.06
			SD		0				0.16	0.02

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard deviation.

Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight.

TABLE 4.6-18

Cobalt Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.19	0.22	0.21	0.22	0.17	0.19	0.21
			SD	0.038	0.03	0.004	0.025	0.023	0.059	0.041
		Flesh	N	5	5	10	5	5	5	5
			N<DL	2	0	2	0	0	3	2
			Mean	0.01	0.02	0.015	0.04	0.04	0.01	0.01
			SD	0.005	0.005	0	0.01	0.008	0	0.004
		ERA Prediction	Mean	-	-	-	10	2.5	0.5	0.4
			95th %				37	8.7	2.1	1.3
		Gonad	N	5	4	9	2	2	4	3
			N<DL	0	0	0	0	0	0	0
			Mean	0.26	0.38	0.32	0.78	0.74	0.2	0.22
			SD	0.062	0.026	0.018	0.28	0.049	0.12	0.051
		Kidney	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.48	0.5	0.49	3.3	2.1	0.35	0.5
			SD	0.27	0.18	0.045	1.2	0.95	0.032	0.18
		Liver	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.082	0.11	0.096	0.11	0.26	0.078	0.084
			SD	0.024	0.019	0.0025	0.094	0.094	0.033	0.039
	White Sucker	Bone	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		0.15				0.21	0.2
			SD		0.078				0.046	0.025
		Flesh	N	-	3	-	-	-	3	5
			N<DL		1				0	2
			Mean		0.01				0.02	0.02
			SD		0				0.006	0.005
		ERA Prediction	Mean	-	-	-	10	2.5	0.5	0.4
			95th %				37	8.7	2.1	1.3
		Gonad	N	-	3	-	-	-	1	3
			N<DL		0				0	0
			Mean		0.04				0.07	0.07
			SD		0.01				-	0.01
		Kidney	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		0.18				0.85	0.32
			SD		0.046				0.65	0.17
		Liver	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		0.08				0.12	0.1
			SD		0.02				0.085	0.013

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard deviation.

Shaded values inidicate means exceed the exceeded the most recent mean or 95th percentile prediction presented in Table 4.6-7.

Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight.

TABLE 4.6-19

Copper Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.3	0.4	0.35	0.4	0.4	0.5	0.5
			SD	0.05	0.04	0.005	0.2	0.1	0.1	0.2
		Flesh	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.72	0.88	0.8	1	0.85	0.73	0.72
			SD	0.17	0.52	0.175	0.13	0.16	0.056	0.18
		ERA Prediction	Mean	-	-	-	1.0	1.0	1.0	1.0
			95th %				1.9	1.9	1.9	1.9
		Gonad	N	5	4	9	2	2	4	3
			N<DL	0	0	0	0	0	0	0
			Mean	4.1	5.6	4.85	5.5	5.2	4.3	5.4
			SD	1	0.17	0.415	0.99	0.071	1.1	0.57
		Kidney	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	5	4.3	4.65	5.7	4.7	4.2	4.6
			SD	0.46	0.045	0.2075	1.7	2.3	0.29	0.63
		Liver	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	43	59	51	52.6	65.2	30	33
			SD	19	20	0.5	42.2	37.3	22	30
	White Sucker	Bone	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		0.5				0.5	0.4
			SD		0.06				0.06	0.1
		Flesh	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		1.1				1.3	1.5
			SD		0.15				0.58	0.62
		ERA Prediction	Mean	-	-	-	1.0	1.0	1.0	1.0
			95th %				1.9	1.9	1.9	1.9
		Gonad	N	-	3	-	-	-	1	3
			N<DL		0				0	0
			Mean		3.5				4.9	5.1
			SD		0.25				-	0.76
		Kidney	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		6.2				6.2	4.9
			SD		0.51				1.3	0.33
		Liver	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		31				22	35
			SD		12				12	7.3

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard deviation.

Shaded values inidicate means exceed the exceeded the most recent mean or 95th percentile prediction presented in Table 4.6-7.

Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight.

TABLE 4.6-20

Lead Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	5	5	10	5	5	5	5
			Mean	0.05	0.05	0.05	0.05	0.05	0.05	0.05
			SD	0	0	0	0	0	0	0
		Flesh	N	5	5	10	5	5	5	5
			N<DL	5	5	10	5	5	4	5
			Mean	0.01	0.01	0.01	0.01	0.01	0.01	0.01
			SD	0	0	0	0	0	0.004	0
		ERA Prediction	Mean	-	-	-	0.1	0.04	0.02	0.02
			95th %				0.2	0.07	0.05	0.05
		Gonad	N	5	4	9	2	2	4	3
			N<DL	5	4	9	2	1	3	3
			Mean	0.01	0.01	0.01	0.01	0.01	0.02	0.01
			SD	0	0	0	0	0	0.01	0
		Kidney	N	5	5	10	5	5	5	5
			N<DL	3	2	5	0	4	4	4
			Mean	0.01	0.01	0.01	0.02	0.01	0.01	0.01
			SD	0.009	0.004	0.003	0.02	0	0.009	0.004
		Liver	N	5	5	10	5	5	5	5
			N<DL	4	2	6	5	5	4	5
			Mean	0.01	0.01	0.01	0.01	0.01	0.01	0.01
			SD	0	0.005	0.0025	0	0	0.009	0
	White Sucker	Bone	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.05				0.05	0.05
			SD		0				0	0
		Flesh	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.01				0.01	0.01
			SD		0				0	0
		ERA Prediction	Mean	-	-	-	0.1	0.04	0.02	0.02
			95th %				0.2	0.07	0.05	0.05
		Gonad	N	-	3	-	-	-	1	3
			N<DL		2				1	3
			Mean		0.01				0.01	0.01
			SD		0.006				-	0
		Kidney	N	-	3	-	-	-	3	5
			N<DL		0				2	4
			Mean		0.02				0.02	0.01
			SD		0.006				0.02	0
		Liver	N	-	3	-	-	-	3	5
			N<DL		0				2	5
			Mean		0.02				0.04	0.01
			SD		0.006				0.05	0

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard deviation.

Shaded values inidicate means exceed the exceeded the most recent mean or 95th percentile prediction presented in Table 4.6-7.

Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight.

TABLE 4.6-21

Iron Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	7	11	9	5	7.6	6	7.6
			SD	2.5	2.7	0.1	3	2.3	3	3.6
		Flesh	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	8.4	21	14.7	11	11	8.4	10
			SD	2.8	6.9	2.05	3.2	3.5	2.2	1.2
		Gonad	N	5	4	9	2	2	4	3
			N<DL	0	0	0	0	0	0	0
			Mean	234	322	278	280	240	232	280
			SD	85.6	35.9	24.85	14.1	0	71.8	79.4
		Kidney	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	452	584	518	776	608	520	658
			SD	33.5	170	68.25	402.7	65.7	85.4	362.7
		Liver	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	1332	3560	2446	1736	998	1110	734
			SD	1999	1831	84	1025	896.8	625.9	824.7
	White Sucker	Bone	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		8				7.3	6.4
			SD		1				3.8	3.9
		Flesh	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		11				13	15
			SD		2.5				4	8.1
		Gonad	N	-	3	-	-	-	1	3
			N<DL		0				0	0
			Mean		67				57	57
			SD		9.9				-	4.7
		Kidney	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		587				447	290
			SD		107				155	41.8
		Liver	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		940				626.7	570
			SD		319.5				587.3	601.5

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard deviation.
Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations.
Concentrations are reported in µg/g dry weight.

TABLE 4.6-22

Manganese Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	23	44	33.5	33	36	30	62
			SD	15	12	1.5	4.3	8.2	9.1	19
		Flesh	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.4	0.6	0.5	0.5	0.7	0.5	0.6
			SD	0.07	0.1	0.015	0.2	0.3	0.2	0.2
		Gonad	N	5	4	9	2	2	4	3
			N<DL	0	0	0	0	0	0	0
			Mean	40	56	48	69	80	48	75.7
			SD	14	8.4	2.8	27	2.8	29	31.7
		Kidney	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	2.2	2.1	2.15	2.8	2.1	2	5.1
			SD	0.11	0.31	0.1	1.3	0.5	0.22	5.5
		Liver	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	4.3	5.2	4.75	2.1	4.2	3.1	4.9
			SD	1.5	1.5	0	1.8	2.7	1	3.3
	White Sucker	Bone	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		27				58.7	46
			SD		9.5				53.4	4.5
		Flesh	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		0.4				0.8	0.6
			SD		0.06				0.3	0.2
		Gonad	N	-	3	-	-	-	1	3
			N<DL		0				0	0
			Mean		17				10	23
			SD		5.5				-	7.1
		Kidney	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		2.8				5.1	2.4
			SD		0.38				4.3	0.44
		Liver	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		11				9.6	11
			SD		1.5				8.6	2.6

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard deviation.
Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight.

TABLE 4.6-23

Molybdenum Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	5	5	10	4	5	5	5
			Mean	0.2	0.2	0.2	0.2	0.2	0.2	0.2
			SD	0	0	0	0.04	0	0	0
		Flesh	N	5	5	10	5	5	5	5
			N<DL	4	5	9	2	5	5	5
			Mean	0.02	0.02	0.02	0.02	0.02	0.02	0.02
			SD	0	0	0	0	0	0	0
		ERA Prediction	Mean	-	-	-	0.1	0.10	0.08	0.08
			95th %				0.3	0.2	0.2	0.2
		Gonad	N	5	4	9	2	2	4	3
			N<DL	0	0	0	0	0	0	0
			Mean	0.11	0.21	0.16	0.27	0.18	0.21	0.28
			SD	0.035	0.043	0.004	0.014	0.021	0.087	0.11
		Kidney	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.37	0.46	0.415	2.3	1	0.39	0.5
			SD	0.14	0.18	0.02	1.2	1.1	0.092	0.18
		Liver	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.46	0.78	0.62	0.48	0.66	0.56	0.56
			SD	0.11	0.077	0.0165	0.19	0.26	0.22	0.24
	White Sucker	Bone	N	-	3	-	-	-	3	5
			N<DL		2				1	1
			Mean		0.2				0.3	0.3
			SD		0.06				0.1	0.2
		Flesh	N	-	3	-	-	-	3	5
			N<DL		1				0	0
			Mean		0.02				0.03	0.04
			SD		0				0.006	0.01
		ERA Prediction	Mean	-	-	-	0.1	0.10	0.08	0.08
			95th %				0.3	0.2	0.2	0.2
		Gonad	N	-	3	-	-	-	1	3
			N<DL		0				0	0
			Mean		0.12				0.13	0.17
			SD		0.0058				-	0.031
		Kidney	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		0.93				1.1	0.77
			SD		0.19				0.39	0.14
		Liver	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		0.94				0.93	0.91
			SD		0.071				0.69	0.18

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard deviation.

Shaded values inidicate means exceed the exceeded the most recent mean or 95th percentile prediction presented in Table 4.6-7.

Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight.

TABLE 4.6-24

Nickel Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	5	5	10	5	5	4	5
			Mean	0.1	0.1	0.1	0.1	0.1	0.1	0.1
			SD	0	0	0	0	0	0.04	0
		Flesh	N	5	5	10	5	5	5	5
			N<DL	3	5	8	5	5	5	5
			Mean	0.05	0.05	0.05	0.05	0.05	0.05	0.05
			SD	0	0	0	0	0	0	0
		ERA Prediction	Mean	-	-	-	0.2	0.09	0.06	0.06
			95th %				0.4	0.23	0.12	0.12
		Gonad	N	5	4	9	2	2	4	3
			N<DL	5	4	9	0	0	0	3
			Mean	0.05	0.05	0.05	0.1	0.14	0.088	0.05
			SD	0	0	0	0.028	0.0071	0.021	0
		Kidney	N	5	5	10	5	5	5	5
			N<DL	2	0	2	0	0	0	0
			Mean	0.06	0.16	0.11	2.7	2.5	0.38	0.3
			SD	0.008	0.068	0.03	2.3	2.4	0.13	0.16
		Liver	N	5	5	10	5	5	5	5
			N<DL	5	5	10	0	0	2	3
			Mean	0.05	0.05	0.05	0.1	0.27	0.06	0.06
			SD	0	0	0	0.065	0.22	0.01	0.009
	White Sucker	Bone	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.1				0.1	0.1
			SD		0				0	0
		Flesh	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.05				0.05	0.05
			SD		0				0	0
		ERA Prediction	Mean	-	-	-	0.2	0.09	0.06	0.06
			95th %				0.4	0.23	0.12	0.12
		Gonad	N	-	3	-	-	-	1	3
			N<DL		3				0	3
			Mean		0.05				0.07	0.05
			SD		0				-	0
		Kidney	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		0.13				0.43	0.22
			SD		0.026				0.076	0.12
		Liver	N	-	3	-	-	-	3	5
			N<DL		3				1	1
			Mean		0.05				0.18	0.07
			SD		0				0.21	0.01

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard deviation.

Shaded values inidicate means exceed the exceeded the most recent mean or 95th percentile prediction presented in Table 4.6-7.

Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight.

TABLE 4.6-25

Selenium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.3	0.3	0.3	7.3	7	1.2	0.5
			SD	0.07	0.09	0.01	0.93	1.2	0.51	0.1
		Flesh	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.69	0.82	0.755	**28**	**19**	4.2	1.3
			SD	0.1	0.12	0.01	1.1	1.5	0.65	0.18
		ERA Predictio	Mean	-	-	-	19	14	6.5	1.7
			95th %				28	22	16.5	4.3
		Gonad	N	5	4	9	2	2	4	3
			N<DL	0	0	0	0	0	0	0
			Mean	3.9	5.1	4.5	**33**	**34**	8.6	6.2
			SD	1.2	0.26	0.47	7.1	6.4	0.5	0.44
		Kidney	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	5.8	5.9	5.85	42.1	36	8.5	7.3
			SD	1.5	1.2	0.15	20.5	15	1.5	1.5
		Liver	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	4.9	5.9	5.4	25	34	8.7	6.7
			SD	1.1	0.44	0.33	12	14	1.5	2.4
	White Sucker	Bone	N		3				3	5
			N<DL	-	0	-	-	-	0	0
			Mean		0.3				0.8	0.4
			SD		0.1				0.2	0.1
		Flesh	N		3				3	5
			N<DL	-	0	-	-	-	0	0
			Mean		0.83				2.6	1.1
			SD		0.047				0.95	0.23
		ERA Predictio	Mean	-	-	-	19	14	6.5	1.7
			95th %				28	22	16.5	4.3
		Gonad	N		3				1	3
			N<DL	-	0	-	-	-	0	0
			Mean		1.6				5	2.5
			SD		0.2				-	0.32
		Kidney	N		3				3	5
			N<DL	-	0	-	-	-	0	0
			Mean		3				4.7	3
			SD		0.4				0.76	0.44
		Liver	N		3				3	5
			N<DL	-	0	-	-	-	0	0
			Mean		3.1				3.7	3.6
			SD		0.12				1.4	0.44

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard deviation.
Shaded values inidicate means exceed the exceeded the most recent mean or 95th percentile prediction presented in Table 4.6-7.
Bolded values exceed the site specific benchmark for selenium in fish tissue presented in Table 4.6-8 (13.0 µg/g dry weight)
Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight.

TABLE 4.6-26

Silver Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	5	5	10	5	5	5	5
			Mean	0.05	0.05	0.05	0.05	0.05	0.05	0.05
			SD	0	0	0	0	0	0	0
		Flesh	N	5	5	10	5	5	5	5
			N<DL	5	5	10	5	5	5	5
			Mean	0.01	0.01	0.01	0.01	0.01	0.01	0.01
			SD	0	0	0	0	0	0	0
		Gonad	N	5	4	9	2	2	4	3
			N<DL	5	4	9	1	2	0	0
			Mean	0.01	0.01	0.01	0.02	0.01	0.02	0.01
			SD	0	0	0	0.007	0	0.01	0.006
		Kidney	N	5	5	10	5	5	5	5
			N<DL	5	5	10	3	3	4	5
			Mean	0.01	0.01	0.01	0.02	0.03	0.01	0.01
			SD	0	0	0	0.02	0.03	0.004	0
		Liver	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.59	0.91	0.75	0.7	0.42	0.49	0.59
			SD	0.39	0.32	0.035	0.73	0.3	0.26	0.42
	White Sucker	Bone	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.05				0.05	0.05
			SD		0				0	0
		Flesh	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.01				0.01	0.01
			SD		0				0	0
		Gonad	N	-	3	-	-	-	1	3
			N<DL		0				0	0
			Mean		0.03				0.02	0.07
			SD		0.006				-	0.02
		Kidney	N	-	3	-	-	-	3	5
			N<DL		1				1	1
			Mean		0.01				0.02	0.01
			SD		0				0.02	0.005
		Liver	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		0.22				0.28	0.67
			SD		0.075				0.31	0.25

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard
Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight. Bolded values exceed the site specific benchmark for selenium in fish tissue.

TABLE 4.6-27

Strontium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	150	170	163	26	12	76	64
			SD	30.3	39.7	4.7	5.8	0.71	28.9	13
		Flesh	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.79	1.3	1.045	0.25	0.2	0.6	0.52
			SD	0.32	0.69	0.185	0.15	0.055	0.47	0.19
		Gonad	N	5	4	9	2	2	4	3
			N<DL	0	0	0	0	0	0	0
			Mean	1.5	0.94	1.22	0.39	0.26	0.44	0.6
			SD	0.61	0.14	0.235	0.0071	0	0.17	0.25
		Kidney	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.84	0.49	0.665	0.4	0.11	0.37	0.59
			SD	0.067	0.098	0.0155	0.27	0.017	0.19	0.68
		Liver	N	5	5	10	5	5	5	5
			N<DL	0	0	0	4	3	0	0
			Mean	0.31	0.31	0.31	0.06	0.05	0.13	0.16
			SD	0.077	0.094	0.0085	0.01	0.005	0.062	0.062
	White Sucker	Bone	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		160				130	100
			SD		66				102	27.9
		Flesh	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		0.34				0.53	0.37
			SD		0.075				0.34	0.2
		Gonad	N	-	3	-	-	-	1	3
			N<DL		0				0	0
			Mean		0.56				0.28	0.5
			SD		0.12				-	0.2
		Kidney	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		0.57				1.2	0.24
			SD		0.076				1.6	0.12
		Liver	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		0.75				2	1.3
			SD		0.4				3.1	0.65

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard deviation.

Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight.

TABLE 4.6-28

Thallium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	5	5	10	3	4	5	5
			Mean	0.1	0.1	0.1	0.1	0.1	0.1	0.1
			SD	0	0	0	0.04	0	0	0
		Flesh	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.011	0.01	0.0105	0.088	0.065	0.027	0.016
			SD	0.0022	0.0014	0.0004	0.019	0.011	0.0081	0.004
		Gonad	N	5	4	9	2	2	4	3
			N<DL	0	0	0	0	0	0	0
			Mean	0.019	0.02	0.0195	0.12	0.096	0.053	0.037
			SD	0.0043	0.0024	0.00095	0.0071	0.021	0.03	0.007
		Kidney	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.039	0.03	0.0345	0.17	0.12	0.059	0.047
			SD	0.0076	0.0036	0.002	0.056	0.035	0.017	0.008
		Liver	N	5	5	10	5	5	5	5
			N<DL	0	0	0	0	0	0	0
			Mean	0.022	0.03	0.026	0.038	0.084	0.038	0.027
			SD	0.0069	0.0099	0.0015	0.019	0.023	0.022	0.013
	White Sucker	Bone	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.1				0.1	0.1
			SD		0				0	0
		Flesh	N	-	3	-	-	-	3	5
			N<DL		3				0	1
			Mean		0.005				0.009	0.007
			SD		0				0.002	0.001
		Gonad	N	-	3	-	-	-	1	3
			N<DL		1				0	0
			Mean		0.006				0.017	0.009
			SD		0.0006				-	0.005
		Kidney	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		0.018				0.027	0.021
			SD		0.0032				0.011	0.004
		Liver	N	-	3	-	-	-	3	5
			N<DL		0				0	0
			Mean		0.0093				0.027	0.022
			SD		0.0015				0.018	0.007

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard deviation.

Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight.

TABLE 4.6-29

Titanium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	1	0	1	1	3	3	2
			Mean	0.2	0.2	0.2	0.2	0.1	0.1	0.2
			SD	0.08	0.1	0.01	0.05	0.04	0.09	0.05
		Flesh	N	5	5	10	5	5	5	5
			N<DL	5	5	10	5	5	5	5
			Mean	0.2	0.2	0.2	0.2	0.2	0.2	0.2
			SD	0	0	0	0	0	0	0
		Gonad	N	5	4	9	2	2	4	3
			N<DL	5	4	9	2	1	4	3
			Mean	0.2	0.2	0.2	0.2	0.3	0.2	0.2
			SD	0	0	0	0	0.1	0	0
		Kidney	N	5	5	10	5	5	5	5
			N<DL	5	4	9	2	3	5	3
			Mean	0.2	0.2	0.2	0.4	0.3	0.2	0.2
			SD	0	0.04	0.02	0.2	0.09	0	0.05
		Liver	N	5	5	10	5	5	5	5
			N<DL	5	4	9	5	5	5	5
			Mean	0.2	0.3	0.25	0.2	0.2	0.2	0.2
			SD	0	0.1	0.05	0	0	0	0
	White Sucker	Bone	N	-	3	-	-	-	3	5
			N<DL		1				2	2
			Mean		0.1				0.1	0.3
			SD		0				0.06	0.2
		Flesh	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.2				0.2	0.2
			SD		0				0	0
		Gonad	N	-	3	-	-	-	1	3
			N<DL		3				1	2
			Mean		0.2				0.2	0.2
			SD		0				-	0
		Kidney	N	-	3	-	-	-	3	5
			N<DL		2				3	5
			Mean		0.2				0.3	0.2
			SD		0				0.2	0
		Liver	N	-	3	-	-	-	3	5
			N<DL		2				2	5
			Mean		0.2				2	0.2
			SD		0				3	0

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard deviation.

Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight.

TABLE 4.6-30

Uranium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	5	5	10	2	5	4	5
			Mean	0.1	0.1	0.1	0.1	0.1	0.1	0.1
			SD	0	0	0	0.04	0	0	0
		Flesh	N	5	5	10	5	5	5	5
			N<DL	5	4	9	4	4	4	3
			Mean	0.01	0.01	0.01	0.01	0.01	0.01	0.01
			SD	0	0	0	0.004	0	0	0.004
		ERA Predictio	Mean 95th %	-	-	-	0.03 0.10	0.02 0.04	0.01 0.03	0.01 0.02
		Gonad	N	5	4	9	2	2	4	3
			N<DL	4	4	8	0	1	2	2
			Mean	0.01	0.01	0.01	0.03	0.02	0.01	0.01
			SD	0	0	0	0.01	0.01	0.005	0.006
		Kidney	N	5	5	10	5	5	5	5
			N<DL	1	0	1	0	2	0	3
			Mean	0.02	0.02	0.02	0.35	0.056	0.02	0.01
			SD	0.009	0.007	0.001	0.44	0.068	0.01	0.004
		Liver	N	5	5	10	5	5	5	5
			N<DL	5	3	8	4	2	4	5
			Mean	0.01	0.01	0.01	0.02	0.01	0.01	0.01
			SD	0	0	0	0.03	0.004	0.004	0
	White Sucker	Bone	N		3				3	5
			N<DL	-	3	-	-	-	3	4
			Mean		0.1				0.1	0.1
			SD		0				0	0
		Flesh	N		3				3	5
			N<DL	-	3	-	-	-	3	3
			Mean		0.01				0.01	0.02
			SD		0				0	0.009
		ERA Predictio	Mean 95th %	-	-	-	0.03 0.10	0.02 0.04	0.01 0.03	0.01 0.02
		Gonad	N		3				1	3
			N<DL	-	3	-	-	-	0	3
			Mean		0.01				0.01	0.01
			SD		0				-	0
		Kidney	N		3				3	5
			N<DL	-	0	-	-	-	0	0
			Mean		0.02				0.06	0.03
			SD		0.006				0.01	0.03
		Liver	N		3				3	5
			N<DL	-	1	-	-	-	1	2
			Mean		0.01				0.03	0.01
			SD		0.006				0.03	0.004

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard deviation.

Shaded values inidicate means exceed the exceeded the most recent mean or 95th percentile prediction presented in Table 4.6-7.

Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight.

TABLE 4.6-31

Vanadium Concentrations in Large-Bodied Fish Tissue from the McClean Lake Operation LSA and Associated Reference Areas, September/October 2024.

Year	Species	Tissue	Values[1]	Reference		Pooled Reference	Exposure			
				Henday Lake	Konner Lake		Sink Reservoir	Vulture Lake	McClean Lake East Basin	Kewen Lake
2024	Northern Pike	Bone	N	5	5	10	5	5	5	5
			N<DL	5	5	10	2	5	5	5
			Mean	0.2	0.2	0.2	0.2	0.2	0.2	0.2
			SD	0	0	0	0.05	0	0	0
		Flesh	N	5	5	10	5	5	5	5
			N<DL	5	5	10	5	5	5	5
			Mean	0.1	0.1	0.1	0.1	0.1	0.1	0.1
			SD	0	0	0	0	0	0	0
		Gonad	N	5	4	9	2	2	4	3
			N<DL	5	4	9	0	1	4	3
			Mean	0.1	0.1	0.1	0.4	0.2	0.1	0.1
			SD	0	0	0	0.2	0.07	0	0
		Kidney	N	5	5	10	5	5	5	5
			N<DL	2	1	3	0	2	0	0
			Mean	0.3	0.68	0.49	4.1	1.3	0.3	0.2
			SD	0.3	0.49	0.095	4.8	1.6	0.2	0.2
		Liver	N	5	5	10	5	5	5	5
			N<DL	2	1	3	0	2	0	3
			Mean	0.42	0.72	0.57	1.3	0.92	0.3	0.3
			SD	0.46	0.59	0.065	1.5	0.88	0.2	0.2
	White Sucker	Bone	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.2				0.2	0.2
			SD		0				0	0
		Flesh	N	-	3	-	-	-	3	5
			N<DL		3				3	5
			Mean		0.1				0.1	0.1
			SD		0				0	0
		Gonad	N	-	3	-	-	-	1	3
			N<DL		3				1	3
			Mean		0.1				0.1	0.1
			SD		0				-	0
		Kidney	N	-	3	-	-	-	3	5
			N<DL		0				1	1
			Mean		0.3				0.3	0.2
			SD		0.06				0.1	0.08
		Liver	N	-	3	-	-	-	3	5
			N<DL		3				0	3
			Mean		0.1				0.2	0.1
			SD		0				0.2	0.04

[1]N = sample size; N<DL = number of samples with concentrations lower than the laboratory detection limit; SD = standard deviation.

Note: Values that were measured below the detection limit were set to the detection limit when calculating means and standard deviations. Concentrations are reported in µg/g dry weight.

TABLE 4.6-32

Summary of McClean Lake Operation Fish Tissue Muscle, Whole-body, and Egg/Ovary Selenium Levels.

Species	Waterbody	Tissue	2005[2]		2006[3]		2008		2011		2015		2016		2018		2019[4]		2021		2022[5]		2024	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Lake Whitefish	Henday Lake	Muscle	3.27	0.59	-	-	-	-	1.43	0.43	-	-	-	-	1.6	1.0	-	-	1.3	0.41	-	-	1.27	0.9
		Egg/Ovary	-	-	-	-	-	-	-	-	-	-	-	-	1.9	0.14	-	-	2.2	0.35	-	-	2.00	-
	Mallen Lake	Muscle	-	-	-	-	-	-	1.72	0.58	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	McClean Lake - East	Muscle	-	-	-	-	-	-	-	-	-	-	3.22	1.07	-	-	-	-	3	1.1	-	-	4.94	1.6
		Egg/Ovary	-	-	-	-	-	-	-	-	-	-	6.28	0.82	-	-	-	-	6.3	2.3	-	-	6.64	0.55
	Kewen Lake	Muscle	1.76	0.49	-	-	1.15	0.30	-	-	-	-	-	-	1.0	0.4	-	-	-	-	-	-	-	-
		Egg/Ovary	-	-	-	-	-	-	-	-	-	-	-	-	2.4	0.28	-	-	-	-	-	-	-	-
Northern Pike	Henday Lake	Muscle	-	-	-	-	1.02	0.27	0.85	0.09	1.04	0.17	-	-	0.82	0.08	-	-	0.78	0.06	-	-	0.69	0.10
		Egg/Ovary	-	-	-	-	-	-	-	-	-	-	-	-	4.2	-	-	-	3.3	0.1	-	-	3.94	1.17
	Indigo Lake	Muscle	-	-	0.70	0.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Whole body[1]	0.75	0.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Egg/Ovary	-	-	2.35	0.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Konner Lake	Muscle	2.30	0.50	-	-	1.08	0.09	0.92	0.08	0.76	0.07	-	-	0.80	0.031	-	-	0.89	0.052	-	-	0.82	0.12
		Egg/Ovary	-	-	-	-	-	-	-	-	-	-	-	-	4.58	0.54	-	-	5.1	0.32	-	-	5.13	0.26
	Mallen Lake	Muscle	2.69	0.19	-	-	1.36	0.15	0.91	0.13	0.76	0.12	2.76	0.58	-	-	-	-	-	-	-	-	-	-
	Sink Reservoir	Muscle	-	-	-	-	9.57	0.89	**13.56**	3.08	**17.46**	2.47	-	-	**15**	1.1	-	-	**25**	2	-	-	**28**	1.1
		Egg/Ovary	-	-	-	-	-	-	-	-	-	-	-	-	**25**	-	-	-	**43**	-	-	-	**33**	7.1
	Vulture Lake	Muscle	6.54	1.70	4.21	0.54	7.77	1.60	11.17	1.90	**14.96**	1.47	-	-	**15**	2.9	-	-	**19**	1.4	-	-	**19**	1.5
		Whole body[1]	1.26	0.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Egg/Ovary	-	-	8.02	0.73	-	-	-	-	-	-	-	-	**32**	-	-	-	**39**	6.4	-	-	**34**	6.4
	McClean Lake - East	Muscle	-	-	-	-	-	-	-	-	-	-	7.92	2.06	-	-	-	-	3.7	0.76	-	-	4.2	0.65
		Egg/Ovary	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.6	1.6	-	-	8.6	0.5
	Kewen Lake	Muscle	2.27	0.55	-	-	1.22	0.10	1.28	0.05	1.43	0.15	-	-	1.4	0.12	-	-	1.5	0.23	-	-	1.3	0.18
		Egg/Ovary	-	-	-	-	-	-	-	-	-	-	-	-	4.5	2.5	-	-	5.8	0.73	-	-	6.2	0.44
White Sucker	Henday Lake	Muscle	-	-	-	-	1.09	0.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Indigo Lake	Muscle	-	-	1.89	0.13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Whole body[1]	0.99	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Egg/Ovary	-	-	1.94	0.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Konner Lake	Muscle	2.26	0.39	-	-	0.99	0.08	0.79	-	0.69	0.06	-	-	-	-	-	-	-	-	-	-	0.83	0.047
		Egg/Ovary	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.6	0.2
	Mallen Lake	Muscle	-	-	-	-	1.53	0.09	-	-	0.81	0.13	-	-	-	-	-	-	-	-	-	-	-	-
	Sink Reservoir	Muscle	-	-	-	-	8.76	1.98	10.88	2.87	**13.60**	1.70	-	-	**13**	2.8	-	-	-	-	-	-	-	-
		Egg/Ovary	-	-	-	-	-	-	-	-	-	-	-	-	13	1.2	-	-	-	-	-	-	-	-
	Vulture Lake	Muscle	6.70	0.73	4.37	0.52	9.07	0.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Whole body[1]	3.37	0.30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Egg/Ovary	-	-	4.89	0.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	McClean Lake - East	Muscle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.9	0.61	-	-	2.6	0.95
		Egg/Ovary	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5	1.1	-	-	5	-
	Kewen Lake	Muscle	-	-	-	-	1.68	0.26	1.30	0.32	1.21	0.13	-	-	1.2	0.17	-	-	1.8	0.34	-	-	1.1	0.23
		Egg/Ovary	-	-	-	-	-	-	-	-	-	-	-	-	2.4	0.34	-	-	2.8	0.2	-	-	2.5	0.32
Slimy Sculpin	Collins Creek upstream	Muscle	-	-	-	-	-	-	-	-	-	-	0.83	0.10	-	-	1.34	0.28	-	-	1.30	0.23	-	-
		Egg/Ovary	-	-	-	-	-	-	-	-	-	-	6.55	0.90	-	-	4.40	-	-	-	3.76	0.62	-	-
	Collins Creek downstream	Muscle	-	-	-	-	-	-	-	-	-	-	1.70	0.19	-	-	2.09	0.24	-	-	3.34	0.44	-	-
		Egg/Ovary	-	-	-	-	-	-	-	-	-	-	3.08	0.65	-	-	2.10	-	-	-	9.44	1.27	-	-
Ninespine Stickleback	Indigo Lake	Whole body[1]	0.01	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Vulture Lake	Whole body[1]	4.15	0.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Burbot	Indigo Lake	Whole body[1]	1.07	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Vulture Lake	Whole body[1]	**10.96**	1.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Collins Creek upstream	Muscle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.27	0.21	-	-	1.30	0.32	-	-
		Egg/Ovary	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.18	1.95	-	-	1.81	1.43	-	-
	Collins Creek downstream	Muscle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.13	0.29	-	-	2.93	0.23	-	-
		Egg/Ovary	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.50	0.80	-	-	8.08	1.56	-	-

All data presented on a µg/g dry weight basis; bolded values exceed the Mcclean Lake Operation site specific tissue guidelines (Table 4.6-8).

[1]Muscatello and Janz 2009.

[2]Muscle tissue data converted from wet to dry weight basis using mean percent moisture data at the species x year level. Lake whitefish data converted to dry weight assuming 73.6 - 75.7% moisture, northern pike were converted assuming 77.9 - 79.6% moisture, and white sucker were converted assuming 73.2 - 78.3% moisture. Values from 2005 were converted using mean percent moisture from 2008 to 2021 (75.0% for Lake Whitefish, 78.6% for Northern Pike, and 77.0% for White Sucker).

[3]Muscatello 2009.

[4]Orano 2020.

[5]2022 EEM data presented in Phase 7 Interpretative report (CanNorth and Kilgour 2023).

TABLE 4.6-33

Summary of McClean Lake Operation EMP Northern Pike and White Sucker Converted Selenium in Muscle to Selenium in Ovary Data for Comparison to Ovary Tissue Guidelines.

Conversion Approach	Species	Waterbody	2005		2008		2011		2015		2018		2021		2024	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Regression 1[1]	Northern Pike	Fox Lake	3.69	0.83	-	-	-	-	-	-	-	-	-	-	-	-
		Henday Lake	-	-	2.93	0.39	2.68	0.12	2.91	0.21	2.63	0.11	2.58	0.08	2.46	0.14
		Kewen Lake	4.61	0.74	3.15	0.14	3.26	0.06	3.23	0.38	3.42	0.17	3.53	0.31	3.34	0.25
		Konner Lake	4.64	0.68	2.99	0.15	2.78	0.10	2.55	0.10	2.61	0.04	2.73	0.07	2.63	0.16
		Mallen Lake	5.18	0.29	3.34	0.20	2.75	0.16	2.55	0.17	-	-	-	-	-	-
		McClean Lake East	-	-	-	-	-	-	-	-	-	-	6.53	1.03	7.18	0.88
		Sink Reservoir	-	-	14.45	1.27	**19.36**	5.00	**26.39**	3.89	**21.53**	1.48	**35.31**	2.70	**38.82**	1.54
		Vulture Lake	10.36	2.27	12.04	2.13	**16.45**	2.60	**21.53**	2.00	**21.26**	3.89	**27.20**	1.91	**26.66**	2.05
	White Sucker	Henday Lake	-	-	4.04	0.10	-	-	-	-	-	-	-	-	-	-
		Kewen Lake	-	-	4.31	0.13	4.13	0.16	4.06	0.06	4.09	0.08	4.37	0.16	4.04	0.11
		Konner Lake	4.60	0.19	3.97	0.04	3.88	0.0	3.83	0.03	3.88	0.04	3.88	0.04	3.90	0.02
		Mallen Lake	-	-	4.24	0.06	-	-	3.89	0.06	-	-	-	-	-	-
		McClean Lake East	-	-	-	-	-	-	-	-	-	-	4.91	0.30	4.76	0.46
		Sink Reservoir	-	-	7.74	0.96	8.84	1.48	9.89	1.10	9.69	1.34	-	-	-	-
		Vulture Lake	6.74	0.35	7.82	0.14	-	-	-	-	-	-	-	-	-	-
Regression 2[2]	Northern Pike	Fox Lake	3.35	1.25	-	-	-	-	-	-	-	-	-	-	-	-
		Henday Lake	-	-	2.20	0.58	1.83	0.18	2.18	0.32	1.75	0.16	1.67	0.12	1.49	0.21
		Kewen Lake	4.73	1.11	2.53	0.20	2.69	0.09	2.65	0.57	2.94	0.25	3.10	0.47	2.82	0.37
		Konner Lake	4.78	1.03	2.29	0.22	1.97	0.16	1.62	0.15	1.72	0.06	1.90	0.11	1.75	0.24
		Mallen Lake	5.59	0.43	2.82	0.31	1.93	0.24	1.62	0.25	-	-	-	-	-	-
		McClean Lake East	-	-	-	-	-	-	-	-	-	-	7.63	1.55	8.61	1.33
		Sink Reservoir	-	-	**19.59**	1.92	**27.02**	7.55	**37.63**	5.88	**30.29**	2.24	**51.10**	4.08	**56.41**	2.33
		Vulture Lake	13.43	3.44	**15.96**	3.22	**22.61**	3.93	**30.29**	3.03	**29.88**	5.88	**38.86**	2.89	**38.04**	3.10
	White Sucker	Henday Lake	-	-	1.97	0.21	-	-	-	-	-	-	-	-	-	-
		Kewen Lake	-	-	2.52	0.26	2.15	0.33	2.01	0.13	2.08	0.17	2.64	0.34	1.98	0.23
		Konner Lake	3.12	0.39	1.84	0.08	1.64	0.0	1.55	0.05	1.64	0.09	1.65	0.08	1.69	0.05
		Mallen Lake	-	-	2.39	0.11	-	-	1.66	0.13	-	-	-	-	-	-
		McClean Lake East	-	-	-	-	-	-	-	-	-	-	3.75	0.61	3.44	0.94
		Sink Reservoir	-	-	9.53	1.96	11.79	3.03	13.93	2.26	13.53	2.75	-	-	-	-
		Vulture Lake	7.50	0.71	9.69	0.29	-	-	-	-	-	-	-	-	-	-
Ratio[3]	Northern Pike	Fox Lake	3.00	1.15	-	-	-	-	-	-	-	-	-	-	-	-
		Henday Lake	-	-	1.95	0.53	1.61	0.17	1.92	0.29	1.53	0.15	1.46	0.11	1.29	0.19
		Kewen Lake	4.28	1.02	2.25	0.19	2.40	0.08	2.36	0.52	2.63	0.23	2.78	0.43	2.51	0.34
		Konner Lake	4.31	0.95	2.03	0.21	1.73	0.14	1.41	0.14	1.51	0.06	1.67	0.10	1.53	0.22
		Mallen Lake	5.06	0.40	2.51	0.28	1.70	0.22	1.42	0.23	-	-	-	-	-	-
		McClean Lake East	-	-	-	-	-	-	-	-	-	-	6.94	1.43	7.84	1.22
		Sink Reservoir	-	-	**17.93**	1.76	**24.75**	6.94	**34.50**	5.40	**27.75**	2.05	**46.88**	3.75	**51.75**	2.14
		Vulture Lake	12.26	3.16	14.59	2.96	**20.70**	3.61	**27.75**	2.78	**27.38**	5.40	**35.63**	2.65	**34.88**	2.84
	White Sucker	Henday Lake	-	-	2.10	0.40	-	-	-	-	-	-	-	-	-	-
		Kewen Lake	-	-	3.15	0.49	2.45	0.62	2.18	0.25	2.31	0.31	3.38	0.64	1.13	0.23
		Konner Lake	4.28	0.73	1.85	0.14	1.48	0.0	1.31	0.10	1.47	0.17	1.49	0.16	0.83	0.05
		Mallen Lake	-	-	2.89	0.21	-	-	1.52	0.25	-	-	-	-	-	-
		McClean Lake East	-	-	-	-	-	-	-	-	-	-	5.48	1.15	2.60	0.95
		Sink Reservoir	-	-	**16.43**	3.70	**20.70**	5.74	**24.75**	4.28	**24.00**	5.20	-	-	-	-
		Vulture Lake	12.56	1.35	**16.73**	0.55	-	-	-	-	-	-	-	-	-	-

All data presented on a µg/g dry weight basis; bolded values exceed at least one of the available egg/ovary guidelines shown in Table 4.6-8.

[1]Converted for northern pike using ovary [Se] = (muscle [Se] + 1.13)/0.74 (Muscatello and Janz 2006); Converted for white sucker using ovary [Se] = 3.498 + 0.484*muscle [Se] (regression of data provided in U.S. EPA 2015).

[2]Converted for northern pike using ovary [Se] = (muscle [Se] + 0.04)/0.49 (Muscatello 2009); Converted for white sucker using ovary [Se] = (muscle [Se] + 0.87)/1.01 (Muscatello 2009).

[3]Median ratio (muscle egg-ovary[Se]/muscle [Se]) based on data presented in U.S. EPA (2015) = 1.875 for northern pike and 1.0 for white sucker.

TABLE 4.6-34

Statistical Analyses Used to Test for Effects on EEM Endpoints.

Endpoint	Description	Analysis
Survival	Length frequency distribution (YOY)	Two-sided Kolmogorov-Smirnov test
	Length frequency distribution (non-YOY)	Two-sided Kolmogorov-Smirnov test
Energy Use (Growth)	Size (length and weight) of YOY (age 0+) fish at end of growth period	ANOVA on logarithms of length and weight
	Size at age (weight) of 1+ fish	ANCOVA on logarithms of length in relation to logarithms of age
Energy Use (Reproduction)	Relative abundance of YOY (% composition of YOY)	Confidence limits on proportions
Energy Storage (Condition)	Body weight relative to length YOY	Visual inspection of box plots of condition factor (K), ANCOVA on logarithms of weight relative to length
	Body weight relative to length non-YOY	Visual inspection of box plots of condition factor (K), ANCOVA on logarithms of weight relative to length
Multiyear Analysis	Body weight relative to length YOY	Inspection of Box Plots in relation to 95% confidence intervals of reference data for all years, ANOVA with contrasts
	Body weight relative to length of 1+ fish	Inspection of Box Plots in relation to 95% confidence intervals of reference data for all years, ANOVA with contrasts
	Length, Weight, Condition YOY	Inspection of Box Plots in relation to 95% confidence intervals of reference data for all years, ANOVA with contrasts
	Length, Weight, Condition non-YOY fish	Inspection of Box Plots in relation to 95% confidence intervals of reference data for all years, ANOVA with contrasts

TABLE 4.6-35

Summary Statistics of YOY and Non-YOY Burbot from the Reference Area and Exposure Area of Collins Creek, October 2022.

Area	Fish	Parameter	Total Length (mm)	Body Weight (g)	K	Age
Reference	YOY	N	8	8	8	-
		Min	82	3.2	0.51	-
		Max	118	14.8	1.32	-
		Median	99.9	7.6	0.74	-
		Mean	99.5	8.1	0.61	-
		SD	12.8	3.63	0.29	-
		SE	4.5	1.28	0.10	-
	non-YOY	N	96	96	96	96
		Min	120	8.2	0.21	1
		Max	411	248.5	0.80	8
		Median	176.0	30.0	0.46	2.35
		Mean	164.5	19.6	0.46	2.00
		SD	47.8	33.93	0.09	1.45
		SE	4.9	3.46	0.01	0.15
Exposure	YOY	N	31	31	31	-
		Min	66	2.1	0.40	-
		Max	119	13.7	0.86	-
		Median	99.3	6.2	0.61	-
		Mean	99.0	5.8	0.60	-
		SD	11.0	2.20	0.10	-
		SE	2.0	0.40	0.02	-
	Non-YOY	N	94	94	94	94
		Min	122	9.2	0.35	1
		Max	306	134.5	0.75	6
		Median	167.1	27.8	0.55	1.99
		Mean	162.0	22.1	0.54	2.00
		SD	31.3	17.72	0.07	0.99
		SE	3.2	1.83	0.01	0.10

SD = standard deviation, SE = Standard Error.

TABLE 4.6-36

Results of Various Analyses Testing for Differences in Body Size and Condition of YOY and Non-YOY Burbot Collected in the Reference and Exposure Areas of Collins Creek, October 2022.

Age Class	Component	Dependent Variable	Source	SS	df	MS	F-Ratio	p-Value	Ref LS Mean	Exp LS Mean	% Difference
YOY	Survival	Log Total Length (Freq Dist)	n/a	n/a	n/a	n/a	n/a	0.934	n/a	n/a	n/a
Non-YOY		Log of Age (Freq Dist)	n/a	n/a	n/a	n/a	n/a	0.229	n/a	n/a	n/a
		Log Total Length (Freq Dist)	n/a	n/a	n/a	n/a	n/a	0.279	n/a	n/a	n/a
All Fish		Log Total Length (Freq Dist)	n/a	n/a	n/a	n/a	n/a	0.060	n/a	n/a	n/a
YOY	Energy Use (Growth)	Log Body Weight	Area	0.03	1	0.032	1.14	0.292	n/a	n/a	n/a
			Error	1.03	37	0.028	n/a	n/a			
		Log Total Length	Area	0.00	1	0.000	0.01	0.924	n/a	n/a	n/a
			Error	0.10	37	0.003	n/a	n/a			
Non-YOY		Log Body Weight	Area	0.34	1	0.342	23.67	**<0.001**	21.1	25.7	22
			Log of Age	9.79	1	9.787	676.45	<0.001			
			Error	2.71	187	0.014	n/a	n/a			
		Log Total Length	Area	0.00	1	0.000	0.07	0.796	n/a	n/a	n/a
			Log of Age	1.37	1	1.366	1286.85	<0.001			
			Error	0.20	187	0.001	n/a	n/a			
YOY	Energy Storage (Condition)	Log Body Weight	Area	0.03	1	0.027	3.23	0.081	n/a	n/a	n/a
			Log of Total Ler	0.74	1	0.736	87.34	<0.001			
			Error	0.30	36	0.008	n/a	n/a			
Non-YOY		Log Body Weight	Area	0.32	1	0.318	53.23	**<0.001**	21.2	25.6	21
			Log of Total Ler	11.40	1	11.397	1904.87	<0.001			
			Error	1.12	187	0.006	n/a	n/a			

Statistically significant p-values (i.e., < 0.05) for the Area term are in bold.
Prior results (Cannorth & Kilgour, 2023) used SYSTAT 13; all 2024 EP-TID analyses were re-run in R v4.1.3 for consistency. Minor differences (e.g., KS p-values, ANOVA details) reflect software default methods—not data changes; values reported here are from R.

TABLE 4.6-37

Results of Various Analyses Testing for Differences in Body Size and Condition of Non-YOY Burbot Among years (2008, 2013, 2016, and 2022) Collected in the Reference and Exposure Areas of Collins Creek, October 2022.

Age	Component	Dependent Variable	Source	SS	df	MS	F-Ratio	p-Value
1 +	Energy Use (Growth)	Log of Body Weight	Treatment	0.567	7	0.081	10.13	**<0.001**
			H02: Difference in 2022 vs prior year	0.055	1	0.055	6.86	**0.009**
			H03: 2022 and 2016 Differed from prior years	0.067	1	0.067	8.33	**0.004**
			Error	1.936	242	0.008	n/a	n/a
	Energy Use (Growth)	Log of Total Length	Treatment	0.054	7	0.008	10.99	**<0.001**
			H02: Difference in 2022 vs prior year	0.000	1	0.000	0.15	0.696
			H03: 2022 and 2016 Differed from prior years	0.010	1	0.010	14.51	**<0.001**
			Error	0.169	242	0.001	n/a	n/a
All Adult Fish	Energy Storage (Condition)	Log of Body Weight	Log of Total Length	42.769	1	42.769	14993.43	**<0.001**
			Treatment	2.112	7	0.302	105.75	**<0.001**
			H02: Difference in 2022 vs prior year	0.012	1	0.012	4.09	**0.043**
			H03: 2022 and 2016 Differed from prior years	0.205	1	0.205	71.93	**<0.001**
			Error	2.311	810	0.003	n/a	n/a

YOY could not be tested among years because no YOY Burbot were collected from the reference area prior to 2022.
Bold values are <0.05 and are statistically significant.

TABLE 4.6-38

Summary Statistics of YOY and Non-YOY Slimy Sculpin in Reference Area and Exposure Area in Collins Creek, October 2022.

Area	Fish	Parameter	Total Length (mm)	Body Weight (g)	K	Age
Reference	YOY	N	38	38	38	-
		Min	30	0.29	0.73	-
		Max	47	1.08	1.78	-
		Median	37.5	0.63	1.16	-
		Mean	36.5	0.58	1.08	-
		SD	4.5	0.22	0.24	-
		SE	0.7	0.04	0.04	-
	non-YOY	N	96	96	96	96
		Min	50	1.16	0.76	1
		Max	133	32.15	1.77	5
		Median	89.7	9.00	1.08	2.23
		Mean	94.0	8.32	1.07	2.00
		SD	19.4	6.15	0.20	1.10
		SE	2.0	0.63	0.02	0.11
Exposure	YOY	N	6	6	6	-
		Min	34	0.39	0.55	-
		Max	47	1.37	1.32	-
		Median	43.5	0.88	1.03	-
		Mean	46.0	0.93	1.08	-
		SD	5.0	0.39	0.26	-
		SE	2.0	0.16	0.11	-
	non-YOY	N	103	103	103	103
		Min	53	1.60	0.61	1
		Max	122	23.88	3.46	4
		Median	86.2	8	1.15	2.23
		Mean	84.0	6.58	1.11	2.00
		SD	16.4	4.71	0.35	0.89
		SE	1.6	0.46	0.03	0.09

SD = standard deviation, SE = Standard Error.

TABLE 4.6-39

Results of Various Analyses Testing for Differences in Body Size and Condition of YOY and Non-YOY Slimy Sculpin Collected in the Reference and Exposure Areas of Collins Creek, October 2022.

Age Class	Component	Dependent Variable	Source	SS	df	MS	F-Ratio	p-Value	Ref LS Mean	Exp LS Mean	% Difference
YOY	Survival	Log Total Length (Freq Dist)	n/a	n/a	n/a	n/a	n/a	**0.025**	n/a	n/a	n/a
Non-YOY		Log of Age (Freq Dist)	n/a	n/a	n/a	n/a	n/a	0.766	n/a	n/a	n/a
		Log Total Length (Freq Dist)	n/a	n/a	n/a	n/a	n/a	**0.027**	n/a	n/a	n/a
All Fish		Log Total Length (Freq Dist)	n/a	n/a	n/a	n/a	n/a	**<0.001**	n/a	n/a	n/a
YOY	Energy Use (Growth)	Log Body Weight	Area	0.09	1	0.092	3.47	0.069	n/a	n/a	n/a
			Error	1.11	42	0.027	n/a	n/a	n/a	n/a	n/a
		Log Total Length	Area	0.02	1	0.022	8.03	**0.007**	37.3	43.2	16
			Error	0.11	42	0.003	n/a	n/a			
Non-YOY		Log Body Weight	Area	0.09	1	0.089	4.83	**0.029**	7.3	6.6	-9
			Log of Age	12.77	1	12.775	691.21	<0.001			
			Error	3.62	196	0.018	n/a	n/a			
		Log Total Length	Area	0.02	1	0.019	15.33	**<0.001**	88.0	84.1	-4
			Log of Age	1.41	1	1.407	1113.27	<0.001			
			Error	0.25	196	0.001	n/a	n/a			
YOY	Energy Storage (Condition)	Log Body Weight	Area	0.01	1	0.005	0.59	0.446	n/a	n/a	n/a
			Log of Total Ler	0.85	1	0.849	98.48	<0.001			
			Error	0.35	41	0.009	n/a	n/a			
Non-YOY		Log Body Weight	Area	0.01	1	0.013	1.34	0.248	n/a	n/a	n/a
			Log of Total Ler	14.56	1	14.561	1492.28	<0.001			
			Error	1.91	196	0.010	n/a	n/a			

Statistically significant p-values (i.e., < 0.05) for the Area term are in bold.

Prior results (Cannorth & Kilgour, 2023) used SYSTAT 13; all 2024 EP-TID analyses were re-run in R v4.1.3 for consistency. Minor differences (e.g., KS p-values, ANOVA details) reflect software default methods—not data changes; values reported here are from R.

TABLE 4.6-40

Results of Various Analyses Testing for Differences in Body Size and Condition of Slimy Sculpin among years (2002, 2005, 2008, 2013, 2016, and 2022) Collected in the Reference and Exposure Areas of Collins Creek, October 2022.

Age	Component	Dependent Variable	Source	SS	df	MS	F-Ratio	p-Value
YOY	Energy Use (Growth)	Log of Body Weight	Treatment	8.50	9	0.94	31.76	**<0.001**
			H02: Difference in 2022 vs prior years	0.18	1	0.18	6.20	**0.014**
			H03: 2022 and 2016 Differed from prior years	1.55	1	1.55	52.11	**<0.001**
			H04: 2008, 2013, 2016, and 2022 vs differences in prior	1.15	1	1.15	38.73	**<0.001**
			Error	6.87	231	0.03		
	Energy Use (Growth)	Log of Total Length	Treatment	0.98	9	0.11	46.30	**<0.001**
			H02: Difference in 2022 vs prior years	0.0163	1	0.0163	6.88	**0.009**
			H03: 2022 and 2016 Differed from prior years	0.27	1	0.27	115.11	**<0.001**
			H04: 2008, 2013, 2016, and 2022 vs differences in prior years	0.101	1	0.101	42.70	**<0.001**
			Error	0.55	231	0.002		
1+	Energy Use (Growth)	Log of Body Weight	Treatment	5.29	11	0.48	25.52	**<0.001**
			H02: Difference in 2022 vs prior years	0.29	1	0.29	15.40	**<0.001**
			H03: 2022 and 2016 Differed from prior years	0.04	1	0.04	2.12	0.146
			H04: 2008, 2013, 2016, and 2022 vs differences in prior years	0.003	1	0.003	0.15	0.699
			H05: 2005–2022 vs difference in 2002	0.35	1	0.35	18.57	**<0.001**
			Error	8.68	461	0.02		
	Energy Use (Growth)	Log of Length	Treatment	0.43	11	0.04	24.29	**<0.001**
			H02: Difference in 2022 vs prior years	0.03	1	0.03	18.59	**<0.001**
			H03: 2022 and 2016 Differed from prior years	0.001	1	0.001	0.54	0.464
			H04: 2008, 2013, 2016, and 2022 vs differences in prior years	0.001	1	0.001	0.41	0.520
			H05: 2005–2022 vs difference in 2002	0.032	1	0.03	19.82	**<0.001**
			Error	0.75	461	0.00		
All Adult Fish	Energy Storage (Condition)	Log of Body Weight	Log of Length	83.38	1	83.38	17367.73	**<0.001**
			Treatment	6.367	11	0.58	120.56	**<0.001**
			H02: Difference in 2022 vs prior years	0.047	1	0.047	9.81	**0.002**
			H03: 2022 and 2016 Differed from prior years	0.042	1	0.04	8.65	**0.003**
			H04: 2008, 2013, 2016, and 2022 vs differences in prior years	0.023	1	0.02	4.84	**0.028**
			H05: 2005–2022 vs difference in 2002	0.007	1	0.007	1.41	0.236
			Error	5.37	1119	0.005		

Bold values are <0.05 and are statistically significant.

TABLE 4.7-1

Aquatic Plant Species Detected During 2024 Aquatic Vegetation Surveys at the McClean Lake Operaton

Scientific Name	Common Name	SKCDC Rank[1]
Alisma triviale	Broad-leaved water plantain	S4
Calamagrostis canadensis var. canadensis	Blue-joint reedgrass	S4
Carex aquatilis var. aquatilis	Water sedge	S4
Ceratophyllum demersum	Hornwort	S4
Equisetum fluviatile	Swamp horsetail	S4
Equisetum palustre	Marsh horsetail	S4
Hippuris vulgaris	Common mare's-tail	S4
Isoetes echinospora	Spiny-spored quillwort	S4
Lobelia dortmanna	Water lobelia	S3
Menyanthes trifoliata	Bog buckbean	S4
Myriophyllum sibiricum	Siberian water-milfoil	S5
Nuphar variegata	Yellow cowlily	S4
Potamogeton alpinus	Northern pondweed	S4
Potamogeton foliosus ssp. foliosus	Leafy pondweed	S4
Potamogeton friesii	Fries' pondweed	S4
Potamogeton gramineus	Various-leaved pondweed	S4
Sagittaria cuneata	Arum-leaved arrowhead	S4
Sparganium angustifolium	Narrow-leaved bur-reed	S4
Subularia aquatica ssp. americana	Water awlwort	S3
Utricularia intermedia	Flat-leaved bladderwort	S4
Utricularia vulgaris ssp. macrorhiza	Common bladderwort	S4
Zannichellia palustris	Horned pondweed	S4

Source: Stantec (2025)

[1] Provincial Rankings: S1 – critically imperiled; S2 – imperiled/very rare; S3 – vulnerable; S4 – apparently secure; S5 – secure/common; SNR – not ranked; SU – status is uncertain (SKCDC 2025).

TABLE 4.7-2

2024 Aquatic Rare Plant Occurrences Observed During the 2024 Aquatic Vegetation Surveys at the McClean Lake Operation

Scientific Name	Common Name	SKCDC Rank[1]	Preferred Habitat	UTM Coordinates (13V)		No. of Plants	Location of Occurrence(s)
				Easting	Northing		
Lobelia dortmanna	Water lobelia	S3	Shallow lake and pond margins in the boreal forest regions of Saskatchewan (SMOE 2025; Fryer et al. 2022)	566921	6458628	200-300	McClean Lake East Basin
				566331	6458968	50-100	
				566894	6458852	15	
Subularia aquatica ssp. americana	Water awlwort	S3	Submerged in shallow lake bottoms within the subarctic transition and boreal forest regions of Saskatchewan (SMOE 2025; W.P. Fraser Herbarium 2006)	565036	6452964	50-100	Collins Creek Downstream
				567383	6450374	50-100	Kewen Lake
				568641	6450444	50-100	
				568225	6450027	50-100	
				567359	6450391	50-100	

Source: Stantec (2025)

[1] Provincial Rankings: S3 – vulnerable (SKCDC 2025)

TABLE 4.7-3

Sediment Chemistry Data from the 2024 McClean Lake Aquatic Vegetation Sampling Program.

Parameter[1]	Reference					Exposure												Guidelines		
	Konner Lake					Vulture Lake				McClean Lake East Basin				Kewen Lake						
	N	<DL	Mean	SD	Mean+2SD	N	<DL	Mean	SD	N	<DL	Mean	SD	N	<DL	Mean	SD	ISQG[2]	PEL[3]	LEL[4]
Metals and Trace Elements																				
Arsenic	5	0	1.880	0.92	3.72	5	0	**11.06**	12.48	5	0	1.80	1.28	5	0	1.12	0.41	5.9	17	9.8
Cobalt	5	0	1.560	0.40	2.37	5	0	1.24	0.46	5	0	1.36	0.63	5	0	0.90	0.27	-	-	-
Copper	5	0	3.680	1.75	7.17	5	0	2.20	1.47	5	0	1.72	1.00	5	0	0.94	0.24	35.7	197.0	22.2
Lead	5	0	3.180	1.26	5.70	5	0	2.00	0.29	5	0	2.00	0.62	5	0	1.76	0.52	35.0	91.3	36.7
Molybdenum	5	0	1.140	0.64	2.43	5	0	**8.10**	8.03	5	0	**14.20**	18.11	5	0	0.50	0.22	-	-	13.8
Nickel	5	0	2.780	0.42	3.62	5	0	3.28	1.09	5	0	**5.04**	3.53	5	0	2.38	0.83	-	-	23.4
Selenium	5	1	0.440	0.26	0.96	5	0	0.24	0.31	5	1	0.38	0.27	5	5	<0.1	0.00	-	-	1.9
Uranium	5	0	0.700	0.21	1.12	5	0	0.70	0.23	5	0	0.84	0.78	5	0	0.520	0.15	-	-	104.4
Zinc	5	0	21.880	10.34	42.57	5	0	10.12	8.92	5	0	8.62	3.91	5	0	6.28	2.43	123	315	-
Radionuclides																				
Lead-210 (Bq/g)	5	3	0.08	0.05	0.18	5	5	<0.04	0.00	5	4	0.05	0.03	5	5	<0.04	0.00	-	-	0.9
Polonium-210 (Bq/g)	5	0	0.09	0.07	0.22	5	2	0.02	0.01	5	0	0.06	0.05	5	0	0.02	0.01	-	-	0.8
Radium-226 (Bq/g)	5	0	0.04	0.01	0.06	5	1	0.02	0.01	5	0	0.02	0.01	5	1	0.02	0.01	-	-	0.6
Thorium-230 (Bq/g)	5	4	0.02	0.00	0.02	5	5	<0.02	0.00	5	4	0.02	0.01	5	0	0.02	0.00	-	-	-

[1]Results presented in µg/g on a dry weight basis, unless specified otherwise.

[2]ISQG = Interim Sediment Quality Guidelines (CCME 2011).

[3]PEL = Probable Effects Level (CCME 2011).

[4]LEL = Lowest Effects Level (Thompson et al. 2005).

Shaded cells indicate values higher than guidelines. Bold values indicate exceedances above the upper reference range (i.e. reference mean+ 2 * standard deviation)

Note: Values measured below detection limit were set equal to detection limit in calculation of the mean and standard deviation.

TABLE 4.7-4

Pond Lily Root Chemistry Data from the 2024 McClean Lake Aquatic Vegetation Sampling Program.

Parameter[1]	Reference					Exposure											
	Konner Lake					Vulture Lake				McClean Lake East				Kewen Lake			
	N	<DL	Mean	SD	Mean+2SD	N	<DL	Mean	SD	N	<DL	Mean	SD	N	<DL	Mean	SD
Metals and Trace Elements																	
Arsenic	5	0	0.27	0.13	0.530	5	0	**0.82**	0.56	5	0	0.26	0.14	5	0	0.50	0.50
Cobalt	5	0	0.05	0.02	0.09	5	0	**0.15**	0.13	5	0	0.05	0.02	5	0	**0.10**	0.04
Copper	5	0	0.34	0.13	0.61	5	1	0.38	0.31	5	0	0.37	0.15	5	1	0.24	0.12
Lead	5	0	0.13	0.03	0.19	5	0	0.14	0.12	5	0	0.09	0.03	5	0	0.16	0.08
Molybdenum	5	0	0.36	0.17	0.69	5	0	**2.44**	0.78	5	0	**1.02**	0.33	5	0	**0.78**	0.71
Nickel	5	0	0.18	0.07	0.32	5	0	**0.59**	0.22	5	0	0.25	0.07	5	0	0.29	0.11
Selenium	5	1	0.09	0.03	0.14	5	0	**0.23**	0.09	5	2	0.07	0.03	5	1	0.10	0.04
Uranium	5	0	0.02	0.01	0.03	5	0	**0.08**	0.04	5	1	0.02	0.01	5	0	0.04	0.03
Zinc	5	0	13.72	6.44	26.60	5	0	5.88	1.76	5	0	8.60	2.46	5	0	8.80	5.18
Radionuclides																	
Lead-210 (Bq/g)	5	0	0.01	0.00	0.02	5	3	0.003	0.001	5	4	0.002	0.001	5	1	0.008	0.01
Polonium-210 (Bq/g)	5	0	0.01	0.00	0.02	5	0	0.006	0.001	5	0	0.0052	0.0004	5	0	0.011	0.01
Radium-226 (Bq/g)	5	0	0.02	0.01	0.04	5	0	0.005	0.002	5	0	0.007	0.003	5	0	0.012	0.01
Thorium-230 (Bq/g)	5	3	0.003	0.003	0.003	5	5	<0.001	0.000	5	4	0.001	0.000	5	4	0.001	0.001

[1]Results presented in µg/g on a dry weight basis, unless specified otherwise.

Bold values indicate exceedances above the upper reference range (i.e. reference mean+ 2 * standard deviation)

Note: Values measured below detection limit were set equal to detection limit in calculation of the mean and standard deviation.

TABLE 4.7-5

Pond Lily Shoot Chemistry Data from the 2024 McClean Lake Aquatic Vegetation Sampling Program.

Parameter[1]	Reference					Exposure											
	Konner Lake					Vulture Lake				McClean Lake East				Kewen Lake			
	N	<DL	Mean	SD	Mean+2SD	N	<DL	Mean	SD	N	<DL	Mean	SD	N	<DL	Mean	SD
Metals and Trace Elements																	
Arsenic	5	0	0.11	0.02	0.14	5	0	**1.24**	0.11	5	0	**0.27**	0.08	5	0	**0.39**	0.28
Cobalt	5	0	0.13	0.01	0.16	5	0	**2.62**	0.65	5	0	**0.34**	0.16	5	0	**0.43**	0.36
Copper	5	0	0.35	0.06	0.47	5	0	0.18	0.08	5	0	0.32	0.05	5	0	0.22	0.09
Lead	5	0	0.50	0.95	2.40	5	0	0.09	0.02	5	0	0.08	0.06	5	0	0.09	0.05
Molybdenum	5	0	0.24	0.05	0.35	5	0	**4.36**	0.68	5	0	**0.90**	0.23	5	0	**2.02**	1.04
Nickel	5	0	0.14	0.05	0.25	5	0	**6.16**	1.22	5	0	**0.49**	0.19	5	0	**0.40**	0.12
Selenium	5	0	0.12	0.01	0.13	5	0	**0.90**	0.06	5	0	**0.19**	0.05	5	0	**0.20**	0.06
Uranium	5	0	0.03	0.01	0.04	5	0	**0.31**	0.04	5	0	**0.06**	0.02	5	0	0.04	0.02
Zinc	5	0	21.40	5.22	31.85	5	0	14.00	2.65	5	0	11.62	2.50	5	0	15.78	5.24
Radionuclides																	
Lead-210 (Bq/g)	5	0	0.020	0.005	0.03	5	0	0.03	0.01	5	2	0.003	0.003	5	0	0.01	0.01
Polonium-210 (Bq/g)	5	0	0.019	0.003	0.03	5	0	0.025	0.002	5	0	0.013	0.005	5	0	0.02	0.01
Radium-226 (Bq/g)	5	0	0.02	0.01	0.03	5	0	0.03	0.01	5	0	0.01	0.01	5	0	0.01	0.01
Thorium-230 (Bq/g)	5	3	0.002	0.001	0.003	5	4	0.0012	0.0004	5	5	<0.001	0.000	5	5	<0.001	0.000

[1]Results presented in µg/g on a dry weight basis, except when specified otherwise.

Bold values indicate exceedances above the upper reference range (i.e. reference mean+ 2 * standard deviation)

Note: Values measured below detection limit were set equal to detection limit in calculation of the mean and standard deviation.

TABLE 4.7-6

Comparison of Mean Sediment Chemistry Data from the 2008 and 2024 Sampling

Parameter[1]	Reference						Exposure											
	Konner Lake						Vulture Lake[2]						Kewen Lake					
	Summer 2008[3]		Winter 2024[4]		Summer 2024[5]		Sumemr 2008[3]		Winter 2024[4]		Summer 2024[5]		Summer 2008[3]		Winter 2024[4]		Summer 2024[5]	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Metals and Trace Elements																		
Arsenic	3.62	1.25	4.70	0.33	1.88	0.92	23.91	30.76	28.00	18.00	11.06	12.48	4.36	1.36	3.20	0.07	1.12	0.41
Cobalt	2.48	1.43	4.40	1.10	1.56	0.40	4.01	3.34	11.00	4.40	1.24	0.46	3.78	1.34	3.50	0.40	0.90	0.27
Copper	5.92	1.83	5.60	0.32	3.68	1.75	4.72	1.63	7.34	1.02	2.20	1.47	4.74	1.65	1.92	0.33	0.94	0.24
Lead	5.48	2.21	2.88	1.36	3.18	1.26	5.07	2.26	7.22	2.76	2.00	0.29	3.32	0.62	2.60	0.35	1.76	0.52
Molybdenum	2.68	1.00	5.84	1.05	1.14	0.64	124.20	84.88	350.80	210.23	8.10	8.03	5.92	3.62	7.66	0.90	0.50	0.22
Nickel	4.78	1.64	6.76	0.28	2.78	0.42	27.78	26.44	67.80	35.63	3.28	1.09	6.14	1.54	6.18	0.86	2.38	0.83
Selenium	0.64	0.35	0.66	0.15	0.44	0.26	1.06	0.81	6.14	2.52	0.24	0.31	0.64	0.32	0.50	0.10	<0.1	0.00
Uranium	1.12	0.40	1.12	0.08	0.70	0.21	6.51	5.25	8.14	5.84	0.70	0.23	1.22	0.25	1.22	0.16	0.52	0.15
Zinc	44.40	20.55	64.80	8.50	21.88	10.34	25.76	16.55	52.40	14.97	10.12	8.92	33.60	13.43	23.20	1.33	6.28	2.43
Radionuclides																		
Lead-210 (Bq/g)	0.19	0.16	0.07	0.04	0.08	0.05	0.13	0.12	0.29	0.14	<0.04	0.00	0.03	0.02	0.07	0.03	<0.04	0.00
Polonium-210 (Bq/g	0.22	0.18	0.12	0.05	0.09	0.07	0.15	0.13	0.31	0.16	0.02	0.01	0.07	0.02	0.14	0.03	0.02	0.01
Radium-226 (Bq/g)	0.05	0.005	0.04	0.02	0.04	0.01	0.07	0.08	0.07	0.04	0.02	0.01	0.03	0.02	0.03	0.01	0.02	0.01
Thorium-230 (Bq/g)	0.01	0.009	<0.02	0.00	0.02	0.00	0.03	0.01	0.03	0.01	<0.02	0.00	0.02	0.01	0.02	0.00	0.02	0.00

[1]Results presented in µg/g on a dry weight basis, unless specified otherwise.

[2]2008 Vulture Lake data was calculated by averaging data from the 2 sampling locations (Vulture lake Inlet and Outlet).

[3]2008 Aquatic Macrophyte Chemistry Sampling results.

[4]2024 Sediment Chemistry Results collected as part of routine EMP in Feb/March 2024

[5]2024 Aquatic Vegetation and Sediment Chemistry results collected in Aug/Sept 2024.

Shaded cells indicate values higher than 2008 aquatic macrophyte chemistry data. McClean Lake East Basin is not available as no sampling was completed in 2008 at that location.

Note: Values measured below detection limit were set equal to one half detection limit in calculation of the mean and standard deviation.

TABLE 4.7-7

Comparison of Mean Pond Lily Root Chemistry Data from 2008 and 2024 Sampling Programs.

Parameter[1]	Reference				Exposure							
	Konner Lake				Vulture Lake[2]				Kewen Lake			
	Summer 2008[3]		Summer 2024[4]		Summer 2008[3]		Summer 2024[4]		Summer 2008[3]		Summer 2024[4]	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Metals and Trace Elements												
Arsenic	1.53	1.99	0.27	0.13	7.00	11.89	0.82	0.56	1.04	0.79	0.50	0.50
Cobalt	0.21	0.26	0.05	0.02	0.44	0.20	0.15	0.13	0.32	0.29	0.10	0.04
Copper	0.43	0.25	0.34	0.13	0.68	0.22	0.38	0.31	0.46	0.16	0.24	0.12
Lead	0.73	1.07	0.13	0.03	0.45	0.30	0.14	0.12	0.23	0.14	0.16	0.08
Molybdenum	1.26	1.41	0.36	0.17	13.63	10.77	2.44	0.78	5.66	4.02	0.78	0.71
Nickel	0.32	0.29	0.18	0.07	2.31	1.05	0.59	0.22	0.55	0.32	0.29	0.11
Selenium	0.07	0.07	0.09	0.03	0.18	0.07	0.23	0.09	0.09	0.05	0.10	0.04
Uranium	0.05	0.05	0.02	0.01	0.56	0.51	0.08	0.04	0.09	0.07	0.04	0.03
Zinc	18.10	9.49	13.72	6.44	8.00	3.40	5.88	1.76	17.40	4.98	8.80	5.18
Radionuclides												
Lead-210 (Bq/g)	0.042	0.038	0.011	0.004	0.020	0.009	0.003	0.001	0.017	0.012	0.008	0.005
Polonium-210 (Bq/g)	0.041	0.030	0.014	0.003	0.013	0.007	0.006	0.001	0.014	0.008	0.011	0.005
Radium-226 (Bq/g)	0.031	0.019	0.024	0.006	0.009	0.007	0.005	0.002	0.016	0.014	0.012	0.009
Thorium-230 (Bq/g)	0.002	0.001	0.003	0.003	0.005	0.002	<0.001	0.000	0.003	0.003	0.001	0.001

[1]Results presented in µg/g on a dry weight basis, unless specified otherwise.

[2]2008 Vulture Lake data was calculated by averaging data from the 2 sampling locations (Vulture lake Inlet and Outlet).

[3]2008 Aquatic Macrophyte Chemistry Sampling results.

[4]2024 Aquatic Vegetation and Sediment Chemistry results collected in Aug/Sept 2024.

Shaded cells indicate values higher than 2008 aquatic macrophyte chemistry data. McClean Lake East Basin is not available as no sampling was completed in 2008 at that location.

Note: Values measured below detection limit were set equal to one half detection limit in calculation of the mean and standard deviation.

TABLE 4.7-8

Comparison of Mean Pond Lily Shoot Chemistry Data from 2008 and 2024 Sampling Programs.

Parameter[1]	Reference				Exposure							
	Konner Lake				Vulture Lake[2]				Kewen Lake			
	Summer 2008[3]		Summer 2024[4]		Summer 2008[3]		Summer 2024[4]		Summer 2008[3]		Summer 2024[4]	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Metals and Trace Elements												
Arsenic	0.09	0.02	0.11	0.02	1.80	0.69	1.24	0.11	0.29	0.11	0.39	0.28
Cobalt	0.10	0.04	0.13	0.01	7.56	3.00	2.62	0.65	0.48	0.16	0.43	0.36
Copper	0.29	0.07	0.35	0.06	0.47	0.28	0.18	0.08	0.32	0.12	0.22	0.09
Lead	0.07	0.03	0.50	0.95	0.15	0.06	0.09	0.02	0.12	0.05	0.09	0.05
Molybdenum	0.28	0.16	0.24	0.05	15.06	3.84	4.36	0.68	5.66	1.75	2.02	1.04
Nickel	0.10	0.03	0.14	0.05	17.76	14.13	6.16	1.22	0.84	0.26	0.40	0.12
Selenium	0.04	0.02	0.12	0.01	0.38	0.05	0.90	0.06	0.10	0.02	0.20	0.06
Uranium	0.03	0.02	0.03	0.01	0.77	0.36	0.31	0.04	0.04	0.00	0.04	0.02
Zinc	17.60	4.62	21.40	5.22	22.00	10.60	14.00	2.65	18.80	5.89	15.78	5.24
Radionuclides												
Lead-210 (Bq/g)	0.011	0.005	0.020	0.005	0.022	0.012	0.033	0.011	0.006	0.002	0.014	0.007
Polonium-210 (Bq/g)	0.019	0.007	0.019	0.003	0.015	0.003	0.025	0.002	0.011	0.001	0.020	0.008
Radium-226 (Bq/g)	0.021	0.007	0.021	0.005	0.020	0.006	0.026	0.009	0.019	0.004	0.013	0.008
Thorium-230 (Bq/g)	0.003	0.004	0.002	0.001	0.003	0.001	0.001	0.0004	0.002	0.002	<0.001	0.000

[1]Results presented in µg/g on a dry weight basis, unless specified otherwise.

[2]2008 Vulture Lake data was calculated by averaging data from the 2 sampling locations (Vulture lake Inlet and Outlet).

[3]2008 Aquatic Macrophyte Chemistry Sampling results.

[4]2024 Aquatic Vegetation and Sediment Chemistry results collected in Aug/Sept 2024.

Shaded cells indicate values higher than 2008 aquatic macrophyte chemistry data. McClean Lake East Basin is not available as no sampling was completed in 2008 at that location.

Note: Values measured below detection limit were set equal to one half detection limit in calculation of the mean and standard deviation.

TABLE 5.2-1

Summary of Wildlife and Wildlife Habitat Surveys

Environment Aspect	Purpose	Year(s)	Reference Documents
Wildlife			
Caribou and Moose	to assess abundance of caribou and moose	1976, 1977, 1978, 1979, 1980 1988, 1989, 1990, 1993, and 1994	Minatco Limited. 1991. McClean Lake Project EIS. COGEMA Resources Inc. (COGEMA). 1995. The Midwest Project Environmental Impact Statement. Terrestrial and Aquatic Environmental Managers Ltd. (TAEM). 1995. McClean Project Baseline Investigations 1993 – 1995.
Waterfowl	to estimate waterfowl abundance	1977-1979	MacLaren, James F. Limited and the Saskatchewan Research Council (SRC). 1979. Environmental Baseline Studies for Project Wolly McClean Lake Area. Interim Report No.1. Prepared by MacLaren, James F. Limited and the SRC for Canadian Occidental Petroleum Limited.
Beaver	to locate and assess the status of beaver lodges around the McClean Lake Operation development area	1978, 1979, 1989	MacLaren, James F. Limited and the Saskatchewan Research Council (SRC). 1979. Environmental Baseline Studies for Project Wolly McClean Lake Area. Interim Report No.1. Prepared by MacLaren, James F. Limited and the SRC for Canadian Occidental Petroleum Limited. Canada Wide Mines Ltd. 1980. Midwest Lake Environmental Baseline Study. Minatco Limited. 1991. McClean Lake Project EIS.
Small Mammals	to determine small mammal abundance and habitat use	1979	MacLaren, James F. Limited and the Saskatchewan Research Council (SRC). 1979. Environmental Baseline Studies for Project Wolly McClean Lake Area. Interim Report No.1. Prepared by MacLaren, James F. Limited and the SRC for Canadian Occidental Petroleum Limited.
Raptor	to locate raptor nests	1989	Minatco Limited. 1991. McClean Lake Project EIS.
Willow Ptarmigan	to assess abundance of willow ptarmigan	1989	Minatco Limited. 1991. McClean Lake Project EIS.
Snowshoe Hare	to assess both habitat use and relative abundance of snowshoe hare	1989	Minatco Limited. 1991. McClean Lake Project EIS.
Red-backed Vole	to obtain baseline radionuclide and trace metal concentrations in small mammals (represented by red-backed vole) within and adjacent to the LSA of the McClean Lake Operation.	1995, 1996	Terrestrial and Aquatic Environmental Managers Ltd. (TAEM). 1997. McClean Project Additional Baseline Collections 1995 – 1996. Prepared for COGEMA Resources Inc.
Birds	to investigate the presence/absence of waterbirds, raptors, colloniual-nesting waterfowl, upland game birds, and passerine in the Midwest Project area.	2003 - 2004	AREVA Resources Canada Inc. (AREVA). 2009b. Midwest Project Area Existing Environment Technical Information Document.
Small Mammals	to investigate the presence/absence of small mammals the Midwest Project area through winter track survey and small mammal trapping	2003 - 2004	AREVA Resources Canada Inc. (AREVA). 2009b. Midwest Project Area Existing Environment Technical Information Document.
Furbearers	to investigate the presence/absence of furbearers in the Midwest Project area through pellet group survey and winter track survey	2003 - 2004	AREVA Resources Canada Inc. (AREVA). 2009b. Midwest Project Area Existing Environment Technical Information Document.
Ungulates	to identify presence of ungulates	2003 - 2004	AREVA Resources Canada Inc. (AREVA). 2009b. Midwest Project Area Existing Environment Technical Information Document.
Semi-Aquatic Furbearers	to investigate the presence/absence and relative abundance of semi-aquatic mammal populations that occur near to the project site	2010	HAB-TECH Environmental. 2011. McClean Lake Operation 2010 Semi-Aquatic Furbearer Shoreline Survey.
Birds and Species at Risk	to collect additional information about rare species present in the area and address CNSC comment on the 2016 EP TID regarding the SARA species	2018	Birds Studies Canada 2018. 2018 Monitoring Report for the McClean Lake Mine Site. Prepared for Orano Resources Canada.
Bats	to update the flora and fauna inventory as per the Mining BU Biodiversity Policy Action Plan	2023 - 2025	University of Saskatchewan. 2024. McClean Lake Operation Preliminary Bat Survey. University of Saskatchewan. 2025a. McClean Lake Operation 2023-2024 Draft Bat Survey Report.
Semi-Aquatic Furbearers	to update the flora and fauna inventory as per the Mining BU Biodiversity Policy Action Plan and to collect additional information on semi-aquatic furbearers' presence in Candy Creek and Caribou Lake in preparation for future mining of McClean and Sue F deposits using the SABRE method	2024	CanNorth Environmental Services. 2025b. Semi-Aquatic Furbearer and Small Mammal Surveys. CanNorth Environmental Services. 2025c. Caribou Lake and Candy Creek Semi-Aquatic Furbearer Surveys. CanNorth Environmental Services. 2025d. Semi-Aquatic Furbearer and Small Mammal Surveys – Analytical Report: Draft Rev 2.
Small Mammals	to update the flora and fauna inventory as per the Mining BU Biodiversity Policy Action Plan and to obtain small mammal chemistry data for the 2025 ERA	2024	CanNorth Environmental Services. 2025b. Semi-Aquatic Furbearer and Small Mammal Surveys. CanNorth Environmental Services. 2025d. Semi-Aquatic Furbearer and Small Mammal Surveys – Analytical Report: Draft Rev 2.
Migratory Bird Nest Survey	to assess the potential use of the future mining footprint for nesting by pileated woodpecker and great blue heron	2024	Stantec (Stantec Consulting Ltd.) 2024. 2024-2025 Flora and Fauna Inventory Update: Pileated Woodpecker and Great Blue Heron Assessment.
Northern Leopard Frog	to determine the presence of northern leopard frog via an eDNA survey at waterbodies at the McClean Lake Operations and Midwest Project Areas	2024	Stantec (Stantec Consulting Ltd.). 2025c. 2024-2025 Vegetation and Wildlife Surveys – Summer 2024 Field Report.
Large Mammals	to update the flora and fauna inventory as per the Mining BU Biodiversity Policy Action Plan and perform aerial surveys of large mammals and vegetation cover with high resolution colour and infrared cameras	2024 - 2025	McLoughlin, P. 2024. Biodiversity Monitoring in the Saskatchewan Boreal Shield: Large Mammals and Vegetation. Interim Progress Report.
Large and Medium-Sized Mammals	to update the flora and fauna inventory as per the Mining BU Biodiversity Policy Action Plan using remote wildlife cameras	2024 - 2025	Stantec (Stantec Consulting Ltd.). 2025c. 2024-2025 Vegetation and Wildlife Surveys – Summer 2024 Field Report. Stantec (Stantec Consulting Ltd.). 2025d. 2024-2025 Vegetation and Wildlife Surveys – Spring 2024 Field Report. Stantec (Stantec Consulting Ltd.) 2025e. Daily Updates (June 2024–February 2025). Unpublished internal communications provided to Orano Canada Inc., Saskatoon, Saskatchewan.
Terrestrial Wildlife Habitat			
Soil Surveys	baseline soil classification and chemistry assessments to characterize the local soils and provide a basis to predict potential environmental effects	1988-1989, 1993-1994, 1995	COGEMA Resources Inc. (COGEMA). 2003. McClean Lake Operation Existing Environment Technical Information Document.
Vegetation (browse)	to estimate the distribution and abundance of woody shrubs (i.e., browse), which provide an important source of forage for moose and other wildlife	1989	Minatco Limited. 1991. McClean Lake Project EIS.
Vegetation Classification	to determine major cover types for the McClean Lake Project Area	1989	Minatco Limited. 1991. McClean Lake Project EIS.
Rare Plant Surveys	targetted rare plant survey of areas with high rare plant potential within the Midwest Project area	2003	AREVA Resources Canada Inc. (AREVA). 2009b. Midwest Project Area Existing Environment Technical Information Document.

TABLE 5.2-1

Summary of Wildlife and Wildlife Habitat Surveys

Environment Aspect	Purpose	Year(s)	Reference Documents
Wetland Communities	to determine if wetland vegetation communities have been altered by groundwater dewatering programs associated with mine development and operation at the McClean Lake Project.	1993 (baseline), 2002, 2008, 2015	AREVA Resources Canada Inc. (AREVA) 2016a. Environmental Performance Technical Document. Volume 1.
Vegetation (browse)	to estimate the distribution and abundance of woody shrubs in the Midwest Project area (i.e., browse), which provide an important source of forage for moose and other wildlife	2003	AREVA Resources Canada Inc. (AREVA). 2009b. Midwest Project Area Existing Environment Technical Information Document.
Lichen / Caribou	to estimate caribou habitat quality	2003	AREVA Resources Canada Inc. (AREVA). 2009b. Midwest Project Area Existing Environment Technical Information Document.
Ecosite Mapping and Classification	to refine the land cover classification, collect information about key vegetation communities, rank ecosites with potential of rare plant species and VEC presense, quantify the extent of critical wildlife habitat in the local assessment area	2003 - 2004	AREVA Resources Canada Inc. (AREVA).2007. Midwest Project Environmental Impact Statement. October 2007. Saskatoon, Saskatchewan. AREVA Resources Canada Inc. (AREVA). 2009b. Midwest Project Area Existing Environment Technical Information Document. AREVA Resources Canada Inc. (AREVA). 2011. Midwest Project Environment Environmental Impact Statement. September 2011.
Rare Plant Checks	to confirm locations and statuses of previously observed rare plant locations and to check the SABRE expansion area for its potential to include rare plant populations	2023	CanNorth Environmental Services. 2023.2023 Orano McClean Lake and Midwest Lease Rare Plant Status Checks.
Habitat Classification	to update the habitat classification based on the most recent data and align it with the Saskatchewan Forest Ecosite Classification	2023-2025	Stantec (Stantec Consulting Ltd.). 2025a. McClean Lake Operation Project Ecosite Refinement: 2025 Terrestrial Habitat Mapping and Habitat Sustainability: Draft Report.
Vegetation Assessment	to survey for vascular plant species of conservation concern, weeds, and invasive plant species	2024	Stantec (Stantec Consulting Ltd.). 2025b. McClean Lake Operation Flora Inventory Update Report.

TABLE 5.2-2

Ecosites Within the McClean Lake Operation Local Assessment Boundary

Ecosite Group	Ecosites[1]	Area Classified in the LAB (ha)	% of Total LAB
UPLAND FOREST			
BS3/4 (jack pine dominant)	BS3 - jack pine/blueberry/lichen: moderately fresh sand	24,988.90	33.7
	BS4 - jack pine - black spruce/feathermoss: moderately dry sand		
BS5/6 (jack pine mixedwood)	BS5 - jack pine - white birch/feathermoss: moderately dry sand	531.2	0.7
	BS6 - jack pine - trembling aspen/green alder: moderately fresh loamy sand		
BS7/8/9/10 (black spruce dominant)	BS7 - black spruce/blueberry/lichen: moderately dry sand	12,530.20	16.9
	BS8 - black spruce - white birch/lichen: moderately dry sandy loam		
	BS9 - black spruce - jack pine/feathermoss: moderately fresh sandy loam		
	BS10 - black spruce - white birch/feathermoss: fresh sand		
BS13 (white birch-black spruce)	BS13 - white birch - black spruce - trembling aspen: moderately fresh sand	87	0.1
BS14 (white birch-dominant)	BS14 - white birch/lingonberry - Labrador tea: moderately dry sand	19.4	0.03
BS15 (aspen-dominant)	BS15 - trembling aspen - white birch/green alder: moderately fresh loamy sand	3.6	0.005

TABLE 5.2-2

Ecosites Within the McClean Lake Operation Local Assessment Boundary

Ecosite Group	Ecosites[1]	Area Classified in the LAB (ha)	% of Total LAB
WETLANDS			
BS16 (treed swamp >10m)	BS16 - black spruce/balsam poplar/river alder swamp: very moist mesic organic	1,109.00	1.5
BS17 (black spruce treed bog)	BS17 - black spruce treed bog: very moist mesic organic	812.4	1.1
BS18 (Labrador tea shrubby bog)	BS18 - Labrador tea shrubby bog: moderately wet mesic organic	1,047.60	1.4
BS19/20 (graminoid/open bog)	BS19 - graminoid bog: very wet humic organic	122.3	0.2
	BS20 - open bog: moderately wet fibric organic		
BS21 (tamarack treed fen)	BS21 - tamarack treed fen: wet fibric organic	1,824.70	2.5
BS22/23 (shrubby fen)	BS22 - leatherleaf shrubby poor fen: very wet fibric organic	3,027.20	4.1
	BS23 - willow shrubby rich fen: wet fibric organic		
BS24/25 (graminoid/open fen)	BS24 - graminoid fen: very wet humic organic	2,619.70	3.5
	BS25 - open fen: wet mesic organic		
SPARSELY VEGETATED			
BS2 (lichen/felsenmeer - bedrock)	BS2 - lichen/felsenmeer - bedrock: dry nonsoil	294.2	0.4
BS27 (sedge rocky shore)	BS27 - sedge rocky shore: very moist sand	10.9	0.01

TABLE 5.2-2

Ecosites Within the McClean Lake Operation Local Assessment Boundary

Ecosite Group	Ecosites[1]	Area Classified in the LAB (ha)	% of Total LAB
ADDED CLASSIFICATIONS			
Cloud - upland	Areas in which cloud cover in the imagery prevented ecosite classification but upland landscapes could still be identified	411.2	0.6
Cloud - wetland	Areas in which cloud cover in the imagery prevented ecosite classification but wetland/water landscapes could still be identified	48.6	0.1
Disturbed - anthropogenic	Disturbance due to anthropogenic causes	1,130.00	1.5
Disturbed - recent fire	Disturbance due to forest fires that have occurred since 2021	2,387.20	3.2
Regenerating	Habitats in a regeneration phase and did not demonstrate enough established features to be classified into a specific ecosite type	7,318.30	9.9
Water	Areas of open water	13,846.60	18.7
	TOTAL	**74,170.2**	**100**

Source: Stantec (2025a)

[1]Ecosite names and codes obtained from McLaughlan et al. (2010) and Stantec (2025a).

TABLE 5.2-3

Revegetation Activities at the Sue C Clean Waste Rock Pile at the McClean Lake Operation, 2022-2023

Year	Location	Area (ha)	Method	Seeding Dates	Seed Mixture (Pure Live Seeds, %)
2022	South-west and western slopes	8	Hydroseeding	Sept 21 - Oct 1	11.5% Northern Wheatgrass (*Elymus lanceolatus)* 12.4% American Vetch (*Vicia Americana)* 21.5% Tufted hairgrass (*Deschampsia caespitosa)* 26.5% Canada Wildrye (*Elymus canadensis)* 16.5% Slender Wheatgrass (*Elymus trachycaulus)* 11.6% Rocky Mountain Fescue (*Festuca saximontana)*
2023	Northwestern slopes	9.7	Hydroseeding	Sept 15 - 27	10% Northern Wheatgrass (*Elymus lanceolatus)* 20% Canada Milkvetch (*Astralagus canadensis)* 20% Tufted hairgrass (*Deschampsia caespitosa)* 25% Canada Wildrye (*Elymus canadensis)* 15% Slender Wheatgrass (*Elymus trachycaulus)* 10% Rocky Mountain Fescue (*Festuca saximontana)*

Source: Orano 2023a, Orano 2024

TABLE 5.2-4

Rare Plant Population Status Within the McClean Lake and Midwest Local Study Areas, June and August 2023

Site ID	Scientific Name[1]	Common Name[1]	SKCDC Rank[1]	Preferred Habitat	UTM Coordinates[2]		June Survey Result	August Survey Result	Overall Result	Reasoning for Non-Detection	Estimated Quantity	Forest Ecosite/Habitat
					Easting	Northing						
1	*Diphasiastrum sitchense*	Alaskan clubmoss	S3	Dry, open, coniferous woods (Harms and Leighton 2011a).	569736	6458168	Not confirmed	Completed - not found	not found	Coordinate error	0	BS3
2	*Pedicularis labradorica*	Labrador lousewort	S3	Open forests, tundras, heathlands, rocky slopes, muskegs (FNA 2020).	570178	6459321	Not confirmed	Completed - not found	not found	Coordinate error	0	BS3/BS4
3	*Diphasiastrum sitchense*	Alaskan clubmoss	S3	Dry, open, coniferous woods (Harms and Leighton 2011a).	570270	6459306	Incidental	-	n/a (new record)	-	200	BS3/BS4
					570310	6459320	Incidental				20	BS3/BS4
					570315	6459297	Incidental				34	BS3/BS4
3	*Pedicularis labradorica*	Labrador lousewort	S3	Open forests, tundras, heathlands, rocky slopes, muskegs (FNA 2020).	570346	6459319	Not confirmed	Completed - not found	not found	Coordinate error	0	BS3/BS4
4	*Phegopteris connectilis*	Long beech-fern	S3	Moist woods (Harms and Leighton 2011a).	567103	6467149	Confirmed	-	confirmed	-	100	Creek
5	*Carex buxbaumii*	Brown sedge	S3	Wet shrublands, meadows, shore fens, bogs, and muskegs, including shallow sodden calcareous bogs or swampy shores (Leighton 2012).	567513	6467882	Not confirmed	Completed - not found	not found	Natural causes (e.g., changes in hydrological regime, vegetation dynamics, or herbivory) or plant identification error in the past	0	BS24/ disturbed
6	*Carex buxbaumii*	Brown sedge	S3	Wet shrublands, meadows, shore fens, bogs, and muskegs, including shallow sodden calcareous bogs or swampy shores (Leighton 2012).	567647	6467526	Not confirmed	Completed - not found	not found	Potential change in hydrology due to nearby earthworks, natural causes (e.g., changes in hydrological regime, vegetation dynamics, or herbivory), or plant identification error in the past.	0	BS21/ disturbed
7	*Carex buxbaumii*	Brown sedge	S3	Wet shrublands, meadows, shore fens, bogs, and muskegs, including shallow sodden calcareous bogs or swampy shores (Leighton 2012).	567608	6467443	Not confirmed	Completed - not found	not found	Natural causes (e.g., changes in hydrological regime, vegetation dynamics, or herbivory) or plant identification error in the past	0	BS24
8	*Drosera anglica*	English sundew	S3	Marly shores, fens, and drainage tracks in peat bogs (FNA 2020).	567589	6467480	Not confirmed	Completed - not found	not found	Natural causes (e.g., changes in hydrological regime or vegetation dynamics)	0	BS24
9	*Diphasiastrum sitchense*	Alaskan clubmoss	S3	Dry, open, coniferous woods (Harms and Leighton 2011a).	568786	6465472	Incidental	-	n/a (new record)	-	100	Microhabitats - BS3/BS17
9	*Pinguicula villosa*	Hairy butterwort	S3	Tundra and subarctic bogs (Looman and Best 1979).	568831	6465494	Confirmed	-	confirmed	-	100	Microhabitats - BS3/BS17
10	*Pinguicula villosa*	Hairy butterwort	S3	Tundra and subarctic bogs (Looman and Best 1979).	569256	6465042	Confirmed	-	confirmed	-	400	BS17
11	*Drosera anglica*	English sundew	S3	Marly shores, fens, and drainage tracks in peat bogs (FNA 2020).	554927	6465796	Not confirmed	Population found in different location - Site 13	wrong location	Coordinate error/wrong habitat	0	BS16
11	*Sorbus scopulina*	Western mountain-ash	S3	Slopes, open forests, forest edges, riparian zones, and lakeshores (FNA 2020).	554866	6465801	Incidental	-	n/a (new record)	-	45	BS16
11	*Athyrium filix-femina* var. *cyclosorum*	Northern lady-fern	S4	Moist woods and streambanks (Harms and Leighton 2011a).	554919	6465769	Incidental	-	confirmed (corrected location)	Common subspecies found here, confirmed to be the apparently secure (S4) fern *Athyrium felix-femina* var. *cyclosorum.*	100	BS16
12	*Athyrium filix-femina* var. *angustum*	Northern lady-fern	S3	Moist woods and streambanks (Harms and Leighton 2011a).	554931	6465713	Not confirmed	Population found in different location - Site 11	wrong location	Coordinate error/wrong habitat	-	Wrong habitat

TABLE 5.2-4

Rare Plant Population Status Within the McClean Lake and Midwest Local Study Areas, June and August 2023

Site ID	Scientific Name[1]	Common Name[1]	SKCDC Rank[1]	Preferred Habitat	UTM Coordinates[2]		June Survey Result	August Survey Result	Overall Result	Reasoning for Non-Detection	Estimated Quantity	Forest Ecosite/Habitat
					Easting	Northing						
13	*Drosera anglica*	English sundew	S3	Marly shores, fens, and drainage tracks in peat bogs (FNA 2020).	555002	6465813	Confirmed	-	confirmed (corrected location)	-	200	BS24
13	*Juncus stygius* ssp. *americanus*	Moor rush	S3	Wet moss, bogs, and bog-pools (FNA 2020).	554990	6465799	Confirmed	-	confirmed	-	6	BS24
13	*Pinguicula villosa*	Hairy butterwort	S3	Tundra and subarctic bogs (Looman and Best 1979).	554978	6465792	Incidental	-	n/a (new record)	-	50	BS24
14	*Diphasiastrum sitchense*	Alaskan clubmoss	S3	Dry, open, coniferous woods (Harms and Leighton 2011a).	553041	6462167	Confirmed	-	confirmed	-	200	BS7
15	*Phegopteris connectilis*	Long beech-fern	S3	Moist woods (Harms and Leighton 2011a).	554353	6464281	Incidental	-	confirmed (corrected location)	-	65	Creek
15	*Pinguicula villosa*	Hairy butterwort	S3	Tundra and subarctic bogs (Looman and Best 1979).	554339	6464254	Not confirmed	-	not found	Coordinate error/wrong habitat	0	Creek
15	*Sorbus scopulina*	Western mountain-ash	S3	Slopes, open forests, forest edges, riparian zones, and lakeshores (FNA 2020).	554353	6464281	Confirmed	-	confirmed	-	50	Creek
16	*Lobelia dortmanna*	Water lobelia	S3	Shallow lakes (Looman and Best 1979).	554281	6464174	Not confirmed	Population found in different location - Site 18	wrong location	Coordinate error	0	Wrong habitat -upland (BS10)
16	*Phegopteris connectilis*	Long beech-fern	S3	Moist woods (Harms and Leighton 2011a).	554279	6464182	Not confirmed	Completed - not found/ population found in different location - Site 15	wrong location	Coordinate error	0	Wrong habitat -upland (BS10)
17	*Pinguicula villosa*	Hairy butterwort	S3	Tundra and subarctic bogs (Looman and Best 1979).	554294	6464016	Confirmed	-	confirmed (corrected location)	-	250	BS17
18	*Pinguicula villosa*	Hairy butterwort	S3	Tundra and subarctic bogs (Looman and Best 1979).	554391	6464027	Not confirmed	Population found in different location - Site 17	wrong location	Coordinate error	0	Lake
18	*Lobelia dortmanna*	Water lobelia	S3	Shallow lakes (Looman and Best 1979).	554263	6463887	Confirmed	-	confirmed (corrected location)	Possible waypoint transcription error with Site 16	1	Lake
					554394	6463857	Confirmed	-			10	Lake
					554475	6463889	Confirmed	-			25	Lake
					554482	6463899	Confirmed	-			20	Lake
					554515	6463947	Confirmed	-			15	Lake
19	*Drosera anglica*	English sundew	S3	Marly shores, fens, and drainage tracks in peat bogs (FNA 2020).	552876	6463340	Incidental	-	n/a (new record)	-	200	BS24
19	*Juncus stygius* ssp. *americanus*	Moor rush	S3	Wet moss, bogs, and bog-pools (FNA 2020).	552876	6463340	Confirmed	-	confirmed	-	100	BS24
20	*Diphasiastrum sitchense*	Alaskan clubmoss	S3	Dry, open, coniferous woods (Harms and Leighton 2011a).	553305	6463465	Confirmed	-	confirmed	-	50	BS9
21	*Rhinanthus minor* ssp. *minor*	Little yellow-rattle	S3	Moist places and open woodlands (Looman and Best 1979), anthropogenically disturbed locations (FNA 2023a, 2023b).	570424	6458931	-	Incidental	n/a (new record)	-	200	Disturbed trail

Source: CanNorth (2023)

SKCDC = Saskatchewan Conservation Data Centre; UTM = Universal Transverse Mercator.

S3 = Vulnerable/rare to uncommon; S4 = apparently secure.

[1]Scientific and common names and provincial rank as per SKCDC (2025).

[2]All UTM coordinates are in NAD83, Zone 13.

TABLE 5.2-5

2024 Vegetation Survey Transects and Plots per Ecosite Type and Areas of Specific Interests

Location Type	Ecosite Category	Ecosite Code[1]	Ecosite Name[1]	No. of Transects	No. of Plots
Ecosite-specfic	Sparsely Vegetated	BS2	lichen/felsenmeer – bedrock: dry nonsoil	1	3
		BS27	sedge rocky shore: very moist sand	1	2
	Forest	BS3	jack pine/blueberry/lichen: moderately fresh sand	2	3
		BS5	jack pine – white birch/feathermoss: moderately dry sand	1	3
		BS7	black spruce/blueberry/lichen – moderately dry sand	1	1
		BS9	black spruce – jack pine/feathermoss: moderately fresh sand loam	1	2
		BS14	white birch/lingonberry – Labrador tea: moderately dry sand	n/a	2
	Wetland	BS16	black spruce/balsam poplar/ river alder swamp: very moist mesic organic	1	2
		BS17	black spruce treed bog: very moist mesic organic	1	3
		BS18	Labrador tea shrubby bog: moderately wet mesic organic	1	3
		BS19	graminoid bog: very wet humic organic	1	3
		BS21	tamarack treed fen: wet fibric organic	1	3
		BS22	leatherleaf shrubby poor fen: very wet fibric organic	2	3
		BS24	graminoid fen: very wet humic organic	1	3
	Disturbed	Burn	Disturbed - recent fire	1	3
		Disturbed	Disturbed - anthropogenic	1	n/a
		Regenerating	Regenerating	1	3
Areas of Interest	n/a	2015 Brown Sedge Search Site	n/a	3	n/a
		Future McClean Mining Area	n/a	4	n/a
		Future Sue F Mining Area	n/a	6	n/a

Source: Stantec (2025b)

[1]Ecosite names and codes obtained from McLaughlan et al. (2010)

TABLE 5.2-6

Vascular Plant, Bryophyte, Lichen and Fungi Species Detected During 2024 Terrestrial Vegetation Surveys

Type	Common Name	Scientific Name	SKCDC Rank[1]
Bryophyte	Asplenium pocket moss	*Fissidens asplenioides*	n/a
Bryophyte	Big red stem feathermoss	*Pleurozium schreberi*	S5
Bryophyte	Bog hair cap moss	*Polytrichum strictum*	S5
Bryophyte	Broom moss	*Dicranum scoparium*	S5
Bryophyte	Common large wetland moss	*Calliergonella cuspidata*	SU
Bryophyte	Felt round moss	*Rhizomnium pseudopunctatum*	S5
Bryophyte	Lesser featherwort	*Plagiochila porelloides*	S3
Bryophyte	Midway peat moss	*Sphagnum magellanicum*	S5
Bryophyte	Spreading threadwort	*Cephaloziella divaricata*	SNR
Bryophyte	Squarrose peat moss	*Sphagnum squarrosum*	S5
Bryophyte	Thin-leafed peat moss	*Sphagnum teres*	S5
Fungus	A fungus	*Russula* sp.	n/a
Fungus	Blueish Hydnellum	*Hydnellum caeruleum*	S4
Fungus	Frosty Lyophyllum	*Lyophyllum loricatum*	n/a
Fungus	Red belt fungus	*Fomitopsis pinicola*	n/a
Lichen	Concentric ring lichen	*Arctoparmelia centrifuga*	S2
Lichen	Pale-footed horsehair lichen	*Bryoria fuscescens*	S5
Lichen	A lichen	*Calvitimela aglaea*	n/a
Lichen	A lichen	*Lecidea fuscoatra*	n/a
Lichen	A lichen	*Lecidea leprarioides*	n/a
Lichen	A lichen	*Miriquidica liljenstroemii*	n/a
Lichen	A map lichen	*Rhizocarpon atroflavescens*	n/a
Lichen	A pelt lichen	*Peltigera vitikainenii*	n/a
Lichen	American starburst lichen	*Imshaugia placorodia*	S1
Lichen	Arctic kidney lichen	*Nephroma arcticum*	S1
Lichen	Bighorn cladonia	*Cladonia cornuta*	S4
Lichen	Black-footed pixie-cup	*Cladonia albonigra*	n/a
Lichen	Black-footed reindeer lichen	*Melanelia stygia*	S1
Lichen	Blistered rock tripe	*Umbilicaria hyperborea*	S2
Lichen	Boreal oakmoss lichen	*Evernia mesomorpha*	S5
Lichen	Bristly beard lichen	*Usnea hirta*	S4
Lichen	Bronzed pixie lichen	*Cladonia gracilis* ssp. *turbinata*	SU
Lichen	Candy lichen	*Icmadophila ericetorum*	S3
Lichen	Crinkled snow lichen	*Flavocetraria nivalis*	S3
Lichen	Easter lichen	*Stereocaulon paschale*	S2
Lichen	Fringed wrinkle-lichen	*Tuckermannopsis americana*	S3
Lichen	Granite-speck rim-lichen	*Lecanora polytropa*	S3
Lichen	Gray reindeer lichen	*Cladonia rangiferina*	S5
Lichen	Greater sulphur-cup	*Cladonia sulphurina*	S2
Lichen	Green starburst lichen	*Parmeliopsis ambigua*	S3
Lichen	Hammered shield lichen	*Parmelia sulcata*	S5
Lichen	Lesser sulphur-cup	*Cladonia deformis*	S3
Lichen	Monk's-hood lichen	*Hypogymnia physodes*	S4
Lichen	Organ-pipe lichen	*Cladonia crispata*	S3
Lichen	Powdered funnel lichen	*Cladonia cenotea*	S3
Lichen	Powdered sunshine lichen	*Vulpicida pinastri*	S4
Lichen	Quill lichen	*Cladonia amaurocraea*	S2
Lichen	Red-fruited pixie-cup	*Cladonia pleurota*	S2
Lichen	Scabby pelt	*Peltigera scabrosa*	S2
Lichen	Yellow map lichen	*Rhizocarpon geographicum*	S2
Vascular plant	Alaska paper birch	*Betula neoalaskana*	S4
Vascular plant	Alaskan clubmoss	*Diphasiastrum sitchense*	S3
Vascular plant	Alpine cotton-grass	*Trichophorum alpinum*	S4
Vascular plant	American red raspberry	*Rubus idaeus* ssp. *strigosus*	S5

TABLE 5.2-6

Vascular Plant, Bryophyte, Lichen and Fungi Species Detected During 2024 Terrestrial Vegetation Surveys

Type	Common Name	Scientific Name	SKCDC Rank[1]
Vascular plant	American scheuchzeria	*Scheuchzeria palustris*	S4
Vascular plant	Awned sedge	*Carex atherodes*	S4
Vascular plant	Balsam willow	*Salix pyrifolia*	S4
Vascular plant	Basket willow	*Salix petiolaris*	S4
Vascular plant	Beaked sedge	*Carex rostrata*	S4
Vascular plant	Bearberry	*Arctostaphylos uva-ursi*	S5
Vascular plant	Bitter fleabane	*Erigeron acris* var. *kamtschaticus*	S4
Vascular plant	Black crowberry	*Empetrum nigrum*	S4
Vascular plant	Black spruce	*Picea mariana*	S5
Vascular plant	Black-girdle bulrush	*Scirpus atrocinctus*	S4
Vascular plant	Bladder campion	*Silene vulgaris*	SNA[2]
Vascular plant	Blueberry	*Vaccinium myrtilloides*	S5
Vascular plant	Blue-joint reedgrass	*Calamagrostis canadensis var. canadensis*	S4
Vascular plant	Bog adder's-mouth orchid	*Malaxis paludosa*	S3
Vascular plant	Bog bilberry	*Vaccinium uliginosum*	S4
Vascular plant	Bog buckbean	*Menyanthes trifoliata*	S4
Vascular plant	Bog cranberry	*Vaccinium vitis-idaea*	S5
Vascular plant	Bog willow	*Salix pedicellaris*	S4
Vascular plant	Bog-rosemary	*Andromeda polifolia* var. *polifolia*	S4
Vascular plant	Boreal-bog sedge	*Carex magellanica ssp. irrigua*	S4
Vascular plant	Bristle-stalked sedge	*Carex leptalea ssp. leptalea*	S5
Vascular plant	Broad-fruited bur-reed	*Sparganium eurycarpum*	S4
Vascular plant	Brownish sedge	*Carex brunnescens*	S4
Vascular plant	Bunchberry	*Cornus canadensis*	S5
Vascular plant	Cloudberry	*Rubus chamaemorus*	S5
Vascular plant	Common cattail	*Typha latifolia*	S4
Vascular plant	Common dandelion	*Taraxacum officinale* ssp. *officinale*	SNA[2]
Vascular plant	Common horsetail	*Equisetum arvense*	S5
Vascular plant	Common Labrador tea	*Rhododendron groenlandicum*	S5
Vascular plant	Common shinleaf	*Pyrola elliptica*	S4
Vascular plant	Creeping snowberry	*Gaultheria hispidula*	S4
Vascular plant	Dewberry	*Rubus pubescens*	S5
Vascular plant	Dwarf birch	*Betula glandulosa*	S4
Vascular plant	Early blue violet	*Viola adunca* var. *adunca*	S5
Vascular plant	Early coralroot	*Corallorhiza trifida*	S4
Vascular plant	English sundew	*Drosera anglica*	S3
Vascular plant	Few-flowered sedge	*Carex pauciflora*	S4
Vascular plant	Few-seeded sedge	*Carex oligosperma var. oligosperma*	S4
Vascular plant	Flat-leaved bladderwort	*Utricularia intermedia*	S4
Vascular plant	Floating bur-reed	*Sparganium fluctuans*	S4
Vascular plant	Fowl blue grass	*Poa palustris*	S4
Vascular plant	Goldthread	*Coptis trifolia*	S4
Vascular plant	Green alder	*Alnus viridis* ssp. *crispa*	S4
Vascular plant	Ground-pine	*Lycopodium dendroideum*	S4
Vascular plant	Hair grass	*Agrostis scabra* var. *scabra*	S4
Vascular plant	Hairy butterwort	*Pinguicula villosa*	S3
Vascular plant	Hickey's clubmoss	*Lycopodium hickeyi*	S1
Vascular plant	Hoary sedge	*Carex canescens ssp. canescens*	S4
Vascular plant	Hooded lady's-tresses	*Spiranthes romanzoffiana*	S4
Vascular plant	Jack pine	*Pinus banksiana*	S5
Vascular plant	Kidney-leaved white violet	*Viola renifolia*	S5
Vascular plant	Labrador lousewort	*Pedicularis labradorica*	S3
Vascular plant	Lapland buttercup	*Ranunculus lapponicus*	S4
Vascular plant	Leatherleaf	*Chamaedaphne calyculata*	S4

TABLE 5.2-6

Vascular Plant, Bryophyte, Lichen and Fungi Species Detected During 2024 Terrestrial Vegetation Surveys

Type	Common Name	Scientific Name	SKCDC Rank[1]
Vascular plant	Little yellow-rattle	*Rhinanthus minor* ssp. *minor*	S3
Vascular plant	Long-beaked willow	*Salix bebbiana*	S4
Vascular plant	Low bush-cranberry	*Viburnum edule*	S5
Vascular plant	Marsh cinquefoil	*Comarum palustre*	S4
Vascular plant	Marsh skullcap	*Scutellaria galericulata*	S4
Vascular plant	Marsh violet	*Viola palustris*	S4
Vascular plant	Marsh willowherb	*Epilobium palustre*	S4
Vascular plant	Maystar	*Trientalis borealis*	S5
Vascular plant	Moor rush	*Juncus stygius* ssp. *americanus*	S3
Vascular plant	Mud sedge	*Carex limosa*	S4
Vascular plant	Nagoon berry	*Rubus arcticus* ssp. *acaulis*	S4
Vascular plant	Narrow-leaf fireweed	*Chamerion angustifolium* ssp. *angustifolium*	S4
Vascular plant	Narrow-leaved willowherb	*Epilobium leptophyllum*	S4
Vascular plant	Northern comandra	*Geocaulon lividum*	S5
Vascular plant	Northern green rush	*Juncus alpinoarticulatus*	S4
Vascular plant	Northern lady-fern	*Athyrium filix-femina* var. *angustum*	S3
Vascular plant	Northern rice grass	*Piptatherum pungens*	S4
Vascular plant	Northern stitchwort	*Stellaria borealis* ssp. *borealis*	S4
Vascular plant	Oak fern	*Gymnocarpium dryopteris*	S4
Vascular plant	One-sided wintergreen	*Orthilia secunda*	S5
Vascular plant	Pale laurel	*Kalmia polifolia*	S4
Vascular plant	Palmate-leaved colt's-foot	*Petasites frigidus* var. *palmatus*	S4
Vascular plant	Pin cherry	*Prunus pensylvanica*	S5
Vascular plant	Plane-leaf willow	*Salix planifolia* ssp. *planifolia*	S4
Vascular plant	Purple oat grass	*Schizachne purpurascens*	S4
Vascular plant	Pussy willow	*Salix discolor*	S4
Vascular plant	Rocky mountain fescue	*Festuca saximontana* var. *saximontana*	S5
Vascular plant	Rough cinquefoil	*Potentilla norvegica*	S4
Vascular plant	Round-leaved sundew	*Drosera rotundifolia*	S4
Vascular plant	Running pine	*Lycopodium lagopus*	S4
Vascular plant	Russet cotton-grass	*Eriophorum chamissonis*	S4
Vascular plant	Scouler's willow	*Salix scouleriana*	S4
Vascular plant	Sheathed cotton-grass	*Eriophorum vaginatum*	S4
Vascular plant	Sheathed sedge	*Carex vaginata*	S4
Vascular plant	Short-tail rush	*Juncus brevicaudatus*	S4
Vascular plant	Skunk currant	*Ribes glandulosum*	S4
Vascular plant	Slender wood grass	*Cinna latifolia*	S4
Vascular plant	Small bedstraw	*Galium trifidum* ssp. *trifidum*	S4
Vascular plant	Small cranberry	*Vaccinium oxycoccos*	S5
Vascular plant	Soft-stem spike-rush	*Eleocharis mamillata* ssp. *mamillata*	S1
Vascular plant	Speckled alder	*Alnus incana* ssp. *rugosa*	S4
Vascular plant	Spinulose wood fern	*Dryopteris carthusiana*	S4
Vascular plant	Spotted water-hemlock	*Cicuta maculata* var. *maculata*	S4
Vascular plant	Starflower false Solomon's-seal	*Maianthemum stellatum*	S4
Vascular plant	Stiff clubmoss	*Lycopodium annotinum*	S5
Vascular plant	Swamp aster	*Symphyotrichum puniceum* var. *puniceum*	S4
Vascular plant	Swamp birch	*Betula pumila*	S5
Vascular plant	Swamp horsetail	*Equisetum fluviatile*	S4
Vascular plant	Swamp red currant	*Ribes triste*	S4
Vascular plant	Sweet gale	*Myrica gale*	S4
Vascular plant	Tall cotton-grass	*Eriophorum angustifolium* ssp. *angustifolium*	S4
Vascular plant	Tamarack	*Larix laricina*	S5
Vascular plant	Thin-flowered sedge	*Carex tenuiflora*	S4
Vascular plant	Thin-leaved cotton-grass	*Eriophorum viridicarinatum*	S4

TABLE 5.2-6

Vascular Plant, Bryophyte, Lichen and Fungi Species Detected During 2024 Terrestrial Vegetation Surveys

Type	Common Name	Scientific Name	SKCDC Rank[1]
Vascular plant	Thread rush	*Juncus filiformis*	S4
Vascular plant	Three-fruited sedge	*Carex trisperma var. trisperma*	S4
Vascular plant	Three-leaf Solomon's-seal	*Maianthemum trifolium*	S4
Vascular plant	Three-toothed cinquefoil	*Sibbaldiopsis tridentata*	S4
Vascular plant	Trailing clubmoss	*Diphasiastrum complanatum*	S4
Vascular plant	Trembling aspen	*Populus tremuloides*	S5
Vascular plant	Tufted bulrush	*Trichophorum cespitosum*	S4
Vascular plant	Tufted hair grass	*Deschampsia cespitosa ssp. cespitosa*	S4
Vascular plant	Two-seeded sedge	*Carex disperma*	S4
Vascular plant	Water calla	*Calla palustris*	S4
Vascular plant	Water hemlock	*Cicuta bulbifera*	S4
Vascular plant	Water sedge	*Carex aquatilis var. aquatilis*	S4
Vascular plant	Western river alder	*Alnus incana* ssp. *tenuifolia*	S4
Vascular plant	Wild mint	*Mentha canadensis*	S4
Vascular plant	Woodland horsetail	*Equisetum sylvaticum*	S4
Vascular plant	Yellow marsh-marigold	*Caltha palustris* var. *palustris*	S4

Source: Stantec (2025b)

[1] Provincial Rankings: S1 – critically imperiled; S2 – imperiled/very rare; S3 – vulnerable; S4 – apparently secure; S5 – secure/common; SNR – not ranked; SU – status is uncertain (SKCDC 2025).

[2] Species is not native to Saskatchewan.

TABLE 5.2-7

Rare Species Detected During the 2024 Terrestrial Vegetation Surveys

Form/Type	Scientific Name	Common Name	SKCDC Rank[1]	Preferred Habitat	UTM Coordinates (13V)		No. of Plants[2]	No. of Occurrences
					Easting	Northing		
Vascular Plant	*Athyrium filix-femina* var. *angustum*	Northern lady-fern	S3	Moist woods and along streambanks in the easternmost boreal regions of Saskatchewan (Harms and Leighton 2011a).	**569338**	**6471167**	50-100	1
Vascular Plant	*Diphasiastrum sitchense*	Alaskan clubmoss	S3	Dry, open coniferous woods in the northern boreal forest region of Saskatchewan (Harms and Leighton 2011a).	569889	6470295	20	8
					569909	6470159	20	
					555933	**6463338**	>500	
					555955	**6463340**	>500	
					568440	6456893	50-100	
					566933	**6453287**	>500	
					569860	6462754	5	
					567609	**6458396**	>500	
Vascular Plant	*Drosera anglica*	English sundew	S3	Fens, peat bogs, and marly shores within the subarctic transition and boreal forest regions of Saskatchewan (SMOE 2025; Mellichamp 2020).	**569091**	**6459486**	300-400	1
Vascular Plant	*Eleocharis mamillata ssp. mamillata*	Soft-stem spike-rush	S1	Stream, creek, and shallow pond margins in the boreal forest regions of Saskatchewan (Harms et al. 2018).	569800	6462815	>500	1
Vascular Plant	*Juncus stygius ssp. americanus*	Moor rush	S3	Wet mossy woods, peaty lake shores, bog pools, and calcareous fen margins within the subarctic transition and boreal forest regions of Saskatchewan (Harms et al. 2018).	**569035**	**6459464**	>500	1
Vascular Plant	*Lycopodium hickeyi*	Hickey's clubmoss	S1	Understory species, located in the northern boreal forest region (Harms and Leighton 2011a).	569449	6458831	50-100	1
Vascular Plant	*Malaxis paludosa*	Bog adder's-mouth orchid	S3	Wet, spring-fed black spruce woods, peat (*Sphagnum* spp.) bogs, and fens in the boreal forest regions of Saskatchewan (Harms and Leighton 2011b).	569040	6459462	10	2
					569117	6459479	1	
Vascular Plant	*Pedicularis labradorica*	Labrador lousewort	S3	Black spruce woods, treed bogs, regenerating burns, and lichen tundra within the subarctic transition and boreal forest regions of Saskatchewan (SMOE 2025; Robart 2020; W.P. Fraser Herbarium 2006).	**569901**	**6470214**	>500	3
					567828	6458855	10	
					567496	6458350	25	
Vascular Plant	*Pinguicula villosa*	Hairy butterwort	S3	On *Sphagnum* hummocks in treed and open bogs within the subarctic transition and boreal forest regions of Saskatchewan (SMOE 2025; W.P. Fraser Herbarium 2006).	**569013**	**6459465**	30	3
					569896	6470239	25	
					569015	6458992	12	
Vascular Plant	*Rhinanthus minor ssp. minor*	Little yellow-rattle	S3	Clearings, rocky slopes, woodland margins, and roadsides throughout the forested regions of Saskatchewan (SMOE 2025; Tucker and Daugherty 2020).	**570431**	**6458918**	>500	1

TABLE 5.2-7

Rare Species Detected During the 2024 Terrestrial Vegetation Surveys

Form/Type	Scientific Name	Common Name	SKCDC Rank[1]	Preferred Habitat	UTM Coordinates (13V)		No. of Plants[2]	No. of Occurrences
					Easting	Northing		
Bryophyte	*Plagiochila porelloides*	Lesser featherwort	S3	Shaded rocks, cliffs, logs, tree bases, and stream-banks (Harms and Leighton 2011a).	569338	6471165	n/a	1
Lichen	*Arctoparmelia centrifuga*	Concentric ring lichen	S2	On siliceous rocks usually in the open; mainly arctic or alpine (Brodo et al. 2001).	570131	6470735	n/a	2
					569239	6458668	n/a	
Lichen	*Cladonia amaurocrea*	Quill lichen	S2	Mainly found in the boreal foest, growing on talus slopes between boulders and on rocky ground or wetter sites (Brodo et al. 2001).	569239	6458668	n/a	2
					568043	6456769	n/a	
Lichen	*Cladonia cenotea*	Powdered funnel lichen	S3	Commonly found in the boreal forest on wood or earth, usually in shade (Brodo et al. 2001).	569436	6470706	n/a	1
Lichen	*Cladonia crispata*	Organ-pipe lichen	S3	On soil, rocks, mainly in open areas, frequently associated with bogs (Brodo et al. 2001).	569436	6470706	n/a	3
					569078	6461737	n/a	
					568043	6456769	n/a	
Lichen	*Cladonia deformis*	Lesser sulphur-cup	S3	On rotting wood or soil in full sun (Brodo et al. 2001).	569078	6461737	n/a	1
Lichen	*Cladonia pleurota*	Red-fruited pixie-cup	S2	On wood, bark, or soil (Brodo et al. 2001).	569436	6470706	n/a	1
Lichen	*Cladonia sulphurina*	Greater sulphur-cup	S2	On soil or well-rotted wood such as mossy logs, generally in full sun (Brodo et al. 2001).	569436	6470706	n/a	1
Lichen	*Flavocetraria nivalis*	Crinkled snow lichen	S3	In open heath close to treeline or on tundra soil (Brodo et al. 2001).	553326	6461962	n/a	2
					568043	6456769	n/a	
Lichen	*Icmadophila ericetorum*	Candy lichen	S3	Aggressively overgrowing mosses, well-rotted wood, or peat (Brodo et al. 2001).	567676	6454176	n/a	1
Lichen	*Imshaugia placorodia*	American starburst lichen	S1	Almost restricted to the bark of pine trees and on wood (Brodo et al. 2001).	570192	6463763	n/a	1
Lichen	*Lecanora polytropa*	Granite-speck rim-lichen	S3	On siliceous rocks, especially granite, in full sun (Brodo et al. 2001).	568043	6456769	n/a	1
Lichen	*Melanelia stygia*	Alpine camouflage lichen	S1	Noncalcareous rocks at high elevations or in the Arctic (Brodo et al. 2001).	567676	6454176	n/a	1
Lichen	*Nephroma arcticum*	Arctic kidney lichen	S1	On the ground, usually among mosses throughout subarctic to arctic regions (Brodo et al. 2001).	568198	6456879	n/a	2
					567177	6453280	n/a	
Lichen	*Parmeliopsis ambigua*	Green starburst lichen	S3	On conifer stumps, logs, and bark in full sun (Brodo et al. 2001).	570192	6463763	n/a	1
Lichen	*Peltigera scabrosa*	Scabby pelt lichen	S2	On mossy soil or rock, or on tree bases, usually in open sites (Brodo et al. 2001).	567177	6453280	n/a	1
Lichen	*Rhizocarpon geographicum*	Yellow map lichen	S2	On exposed siliceous rocks, especially in alpine or arctic regions (Brodo et al. 2001).	568043	6456769	n/a	1
Lichen	*Stereocaulon paschale*	Easter lichen	S2	On soil and mossy rocks (Brodo et al. 2001).	569080	6461746	n/a	1

TABLE 5.2-7

Rare Species Detected During the 2024 Terrestrial Vegetation Surveys

Form/Type	Scientific Name	Common Name	SKCDC Rank[1]	Preferred Habitat	UTM Coordinates (13V)		No. of Plants[2]	No. of Occurrences
					Easting	Northing		
Lichen	*Tuckermannopsis americana*	Fringed wrinkle-lichen	S3	On twigs and branches, mostly of conifers and birch, in exposed sites (Brodo et al. 2001).	570192	6463763	n/a	1
Lichen	*Umbilicaria hyperborea*	Blistered rock tripe	S2	On exposed rocks in arctic or alpine sites (Brodo et al. 2001).	569239	6458668	n/a	2
					568043	6456769	n/a	

Source: Stantec (2025a, 2025b)

[1]Provincial Rankings: S1 – critically imperiled; S2 – imperiled/very rare; S3 – vulnerable; S4 – apparently secure; S5 – secure/common; SNR – not ranked; SU – status is uncertain (SKCDC, 2025).

[2]Number of plants per occurrence was counted if less than 50 or estimated if >50 plants were detected. Totals presented in this table were calculated using mean estimated values for each occurrence (e.g., if 50-100 plants were detected at an occurrence, a value of 75 was used). For non-vascular species (e.g., bryophytes, lichens, fungi), only the number of occurrences was recorded, as counts of individual organisms were not conducted.

Bolded coordinates indicate that occurrence was recorded as a polygon as per the SKCDC Guidelines for Collecting Spatial Data During Vascular Plant Surveys (SKCDC, 2016). The UTM coordinates provided do not represent the full extent of the occurrence.

TABLE 5.2-8

Non-native Plant Species Detected During the 2024 Terrestrial Vegetation Surveys

Scientific Name	Common Name	SKCDC Rank[1]	UTM Coordinates (13V)		Density Distribution Class[2]	Patch Area (m^2)
			Easting	Northing		
Silene vulgaris	Bladder campion	SNA	568154	6466539	8	18,000
Taraxacum officinale ssp. *officinale*	Common dandelion	SNA	567905	6458541	4	20
			567957	6466718	10	750
			567655	6458377	2	4

Source: Stantec (2025b)

[1]SKCDC = Saskatchewan Conservation Data Centre. NA = conservation status inapplicable (SKCDC, 2025).

[2]Density Distribution Class: 2 – a few sporadically occurring individual plants; 4 – a single patch plus a few sporadically occurring plants; 8 – a few patches plus several sporadically occurring plants; 10 – continuous uniform occurrences of well-spaced plants (Saskatchewan PCAP Greencover Committee, 2008).

TABLE 5.2-9

Shoreline Survey Locations, Survey Dates, and Shoreline Length for Each Semi-Aquatic Furbearer Survey Area, August 2024

MCCLEAN LAKE LSA WATERBODIES	
Survey Area	**Transect Length (km)**
Exposure	
Bena Lake	2.0
Candy Creek	1.1
Caribou Lake	0.9
Collins Creek Downstream	4.5
Fox Lake	9.7
Kewen Lake	12.2
McClean Lake East Basin	9.2
Sink Reservoir	3.9
Vulture Lake	7.3
Reference	
Collins Creek Upstream	4.2
Konner Lake	4.9
McClean Lake West Basin	8.8
MIDWEST LSA WATERBODIES	
Survey Area	**Transect Length (km)**
South McMahon Lake	13.3
Lake C1	5.3
Lake C2	2.7

Source: CanNorth (2025b, 2025c, 2025d)

TABLE 5.2-10

Shoreline Survey Observations by Semi-Aquatic Furbearer Survey Area and Species, August 2024

Survey Area	Total Survey Length (km)	Total No. of Observations	Observation Density (Observations/km)														Total Observation Density (observations/km)
			North American Beaver					American Mink				Muskrat				River Otter	
			Cuttings	Dam	Active Lodge	Inactive Lodge	Runway	Feeding Sites	Fresh Scat	Old Scat	Visual	Cuttings	Runway	Fresh Scat	Old Scat	Old Scat	
MCCLEAN LAKE LSA WATERBODIES																	
Potential Exposure																	
Bena Lake	1.95	7	2.56	0	0	1.03	0	0	0	0	0	0	0	0	0	0	3.59
Candy Creek	1.11	24	12.6	7.2	0.9	0.9	0	0	0	0	0	0	0	0	0	0	21.62
Caribou Lake	0.89	1	0	0	0	0	0	0	0	0	0	0	1.12	0	0	0	1.12
Collins Creek Downstream	4.52	9	0.66	0.22	0	0	0	0	0	0	0	0.22	0.66	0.22	0	0	1.99
Fox Lake	9.66	17	1.04	0.21	0.31	0.10	0	0	0.10	0	0	0	0	0	0	0	1.76
Kewen Lake	12.15	8	0.58	0	0	0	0	0.08	0	0	0	0	0	0	0	0	0.66
McClean Lake East Basin	9.21	9	0.54	0	0	0	0.11	0.11	0.22	0	0	0	0	0	0	0	0.98
Sink Reservoir	3.85	2	0.52	0	0	0	0	0	0	0	0	0	0	0	0	0	0.52
Vulture Lake	7.26	4	0.55	0	0	0	0	0	0	0	0	0	0	0	0	0	0.55
All Exposure	**50.6**	**81**	**0.99**	**0.22**	**0.08**	**0.08**	**0.02**	**0.04**	**0.06**	**0**	**0**	**0.02**	**0.08**	**0.02**	**0**	**0**	
Observation Density (Observations/km)			**1.38**					**0.10**				**0.12**				**0**	**1.60**
Species Frequency[1] (%)			**88.9**					**37.5**				**25**				**0**	
Overall Relative Abundance[2] (%)			**86.4**					**6.2**				**7.4**				**0**	
Reference																	
Collins Creek Upstream	4.17	21	2.40	0.48	0.24	0.00	0.48	0	0	0.24	0	0.24	0	0	0.96	0	5.04
Konner Lake	4.88	12	1.23	0.20	0.20	0.41	0.20	0	0.20	0	0	0	0	0	0	0	2.46
McClean Lake West Basin	8.75	9	1.03	0	0	0	0	0	0	0	0	0	0	0	0	0	1.03
All Reference	**17.8**	**42**	**1.40**	**0.17**	**0.11**	**0.11**	**0.17**	**0**	**0.06**	**0.06**	**0**	**0.06**	**0**	**0**	**0.22**	**0**	
Observation Density (Observations/km)			**1.97**					**0.11**				**0.28**				**0**	**2.36**
Species Frequency[1] (%)			**100**					**66.7**				**33.3**				**0**	
Overall Relative Abundance[2] (%)			**83.3**					**4.8**				**11.9**				**0**	
MIDWEST LSA WATERBODIES																	
South McMahon Lake	13.26	10	0.53	0	0	0.08	0	0	0	0.08	0.08	0	0	0	0	0	0.75
Lake C1	5.29	14	1.51	0	0	0.19	0	0.19	0	0.57	0	0	0	0	0	0.19	2.65
Lake C2	2.73	8	2.56	0	0	0.37	0	0	0	0	0	0	0	0	0	0	2.93
All Midwest	**21.28**	**32**	**1.03**	**0**	**0**	**0.14**	**0**	**0.05**	**0**	**0.19**	**0.05**	**0**	**0**	**0**	**0**	**0.05**	
Observation Density (Observations/km)			**1.17**					**0.28**				**0**				**0.05**	**1.50**
Species Frequency[1] (%)			**100**					**66.7**				**0**				**33.3**	
Overall Relative Abundance[2] (%)			**78.1**					**18.8**				**0**				**3.1**	

Source: CanNorth (2025b, 2025c, 2025d)

[1]The percentage of sites where at least once capture was recorded.

[2]Number of observations per species divided by the total number of all species observations per waterbody.

TABLE 5.2-11

Relative Abundance of Small Mammals Captured for Population Surveys
Across McClean Lake and Midwest LSAs, August 2024

		Gapper's Red-backed Vole	Masked Shrew
McClean Lake LSA Reference Sites	Number of Captures	27	1
	Relative Abundance (%)	96	4
McClean Lake LSA Exposure Sites	Number of Captures	24	6
	Relative Abundance (%)	80	20
Midwest	Number of Captures	21	4
	Relative Abundance (%)	84	16
Total Across All Sites	Number of Captures	72	11
	Relative Abundance (%)	87	13

Source: CanNorth (2025b, 2025d)

TABLE 5.2-12

Relative Abundance of Small Mammals Captured in the Study Area by Species and Habitat Category, August 2024

Habitat Category[1]	Trap Nights	Number of Captures		Captures per 100 Trap Nights[2]			Relative Abundance[3]		Productivity per Habitat Category or Area[4]
		Gapper's Red-backed Vole	Masked Shrew	Gapper's Red-backed Vole	Masked Shrew	Total	Gapper's Red-backed Vole	Masked Shrew	
MCCLEAN LAKE LSA									
Exposure									
Coniferous	572	20	5	3.5	0.87	4.37	80%	20%	46%
Deciduous	96	1	0	1.04	-	1.04	100%	-	11%
Mixed-wood	96	3	1	3.13	1.04	4.17	75%	25%	43%
Treed Wetland	12	0	0	-	-	-	-	-	-
Total	**776**	**24**	**6**	**3.09**	**0.77**	**3.87**	**80%**	**20%**	**15%**
Reference									
Coniferous	172	18	1	10.47	0.58	11.05	95%	5%	45%
Mixed-wood	68	9	0	13.24	-	13.24	100%	-	55%
Total	**240**	**27**	**1**	**11.25**	**0.42**	**11.67**	**96%**	**4%**	**45%**
MIDWEST LSA									
Coniferous	192	13	2	6.77	1.04	7.81	87%	13%	27%
Mixed-wood	48	8	2	16.67	4.17	20.83	80%	20%	73%
Total	**240**	**21**	**4**	**8.75**	**1.67**	**10.42**	**84%**	**16%**	**40%**
Total Across All Sites	**1256**	**72**	**11**	**5.73**	**0.88**	**6.61**	**87%**	**13%**	**100%**

Source: CanNorth (2025d)

[1]Based on field observations of dominant tree cover.

[2]Number of captures divided by number of trap nights, multiplied by 100.

[3]Number of observations per species divided by the total number of all species observations per habitat category in each study area.

[4]Percentage of total captures per 100 trap nights.

TABLE 5.2-13

Number of Captures of Small Mammal Species per 100 Trap Nights
at McClean Lake and Midwest Local Study Areas, 2024

Species	Reference	McClean Lake LSA Exposure			Midwest
	Mallen Lake	JEB Site	S/V TEMS	Kewen Lake	South McMahon Lake
Gapper's red-backed vole	56.25	5.00	2.97	12.50	35.00
Masked shrew	2.08	7.50	0.42	2.08	6.66
Total	58.33	12.50	3.39	14.58	41.66

Source: CanNorth (2025b, 2025d)

TABLE 5.2-14

Metal and Radionuclide Concentrations in Gapper's Red-backed Voles Trapped at Exposure and Reference Areas, August 2024

Parameter	Units	Reference		Exposure					
		Mallen Lake (n=5)		JEB Site (n=2)		S/V TEMS (n=11)		Kewen Lake (n=5)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Metals									
Aluminum	µg/g	25	17	87	100	33	41	94	62
Antimony	µg/g	0.01	0	0.01	-	0.01	-	0.01	-
Arsenic	µg/g	0.06	0.02	0.66	0.28	0.081	0.045	0.076	0.025
Barium	µg/g	46	14	30	0.71	49.4	43.5	49.6	36.1
Beryllium	µg/g	0.01	0	0.01	-	0.01	-	0.01	-
Boron	µg/g	1	0.5	2	1	1.1	0.3	1	0.4
Cadmium	µg/g	0.23	0.072	0.44	0.33	0.49	0.41	0.46	0.39
Chromium	µg/g	2	0.59	2.2	2	1.4	0.5	1.5	0.33
Cobalt	µg/g	0.17	0.049	0.23	0	0.18	0.059	0.19	0.056
Copper	µg/g	11	2	13	6.2	10	1	9	2.4
Iron	µg/g	300	95	270	92	232	44	300	110
Lead	µg/g	0.13	0.074	0.19	0.05	0.07	0.04	0.18	0.061
Manganese	µg/g	52	40.5	55	23	40.7	32.1	37	16
Mercury	µg/g	0.17	0.046	0.15	0.0071	0.16	0.038	0.25	0.063
Molybdenum	µg/g	0.49	0.078	0.56	0.13	0.56	0.14	0.42	0.13
Nickel	µg/g	1.3	0.27	1.4	1	0.87	0.28	0.94	0.21
Selenium	µg/g	2.3	1.4	2	0.57	1.5	0.51	0.74	0.14
Silver	µg/g	0.04	0.03	0.06	0.04	0.04	0.02	0.02	0.01
Strontium	µg/g	25	7.4	17	2.8	16	3	28	11
Thallium	µg/g	0.011	0.0063	0.015	0.0049	0.012	0.0067	0.0088	0.0043
Tin	µg/g	0.096	0.056	0.18	0.028	0.105	0.069	0.06	0.01
Titanium	µg/g	1.3	1.1	3	3.4	1.45	2.05	3.9	2.1
Vanadium	µg/g	0.1	0	0.2	0.07	0.17	0.21	0.1	0.05
Zinc	µg/g	98	2.2	110	7.1	88	7.8	91	9.8
Radionuclides									
Lead-210	Bq/g	0.045	0.0071	0.06	-	0.04	0.02	0.1	0.029
Polonium-210	Bq/g	0.14	0.021	0.14	-	0.08	0.006	0.14	0.035
Radium-226	Bq/g	0.006	0.003	0.098	-	0.019	0.018	0.016	0.0092
Thorium-230	Bq/g	-	-	-	-	-	-	-	-
Uranium	µg/g	0.044	0.04	0.61	0.52	0.035	0.036	0.06	0.02

Source: CanNorth (2025b, 2025d)

Note: Results are reported on a dry weight basis.

A dash indicates data are not available or that insufficient data were available to capture summary statistics.

Shaded values indicate exceedance of the reference upper threshold, defined as 2 SD above the mean of the reference data.

TABLE 5.2-15

Recorded Bat Activity at McClean Lake Operation, 2023-2024

Site	Location	Observation Type	Estimated Average Bat Activity (Passes/Night)		Species Detected During Preliminary Acoustic Monitoring				
			2023	2024	*M. lucifugus* Little brown myotis	*M. septentrionalis* Northern myotis	*L. borealis* Eastern red bat	*L. cinereus* Hoary bat	*L. noctivagans* Silver-haired bat
Tooth Lake	Tooth Lake	ARU	n/a	2	-				
JEB Site	Pat Lake North	ARU	5	n/a	✓	-	✓	-	-
	Pat Lake South	ARU	n/a	1	-				
	Tailings Management Facility	ARU	6	2	✓	✓	✓	-	-
	Mill North	ARU	5	n/a	✓	✓	✓	-	-
	Mill Southwest	ARU	29	3	✓	✓	✓	✓	-
	Mill Southeast	ARU	4	n/a	✓	✓	-	-	-
	Storage Tank by the Main Office & Dry Complex	Guano	n/a						
	Historical Mining Display by the Training Building	ARU, guano, bat emergence count	51	12	✓	✓	-	-	-
	JEB Camp	Echo Meter Touch 2 Bat Detector	n/a						
	Back-up Generator Trailer by JEB Camp	ARU, Guano	n/a						
Midwest Site	Water Treatment Plant	ARU, guano, urine staining	2	0	✓	-	-	-	-
	Shaft	ARU, possible guano	1	n/a	-	✓	✓	-	-
S/V TEMS	Sink Reservoir	ARU	2	n/a	✓	-	-	-	-
	S/V TEMS Dam	ARU	6	1	✓	✓	-	-	-
Moffat Site	Core Storage	ARU, guano	8	11	✓	✓	✓	✓	-
Ore Storage	Ore Storage at Candy Lake	ARU	6	1	✓	✓	✓	-	-
McClean Lake	McClean Lake East Basin	ARU	n/a	5	-				
Sue Site	Sue C Pit North	ARU	10	7	✓	✓	✓	-	-
	Sue C Pit South	ARU	12	4	✓	✓	✓	-	-
	Sue E Pit South	ARU	6	3	✓	✓	✓	-	-
Collins Creek	Collins Creek Upstream of HWY905 Bridge	ARU	6	6	✓	✓	✓	✓	-
	Collins Creek Downstream of HWY905 Bridge	ARU	3	22	-	-	-	-	✓
Kewen Lake	Kewen Lake Bridge	ARU, two deceased *M. lucifugus*	n/a	27	✓	✓	-	-	✓

Source: USask (2024, 2025a)

n/a: no acoustic data was reported

✓ = species identified

-: species not identified or detected

TABLE 5.3-1

Potential Rare Plants, Bryophytes and Lichens of the Regional Assessment Boundary and Those Documented Within the Local Assessment Boundary

Scientific Name	Common Name	SKCDC Rank[1]	COSEWIC[2] Status	SARA Schedule 1 Status[3,4]	Historical Observations	2023-2024 Observations
BRYOPHYTES						
Plagiochila porelloides	Lesser featherwort	S3	-	-	-	X
LICHENS						
Arctoparmelia centrifuga	Concentric ring lichen	S2	-	-	-	X
Bryoria furcellata	Burred horsehair lichen	S3	-	-	X	-
Bryoria simplicior	Horsehair lichen	S3	-	-	X	-
Calicium trabinellum	Yellow collar stubble lichen	S2	-	-	X	-
Cetraria ericetorum	Iceland lichen	S3	-	-	X	-
Cladonia amaurocraea	Quill lichen	S2	-	-	-	X
Cladonia borealis	Boreal pixie-cup	S3	-	-	X	-
Cladonia cenotea	Powdered funnel lichen	S3	-	-	-	X
Cladonia coniocraea	Common powderhorn	S2	-	-	X	-
Cladonia crispata	Organ-pipe lichen	S3	-	-	-	X
Cladonia deformis	Lesser sulphur-cup	S3	-	-	-	X
Cladonia pleurota	Red-fruited pixie-cup	S2	-	-	-	X
Cladonia sulphurina	Greater sulphur-cup	S2	-	-	-	X
Flavocetraria nivalis	Crinkled snow lichen	S3	-	-	-	X
Icmadophila ericetorum	Candy lichen	S3	-	-	-	X
Imshaugia aleurites	Salted starburst lichen	S2	-	-	X	-
Imshaugia placorodia	American starburst lichen	S1	-	-	-	X
Lecanora circumborealis	Black-eyed rim-lichen	S3	-	-	X	-
Lecanora polytropa	Granite-speck rim-lichen	S3	-	-	-	X
Melanelia stygia	Alpine camouflage lichen	S1	-	-	-	X
Nephroma arcticum	Arctic kidney lichen	S1	-	-	-	X
Parmeliopsis ambigua	Green starburst lichen	S3	-	-	-	X
Parmeliopsis hyperopta	Gray starburst lichen	S3	-	-	X	-
Peltigera scabrosa	Scabby pelt lichen	S2	-	-	-	X
Rhizocarpon geographicum	Yellow map lichen	S2	-	-	-	X
Stereocaulon grande	Grand foam lichen	S1	-	-	X	-
Stereocaulon paschale	Easter lichen	S2	-	-	-	X
Tuckermannopsis americana	Fringed wrinkle-lichen	S3	-	-	-	X
Umbilicaria hyperborea	Blistered rock tripe	S2	-	-	-	X
VASCULAR PLANTS						
Achillea millefolium var. megacephala	Large-headed woolly yarrow	S1	Special Concern	Special Concern	-	-
Agrostis mertensii	Northern bent-grass	SH	-	-	-	-
Allium schoenoprasum var. sibiricum	Wild chives	S3	-	-	-	-
Anaphalis margaritacea	Pearly everlasting	S3	-	-	-	-
Andromeda polifolia var. latifolia	Glaucous-leaved bog-rosemary	S2	-	-	-	-
Anemone parviflora	Small-flowered anemone	S1	-	-	-	-
Anemone richardsonii	Yellow anemone	S2	-	-	-	-
Antennaria umbrinella	Brown-bracted pussytoes	S2	-	-	-	-
Arabidopsis arenicola	Arctic rock-cress	S2	-	-	-	-
Arceuthobium pusillum	Dwarf mistletoe	S1	-	-	-	-
Arctous rubra	Red alpine bearberry	S3	-	-	-	-
Arethusa bulbosa	Dragon's-mouth orchid	S2	-	-	-	-
Armeria maritima ssp. Interior	Athabasca thrift	S1	Special Concern	Special Concern	-	-
Arnica angustifolia ssp. angustifolia	Narrow-leaf leopardbane	SH	-	-	-	-
Arnica lonchophylla	Spear-leaved arnica	S2	-	-	-	-
Astragalus bodinii	Yukon milk-vetch	S1	-	-	-	-
Athyrium filix-femina var. angustum	Northern lady-fern	S3	-	-	X	X
Bidens beckii	Water marigold	S2	-	-	-	-
Bistorta vivipara	Alpine bistort	S3	-	-	-	-
Botrychium campestre	Prairie Dunewort	S3	-	-	-	-
Botrychium hesperium	Western moonwort	S3	-	-	-	-
Botrychium minganense	Mingan moonwort	S1	-	-	-	-
Botrychium pedunculosum	Stalked moonwort	S2	-	-	-	-
Calamagrostis lapponica	Lapland reed-grass	S3	-	-	-	-
Calamagrostis purpurascens var. purpurascens	Purple reed-grass	S3	-	-	-	-
Calypso bulbosa var. americana	Fairy-slipper	S3	-	-	-	-
Cardamine nymanii	Meadow bittercress	S3	-	-	-	-
Cardamine parviflora	Small bittercress	S1	-	-	-	-
Carex arcta	Bear sedge	S2	-	-	-	-
Carex bicolor	Two-color sedge	SH	-	-	-	-
Carex bigelowii ssp. bigelowii	Bigelow's sedge	S1	-	-	-	-
Carex cryptolepis	Yellow sedge	S2	-	-	-	-

TABLE 5.3-1

Potential Rare Plants, Bryophytes and Lichens of the Regional Assessment Boundary and Those Documented Within the Local Assessment Boundary

Scientific Name	Common Name	SKCDC Rank[1]	COSEWIC[2] Status	SARA Schedule 1 Status[3,4]	Historical Observations	2023-2024 Observations
Carex eburnea	Bristle-leaved sedge	S3	-	-	-	-
Carex echinata ssp. echinata	Prickly sedge	S3	-	-	-	-
Carex garberi	Garber's sedge	S3	-	-	-	-
Carex glacialis	Glacier sedge	SH	-	-	-	-
Carex heleonastes	Hudson bay sedge	S3	-	-	-	-
Carex hystericina	Porcupine sedge	S3	-	-	-	-
Carex maritima	Seaside sedge	S1	-	-	-	-
Carex michauxiana	Michaux' sedge	S3	-	-	X	X
Carex pseudocyperus	Cyperus-like sedge	S3	-	-	-	-
Carex saxatilis	Rocky ground sedge	S3	-	-	-	-
Carex supina ssp. spaniocarpa	Weak arctic sedge	SH	-	-	-	-
Carex vulpinoidea	Fox sedge	S3	-	-	-	-
Castilleja raupii	Purple paintbrush	S2	-	-	-	-
Cerastium alpinum ssp. alpinum	Alpine chickweed	S1	-	-	-	-
Cerastium beeringianum	Bering sea chickweed	S1	-	-	-	-
Chimaphila umbellata ssp. umbellata	Western prince's-pine	S3	-	-	-	-
Chrysosplenium iowense	Iowa golden saxifrage	S1	-	-	-	-
Collinsia parviflora	Blue-eyed mary	S3	-	-	-	-
Corispermum americanum var. americanum	American bugseed	S3	-	-	-	-
Cyperus squarrosus	Awned cyperus	S3	-	-	-	-
Cypripedium passerinum	Sparrow's-egg lady's-slipper	S3	-	-	-	-
Cypripedium reginae	Showy lady's-slipper	S1	-	-	-	-
Deschampsia mackenzieana	Mackenzie hairgrass	S2	Special Concern	Special Concern	-	-
Dichanthelium lanuginosum	Hairy panic-grass	S3	-	-	-	-
Dichanthelium leibergii	Leiberg's witchgrass	S1	-	-	-	-
Diervilla lonicera	Northern bush-honeysuckle	S3	-	-	-	-
Diphasiastrum sitchense	Alaskan clubmoss	S3	-	-	X	X
Draba cana	Hoary whitlow-grass	S2	-	-	-	-
Draba cinerea	Ashy whitlow-grass	S1	-	-	-	-
Drosera anglica	English sundew	S3	-	-	X	X
Drosera linearis	Slenderleaf sundew	S3	-	-	-	-
Dryas drummondii	Yellow mountain-avens	SH	-	-	-	-
Dryopteris cristata	Crested shield-fern	S3	-	-	-	-
Eleocharis mamillata ssp. mamillata	Soft-stem spike-rush	S1	-	-	-	X
Eleocharis nitida	Neat spike-rush	S3	-	-	-	-
Elodea canadensis	Canada waterweed	S3	-	-	-	-
Elymus diversiglumis	Various-glumed wild rye	S3	-	-	-	-
Erigeron compositus	Compound fleabane	S3	-	-	-	-
Erigeron elatus	Tall white fleabane	S3	-	-	-	-
Erigeron hyssopifolius	Hyssop-leaved fleabane	S3	-	-	-	-
Eriophorum scheuchzeri ssp. scheuchzeri	Scheuchzer cotton-grass	S2	-	-	-	-
Eriophorum tenellum	Delicate cotton-grass	SH	-	-	-	-
Euphrasia subarctica	Arctic eyebright	S3	-	-	-	-
Fallopia scandens	Climbing false-buckwheat	S3	-	-	-	-
Festuca brachyphylla ssp. brachyphylla	Short-leaf fescue	S2	-	-	-	-
Festuca prolifera var. lasiolepis	Proliferous red fescue	SH	-	-	-	-
Glyceria canadensis var. canadensis	Canada manna-grass or rattlesnake grass	SH	-	-	-	-
Gymnocarpium jessoense ssp. parvulum	Limestone oak fern	S3	-	-	-	-
Huperzia selago var. densa	Mountain club-moss	S1	-	-	X	-
Huperzia selago var. selago	Mountain club-moss	S1	-	-	-	-
Impatiens noli-tangere	Yellow touch-me-not	S2	-	-	-	-
Isoetes lacustris	Lake quillwort	S2	-	-	-	-
Isoetes x hickeyi	Hickey's quillwort	S1	-	-	-	-
Juncus stygius ssp. americanus	Moor rush	S3	-	-	X	X
Juncus triglumis var. albescens	Pale three-flowered rush	S2	-	-	-	-
Kalmia procumbens	Alpine azalea	S2	-	-	X	-
Lactuca biennis	Tall blue lettuce	S3	-	-	-	-
Lechea intermedia var. depauperata	Impoverished pinweed	S1	Data Deficient	-	-	-
Leymus mollis ssp. mollis	Sea lyme-grass	S2	-	-	-	-
Listera borealis	Northern twayblade	S3	-	-	-	-
Lobelia dortmanna	Water lobelia	S3	-	-	X	X
Luzula acuminata var. acuminata	Hairy wood-rush	S3	-	-	-	-
Luzula confusa	Northern wood-rush	SH	-	-	-	-
Luzula multiflora ssp. multiflora	Many-flowered woodrush	S3	-	-	-	-

TABLE 5.3-1

Potential Rare Plants, Bryophytes and Lichens of the Regional Assessment Boundary and Those Documented Within the Local Assessment Boundary

Scientific Name	Common Name	SKCDC Rank[1]	COSEWIC[2] Status	SARA Schedule 1 Status[3,4]	Historical Observations	2023-2024 Observations
Lycopodiella inundata	Northern bog clubmoss	S1	-	-	X	X
Lycopodium hickeyi	Hickey's clubmoss	S1	-	-	-	X
Malaxis paludosa	Bog adder's-mouth orchid	S3	-	-	X	X
Milium effusum var. cisatlanticum	Tall millet-grass	S1	-	-	-	-
Minuartia rubella	Boreal sandwort	S3	-	-	-	-
Moehringia macrophylla	Large-leaved sandwort	S3	-	-	X	-
Myriophyllum alterniflorum	Alternate-flowered water milfoil	S2	-	-	-	-
Najas flexilis	Flexible naiad	S3	-	-	-	-
Neottia cordata	Heart-leaved twayblade	S3	-	-	-	-
Nymphaea leibergii	Small white water-lily	S2	-	-	-	-
Osmorhiza berteroi	Chilean sweet-cicley	S1	-	-	-	-
Packera streptanthifolia var. streptanthifolia	Northern groundsel	S3	-	-	-	-
Parnassia kotzebuei	Alpine grass-of-parnassus	S2	-	-	-	-
Pedicularis groenlandica	Elephant-head	S2	-	-	-	-
Pedicularis labradorica	Labrador lousewort	S3	-	-	X	X
Pedicularis parviflora	Purple lousewort	S3	-	-	X	-
Pellaea gastonyi	Gastony's cliffbrake	S1	-	-	-	-
Pellaea glabella ssp. occidentalis	Western smooth cliff-brake	S1	-	-	-	-
Persicaria punctata	Dotted smartweed	S2	-	-	-	-
Phegopteris connectilis	Long beech-fern	S3	-	-	X	X
Phleum alpinum	Mountain timothy	S1	-	-	-	-
Pinguicula villosa	Hairy butterwort	S3	-	-	X	X
Pinguicula vulgaris	Common butterwort	S3	-	-	X	X
Platanthera orbiculata	Large roundleaf orchid	S3	-	-	-	-
Poa alpina ssp. alpina	Alpine bluegrass	S2	-	-	-	-
Poa arctica ssp. arctica	Arctic blue grass	S2	-	-	-	-
Polygala paucifolia	Pink fringed milkwort	S3	-	-	-	-
Potamogeton amplifolius	Large-leaved pondweed	S1	-	-	-	-
Potamogeton epihydrus	Ribbon-leaf pondweed	S2	-	-	X	-
Potamogeton obtusifolius	Blunt-leaved pondweed	S3	-	-	-	-
Potamogeton robbinsii	Flatleaf	S3	-	-	-	-
Potentilla arenosa ssp. chamissonis	Creeping cinquefoil	SH	-	-	-	-
Potentilla bimundorum	Cut-leaved cinquefoil	S2	-	-	-	-
Potentilla rubricaulis	Five-fingered cinquefoil	S3	-	-	-	-
Primula mistassinica	Bird's-eye primrose	S3	-	-	-	-
Puccinellia distans ssp. Hauptiana	Haupt's alkali-grass	S2	-	-	-	-
Pyrola grandiflora	Arctic wintergreen	SH	-	-	-	-
Ranunculus hyperboreus	Northern buttercup	S2	-	-	-	-
Rhinanthus minor ssp. minor	Little yellow-rattle	S3	-	-	-	X
Rhus glabra	Smooth sumac	SH	-	-	-	-
Rhynchospora alba	White beaked-rush	S3	-	-	-	-
Rhynchospora capillacea	Hair-like beaked rush	S3	-	-	-	-
Rhynchospora fusca	Sooty beaked rush	S1	-	-	-	-
Ribes aureum var. aureum	Golden currant	S3	-	-	-	-
Sagina nodosa ssp. Borealis	Knotted pearlwort	S2	-	-	-	-
Salix arctophila	Northern willow	S2	-	-	-	-
Salix brachycarpa var. psammophila	Sand-dune Small-fruit Willow	S3	Special Concern	Special Concern	-	-
Salix glauca var. villosa	Grey-leaf willow	S2	-	-	-	-
Salix planifolia ssp. tyrrellii	Tyrrell's willow	S2	Not at Risk	-	-	-
Salix reticulata	Net-leaf willow	S2	-	-	-	-
Salix silicicola	Blanket-leaf Willow	S3	Special Concern	Special Concern	-	-
Salix turnorii	Turnor's willow	S2	Special Concern	Special Concern	-	-
Salix x brachypurpurea	Hybrid willow	SH	-	-	-	-
Schoenoplectus subterminalis	Subterminal bulrush	SH	-	-	-	-
Selaginella selaginoides	Low spike-moss	S2	-	-	-	-
Silene acaulis	Moss campion	S2	-	-	-	-
Silene antirrhina	Sleepy catchfly	S2	-	-	-	-
Sorbus scopulina	Western Mountain-ash	S3	-	-	X	X
Spiranthes lacera var. lacera	Northern slender ladies'-tresses	S3	-	-	-	-
Stellaria longipes ssp. arenicola	Sand chickweed	S3	Not at Risk	-	-	-
Subularia aquatica ssp. americana	Water awlwort	S3	-	-	X	X
Tanacetum huronense var. floccosum	Floccose Tansy	S3	Special Concern	Special Concern	-	-
Taraxacum ceratophorum	Horned dandelion	S3	-	-	X	-
Tofieldia pusilla	Small false-asphodel	S1	-	-	-	-

TABLE 5.3-1

Potential Rare Plants, Bryophytes and Lichens of the Regional Assessment Boundary and Those Documented Within the Local Assessment Boundary

Scientific Name	Common Name	SKCDC Rank[1]	COSEWIC[2] Status	SARA Schedule 1 Status[3,4]	Historical Observations	2023-2024 Observations
Torreyochloa pallida var. fernaldii	Pale manna grass	S3	-	-	-	-
Triadenum fraseri	Marsh St. John's-wort	S1	-	-	-	-
Trientalis europaea	Arctic starwort	S2	-	-	-	-
Trisetum spicatum	Spike trisetum	S3	-	-	-	-
Utricularia cornuta	Horned bladderwort	S3	-	-	-	-
Viola labradorica	Northern Blue Violet	S1	-	-	-	-
Viola macloskeyi	Smooth White Violet	S2	-	-	X	-
Viola selkirkii	Long-spurred Violet	S3	-	-	-	-
Woodsia glabella	Smooth woodsia	S3	-	-	-	-
Woodsia oregana ssp. oregana	Oregon woodsia	S2	-	-	-	-
Woodsia scopulina ssp. scopulina	Rocky mountain woodsia	SH	-	-	-	-
Woodsia x abbeae	Hybrid (sterile triploid)	SH	-	-	-	-

Note: Brown sedge (*Carex buxbaumii*), previously listed, has been omitted due to a possible identification error in past records (CanNorth, 2023).

[1]Saskatchewan Conservation Data Centre Taxa List (2025), where

S1 = extremely rare (5 or fewer occurrences in Saskatchewan, or very few remaining individuals; critically imperiled; may be susceptible to extirpation because of some factor of its biology); S2 = rare (6 to 20 occurences in Saskatchewan or few remaining individuals; imperiled; may be susceptibe to extirpation because of some factor of its biology); S3 = rare to uncommon (21 to 100 occurrences in Saskatchewan; may be rare and local throughout the province or may occur in a restricted provincial range; may be abundant in places; vulnerable; may be susceptible to extirpation by large scale disturbances); SH= Historical (no recent observations in the province).

[2]Committee on the Status of Endangered Wildlife in Canada (SARPR, 2025), where,

Endangered = a species facing imminent extirpation or extinction; Threatened = a species likely to become endangered if limiting factors are not reversed; Special Concern = a species that is particularly sensitive to human activities or natural events but is not an endangered or threatened species; Not at Risk = a species that has been evaluated and found to be not at risk; Data Deficient = the available information is insufficient to resolve a species eligibility for assessment, or to permit an assessment of the species risk of extinction.

[3]Status under the Species at Risk Public Registry (SARPR, 2025).

[4]Assigned schedule under SARPR (2025).

X = documented in the local assessment boundary.

- = Not applicable or not present.

Source: Adapted from AREVA 2007 and updated based on SMOE 2025.

TABLE 5.3-2

Rare Vascular Plants, Bryophyte and Lichen Sightings in the Local Assessment Boundary

Type	Scientific Name	Common Name	SKCDC Rank[1]	Preferred Habitat (Harms et al. 1992, 2011a, 2011b, 2018; Leighton, 2012; Brodo et al. 2001)	Identified (✓) or Number of Occurrences								Total in Local Assessment Boundary
					1991 EA[2]	Harms et al. (1992)	Midwest (2003)[3]	McClean Lake (1993 to 2002)[4]	AREVA (2016a)[5]	Orano (2023)[7]	Orano (2024)[7]	SKMOE (2025)[6]	
Bryophyte	*Plagiochila porelloides*	Lesser featherwort	S3	shaded rocks, cliffs, logs, tree bases, and stream-banks	-	-	-	-	-	-	1	-	1
Lichen	*Arctoparmelia centrifuga*	Concentric ring lichen	S2	on siliceous rocks usually in the open; mainly arctic or alpine	-	-	-	-	-	-	2	1	3
Lichen	*Cladonia amaurocraea*	Quill lichen	S2	mainly found in the boreal foest, growing on talus slopes between boulders and on rocky ground or wetter sites	-	-	-	-	-	-	2	1	3
Lichen	*Cladonia cenotea*	Powdered funnel lichen	S3	commonly found in the boreal forest on wood or earth, usually in shade	-	-	-	-	-	-	1	1	2
Lichen	*Cladonia crispata*	Organ-pipe lichen	S3	on soil, rocks, mainly in open areas, frequently associated with bogs	-	-	-	-	-	-	3	-	3
Lichen	*Cladonia deformis*	Lesser sulphur-cup	S3	on rotting wood or soil in full sun	-	-	-	-	-	-	1	3	4
Lichen	Cladonia pleurota	Red-fruited pixie-cup	S2	on wood, bark, or soil	-	-	-	-	-	-	1	-	1
Lichen	*Cladonia sulphurina*	Greater sulphur-cup	S2	on soil or well-rotted wood such as mossy logs, generally in full sun	-	-	-	-	-	-	1	1	2
Lichen	*Flavocetraria nivalis*	Crinkled snow lichen	S3	in open heath close to treeline or on tundra soil	-	-	-	-	-	-	2	5	7
Lichen	*Icmadophila ericetorum*	Candy lichen	S1	aggressively overgrowing mosses, well-rotted wood, or peat	-	-	-	-	-	-	1	-	1
Lichen	*Imshaugia placorodia*	American starburst lichen	S1	almost restricted to the bark of pine trees and on wood	-	-	-	-	-	-	1	-	1
Lichen	*Lecanora polytropa*	Granite-speck rim-lichen	S3	on siliceous rocks, especially granite, in full sun	-	-	-	-	-	-	1	-	1
Lichen	*Melanelia stygia*	Alpine camouflage lichen	S1	noncalcareous rocks at high elevations or in the Arctic	-	-	-	-	-	-	1	-	1
Lichen	*Nephroma arcticum*	Arctic kidney lichen	S1	on the ground, usually among mosses throughout subarctic to arctic regions	-	-	-	-	-	-	2	-	2
Lichen	*Parmeliopsis ambigua*	Green starburst lichen	S3	on conifer stumps, logs, and bark in full sun	-	-	-	-	-	-	1	5	6
Lichen	*Peltigera scabrosa*	Scabby pelt lichen	S2	on mossy soil or rock, or on tree bases, usually in open sites	-	-	-	-	-	-	1	-	1
Lichen	*Rhizocarpon geographicum*	Yellow map lichen	S2	on exposed siliceous rocks, especially in alpine or arctic regions	-	-	-	-	-	-	1	-	1
Lichen	*Stereocaulon paschale*	Easter lichen	S2	on soil and mossy rocks	-	-	-	-	-	-	1	-	1
Lichen	*Tuckermannopsis americana*	Fringed wrinkle-lichen	S3	on twigs and branches, mostly of conifers and birch, in exposed sites	-	-	-	-	-	-	1	5	6
Lichen	*Umbilicaria hyperborea*	Blistered rock tripe	S2	on exposed rocks in arctic or alpine sites	-	-	-	-	-	-	2	-	2
Lichen	*Imshaugia aleurites*	Salted starburst lichen	S2	on conifer bark or wood in well-lit conifer forests	-	-	-	-	-	-	-	5	5
Lichen	*Cladonia borealis*	Boreal pixie-cup	S3	arctic-alpine, on soil or rocks in full sun	-	-	-	-	-	-	-	3	3
Lichen	*Parmeliopsis hyperopta*	Gray starburst lichen	S3	weathered old wood, especially conifer wood and bark	-	-	-	-	-	-	-	5	5
Lichen	*Bryoria furcellata*	Burred horsehair lichen	S3	conifers of all kinds in open, well-lit woodlands	-	-	-	-	-	-	-	4	4
Lichen	*Cladonia coniocraea*	Common powderhorn	S2	soil, tree bases, and wood, usually in shade	-	-	-	-	-	-	-	3	3
Lichen	*Cetraria ericetorum*	Iceland lichen	S3	with grasses and heath	-	-	-	-	-	-	-	2	2
Lichen	*Stereocaulon grande*	Grand foam lichen	S1	soil or mossy rocks (but rarely attached directly to the rock)	-	-	-	-	-	-	-	4	4
Lichen	*Lecanora circumborealis*	Black-eyed rim-lichen	S3	bark or wood of conifers, alder, birch, and willow	-	-	-	-	-	-	-	1	1
Lichen	*Calicium trabinellum*	Yellow collar stubble lichen	S2	on wood	-	-	-	-	-	-	-	1	1
Lichen	*Bryoria simplicior*	Horsehair lichen	S3	strictly northern boreal, on conifers in open, well-lit woodlands	-	-	-	-	-	-	-	1	1
Vascular plant	*Athyrium filix-femina* var. *angustum*	Northern lady-fern	S3	moist sphagnum lake shores	-	37	-	-	-	-	1	2	3
Vascular plant	*Carex michauxiana*	Michaux' sedge	S3	wet sedge fens, open and treed bogs	-	7	3	2	2	-	-	4	11

TABLE 5.3-2

Rare Vascular Plants, Bryophyte and Lichen Sightings in the Local Assessment Boundary

Type	Scientific Name	Common Name	SKCDC Rank[1]	Preferred Habitat (Harms et al. 1992, 2011a, 2011b, 2018; Leighton, 2012; Brodo et al. 2001)	Identified (✓) or Number of Occurrences								Total in Local Assessment Boundary
					1991 EA[2]	Harms et al. (1992)	Midwest (2003)[3]	McClean Lake (1993 to 2002)[4]	AREVA (2016a)[5]	Orano (2023)[7]	Orano (2024)[7]	SKMOE (2025)[6]	
Vascular plant	*Diphasiastrum sitchense*	Alaskan clubmoss	S3	drier, sandy, coniferous, mostly pine woods	-	15	15	2	-	4	8	17	46
Vascular plant	*Drosera anglica*	English sundew	S3	bogs, fens, wet boggy shores, seepage areas, usually calcareous	✓	47	14	2	4	2	1	11	34
Vascular plant	*Eleocharis mamillata ssp. mamillata*	Soft-stem spike-rush	S1	stream, creek, and shallow pond edges	-	-	-	-	-	-	1	-	1
Vascular plant	*Huperzia selago* var. *densa*	Mountain club-moss	S1	moist woods and lakeshore fens	-	6	2	-	-	-	-	2	4
Vascular plant	*Isoetes lacustris*	Lake quillwort	S2	submersed in cold, nutrient-poor, northern lakes	-	-	-	-	-	-	-	1	1
Vascular plant	*Juncus stygius* ssp. *americanus*	Moor rush	S3	bog lake shores and calcareous bog-fens	-	16	11	-	-	2	1	7	21
Vascular plant	*Kalmia procumbens*	Alpine azalea	S2	dry rock tundra-meadows and open-wooded esker-ridge slopes	-	4	-	-	-	-	-	1	1
Vascular plant	*Lobelia dortmanna*	Water lobelia	S3	aquatic in shallow quiet water	-	22	-	-	-	1	3	11	15
Vascular plant	*Lycopodiella inundata*	Northern bog clubmoss	S1	wet bogs, fens and organic lake shores	-	6	1	-	-	-	-	2	3
Vascular plant	*Lycopodium hickeyi*	Hickey's clubmoss	S1	trailing on the ground or by subterranean rootstocks	-	-	-	-	-	-	1	-	1
Vascular plant	*Malaxis paludosa*	Bog adder's-mouth orchid	S3	wet springy black spruce woods and sphagnaceous bogs	-	6	4	-	-	-	2	1	7
Vascular plant	*Moehringia macrophylla*	Large-leaved sandwort	S3	on thin soil in granitic outcrops in semi-open areas	-	16	-	-	-	-	-	2	2
Vascular plant	*Pedicularis labradorica*	Labrador lousewort	S3	open black spruce woods, drier treed bogs, regenerating burns, and lichen-tundra	-	10	-	2	-	-	3	1	6
Vascular plant	*Pedicularis parviflora*	Purple lousewort	S3	wet marshy fens and bogs	-	23	-	-	-	-	-	1	1
Vascular plant	*Phegopteris connectilis*	Long beech-fern	S3	moist wooded streamsides	-	8	3	-	-	2	-	7	12
Vascular plant	*Pinguicula villosa*	Hairy butterwort	S3	sphagnum hummocks in treed bogs or muskegs	-	10	-	-	6	4	3	11	24
Vascular plant	*Pinguicula vulgaris*	Common butterwort	S3	bogs, damp rocks, and ledges in calcareous areas; cold swampy lands; marly fens, and lake shorelines	-	-	-	-	1	-	-	1	2
Vascular plant	*Potamogeton epihydrus*	Ribbon-leaf pondweed	S2	emersed aquatics in shallow quiet water of lakes, ponds, slow streams, and wet marshy fens	-	17	-	-	-	-	-	3	3
Vascular plant	*Rhinanthus minor ssp. minor*	Little yellow-rattle	S3	wet spots in meadows, forest openings and roadsides, boreal forest	-	-	-	-	-	1	1	1	3
Vascular plant	*Salix glauca var. villosa*	Grey-leaf willow	S2	freshly cleared habitats, floodplains and recent burns	-	-	-	-	2	-	-	-	2
Vascular plant	*Sorbus scopulina*	Western mountain-ash	S3	upper beach borders of shorewoods and wooded bank slopes	✓	24	1	-	-	2	-	3	6
Vascular plant	*Subularia aquatica ssp. americana*	Water awlwort	S3	shallow lake-bottom submerged aquatics	-	24	-	-	-	-	5	3	8
Vascular plant	*Viola macloskeyi*	Smooth white violet	S2	wet, marshy fens and bogs	-	5	1	-	-	-	-	-	1

Note: None of the observed species are listed provincially or federally.

[1]Saskatchewan Conservation Data Centre Taxa List (SKCDC, 2025), where:

S1 = extremely rare (5 or fewer occurrences in Saskatchewan, or very few remaining individuals; critically imperiled; may be susceptible to extirpation because of some factor of its biology); S2 = rare (6 to 20 occurences in Saskatchewan or few remaining individuals; imperiled; may be susceptibe to extirpation because of some factor of its biology); S3 = rare to uncommon (21 to 100 occurrences in Saskatchewan; may be rare and local throughout the province or may occur in a restricted provincial range; may be abundant in places; vulnerable; may be susceptible to extirpation by large scale disturbances); S4 = common (more than 100 occurrences; generally widespread and aundant but may be rare in parts of its range; apparenlty secure but may be of long-term concern); S5 = very common (more than 100 occurrences; widespread and abundant, but may be rare in parts of its range; demonstrably secure).

[2]Identified as occuring in McClean Lake or Midwest area in 1991 Environmental Assessment (Minatco, 1991).

[3]AREVA 2009b

[4]COGEMA 2003.

[5]Additional rare plant species identified during the wetland community studies in 2008 and 2015 as presented in AREVA 2016a.

[6]Saskatchewan Conservation Data Centre HabiSask Search (SMOE, 2025) - database search of LAB with 1 km buffer.

[7]CanNorth (2023), Stantec (2025b).

- = Not present.

Source: Adapted from AREVA 2007.

TABLE 5.3-3

Wildlife Species that have been Observed Within the McClean Lake Area and Species that Potentially Occur in the Region

Common Name	Scientific Name	COSEWIC Status[1]	SARA Schedule 1 Status[2]	SKCDC Rank[3]	Observed or Sign Detected			
					Historical Records[4]			2023-2024[5]
					Athabasca	LAB	McClean Lake LSA	
BIRDS								
Alder flycatcher	*Empidonax alnorum*	-	-	S5B	X	X	X	-
American bittern	***Botaurus lentiginosus***	**-**	**-**	**S5B**	**X**	**-**	**-**	**-**
American coot	*Fulica americana*	Not at Risk	No Status	S5B	X	-	-	-
American crow	*Corvus brachyrhynchos*	-	-	S5B,S4N	X	X	X	-
American golden-plover	*Pluvialis dominica*	-	-	S5M	X	X	-	-
American goldfinch	*Spinus tristis*	-	-	S5B	X	-	-	-
American goshawk	***Accipiter atricapillus***	**Not at Risk**	**No Status**	**S4B,S3N**	**X**	**X**	**X**	**-**
American kestrel	***Falco sparverius***	**-**	**-**	**S5B,S1N**	**X**	**X**	**X**	**-**
American Pipit	*Anthus rubescens*	-	-	S5M	X	-	-	-
American Redstart	*Setophaga ruticilla*	-	-	S5B	X	-	-	-
American robin	***Turdus migratorius***	**-**	**-**	**S5B,SUN**	**X**	**X**	**X**	**-**
American three-toed woodpecker	*Picoides dorsalis*	-	-	S4	X	X	X	-
American tree sparrow	***Spizelloides arborea***	**-**	**-**	**S1B,S5M**	**X**	**-**	**-**	**-**
American white pelican	***Pelecanus erythrorhynchos***	**Not at Risk**	**No Status**	**S5B**	**X**	**-**	**-**	**-**
American wigeon	*Mareca americana*	-	-	S5B	X	-	-	-
Arctic tern	***Sterna paradisaea***	**-**	**-**	**S3B**	**X**	**X**	**-**	**-**
Baird's sandpiper	***Calidris bairdii***	**-**	**-**	**SUM**	**X**	**X**	**X**	**-**
Bald eagle	***Haliaeetus leucocephalus***	**Not at Risk**	**No Status**	**S5B,S5N,S4M**	**X**	**X**	**X**	**-**
Bank swallow	***Riparia riparia***	**Threatened**	**Threatened**	**S4B,S5M**	**X**	**-**	**-**	**-**
Barn swallow	***Hirundo rustica***	**Special Concern**	**Threatened**	**S4B**	**X**	**X**	**X**	**-**
Barred owl	***Strix varia***	**-**	**-**	**S3**	**X**	**-**	**-**	**-**
Bay-breasted warbler	*Setophaga castanea*	-	-	S5B	X	-	-	-
Belted kingfisher	*Megaceryle alcyon*	-	-	S4B	X	X	X	-
Black tern	*Chlidonias niger*	Not at Risk	No Status	S5B	X	-	-	-
Black-and-white warbler	*Mniotilta varia*	-	-	S5B	X	-	-	-
Black-backed woodpecker	*Picoides arcticus*	-	-	S4	X	X	X	-
Black-bellied plover	*Pluvialis squatarola*	-	-	S4M	X	-	-	-
Black-billed magpie	*Pica hudsonia*	-	-	S5	X	-	-	-
Black-capped chickadee	*Poecile atricapillus*	-	-	S5	X	-	-	-
Blackpoll warbler	*Setophaga striata*	-	-	S5B,S4M	X	X	X	-
Black-throated green warbler	*Setophaga virens*	-	-	S4B	X	-	-	-
Blue jay	*Cyanocitta cristata*	-	-	S5	X	-	-	-
Blue-headed vireo	*Vireo solitarius*	-	-	S5B	X	X	X	-
Blue-winged teal	*Spatula discors*	-	-	S5B	X	X	-	-
Bohemian waxwing	*Bombycilla garrulus*	-	-	S4B,S5M	X	X	X	-
Bonaparte's gull	***Chroicocephalus philadelphia***	**-**	**-**	**S4B**	**X**	**X**	**X**	**-**
Boreal chickadee	*Poecile hudsonicus*	-	-	S4	X	X	X	-
Boreal owl	***Aegolius funereus***	**Not at Risk**	**No Status**	**S3**	**X**	**X**	**X**	**-**
Broad-winged hawk	***Buteo platypterus***	**-**	**-**	**S4B,S3M**	**X**	**-**	**-**	**-**
Brown creeper	***Certhia americana***	**-**	**-**	**S4B,S3N**	**X**	**-**	**-**	**-**
Brown-headed cowbird	***Molothrus ater***	**-**	**-**	**S5B,SUN**	**X**	**-**	**-**	**-**
Bufflehead	*Bucephala albeola*	-	-	S5B	X	X	X	-
California gull	*Larus californicus*	-	-	S4B	X	X	X	-
Canada goose	*Branta canadensis*	-	-	S5B	X	X	X	-
Canada jay	*Perisoreus canadensis*	-	-	S5	X	X	X	X
Canada warbler	***Cardellina canadensis***	**Special Concern**	**Threatened**	**S4B,S3M**	**X**	**-**	**-**	**-**
Canvasback	*Aythya valisineria*	-	-	S5B	X	-	-	-
Cape May warbler	*Setophaga tigrina*	-	-	S4B	X	X	X	-
Caspian tern	***Hydroprogne caspia***	**Not at Risk**	**No Status**	**S2B**	**X**	**-**	**-**	**-**
Cedar waxwing	*Bombycilla cedrorum*	-	-	S5B	X	X	X	-
Chipping sparrow	*Spizella passerina*	-	-	S5B	X	X	X	-
Clay-coloured sparrow	*Spizella pallida*	-	-	S5B	X	-	-	-
Cliff swallow	*Petrochelidon pyrrhonota*	-	-	S5B	X	X	X	-
Common goldeneye	*Bucephala clangula*	-	-	S5B	X	X	-	-
Common grackle	*Quiscalus quiscula*	-	-	S5B	X	-	-	-
Common loon	***Gavia immer***	**Not at Risk**	**No Status**	**S5B,SUN**	**X**	**X**	**X**	**X**
Common merganser	*Mergus merganser*	-	-	S5B	X	X	X	-
Common nighthawk	***Chordeiles minor***	**Special Concern**	**Special Concern**	**S4B**	**X**	**X**	**X**	**-**
Common raven	*Corvus corax*	-	-	S5	X	X	X	-
Common tern	*Sterna hirundo*	Not at Risk	No Status	S5B	X	X	X	-
Common yellowthroat	*Geothlypis trichas*	-	-	S5B	X	X	X	-
Connecticut warbler	*Oporornis agilis*	-	-	S4B	X	-	-	-
Cooper's hawk	***Accipiter cooperii***	**Not at Risk**	**No Status**	**S4B,S2N,S2M**	**X**	**-**	**-**	**-**
Dark-eyed junco	*Junco hyemalis*	-	-	S5B,S4N	X	X	X	X
Double-crested cormorant	***Nannopterum auritum***	**Not at Risk**	**No Status**	**S5B**	**X**	**-**	**-**	**-**
Downy woodpecker	*Dryobates pubescens*	-	-	S5	X	X	X	-
Eastern kingbird	*Tyrannus tyrannus*	-	-	S5B	X	-	-	-
Eastern phoebe	*Sayornis phoebe*	-	-	S4B	X	-	-	-
European starling	*Sturnus vulgaris*	-	-	SNA	X	X	X	-
Evening grosbeak	***Coccothraustes vespertinus***	**Special Concern**	**Special Concern**	**S4**	**X**	**-**	**-**	**-**
Fox sparrow	***Passerella iliaca***	**-**	**-**	**S5B,SUM**	**X**	**X**	**X**	**-**
Gadwall	*Mareca strepera*	-	-	S5B	X	-	-	-
Glaucous gull	***Larus hyperboreus***	**-**	**-**	**S2N**	**X**	**-**	**-**	**-**
Golden eagle	***Aquila chrysaetos***	**Not at Risk**	**No Status**	**S3B,S3N,S4M**	**X**	**-**	**-**	**-**
Golden-crowned kinglet	*Regulus satrapa*	-	-	S5B,S4N	X	-	-	-
Gray-cheeked thrush	*Catharus minimus*	-	-	S4B	X	X	X	-
Great blue heron	***Ardea herodias***	**-**	**-**	**S5B**	**X**	**-**	**-**	**-**
Great grey owl	***Strix nebulosa***	**Not at Risk**	**No Status**	**S3**	**X**	**X**	**X**	**-**
Great horned owl	*Bubo virginianus*	-	-	S4	X	-	-	-
Greater scaup	*Aythya marila*	-	-	S5M	X	X	X	-
Greater white-fronted goose	*Anser albifrons*	-	-	S5M	X	X	-	-
Greater yellowlegs	*Tringa melanoleuca*	-	-	S5B	X	X	X	-
Green-winged teal	*Anas crecca*	-	-	S5B	X	X	X	-
Grey catbird	*Dumetella carolinensis*	-	-	S5B	X	-	-	-
Gyrfalcon	*Falco rusticolus*	Not at Risk	No Status	S4N,SNRM	X	-	-	-
Hairy woodpecker	*Dryobates villosus*	-	-	S5	X	X	X	-
Harris's sparrow	***Zonotrichia querula***	**Special Concern**	**Special Concern**	**SUB,S5M**	**X**	**-**	**-**	**-**
Hermit thrush	*Catharus guttatus*	-	-	S5B	X	X	X	-
Herring gull	***Larus argentatus***	**-**	**-**	**S5B**	**X**	**X**	**X**	**-**

TABLE 5.3-3

Wildlife Species that have been Observed Within the McClean Lake Area and Species that Potentially Occur in the Region

Common Name	Scientific Name	COSEWIC Status[1]	SARA Schedule 1 Status[2]	SKCDC Rank[3]	Observed or Sign Detected			
					Historical Records[4]			2023-2024[5]
					Athabasca	LAB	McClean Lake LSA	
Hoary redpoll	*Acanthis hornemanni*	-	-	SNRB	X	X	X	-
Hooded merganser	*Lophodytes cucullatus*	-	-	S4B	X	X	X	-
Horned grebe	***Podiceps auritus***	**Special Concern**	**-**	**S4B**	**X**	**-**	**-**	**-**
Horned lark	***Eremophila alpestris***	**-**	**-**	**S4B,S3N,SUM**	**X**	**X**	**-**	**-**
House sparrow	*Passer domesticus*	-	-	SNA	X	-	-	-
House wren	*Troglodytes aedon*	-	-	S5B	X	-	-	-
Killdeer	*Charadrius vociferus*	-	-	S5B	X	X	X	-
Lapland longspur	*Calcarius lapponicus*	-	-	S4N	X	X	-	-
Least flycatcher	*Empidonax minimus*	-	-	S5B	X	X	-	-
Least sandpiper	***Calidris minutilla***	**-**	**-**	**SUB**	**X**	**X**	**X**	**-**
LeConte's sparrow	*Ammospiza leconteii*	-	-	S5B	X	X	X	-
Lesser scaup	*Aythya affinis*	-	-	S5B	X	X	X	-
Lesser yellowlegs	***Tringa flavipes***	**Threatened**	**No Status**	**S4B**	**X**	**X**	**X**	**-**
Lincoln's sparrow	*Melospiza lincolnii*	-	-	S5B	X	X	X	-
Long-billed dowitcher	***Limnodromus scolopaceus***	**-**	**-**	**SUM**	**X**	**-**	**-**	**-**
Long-eared owl	***Asio otus***	**-**	**-**	**S5B,S2N**	**X**	**X**	**X**	**-**
Long-tailed duck	*Clangula hyemalis*	-	-	S4M	X	-	-	-
Magnolia Warbler	*Setophaga magnolia*	-	-	S5B	X	X	X	-
Mallard	*Anas platyrhynchos*	-	-	S5B	X	X	X	-
Marsh wren	*Cistothorus palustris*	-	-	S5B	X	-	-	-
Merlin	*Falco columbarius*	Not at Risk	No Status	S5B,S5N	X	X	X	-
Mourning dove	*Zenaida macroura*	-	-	S5B	X	-	-	-
Nashville warbler	*Leiothlypis ruficapilla*	-	-	S5B	X	-	-	-
Nelson's Sparrow	*Ammospiza nelsoni*	Not at Risk	No Status	S5B	X	-	-	-
Northern flicker	***Colaptes auratus***	**-**	**-**	**S5B,SUN**	**X**	**X**	**X**	**-**
Northern harrier	*Circus hudsonius*	Not at Risk	No Status	S4B	X	X	X	-
Northern hawk owl	***Surnia ulula***	**Not at Risk**	**No Status**	**S3B,S5N**	**X**	**X**	**X**	**-**
Northern pintail	*Anas acuta*	-	-	S5B	X	-	-	-
Northern shoveler	*Spatula clypeata*	-	-	S5B	X	X	-	-
Northern shrike	***Lanius borealis***	**-**	**-**	**S1B,S4N,S4M**	**X**	**-**	**-**	**-**
Northern waterthrush	*Parkesia noveboracensis*	-	-	S5B	X	X	X	-
Olive-sided flycatcher	***Contopus cooperi***	**Special Concern**	**Special Concern**	**S4B**	**X**	**X**	**X**	**-**
Orange-crowned warbler	*Leiothlypis celata*	-	-	S5B	X	X	X	-
Osprey	***Pandion haliaetus***	**-**	**-**	**S3B**	**X**	**X**	**X**	**-**
Ovenbird	*Seiurus aurocapilla*	-	-	S5B	X	-	-	-
Pacific loon	***Gavia pacifica***	**-**	**-**	**S3M**	**X**	**-**	**-**	**-**
Palm warbler	*Setophaga palmarum*	-	-	S5B	X	X	X	-
Parasitic jaegar	*Stercorarius parasiticus*	-	-	S4M	X	-	-	-
Pectoral sandpiper	***Calidris melanotos***	**-**	**-**	**SUM**	**X**	**-**	**-**	**-**
Peregrine falcon	***Falco peregrinus***	**Not at Risk**	**No Status**	**S4B**	**X**	**X**	**-**	**-**
Philadelphia vireo	*Vireo philadelphicus*	-	-	S5B	X	-	-	-
Pied-billed grebe	*Podilymbus podiceps*	-	-	S5B	X	-	-	-
Pileated woodpecker	***Dryocopus pileatus***	**-**	**-**	**S3**	**X**	**-**	**-**	**-**
Pine grosbeak	***Pinicola enucleator***	**-**	**-**	**S2B,S4N**	**X**	**X**	**X**	**-**
Pine siskin	*Spinus pinus*	-	-	S5	X	X	X	-
Purple finch	*Haemorhous purpureus*	-	-	S5B,S4N	X	X	-	-
Red crossbill	*Loxia curvirostra*	-	-	S4B,S5N,S5M	X	X	X	-
Red-breasted merganser	*Mergus serrator*	-	-	S4B	X	X	X	-
Red-breasted nuthatch	*Sitta canadensis*	-	-	S5B,S5N,S5M	X	X	X	-
Red-eyed vireo	*Vireo olivaceus*	-	-	S5B	X	-	-	-
Redhead	*Aythya americana*	-	-	S5B	X	-	-	-
Red-necked grebe	*Podiceps grisegena*	Not at Risk	No Status	S5B	X	X	-	-
Red-necked phalarope	***Phalaropus lobatus***	**Special Concern**	**Special Concern**	**S4B,S3M**	**X**	**-**	**-**	**-**
Redpoll (Hoary redpoll)	*Acanthis flammea* (*Acanthis hornemanni*)	-	-	SNRB	X	X	X	-
Red-tailed hawk	***Buteo jamaicensis***	**Not at Risk**	**No Status**	**S5B,S1N**	**X**	**X**	**X**	**-**
Red-throated loon	***Gavia stellata***	**-**	**-**	**S1B**	**X**	**X**	**X**	**-**
Red-winged blackbird	***Agelaius phoeniceus***	**-**	**-**	**S5B,SUN**	**X**	**X**	**-**	**-**
Ring-billed gull	*Larus delawarensis*	-	-	S5B	X	X	-	-
Ring-necked duck	*Aythya collaris*	-	-	S5B	X	X	X	-
Rock pigeon	*Columba livia*	-	-	SNA	X	-	-	-
Rose-breasted grosbeak	*Pheucticus ludovicianus*	-	-	S5B	X	-	-	-
Ross's goose	*Anser rossii*	-	-	S5M	X	X	X	-
Rough-legged hawk	*Buteo lagopus*	-	-	S4N	X	X	-	-
Ruby-crowned kinglet	*Corthylio calendula*	-	-	S5B	X	X	X	-
Ruddy duck	*Oxyura jamaicensis*	-	-	S5B	X	-	-	-
Ruddy turnstone	***Arenaria interpres***	**-**	**-**	**SUM**	**X**	**-**	**-**	**-**
Ruffed grouse	*Bonasa umbellus*	-	-	S5	X	-	-	X
Rusty blackbird	***Euphagus carolinus***	**Special Concern**	**Special Concern**	**S3B,SUN**	**X**	**X**	**X**	**-**
Sanderling	*Calidris alba*	-	-	S4M	X	-	-	-
Sandhill crane	*Antigone canadensis*	-	-	S5B	X	X	X	-
Savannah sparrow	*Passerculus sandwichensis*	-	-	S5B	X	X	-	-
Saw-whet owl	*Aegolius acadicus*	-	-	S5B,S4N	X	-	-	-
Semipalmated plover	***Charadrius semipalmatus***	**-**	**-**	**SUB,S5M**	**X**	**X**	**X**	**-**
Semipalmated sandpiper	***Calidris pusilla***	**-**	**-**	**SUM**	**X**	**-**	**-**	**-**
Sharp-shinned hawk	***Accipiter striatus***	**Not at Risk**	**No Status**	**S4B,S2N**	**X**	**X**	**X**	**-**
Sharp-tailed grouse	***Tympanuchus phasianellus***	**-**	**-**	**S5**	**X**	**-**	**-**	**-**
Short-billed dowitcher	***Limnodromus griseus***	**Threatened**	**No Status**	**SUB,S4M**	**X**	**-**	**-**	**-**
Short-billed gull	***Larus brachyrhynchus***	**-**	**-**	**S4B**	**X**	**X**	**X**	**-**
Short-eared owl	***Asio flammeus***	**Threatened**	**Special Concern**	**S3B,S2N**	**X**	**-**	**-**	**-**
Slate-coloured junco	*Junco hyemalis hyemalis*	-	-	S5B	X	X	X	-
Smith's longspur	*Calcarius pictus*	-	-	S4M	X	-	-	-
Snow bunting	*Plectrophenax nivalis*	-	-	S5N	X	X	X	-
Snow goose	*Anser caerulescens*	-	-	S5M	X	X	X	-
Snowy owl	***Bubo scandiacus***	**Threatened**	**No Status**	**S5N**	**X**	**X**	**-**	**-**
Solitary sandpiper	***Tringa solitaria***	**-**	**-**	**SUB**	**X**	**X**	**X**	**-**
Song sparrow	*Melospiza melodia*	-	-	S5B	X	X	X	-
Sora	*Porzana carolina*	-	-	S5B	X	X	X	-
Spotted sandpiper	*Actitis macularius*	-	-	S5B	X	X	X	-
Spruce grouse	*Canachites canadensis*	-	-	S5	X	X	X	-
Stilt sandpiper	*Calidris himantopus*	-	-	S5M	X	-	-	-

TABLE 5.3-3

Wildlife Species that have been Observed Within the McClean Lake Area and Species that Potentially Occur in the Region

Common Name	Scientific Name	COSEWIC Status[1]	SARA Schedule 1 Status[2]	SKCDC Rank[3]	Observed or Sign Detected			
					Historical Records[4]			2023-2024[5]
					Athabasca	LAB	McClean Lake LSA	
Surf scoter	***Melanitta perspicillata***	**-**	**-**	**S3B**	**X**	**X**	**X**	**-**
Swainson's thrush	*Catharus ustulatus*	-	-	S5B	X	X	X	-
Swamp sparrow	*Melospiza georgiana*	-	-	S5B	X	X	X	-
Tennessee warbler	*Leiothlypis peregrina*	-	-	S5B	X	X	X	-
Tree swallow	*Tachycineta bicolor*	-	-	S5B	X	X	X	-
Trumpeter swan	***Cygnus buccinator***	**Not at Risk**	**No Status**	**S3B**	**X**	**-**	**-**	**-**
Tundra swan	*Cygnus columbianus*	-	-	S5M	X	-	-	-
Turkey vulture	***Cathartes aura***	**-**	**-**	**S3B**	**X**	**-**	**-**	**-**
Vesper sparrow	*Pooecetes gramineus*	-	-	S5B	X	-	-	-
Warbling vireo	*Vireo gilvus*	-	-	S5B	X	-	-	-
Western tanager	*Piranga ludoviciana*	-	-	S4B	X	-	-	-
Western wood-pewee	*Contopus sordidulus*	-	-	S4B	X	X	X	-
White-breasted nuthatch	*Sitta carolinensis*	-	-	S5	X	-	-	-
White-crowned sparrow	*Zonotrichia leucophrys*	-	-	S4B	X	X	X	-
White-rumped sandpiper	***Calidris fuscicollis***	**-**	**-**	**SUM**	**X**	**X**	**X**	**-**
White-throated sparrow	*Zonotrichia albicollis*	-	-	S5B	X	X	X	-
White-winged crossbill	***Loxia leucoptera***	**-**	**-**	**S4B,S3N**	**X**	**X**	**X**	**-**
White-winged scoter	***Melanitta deglandi***	**-**	**-**	**S5B,S3M**	**X**	**X**	**-**	**-**
Willow ptarmigan	*Lagopus lagopus*	-	-	S5N	X	X	-	X
Wilson's snipe	*Gallinago delicata*	-	-	S5B	X	X	X	-
Wilson's warbler	***Cardellina pusilla***	**-**	**-**	**S5B,SUM**	**X**	**X**	**X**	**-**
Winter wren	*Troglodytes hiemalis*	-	-	S5B	X	X	X	-
Yellow rail	***Coturnicops noveboracensis***	**Special Concern**	**Special Concern**	**S3B**	**X**	**-**	**-**	**-**
Yellow warbler	*Setophaga petechia*	-	-	S5B	X	X	X	-
Yellow-bellied flycatcher	*Empidonax flaviventris*	-	-	S5B	X	X	X	-
Yellow-bellied sapsucker	*Sphyrapicus varius*	-	-	S5B	X	-	-	-
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	-	-	S5B	X	-		-
Yellow-rumped warbler	*Setophaga coronata*	-	-	S5B	X	X	X	-
MAMMALS								
American beaver	*Castor canadensis*	-	-	S5	X	X	X	X
American mink	*Neogale vison*	-	-	S5	X	X	X	X
Arctic fox	***Vulpes lagopus***	**-**	**-**	**S2**	**X**	**-**	**-**	**-**
Arctic shrew	*Sorex arcticus*	-	-	S4	X	-	-	-
Barren-ground caribou	***Rangifer tarandus groenlandicus***	**Threatened**	**No Status**	**S3N**	**X**	**X**	**X**	**-**
Black bear	*Ursus americanus*	Not at Risk	No Status	S5	X	X	X	X
Woodland caribou (boreal population)	***Rangifer tarandus caribou***	**Threatened**	**Threatened**	**S3**	**X**	**X**	**-**	**X**
Deer mouse	*Peromyscus maniculatus*	-	-	S5	X	X	X	-
Eastern red bat	***Lasiurus borealis***	**Endangered**	**No Status**	**S4B**	**X**	**X**	**X**	**X**
Ermine	*Mustela richardsonii*	-	-	S5	X	-	-	-
Fisher	*Pekania pennanti*	-	-	S4	X	X	X	-
Gapper's red-backed vole	*Clethrionomys gapperi*	-	-	S5	X	X	X	X
Hoary bat	***Lasiurus cinereus***	**Endangered**	**No Status**	**S5B**	**X**	**-**	**-**	**X**
Least chipmunk	*Neotamias minimus*	-	-	S5	X	-	-	-
Least weasel	*Mustela nivalis*	-	-	S5	X	X	-	-
Little brown myotis	***Myotis lucifugus***	**Endangered**	**Endangered**	**S4B,S4N**	**X**	**X**	**X**	**X**
Lynx	*Lynx canadensis*	Not at Risk	No Status	S4	X	X	X	-
Marten	*Martes americana*	-	-	S4	X	X	X	X
Masked shrew	*Sorex cinereus*	-	-	S4	X	X	X	X
Meadow jumping mouse	*Zapus hudsonius*	-	-	S5	X	X	X	-
Meadow vole	*Microtus pennsylvanicus*	-	-	S4	X	X	X	-
Moose	*Alces alces*	-	-	S5	X	X	X	X
Muskrat	*Ondatra zibethicus*	-	-	S5	X	X	X	**X**
North American porcupine	*Erethizon dorsatum*	-	-	S4	X	-	-	X
Northern bog lemming	*Synaptomys borealis*	-	-	S5	X	X	X	-
Northern flying squirrel	*Glaucomys sabrinus*	-	-	S4	X	-	-	-
Northern grey wolf	*Canis lupus occidentalis*	Not at Risk	No Status	S4	X	X	X	X
Northern myotis	***Myotis septentrionalis***	**Endangered**	**Endangered**	**S3**	**X**	**-**	**-**	**X**
Pygmy shrew	*Sorex sp.*	-	-	SNR	X	-	-	-
Red fox	*Vulpes vulpes*	-	-	S5	X	X	X	X
Red squirrel	*Tamiasciurus hudsonicus*	-	-	S5	X	X	X	X
River otter	***Lontra canadensis***	**-**	**-**	**S3**	**X**	**X**	**X**	**X**
Silver-haired bat	***Lasionycteris noctivagans***	**Endangered**	**No Status**	**S5B**	**X**	**-**	**-**	**X**
Snowshoe hare	*Lepus americanus*	-	-	S5	X	X	-	X
Striped skunk	*Mephitis mephitis*	-	-	S5	X	-	-	-
Water shrew	*Sorex palustris*	-	-	S5	X	X	X	-
Western heather vole	*Phenacomys intermedius*	-	-	S5	X	X	X	-
Wolverine	***Gulo gulo***	**Special Concern**	**Special Concern**	**S2**	**X**	**-**	**-**	**-**
Woodchuck	*Marmota monax*	-	-	S4	X	-	-	-
Yellow-cheeked vole	*Microtus xanthognathus*	-	-	S5	X	-	-	-
AMPHIBIANS								
Boreal chorus frog	*Pseudacris maculata*	Not at Risk	-	S5	X	X	X	X
Canadian toad	***Anaxyrus hemiophrys***	**Not at Risk**	**No Status**	**S4**	**X**	**-**	**-**	**-**
Northern leopard frog	***Lithobates pipiens***	**Special Concern**	**Special Concern**	**S3**	**X**	**-**	**-**	**-**[6]
Wood frog	*Lithobates sylvaticus*	-	-	S5	X	X	X	X
REPTILES								
Red-sided garter snake	*Thamnophis sirtalis parietalis*	-	-	S5	X	X	-	-

SKCDC = Saskatchewan Conservation Data Centre. S2 = Imperiled/very rare; S3 = Vulnerable/rare to uncommon; S4 = Apparently secure; S5 = Secure/common; B = migratory species, applies to the breeding population in the province; N = migratory species, applies to the non-breeding population in the province; M = migratory species, rank applies to the transient population; U = status uncertain; NR = rank not assigned or species not assessed; NA = conservation status inapplicable.

Bolded rows indicate species of conservation concern federally or provincially, including species listed under SARA or COSEWIC (SARPR, 2025), species listed as rare (S1 to S3) or with uncertain ranking (SU) status in Saskatchewan (SKCDC, 2025) or species with provincial or federal activity restriction guidelines (EC, 2009; SMOE, 2017) .

[1,2]Federal rank as per SARPR (2025).

[3]Provincial rank as per SKCDC (2025).

[4]Athabasca = Athabasca Basin region (those species with ranges that occur in the greater region); LAB = Local Assessment Boundary (McClean Lake and Midwest LSAs); LSA = Local Study Area; Source: MacLaren and SRC, 1979; Acton et al., 1998; COGEMA, 1995; HAB-TECH, 2011; Bird Studies Canada, 2018; Birds Canada 2022a, 2022b; Rodewald, 2022; SMOE, 2025.

[5]Source: CanNorth (2025b, 2025c, 2025d), USask (2025a), Stantec (2025d, 2025e).

[6] Northern leopard frog presence in LAB not confirmed with 2024 eDNA survey (Stantec 2025c).

TABLE 6.2-1

Archaeological Cultures of Northern Saskatchewan.

Years Ago	Northern Saskatchewan Cultures: Southern Zone	Northern Saskatchewan Cultures: Northern Zone (far northern Saskatchewan)
0	Selkirk; Rainy River Blackduck; Laurel; River House Avonlea Besant	Ancestral Dene
1,000		Taltheilei Tradition
2,000	Plains influences (Mummy Cave, Oxbow, McKean, Pelican Lake)	Arctic Small Tool Tradition
3,000		
4,000		Shield Archaic
5,000		
6,000		Northern Plano
7,000	Angostura/Nipawin	
8,000		
9,000	Agate Basin	

Sources: Meyer 1983a, 1999.

TABLE 6.2-2

Fur Trade Posts in the Regional Study Area.

Trade Post	Location	Company	Year of Establishment
Fond du Lac I	Fond du Lac	North West Company	1805
Fond du Lac II	Fond du Lac	North West Company	1819 to 1821
Harrison's House	Fond du Lac	Hudson's Bay Company	1819 to 1821
Fond du Lac	Fond du Lac	Hudson's Bay Company	1851 to 1930
Black River	Fond du Lac	Hudson's Bay Company	1922 to 1930
Paint River	Reindeer Lake	North West Company	1790
Bedford	Reindeer Lake	Hudson's Bay Company	1796
Bedford	Reindeer Lake	North West Company	1797
Raymond's House	Reindeer Lake	Hudson's Bay Company	1807 to 1809
Deer Lake North	Reindeer Lake	North West Company	1807 to 1809
Swan River	Reindeer Lake	Hudson's Bay Company	1920
Cree Lake I	Cree Lake	North West Company	1803
Mowatt's House	Cree Lake	Private	1803
Dare's House	Cree Lake	Private	1803
Country Tea Lake	Cree Lake	North West Company	1805

TABLE 6.3-1

Archaeological Resource Investigation Permits Issued
for the Local Assessment Boundary.

Permit Holder	Permit Number	Purpose
Van Dyke (Lifeways of Canada)*	79-0	Midwest Project Site Assessment.
Meyer (Saskatchewan Research Council)*	79-0	Project Wolly McClean Lake Area (corresponds to McClean Lake Operation Surface Lease Area).
Meyer (Saskatchewan Research Council)	82-020	Proposed road option from Stony Rapids to the end of Provincial Road 105.
Meyer (Saskatchewan Research Council)	83-015	Dawn Lake Area Assessment.
Saylor (SaskPower)	87-023	Transmission line from Uranium City to Wollaston Lake.
Amundson (Millenium Heritage Resource Consultants)	90-037	Transmission line Island Falls to Points North.
Brewer (Golder Associates)	94-069	Proposed road from the MacArthur River Mine to Provincial Road 905.
Amundson (Sentar Consultants Limited)	96-023	Proposed road running from Points North Landing to Black Lake.
Novescosky (Golder Associates)	02-098	Proposed haul road to the Rabbit Lake Operation.
Novescosky (Golder Associates)*	06-120	An assessment completed for the Midwest Project including the western margin of Too Small Lake and along two proposed transportation corridor options between the Midwest Project and McClean Lake Operation.
Young (Golder Associates)*	08-129	An assessment completed for the Midwest Project including the shoreline of North McMahon Lake and South McMahon Lake as well as portions of Shallow Lake.
Hanna (Western Heritage)	08-304	An assessment of the area near Collins Creek on behalf of Cameco Corporation.
Young (Golder Associates)	10-194	An assessment of the shoreline along North McMahon and South McMahon lakes on behalf of Fission Energy Corporation.
Young (Golder Associates)*	12-105	An assessment of the proposed JEB TMF expansion area.
Markowski (Canada North Environmental Services)	12-120	An assessment of the areas along Lake A, Lake B, Lake C3, Lake C2, and Lake C1 on behalf of Rio Tinto Uranium Corporation.
Korejbo (Canada North Environmental Services)	13-163	An assessment of the Roughrider quarry and proposed access roads on behalf of Rio Tinto Uranium Corporation.
Korejbo (Canada North Environmental Services)*	15-064	An assessment of the proposed road accessing a planned environmental monitoring station on Collins Creek.
Pletz (Canada North Environmental Services)	24-154	An assessment of the proposed McClean Mining site expansion.

* Permits issued for Orano's Projects

TABLE 6.3-2

Previously Recorded Heritage Resources in the Local Assessment Boundary.

Borden Number	Type	Reference
McClean Local Study Area		
IbMx-7	Artifact Scatter	Meyer 1982
IbMx-8	Artifact Find	Meyer 1983
IbMx-9	Artifact Scatter	Meyer 1983
IbMx-10	Artifact Find	Meyer 1983
IbMx-11	Artifact Scatter	Meyer 1983
IbMx-12	Artifact Find	Meyer 1982
IbMx-13	Artifact Find	Meyer 1983
IbMx-14	Artifact Scatter	Amundson 1996
IbNa-1	Artifact Find	Van Dyke 1979
IbNa-2	Artifact Find	Van Dyke 1979
IbNa-3	Unknown	Van Dyke 1979
IbNa-4	Artifact Find	Van Dyke 1979
IbNa-5	Artifact Find	Van Dyke 1979
IbNa-9	Artifact Scatter	Meyer 1982
IcMx-2	Artifact Scatter	Meyer 1982
IcMx-3	Artifact Scatter	Meyer 1983
IcMx-4	Artifact Find	Meyer 1983
IcMx-5	Artifact Find	Meyer 1983
IbMx-5	Artifact Scatter	Van Dyke 1979
IbMx-6	Artifact Scatter	Van Dyke 1979
Midwest Local Study Area		
IbNa-6	Artifact Find	Van Dyke 1979
IbNa-7	Artifact Find	Van Dyke 1979
IcMx-1	Artifact Scatter	Meyer 1982
IcNa-1	Artifact Find	Van Dyke 1979
IcNa-2	Artifact Find	Van Dyke 1979
IcNa-3	Artifact Find	Van Dyke 1979
IcNa-4	Artifact Find	Van Dyke 1979
IcNa-5	Artifact Find	Van Dyke 1979
IcNa-6	Artifact Find	Van Dyke 1979
IcNa-7	Artifact Find	Van Dyke 1979
IcNa-8	Unknown	Van Dyke 1979
IcNa-9	Unknown	Van Dyke 1979
IcNa-10	Unknown	Van Dyke 1979
IcNb-1	Artifact Scatter	Van Dyke 1979

TABLE 6.4-1

Land Uses in the Vicinity of the McClean Lake Operation.

Land Use	Proximity to Mine Sites			
	At Site	Within 10 km	Within 11-30 km	Within 31-50 km
Commercial Fishing	No	No	Yes	Yes
Domestic Fishing	No	No	Yes	Yes
Recreational Fishing	No	No	Yes	Yes
Hunting	No	Yes	Yes	Yes
Trapping	Yes	Yes	Yes	Yes
Wild Rice	No	No	No	No
Mining	No	No	Yes	Yes
Lodges and Resorts	No	No	Yes	Yes
Campgrounds	No	No	Yes	Yes

Source: Minatco 1991b.

TABLE 6.4-2

Value of Saskatchewan Fur Harvest 2004-2005 to 2020-2021.

Year	Fur Conservation Areas[1]		Southern Saskatchewan		Total
	Value ($)	% of Total	Value ($)	% of Total	Value ($)
2004-05	684,791	40.6	1,002,920	59.4	1,687,711
2005-06	854,358	42.7	1,147,718	57.3	2,002,066
2006-07	919,922	31.0	2,046,942	69.0	2,966,864
2007-08	730,904	36.9	1,248,332	63.1	1,979,237
2008-09	523,761	44.2	661,686	55.8	1,185,447
2009-10	493,517	43.8	634,316	56.2	1,127,832
2010-11	804,423	42.7	1,078,296	57.3	1,882,719
2011-12	1,841,002	43.1	2,432,578	56.9	4,273,580
2012-13	2,478,711	43.1	3,277,080	56.9	5,755,790
2013-14	1,617,697	33.1	3,265,262	66.9	4,882,959
2014-15	1,075,713	25.2	4,271,754	79.9	5,347,466
2015-16	633,871	20.6	3,076,512	82.9	3,710,384
2016-17	597,295	20.2	2,952,721	83.2	3,550,016
2017-18	799,091	16.9	4,718,042	85.5	5,517,133
2018-19	570,773	14.9	3,821,833	87.0	4,392,606
2019-20	280,098	8.0	3,236,384	92.0	3,516,482
2020-21	228,941	6.2	3,490,134	93.8	3,719,075

[1]Fur conservation areas refer to all of Northern Saskatchewan.

Source: GS 2021

TABLE 6.4-3

Saskatchewan Trapper Licence Sales 2004-2005 to 2020-2021.

Year	Fur Conservation Area (#)[1]	% of Total	Southern Saskatchewan (#)	% of Total	Youth Trapper Licenses	% of Total	Total (#)
2004-05	2,019	64.2	1,003	31.9	123	3.9	3,145
2005-06	1,789	60.9	1,011	34.4	136	4.6	2,936
2006-07	1,981	57.6	1,321	38.4	140	4.1	3,442
2007-08	1,976	59.4	1,220	36.7	131	3.9	3,327
2008-09	1,992	61.3	1,143	35.2	115	3.5	3,250
2009-10	1,691	59.1	1,076	37.6	96	3.4	2,863
2010-11	1,665	61.3	976	35.9	76	2.8	2,717
2011-12	1,662	53.5	1,358	43.7	86	2.8	3,106
2012-13	1,749	48.2	1,783	49.2	94	2.6	3,626
2013-14	1,892	44.6	2,173	51.3	175	4.1	4,240
2014-15	1,848	40.1	2,552	55.4	209	4.5	4,609
2015-16	1,896	38.0	2,878	57.7	216	4.3	4,990
2016-17	1,639	36.1	2,723	60.1	172	3.8	4,534
2017-18	1,675	36.1	2,812	60.5	159	3.4	4,646
2018-19	1,542	33.0	2,947	63.1	178	3.8	4,667
2019-20	833	25.3	2,276	69.2	181	5.5	3,290[2]
2020-21	1,424	30.9	2,942	63.9	237	5.1	4,603

[1]Fur conservation areas refer to all of Northern Saskatchewan.

[2] Decrease in fur harvesting likely in part related to the influence of the global COVID-19 pandemic

Source: GS 2021.

TABLE 6.4-4

Northern Fur Conservation Area – N26 Wollaston Harvest and Cash Values 2004-2005 to 2019-2020.

Year	Beaver	Fisher	Red Fox	Cross Fox	Silver Fox	White Fox	Lynx	Marten	Mink	Muskrat	Otter	Weasel	Wolf	Wolverine	Total Value
2004-05	1 $20	- -	8 $143	- -	- -	1 $19	- -	160 $10,304	103 $1,840	- -	6 $976	9 $41	5 $757		293 $14,101
2005-06								23 $2,464	5 $145						28 $2,609
2006-07		1 $81	4 $92					216 $15,543	146 $3,013		1 $8		2 $145	1 $254	371 $19,137
2007-08								96 $9,445	44 $700			3 $18	1 $220		144 $10,384
2008-09							5 $659	102 $6,023	42 $532		2 $76	9 $45			160 $7,335
2009-10			2 $31	1 $34				26 $1,616	3 $49		1 $53				33 $1,782
2010-11			2 $55					130 $10,212	23 $392	4 $24					159 $10,683
2011-12			5 $210	2 $78	1 $42			357 $37,271	41 $1,052				1 $276		407 $38,928
2012-13		1 $152	2 $123	1 $60				319 $54,498	41 $1,364		3 $230		3 $762		370 $57,188
2013-14	5 $87						1 $157	411 $36,119	51 $165		5 $279			1 $262	474 $37,068
2014-15			8 $168			2 $98	1 $99	261 $23,286	14 $176		3 $137			3 $994	292 $24,959
2019-20			- -	1 $39		- -	- -	294 $7,697	7 $36		- -			1 $264	303 $8,035

Dash indicates no data is available.

Source: GS 2021; Wollaston specific 2016 to 2018 data not provided; no data available for 2020-21.

TABLE 6.4-5

Commercial Fishing Quotas, by Waterbody.

Waterbody	Quota			
	Whitefish	Pike	Walleye	Trout
Torwalt Lake	350 kg	400 kg combined		-
Wollaston Lake	205,000 kg	17,000 kg		135,000 kg
McClean Lake	-	350 kg combined		
Waterbury Lake	12000 kg	2,800 kg	-	3,600
Charcoal Lake	13800 kg	6, 700 kg	600 kg	5,200

Source: M. Duffy pers. Comm. June 16, 2025.

TABLE 6.4-6

Commercial Fishing Licences for Wollaston Lake.

Year	Number of Licences
2004	33
2005	41
2006	45
2007	25
2008	32
2009	24
2010	21
2011	17
2012	22
2013	11
2014	13
2015	19
2016	23
2017	21
2018	20
2019	10
2020	2
2021	1
2022	2
2023	3
2024	4

Source: M. Duffy pers. Comm. June 16, 2025.

TABLE 6.4-7

Wollaston Lake Commercial Fishing Data 2004 to 2024.

Year	Species (weight in kg)						Total Weight
	Lake Trout	Lake Whitefish	Mullet	Northern Pike	Walleye	Burbot	
2004	118,876	137,188	10,226	6,150	6,336	-	278,776
2005	114,425	90,953	9,553	6,984	5,417	25	227,355
2006	116,904	137,509	5,632	3,589	4,715	-	268,348
2007	18,943	76,075	1,137	414	3,403	-	99,972
2008	49,192	161,995	543	552	1,413	-	213,695
2009	49,547	94,333	1,145	405	2,047	-	147,477
2010	76,038	114,321	29	557	715	-	191,660
2011	69,324	93,668	-	748	4,141	-	167,882
2012	55,400	52,774	-	972	4,382	-	113,528
2013	33,061	33,995	-	52	510	-	67,618
2014	2,393	1,309	-	1,485	4,020	-	9,208
2016	13,704	15,507	-	7,930	7,164	-	44,306
2018	11,181	10,734	-	9,408	3,035	-	34,357
2019	745	772	-	549	2,029	-	4,096
2020	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0
2023	-	-	-	116	1,180	-	1,296
2024	179	369	-	516	1,224	-	2,288

Dash indicates no data is available.

Source: M. Duffy pers. Comm. June 16, 2025.

Table 7.2-1: Current Waste Rock Inventory

Pit	Material Type	Location	Volume (bcm)[1]	Mass (tonnes)
JEB	Organic Overburden	JEB Organics Stockpile	128,369	82,541
	Till Overburden and Clean Waste Rock[2]	JEB Clean Waste Rock Stockpile	4,372,673	10,625,595
	Special Waste Rock	Sue C Pit	27,796	67,544
Sue C	Overburden	Sue C Overburden Stockpile	857,328	1,886,122
	Overburden and Clean Waste Rock	Sue C Clean Waste Rock Stockpile	9,961,302	24,205,964
	Special Waste Rock	Sue C Pit	273,024	663,448
Sue A	Overburden	Sue C Pit	124,580	274,076
	Special Waste Rock	Sue C Pit	1,448,841	3,520,684
Sue B	Overburden	Sue C Overburden Stockpile	184,634	406,195
	Special Waste Rock	Sue E Pit	1,441,350	3,502,481
Sue E	Overburden	Sue E Overburden Stockpile	462,967	1,018,527
	Clean Waste Rock	Sue E Clean Waste Rock Stockpile	4,572,907	11,018,527
	Special Waste Rock	Sue C Pit	2,437,822	5,923,907

[1]For current inventory, the McClean Lake Operation generally reports in bank cubic metres (bcm). This is the in-situ volume prior to excavation. Volume estimates for current inventory are based on site records from the McClean Lake Operation Surface Department as well as 2024 operational data.

[2]Quantities in bcm of till overburden and clean waste rock were not separated, so an overall tonnage was calculated using the waste rock conversion factor of 2.43. The quantity in bcm is considered to be the most reliable measurement.

Source: Waste Rock Management TID (Orano, 2023a); 2025 McClean Lake Operation records

Table 7.2-2: Tailings Discharged to JEB TMF in 2022-2024

Year	Total Quantity of Solids (tonnes)	
	Predictions (2020 Tailings Management TID)[1]	Tailings Generated[2]
2022	108,850	81,137
2023	98,622	84,451
2024	150,282	98,854
Total	357,754	264,442

[1]Source: McClean Lake Operation Tailings Management Technical Information Document (Orano 2020)

[2]Source: 2025 McClean Lake Operation Records (Orano 2025b)

Table 7.2-3: Summary of Waste Materials Generated and Shipped Off Site in 2022-2024

Material Category	Units	2022	2023	2024	2022-2024 Total	Waste Disposal Approach	Shipped Off-Site During Reporting Period (2022-2024)
Domestic Waste	m^3	487	487	487	1461	On Site	No
Industrial Waste	m^3	96	11	0	107	On Site	No
Chemically or Radiologically Contaminated Waste	m^3	1686	2483	3833	8002	On Site	No
Contaminated oil and grease	drums	0	2	12	14	Off Site	No
Hydrocarbon Contaminated Material	m^3	34	62	74	170	On Site	No
Used oil	m^3	0	0	28	28	Off Site	Yes
Used antifreeze	drums	10	7	7	24	Off Site	Yes
Used cooking oil	drums	13	16	3	32	Off Site	Yes
Waste grease	drums	5	9	3	17	Off Site	Yes
Used oil and fuel filters	drums	2	14	15	31	Off Site	Yes
Spent aerosol containers	drums	0	0	6	6	Off Site	Yes
Batteries	cases	6	4	2	12	Off Site	Yes
Paints and related materials	drums	2	2	2	6	Off Site	Yes
Paper and cardboard	m^3	62.5	66.3	32.2	161	Off Site	Yes
Co-mingle Recycled[1]	m^3	30.0	77.7	20.3	128	Off Site	Yes
Misc. (resin, acetone, kerosene)	drums	1.00	0.39	0.09	1.48	Off Site	Yes
Fluorescent lightbulbs	drums	9	3	1	13	Off Site	Yes

[1]glass, plastic, and scrap metal sent to Saskatoon Loraas Recycling

Table 7.2-4: JEB WTP Effluent Quality in 2022-2024

Parameter	Unit	Regulatory Limit[1]	ERA Effluent Quality Assumptions[2]		Actual Effluent Quality (2022-2024)	
			Mean	Max	Mean	Max
Physical Parameters						
Total Dissolved Solids	mg/L	n/a	10,200	22,000	3,410	3,950
Total Suspended Solids	mg/L	22.5	n/a	n/a	2.5	8
Cations/Ions						
Calcium	mg/L	n/a	598	1,300	664	745
Chloride	mg/L	n/a	1,890	3,280	120	155
Fluoride	mg/L	n/a	0.86	1.3	0.77	1.4
Potassium	mg/L	n/a	280	780	29	36
Sulphate	mg/L	n/a	4,810	9,700	2,130	2,440
Nutrients						
Ammonia (as N)	mg/L	n/a	12	41	9	15
Metals						
Arsenic	mg/L	0.45	0.03	0.11	0.04	0.08
Cobalt	mg/L	n/a	0.01	0.07	0.01	0.01
Copper	mg/L	0.45	0.01	0.07	0.002	0.003
Iron	mg/L	n/a	0.6	2.3	0.5	1.0
Lead	mg/L	0.15	0.002	0.03	<0.0001	<0.0001
Molybdenum	mg/L	n/a	0.2	1.8	0.008	0.021
Nickel	mg/L	0.75	0.05	0.25	0.02	0.04
Selenium	mg/L	0.90	n/a	0.029*	0.010	0.028
Uranium	mg/L	3.75	0.01	0.16	0.004	0.013
Vanadium	mg/L	0.75	n/a	n/a	0.0004	0.0011
Zinc	mg/L	0.75	0.001	0.009	0.002	0.005
Radionuclides						
Lead-210	Bq/L	0.92	0.064	0.21	0.01	0.03
Polonium-210	Bq/L	1.38	0.047	0.33	0.020	0.07
Radium-226	Bq/L	0.74	0.02	0.39	0.004	0.008
Thorium-230	Bq/L	2.78	0.03	0.25	0.01	0.02

[1]Maximum composite sample concentration limit as per Schedule 1 of Approval to Operate Pollutant Control Facilities PO24-012 (no exceedances noted)

[2]Source: McClean Lake Operation 2024 Annual Report (Orano 2025b)

*Se Exposure Based Release Limit (EBRL)

n/a - Not Applicable; Shading indicates exceedance of 2016 ERA Effluent Quality Assumptions

Table 7.2-5: Sue WTP Effluent Quality in 2022-2024

Parameter	Unit	Regulatory Limit[1]	ERA Effluent Quality Assumptions[2]		Actual Effluent Quality (2022-2024)	
			Mean	Max	Mean	Max
Physical Parameters						
Total Dissolved Solids	mg/L	n/a	404	1400	215	256
Total Suspended Solids	mg/L	22.5	n/a	n/a	1.1	2.0
Cations/Ions						
Calcium	mg/L	n/a	100	400	46	54
Chloride	mg/L	n/a	100	320	9.3	15
Fluoride	mg/L	n/a	0.07	0.13	0.09	0.10
Potassium	mg/L	n/a	8	33	5	5
Sulphate	mg/L	n/a	205	930	97	110
Nutrients						
Ammonia (as N)	mg/L	n/a	2.6	60	0.05	0.08
Metals						
Arsenic	mg/L	0.45	0.008	0.08	0.004	0.01
Cobalt	mg/L	n/a	0.002	0.01	0.002	0.002
Copper	mg/L	0.45	0.001	0.01	0.0005	0.0014
Iron	mg/L	n/a	0.2	1.7	0.3	0.4
Lead	mg/L	0.15	0.001	0.008	<0.0001	<0.0001
Molybdenum	mg/L	n/a	0.017	0.38	0.013	0.017
Nickel	mg/L	0.75	0.041	0.31	0.040	0.069
Selenium	mg/L	0.90	0.001	0.006	0.001	0.001
Uranium	mg/L	3.75	0.049	1.3	0.001	0.008
Vanadium	mg/L	0.75	n/a	n/a	0.0004	0.0007
Zinc	mg/L	0.75	0.001	0.006	0.001	0.002
Radionuclides						
Lead-210	Bq/L	0.92	0.021	0.17	0.01	0.02
Polonium-210	Bq/L	1.38	0.012	0.14	0.003	0.005
Radium-226	Bq/L	0.74	0.035	0.11	0.005	0.01
Thorium-230	Bq/L	2.78	0.006	0.03	<0.01	<0.01

[1]Maximum composite sample concentration limit as per Schedule 1 of Approval to Operate Pollutant Control Facilities PO24-012 (no exceedances noted)

[2]Source: McClean Lake Operation 2024 Annual Report (Orano 2025b)

N/A = Not Applicable; Shading indicates exceedance of 2016 ERA Effluent Quality Assumptions

Table 7.2-6: Water Treatment Plant Discharge in 2022-2024

WTP	ERA Effluent Flow Assumptions (m^3)	Discharge (m^3)	Difference (%)
JEB	4,104,060	2,344,596	- 43%
Sue	1,642,500	1,692,927	+ 3%

Shading indicates exceedance of ERA Effluent Flow Assumptions

Source: Environmental Risk Assessment Adequacy Reviews (Orano 2025b)

Table 7.2-7: Mass Loadings to S/V TEMS for 2022-2024

Parameter	Units	2016 ERA & 2018 Se RA Mass Loadings Assumptions[1]	Actual Mass Loadings
		2022-2024	2022-2024
Physical Parameters			
Total Dissolved Solids	kg	42,563,818	8,385,778
Anions/Cations			
Calcium	kg	2,620,869	1,634,772
Chloride	kg	7,928,158	318,327
Fluoride	kg	3,648	1,854
Potassium	kg	1,163,339	76,291
Sulfate	kg	20,095,577	5,371,883
Nutrients			
Ammonia (as N)	kg	35,729	10,418
Metals			
Arsenic	kg	136	106
Cobalt	kg	45	17
Copper	kg	42	8
Iron	kg	2,793	1,697
Lead	kg	10	2
Molybdenum	kg	850	43
Nickel	kg	273	121
Selenium	kg	62	29
Uranium	kg	123	13
Zinc	kg	5.7	7.2
Radionuclides			
Lead-210	MBq	297	83
Polonium-210	MBq	213	61
Radium-226	MBq	141	46
Thorium-230	MBq	132	40

[1]Total for JEB and Sue WTP

Shading indicates exceedance of ERA Mass Loadings Assumptions

Table 7.2-8: Acute Lethality Toxicity Testing Results from the McClean Lake Operation, 2022-2024

Sampling Location	Sampling Date	*Daphnia magna*	Rainbow trout (*Oncorhynchus mykiss*)
		48-hr % Mortality[1]	96-hr % Mortality[1]
JEB WTP (CM01B)	28-Feb-22	0	0
	6-Jun-22	0	0
	6-Sep-22	0	0
	6-Dec-22	0	0
	13-Mar-23	0	0
	23-Apr-23[2]	0	n/a
	5-Jun-23	0	0
	5-Sep-23	0	0
	3-Jun-24	0	0
	16-Aug-24[3]	0	0
	2-Sep-24	0	0
	16-Dec-24	0	0
Sue WTP (SC01)	24-Jun-22	0	0
	8-Aug-22	0	0
	13-Aug-22[3]	n/a	0
	4-Oct-22	0	0
	4-Jul-23	0	0
	2-Oct-23	3	0
	8-Jul-24	0	0
	16-Aug-24[3]	0	0
	7-Oct-24	0	0

[1] % Mortality = mean percent mortality in 100% effluent test concentration. “Acutely Lethal”, in respect to effluent, means an effluent at 100% concentration that kills more than 50% of the rainbow trout subjected to it over a 96-hour period or more than 50% of the *Daphnia magna* subjected to it for a period of 48 hours (MDMER 2025).
[2] The April 23rd sample was collected for an uncontrolled release of effluent due to a failed connector in the discharge line. Orano only requested a *Daphnia magna* test.
[3] The samples were collected side-by-side with Environment and Climate Change Canada (ECCC) during onsite inspections as per ECCC request.

Table 7.2-9: Sub-lethal Toxicity Testing Results on the JEB Treated Effluent from the McClean Lake Operation, 2022

Sampling Date	Species Tested (Latin Name)	Test Type	IC_{25}	IC_{25} Lower	IC_{25} Upper
14-Mar-22	*Lemna minor*	Growth (frond number)	14.7	NC	20.7
	Lemna minor	Growth (biomass)	40	NC	64.8
6-Jun-22	*Lemna minor*	Growth (frond number)	5.8	3.5	8.9
	Lemna minor	Growth (biomass)	>97	n/a	n/a
6-Sep-22	*Lemna minor*	Growth (frond number)	2.3	1.1	4.3
	Lemna minor	Growth (biomass)	>97	n/a	n/a
6-Dec-22	*Lemna minor*	Growth (frond number)	12.2	8.6	15.3
	Lemna minor	Growth (biomass)	17.7	3.5	55.8

NC indicates confidence limits could not be calculated.

ICx refers to the effluent concentration at which a 25% inhibition/reduction in endpoint was observed among effluent-exposed organisms relative to the control group.

Table 7.2-10: Sub-lethal Toxicity Testing Results for JEB Treated Effluent from McClean Lake Operation, 2023

Sampling Date	Species Tested (Latin Name)	Test Type	IC_{25}	IC_{25} Lower	IC_{25} Upper
13-Mar-23	*Lemna minor*	Growth (frond number)	5.4	2.2	11.4
	Lemna minor	Growth (biomass)	>97	n/a	n/a
5-Jun-23	*Lemna minor*	Growth (frond number)	2.2	<1.5	5.4
	Lemna minor	Growth (biomass)	60	14.3	>100
5-Sep-23	*Lemna minor*	Growth (frond number)	28.9	n/a	>97
	Lemna minor	Growth (biomass)	>97	n/a	n/a
Quarter 4[1]	*Lemna minor*	Growth (frond number)	JEB Water Treatment Plant Shutdown		
	Lemna minor	Growth (biomass)			

NC indicates confidence limits could not be calculated.

ICx refers to the effluent concentration at which a 25% inhibition/reduction in endpoint was observed among effluent-exposed organisms relative to the control group.

[1]No sampling was completed in Quarter 4 of 2023 as no effluent was being discharged due to the JEB Water Treatment Plant shutdown.

Table 7.2-11: Sub-lethal Toxicity Testing Results for JEB Treated Effluent from McClean Lake Operation, 2024

Sampling Date	Species Tested (Latin Name)	Test Type	IC_{25}	IC_{25} Lower	IC_{25} Upper
Quarter 1[1]	*Lemna minor*	Growth (frond number)	JEB Water Treatment Plant Shutdown		
	Lemna minor	Growth (biomass)			
3-Jun-24	*Lemna minor*	Growth (frond number)	8.3	4.7	13.5
	Lemna minor	Growth (biomass)	>97	>97	>97
16-Aug-24[2]	*Lemna minor*	Growth (frond number)	n/a		
	Lemna minor	Growth (biomass)			
2-Sep-24	*Lemna minor*	Growth (frond number)	4.9	3.4	6.8
	Lemna minor	Growth (biomass)	18.2	6.3	39.6
16-Dec-24	*Lemna minor*	Growth (frond number)	>97	>97	>97
	Lemna minor	Growth (biomass)	>97	>97	>97

NC indicates confidence limits could not be calculated.

ICx refers to the effluent concentration at which a 25% inhibition/reduction in endpoint was observed among effluent-exposed organisms relative to the control group.

[1]No sampling was completed in Quarter 1 of 2024 as no effluent was being discharged due to the JEB Water Treatment Plant shutdown.

[2]The August 16th samples for both CM01B and SC01 were side by side collected with Environment and Climate Change Canada (ECCC) during an onsite inspection. The samples are off schedule (i.e. not part of regular sampling), but it was requested by ECCC.

Table 7.2-12: Hydrocarbon Soil Remediation Analytical Data

Chemical		Benzene (mg/kg)	Ethylbenzene (mg/kg)	Toluene (mg/kg)	Xylene (mg/kg)	F1 (mg/kg)	F2 (mg/kg)	F3 (mg/kg)	F4 (mg/kg)
Remediation Criteria[1]		0.078	0.14	0.12	1.9	210	150	300	2800
2022	n	9	9	9	9	9	9	9	9
	Mean	< 0.005	< 0.01	< 0.02	< 0.04	< 10	5	92	29
	Min	< 0.005	< 0.01	< 0.02	< 0.04	< 10	< 3.9	53	19
	Max	0.005	0.01	< 0.02	< 0.04	< 10	19	170	42
2023	n	10	10	10	10	10	10	10	10
	Mean	< 0.005	< 0.01	< 0.02	< 0.04	< 10	6	57	19
	Min	< 0.005	< 0.01	< 0.02	< 0.04	< 10	< 3.9	38	11
	Max	< 0.005	< 0.01	< 0.02	< 0.04	< 10	8	84	32
2024	n	10	10	10	10	10	10	10	10
	Mean	< 0.005	< 0.01	< 0.02	< 0.04	< 10	4	37	12
	Min	< 0.005	< 0.01	< 0.02	< 0.04	< 10	< 3.9	25	8.6
	Max	< 0.005	< 0.01	< 0.02	< 0.04	< 10	< 3.9	53	18

[1]Tier 1 Hydrocarbon Criteria for Natural Area and Coarse-grained Soils as per Saskatchewan Environmental Quality Guidelines

Source: Hydrocarbon Landfarm Remediation Closeout Report (Orano 2022; Orano 2023d; Orano 2024b)

Figures

List of Figures

Figure 1.1-1 Project Location – Map of Saskatchewan

Figure 1.1-2 Location of McClean Lake Operation and Midwest Site

Figure 1.1-3 McClean Lake Operation Site.

Figure 1.1-4 Midwest Site

Figure 1.3-1 Simplified JEB Site Water Balance

Figure 1.3-2 Simplified Sue Site Water Balance

Figure 1.5-1 Sustainable Development Framework

Figure 1.6-1 Diagram of Linkages Among Valued Ecosystem Components and Monitoring Endpoints.

Figure 1.6-2 Regional Study Area of the McClean Lake Operation

Figure 1.6-3 McClean Lake Operation Local Study Area, Midwest Project Local Study Area, and Local Assessment Boundary

Figure 2.2-1 McClean Lake Operation Groundwater Monitoring Sites

Figure 2.2-2 Sandstone Isopach

Figure 2.2-3 Conceptual Site Model of McClean Lake Operational Flows During the Operational Period

Figure 2.2-4 JEB Site Groundwater Monitoring Locations

Figure 2.2-5 Sue Site Groundwater Monitoring Locations

Figure 2.2-6 Moffat Domestic Landfill Groundwater Monitoring Locations

Figure 2.2-7 Sink Dam Groundwater Monitoring Locations

Figure 2.2-8 McClean Mining Site (SABRE) Groundwater Monitoring Locations

Figure 2.2-9 Jeb Area Hydraulic Head in Sandstone for Dewatered Pit

Figure 2.2-10 Jeb Site Hydraulic Head Cross Section A-A' - 2024

Figure 2.2-11 Water Levels in the Overburden, Athabasca Sandstone, and Basement units relative to baseline

Figure 2.2-12 Upward Groundwater Flow Trends in JEB Monitoring Wells

Figure 2.2-13 JEB Site Pre-Development Potentiometric and 2024 Hydraulic Head Contours Map for Basement

Figure 2.2-14 Pre-Development Potentiometric Map for JEB Site Sandstone

Figure 2.2-15 JEB Site Upper Sandstone Hydraulic Head Contours - 2024

Figure 2.2-16 JEB Site Lower Sandstone Hydraulic Head Contours - 2024

Figure 2.2-17 JEB Site Pre-Development Potentiometric and 2024 Hydraulic Head Contours Map for Overburden

Figure 2.2-18 Downward Groundwater Flow Trend in JEB Overburden Monitoring Wells with Daily Precipitation

Figure 2.2-19 Hydrograph for Multi-Level Monitoring Well 96-03 and 96-07A

Figure 2.2-20 Groundwater directional flow from Mill terrace and Ore pad towards Johannes and Pat Lakes

Figure 2.2-21 Sue Site Pre-Development Potentiometric Surface Map for Sandstone

Figure 2.2-22 Sue Site Hydraulic Head Cross Section B-B' - 2024

Figure 2.2-23 Downward Groundwater Flow Trend in Sue Monitoring Wells

Figure 2.2-24 Sue Site Basement Hydraulic Head Contours - 2024

Figure 2.2-25 Sue Site Lower Sandstone Hydraulic Head Contours - 2024

Figure 2.2-26 Sue Site Overburden Hydraulic Head Contours - 2024

Figure 2.2-27 Sink Dam Groundwater Levels

Figure 2.2-28 McClean Mining (former SABRE Test) Site Groundwater Levels

Figure 2.3-1 Hydrological Monitoring Stations at McClean Lake Operation

Figure 2.3-2 Maximum water level difference from SG08E to SG09E

Figure 2.3-3 Standard Precipitation Index (SPI) at McClean Lake Operation

Figure 2.3-4 Average Annual Water Elevation - top) Mallen Lake (SG01C) and bottom) Fox Lake (SG02E) 1995 to 2024

Figure 2.3-5 Average Annual Water Elevation - top) Pat Lake (SG03E) and bottom) Sue Lake (SG04E) 1995 to 2024

Figure 2.3-6 Average Annual Water Elevation - top) Johannes Lake (SG05E) and bottom) Sink Reservoir (SG06E) 1995 to 2024

Figure 2.3-7 Average Annual Water Elevation - top) Vulture Lake (SG07E) and bottom) McClean Lake (SG09E) 1995 to 2024

Figure 2.3-8 Average Annual Water Elevation - top) Candy Lake (SG10E) and bottom) Isis Lake (SG11E) 1995 to 2024

Figure 2.3-9 Average Annual Water Elevation - top) Osiris Lake (SG12E) and bottom) Tail Lake (SG13E) 1995 to 2024

Figure 2.3-10 Average Annual Water Elevation - top) Moffat Lake (SG14E) and bottom) Tut Lake (SG15E) 1995 to 2024

Figure 2.3-11 Average Annual Water Elevation - top) Esto Lake (SG16E) and bottom) Kewen Lake (SG17E) 1995 to 2024

Figure 2.3-12 Average Annual Water Elevation - top) Sils Lake (SG18E) and bottom) Indigo Lake (SG19C) 1995 to 2024

Figure 2.3-13 Average Annual Water Elevation - top) Bena Lake (SG20E) and bottom) Sharp Lake (SG21E) 1995 to 2024

Figure 2.3-14 Average Annual Water Elevation - top) Telephone Lake (SG22E) 1995 to 2024

Figure 3.1-1 Meteorological Stations within the McClean Lake Operation LSA

Figure 3.1-2 2016 ERA CALMET Wind Rose

Figure 3.1-3 Mean Daily Temperature at McClean Lake Compared to Collins Bay and Key Lake Climate Normals

Figure 3.1-4 Mean Monthly Total Precipitation at McClean Lake Compared to Collins Bay and Key Lake Climate Normals

Figure 3.1-5 Wind Rose at McClean Lake, 2000 to 2010

Figure 3.1-6 Wind Rose at McClean Lake, 2011 to 2015

Figure 3.1-7 Wind Rose for McClean Lake (2016 to 2021 and 2022 to 2024) Compared to Collins Bay (2022 to 2024)

Figure 3.2-1 High Volume Air Sampling Stations Within the McClean Lake Operation LSA

Figure 3.2-2 Measured 24-hour TSP Concentrations at the JEB TMF (HVJ1A), 2022 to 2024

Figure 3.2-3 Measured 24-hour TSP Concentrations at the Mill Site (HVJ2), 2022 to 2024

Figure 3.2-4 Measured 24-hour TSP Concentrations at the JEB Camp (HVJ3), 2022 to 2024

Figure 3.2-5 Measured 24-hour TSP Concentrations at the Sue C Pit (HVS1A), 2022 to 2024

Figure 3.2-6 Measured 24-hour TSP Concentrations at Vulture Lake (HVJ4), 2022 to 2024

Figure 3.2-7 Seasonal Average TSP Concentrations at the JEB TMF (HVJ1A), 2022 to 2024

Figure 3.2-8 Seasonal Average TSP Concentrations at the Mill Site (HVJ2), 2022 to 2024

Figure 3.2-9 Seasonal Average TSP Concentrations at the JEB Camp (HVJ3), 2022 to 2024

Figure 3.2-10 Seasonal Average TSP Concentrations at the Sue C Pit (HVS1A), 2022 to 2024

Figure 3.2-11 Seasonal Average TSP Concentrations at Vulture Lake (HVJ4), 2022 to 2024

Figure 3.2-12 Annual Geomean TSP Concentrations at the JEB Exposure Stations, 2000 to 2024

Figure 3.2-13 Annual Geomean TSP Concentrations at the JEB Camp, 2000 to 2024

Figure 3.2-14 Annual Geomean TSP Concentrations at the Sue C Pit, 2000 to 2024

Figure 3.2-15 Measured Annual Average Arsenic Concentrations, 2000 to 2024

Figure 3.2-16 Measured Annual Average Cadmium Concentrations, 2000 to 2024

Figure 3.2-17 Measured Annual Average Cobalt Concentrations, 2000 to 2024

Figure 3.2-18 Measured Annual Average Copper Concentrations, 2000 to 2024

Figure 3.2-19 Measured Annual Average Lead Concentrations, 2000 to 2024

Figure 3.2-20 Measured Annual Average Molybdenum Concentrations, 2000 to 2024

Figure 3.2-21 Measured Annual Average Nickel Concentrations, 2000 to 2024

Figure 3.2-22 Measured Annual Average Selenium Concentrations, 2000 to 2024

Figure 3.2-23 Measured Annual Average Uranium Concentrations, 2000 to 2024

Figure 3.2-24 Measured Annual Average Vanadium Concentrations, 2000 to 2024

Figure 3.2-25 Measured Annual Average Zinc Concentrations, 2000 to 2024

Figure 3.2-26 Measured Annual Average Lead-210 Concentrations, 2000 to 2024

Figure 3.2-27 Measured Annual Average Polonium-210 Concentrations, 2000 to 2024

Figure 3.2-28 Measured Annual Average Radium-226 Concentrations, 2000 to 2024

Figure 3.2-29 Measured Annual Average Thorium-230 Concentrations, 2000 to 2024

Figure 3.2-30 Special Projects Box Plots for Total Suspended Particulate (TSP) Concentrations from New and Old HVAS Units

Figure 3.2-31 Radon Monitoring Stations within the McClean Lake Operation LSA

Figure 3.2-32 Measured Annual Average Radon Concentrations at the JEB Exposure Stations, 2000 to 2024

Figure 3.2-33 Measured Annual Average Radon Concentrations at the McClean Mining Area and Sue Exposure Stations, 2000 to 2024

Figure 3.2-34 Annual Average pH from Acid Precipitation Monitoring at the McClean Lake Operation Meteorological Station, AR02, 2000 to 2024

Figure 3.2-35 Exhaust Stack Emissions and Sulphur Dioxide Stations Within the McClean Lake Operation LSA

Figure 3.2-36 Historical Ambient Annual Average SO_2 Concentrations, 2000 to 2024

Figure 3.2-37 Historical SO_2 Annual Average Emission Rates from the Acid Plant Stack, 2016 to 2024

Figure 4.2-1 The Location of Reference, Primary Exposure, and Secondary Exposure Waterbodies In 2022 To 2024

Figure 4.2-2 Sink and Vulture Treated Effluent Management System Schematic

Figure 4.3-1 Baseline Water Quality Sampling Areas for the McClean Lake Operation

Figure 4.3-2 Location of Surface Water Quality Monitoring Stations in 2022 to 2024

Figure 4.3-3 COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions

Figure 4.3-4 COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines

Figure 4.3-5 COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines

Figure 4.3-6 COPC Levels in the Reference Area Surface Water with Associated Guidelines

Figure 4.4-1 Baseline Sediment Sampling Areas for the McClean Lake Operation

Figure 4.4-2 Benthic Invertebrate and Sediment Sampling Areas

Figure 4.4-3 Mean and Standard Deviation COPC Levels in the Sediment

Figure 4.5-1 Variations in Indices of Benthic Community Composition for Lake Benthos Samples in Sink Reservoir

Figure 4.5-2 Variations in Indices of Benthic Community Composition for Lake Benthos Samples in Vulture Lake.

Figure 4.5-3 Variations in Indices of Benthic Community Composition for Lake Benthos Samples in McClean Lake – East

Figure 4.5-4 Variations in Indices of Benthic Community Composition for Lake Benthos Samples in Kewen Lake

Figure 4.5-5 Correspondence Analysis Axis Scores for Lake Benthos Samples at the Four Exposure Lakes (Sink, Vulture, McClean East Basin, and Kewen) and the Reference Lake (McClean West Basin)

Figure 4.5-6 Correspondence Analysis Taxa Scores for Lake Benthos Samples

Figure 4.5-7 Scatterplots of Indices of Benthic Community Composition in Relation to Organic Carbon in Lake Sediments

Figure 4.5-8 Variations in Riverine Erosional Abundance, Richness, Simpson’s Diversity, and Evenness in Collins Creek

Figure 4.5-9 Biplot of Riverine Erosional Benthic Invertebrate CA Axis Scores in Collins Creek

Figure 4.5-10 Box Plot and Mean Indices of Benthic Community Composition for Riverine Depositional Benthos Samples from Collins Creek Calculated at the Lowest Practical Level

Figure 4.5-11 Biplot of Riverine Depositional Benthic Invertebrate CA Axis Scores Calculated at the Lowest Practical Level

Figure 4.6-1 Baseline Fish Sampling Areas for the McClean Lake Operation

Figure 4.6-2 Location of Waterbodies Sampled for the Fish Chemistry Program

Figure 4.6-3 Catch per unit effort (CPUE) of Northern Pike for the Fish Chemistry Monitoring Program, 1998 to 2024

Figure 4.6-4 Catch per unit effort (CPUE) of White Sucker for the Fish Chemistry Monitoring Program, 1998 to 2024

Figure 4.6-5 Catch per unit effort (CPUE) of Lake Whitefish for the Fish Chemistry Monitoring Program, 1998 to 2024

Figure 4.6-6 Axes 1 And 2 Samples Scores from Principal Component Analysis (PCA) Carried Out on Fish Tissue Chemistry for Northern Pike (Top Panel) And White Sucker (Lower Panel) From Reference Lakes (Mallen, Henday, Konner), All Years, And Baseline Years, All Lakes

Figure 4.6-7 PCA Scores for Northern Pike Tissue Chemistry from Sink Reservoir

Figure 4.6-8 PCA scores for Northern Pike Tissue Chemistry from Vulture Lake

Figure 4.6-9 PCA Scores for Northern Pike Tissue Chemistry from McClean Lake - East Basin

Figure 4.6-10 PCA Scores for Northern Pike Tissue Chemistry from Kewen Lake

Figure 4.6-11 Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure 4.6-12 PCA Scores for White Sucker Tissue Chemistry from Sink Reservoir

Figure 4.6-13 PCA Scores for White Sucker Tissue Chemistry from Vulture Lake

Figure 4.6-14 PCA Scores for White Sucker Tissue Chemistry from McClean Lake – East Basin

Figure 4.6-15 PCA Scores for White Sucker Tissue Chemistry from Kewen Lake

Figure 4.6-16 Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure 4.6-17 Sampling Locations for the Fish Population Program

Figure 4.6-18 Probability Plots of Slimy Sculpin and Burbot in the Reference and Exposure Areas of Collins Creek, October 2022

Figure 4.6-19 Comparison of Burbot Length-Frequency Histograms Among Years (2008, 2013, 2016, and 2022) in the Reference (left panels) and Exposure (right panels) Areas of Collins Creek with Age Classes Estimated

Figure 4.6-20 Box Plot of Weight and Length for YOY Burbot Collected from the Reference and Exposure Areas of Collins Creek, October 2022

Figure 4.6-21 Box Plot of Weight and Length at age for Non-YOY Burbot Collected from the Reference and Exposure Areas of Collins Creek, October 2022

Figure 4.6-22 Box Plot of Weight and Length for 1+ Burbot Collected from the Reference and Exposure Areas of Collins Creek (October 2008, 2013, 2016, and 2022)

Figure 4.6-23 Variation in Percent Composition of YOY Burbot Collected from the Reference and Exposure Areas of Collins Creek (October 2008, 2013, 2016, and 2022)

Figure 4.6-24 Relationship Between Weight (g) and Length (cm) of YOY and non-YOY Burbot in the Reference and Exposure Areas of Collins Creek, 2022

Figure 4.6-25 Box Plot of Condition Factor for non-YOY Burbot collected from the Reference and Exposure Areas of Collins Creek, 2022

Figure 4.6-26 Probability Plots of Slimy Sculpin in the Reference and Exposure Areas of Collins Creek, October 2022

Figure 4.6-27 Histogram of Slimy Sculpin Length (mm) in the Reference and Exposure Areas of Collins Creek, 2022

Figure 4.6-28 Box Plot of Weight and Length for YOY Slimy Sculpin Collected from the Reference and Exposure Areas of Collins Creek, October 2022

Figure 4.6-29 Box Plot of Weight and Length at age for Non-YOY Slimy Sculpin Collected from the Reference and Exposure Areas of Collins Creek, October 2022

Figure 4.6-30 Box Plot of Body Weight and Total Length Among Years for YOY Slimy Sculpin Collected from the Reference and Exposure Areas of Collins Creek

Figure 4.6-31 Box Plot of Body Weight and Total Length Among Years for 1+ Slimy Sculpin Collected from the Reference and Exposure Areas of Collins Creek

Figure 4.6-32 Variation in Percent Composition of YOY Slimy Sculpin Collected from the Reference and Exposure Areas of Collins Creek (October 2008, 2013, 2016, and 2022)

Figure 4.6-33 Relationship Between Weight (g) and Length (mm) of YOY and non-YOY Slimy Sculpin in the Reference and Exposure Areas of Collins Creek, 2022

Figure 4.6-34 Box Plot of Condition Factor for non-YOY Slimy Sculpin collected from the Reference and Exposure Areas of Collins Creek, 2022

Figure 4.7-1 2024 Aquatic Survey Waterbodies

Figure 4.7-2 2024 Aquatic Vegetation Survey Locations

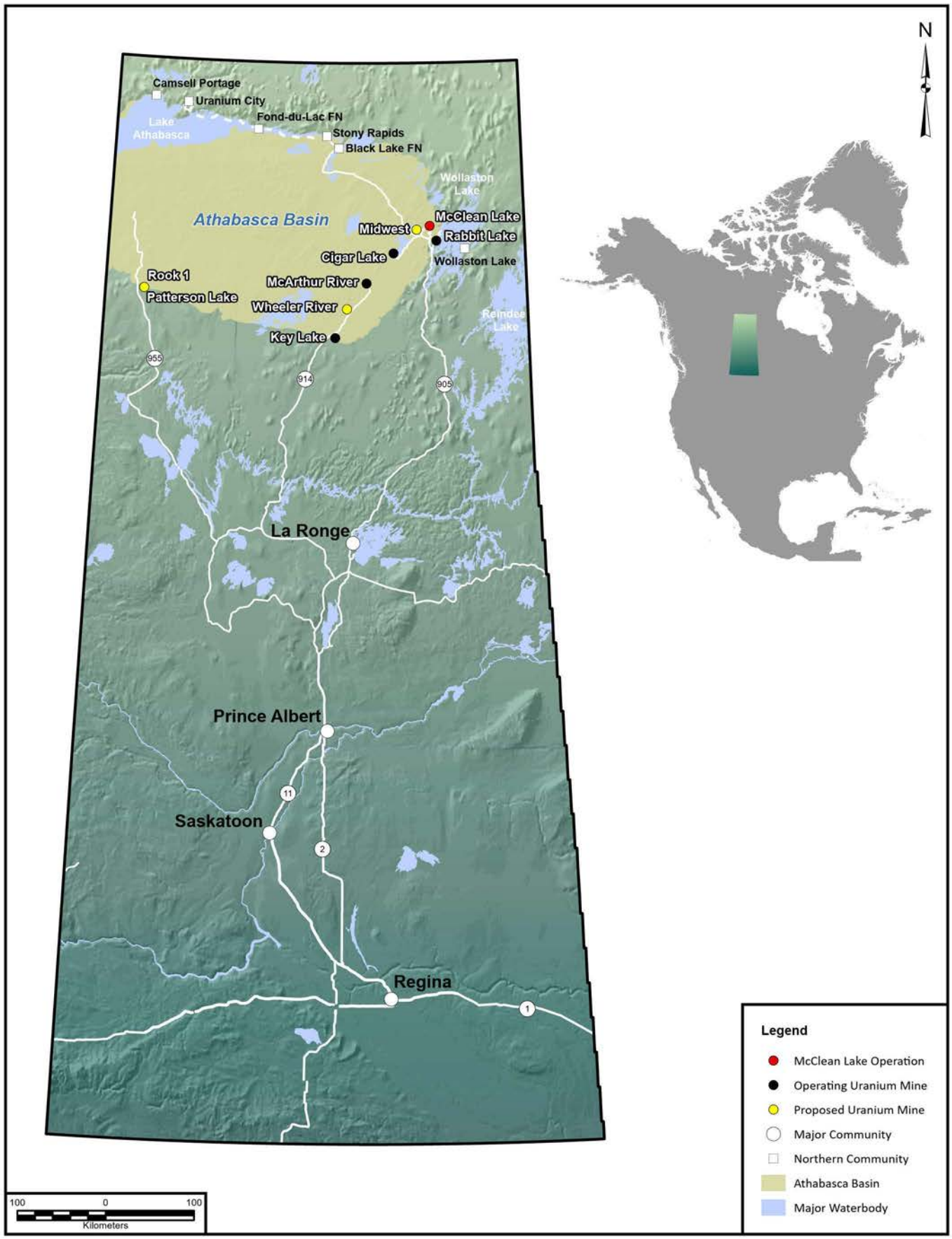
Figure 4.7-3 Locations of 2024 Aquatic Rare Plants Occurrences at the McClean Lake Operation Area

Figure 4.7-4 2024 Aquatic Vegetation and Sediment Chemistry Locations

Figure 5.2-1 Ecosite Pattern Within the Local Assessment Boundary

Figure 5.2-2 Revegetated Area of Sue C CWRP

Figure 5.2-3 2023 Rare Plant Checks Surveyed Locations
Figure 5.2-4 2024 Terrestrial Vegetation Survey Locations
Figure 5.2-5 2024 Semi-Aquatic Furbearer Survey Transects
Figure 5.2-6 2024 Semi-Aquatic Furbearer Observations: Collins Creek Upstream
Figure 5.2-7 2024 Semi-Aquatic Furbearer Observations: Konner Lake
Figure 5.2-8 2024 Semi-Aquatic Furbearer Observations: South McMahon Lake, Lake C1 and Lake C2
Figure 5.2-9 2024 Semi-Aquatic Furbearer Observations: McClean Lake East and West Basins
Figure 5.2-10 2024 Semi-Aquatic Furbearer Observations: Candy Creek, Bena Lake and Caribou Lake
Figure 5.2-11 2024 Semi-Aquatic Furbearer Observations: Collins Creek Downstream and Kewen Lake
Figure 5.2-12 2024 Semi-Aquatic Furbearer Observations: Fox Lake
Figure 5.2-13 2024 Semi-Aquatic Furbearer Observations: Sink Reservoir and Vulture Lake
Figure 5.2-14 2024 Small Mammal Population Survey Locations
Figure 5.2-15 2024 Small Mammal Tissue Collection Locations
Figure 5.2-16 2024 Migratory Bird Nests Survey Area
Figure 5.2-17 2024 eDNA Survey Locations for Northern Leopard Frog
Figure 5.2-18 2024 Wildlife Camera Survey Locations
Figure 5.2-19 2023-2024 Bat Activity Survey Locations
Figure 5.2-20 2024 Supplementary Wildlife Observations
Figure 5.3-1 Locations of Provincially Tracked Rare Vascular Plant Species
Figure 5.3-2 Locations of Provincially Tracked Rare Bryophytes and Lichens Species
Figure 6.3-1 Known Heritage Sites Within the Local Assessment Boundary
Figure 6.3-2 Known Areas of Previous Heritage Assessments in the Vicinity of the McClean Lake Operation and Midwest Surface Lease Areas
Figure 6.4-1 Location of Spiritual Places within the Area of Interest
Figure 6.4-2 Location of Subsistence and Commercial Water Use within the Area of Interest
Figure 6.4-3 Location of Large Animal Kill Sites within the Area of Interest
Figure 6.4-4 Location of Other Animal Harvest Sites within the Area of Interest
Figure 6.4-5 Trapping Density within the Area of Interest
Figure 6.4-6 Location of Overnight Sites, Plant, And Earth Material Areas within the Area of Interest
Figure 7.2-1 Waste Management Facilities at JEB Site
Figure 7.2-2 Waste Management Facilities at Sue Site



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-08-21 8:57 AM Scale: 1:6,000,000
Data Sources: Natural Resources Canada, ESRI, ORANO Canada Inc.

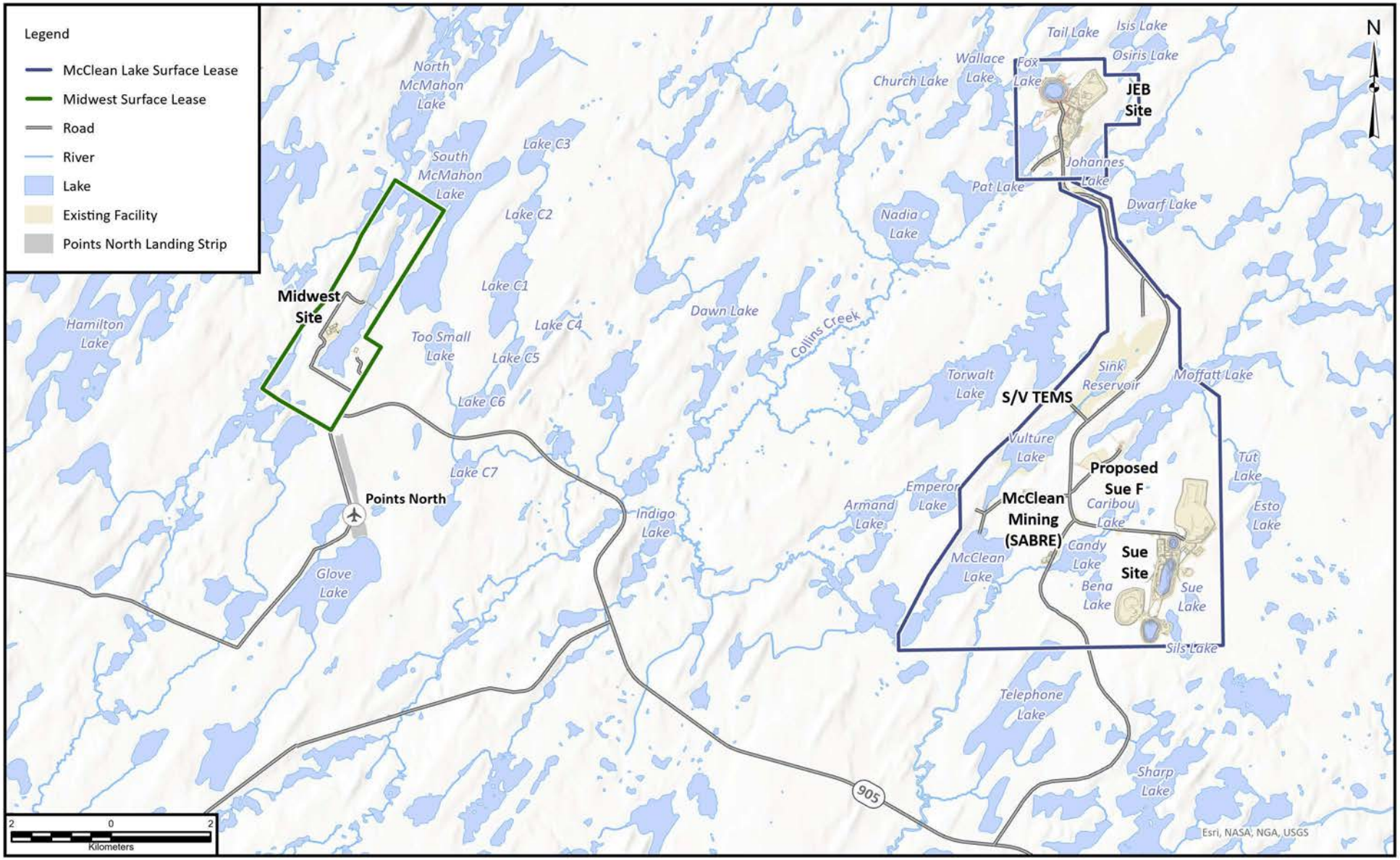
McCLEAN LAKE OPERATION

FIGURE 1.1-1
PROJECT LOCATION - MAP OF SASKATCHEWAN

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 1\EPTID Section 1.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-05-26 9:40 AM Scale: 1:110,000
Data Sources: Nation Topographic Database, ORANO Canada Inc.

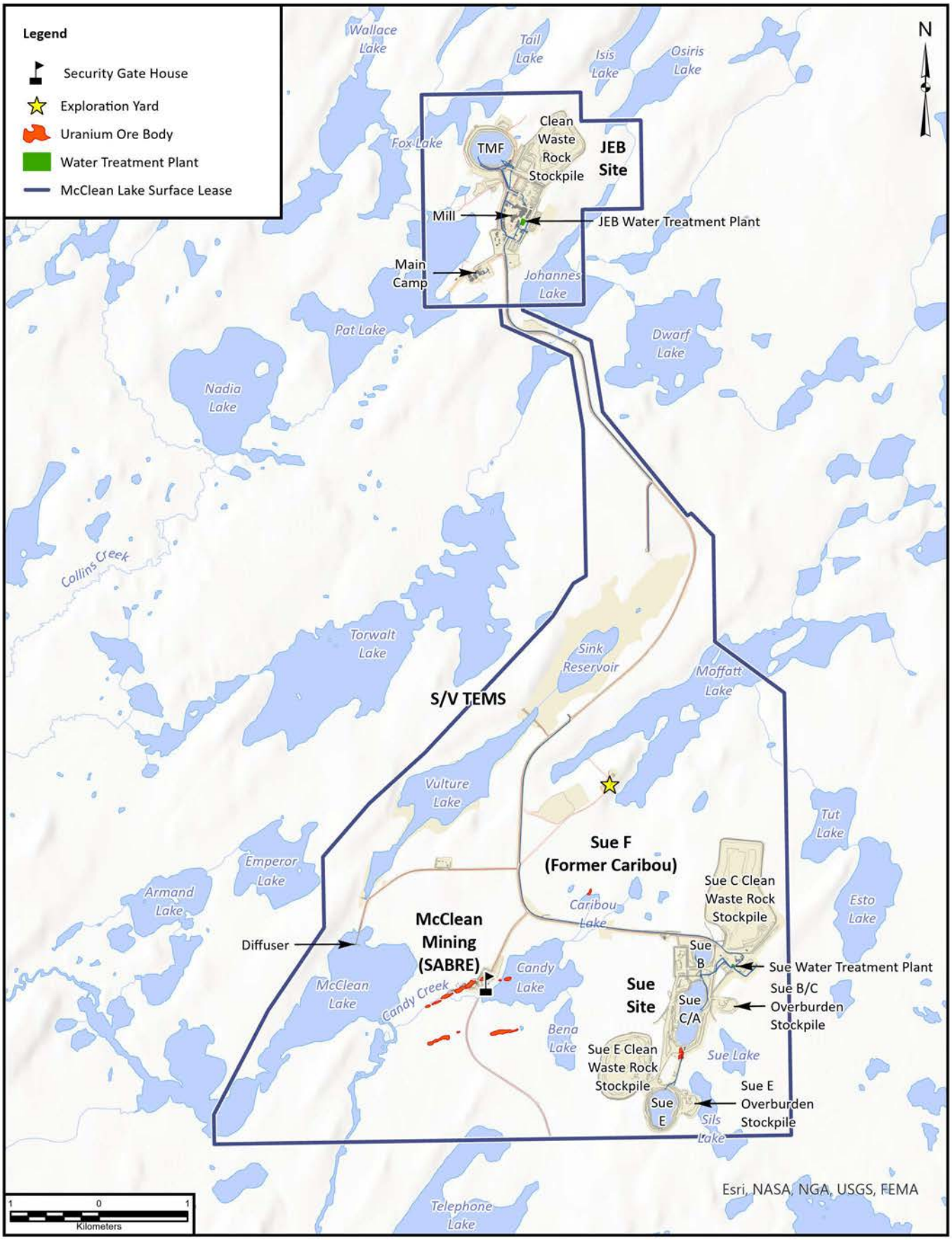
McCLEAN LAKE OPERATION

FIGURE 1.1-2
LOCATION OF McCLEAN LAKE OPERATION AND MIDWEST SITE

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 1\EPTID Section 1.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-05-28 4:06 PM Scale: 1:60,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 1.1-3
McCLEAN LAKE OPERATION SITE

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 1\EPTID Section 1.aprx



Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-05-28 4:06 PM Scale: 1:24,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 1.1-4
MIDWEST SITE

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 1\EPTID Section 1.aprx

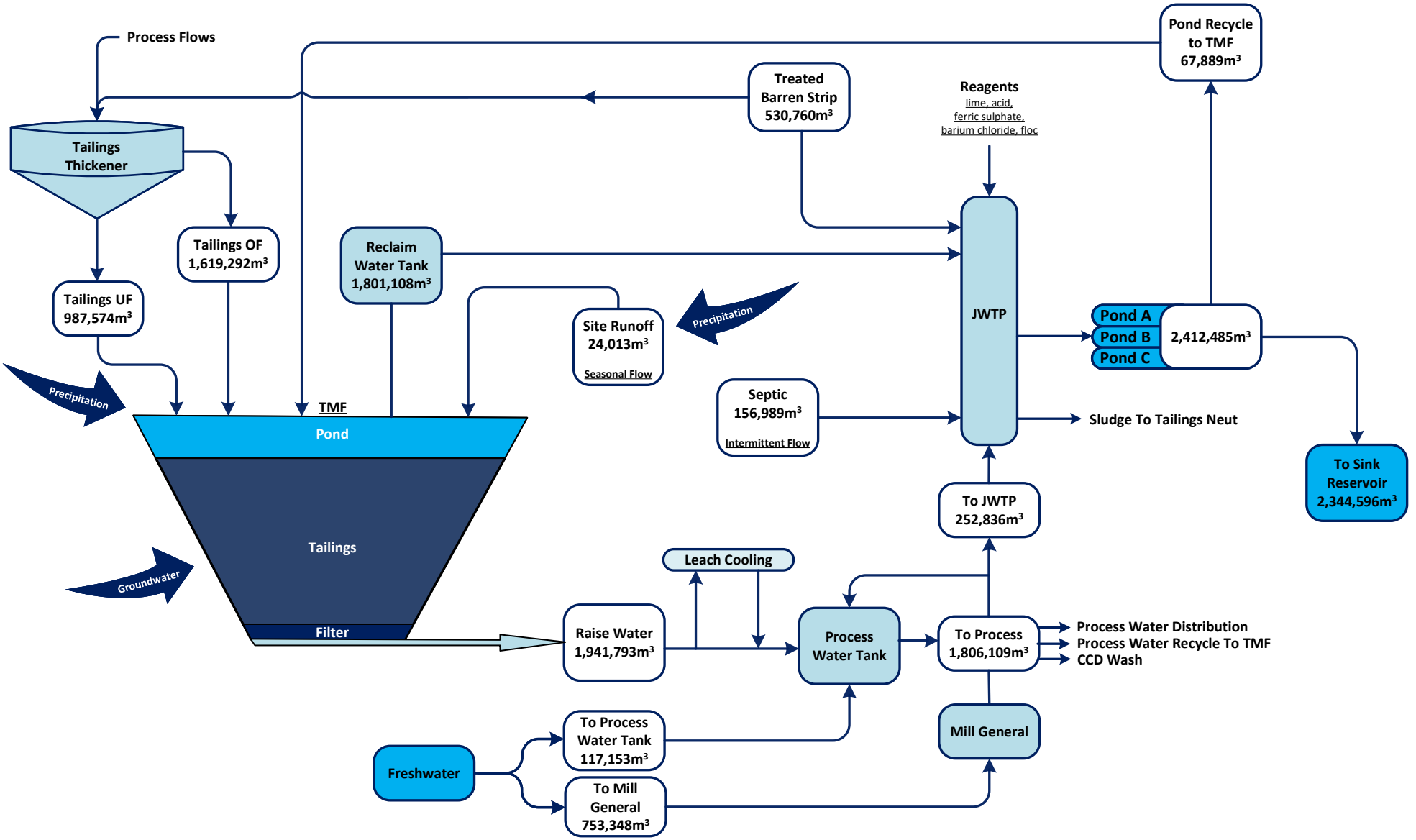


Figure 1.3-1: Simplified JEB Site Water Balance

Does not include water addition via purchased reagents (eg. Peroxide, caustic, ferric sulphate)
Note: All values are in m³

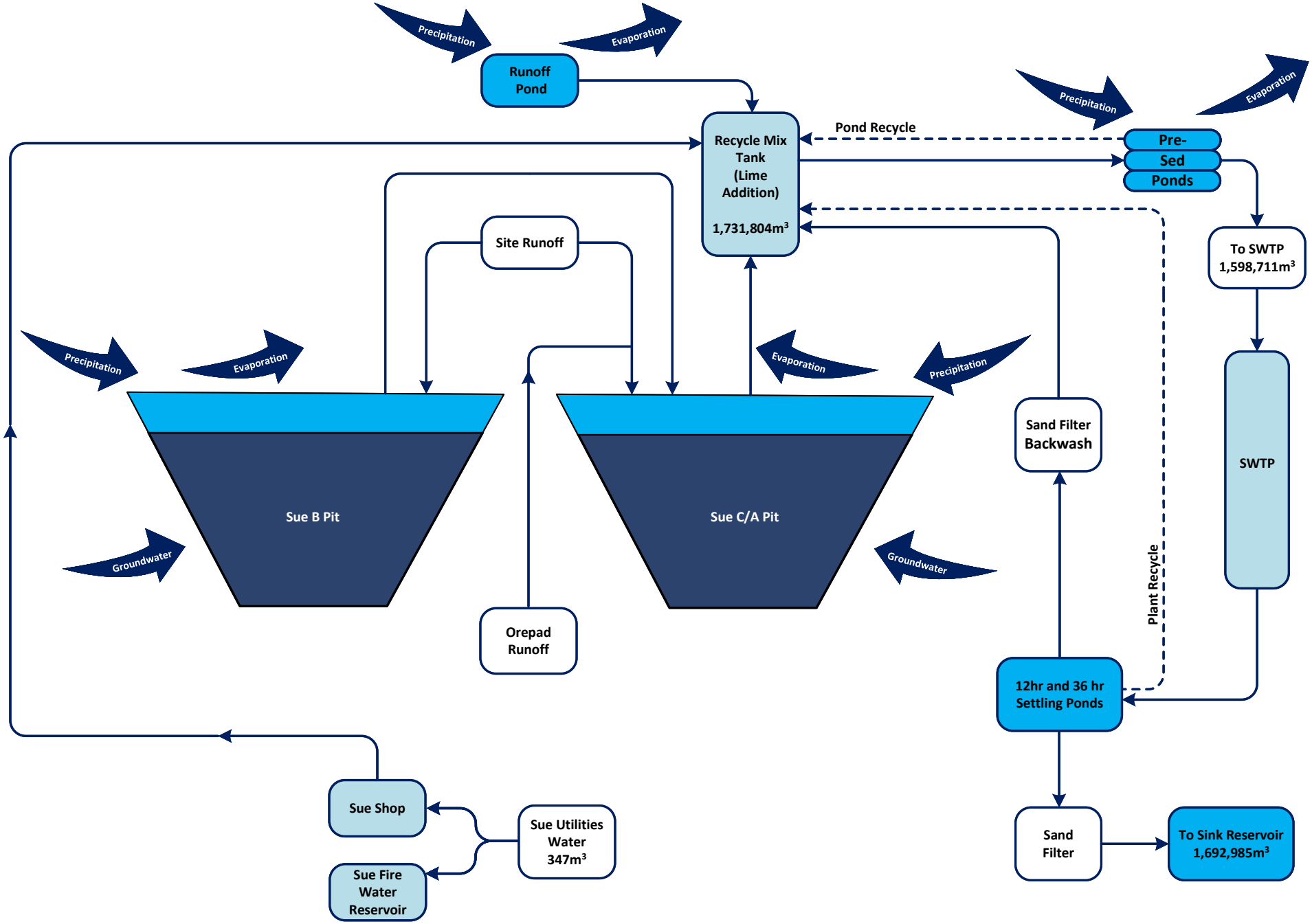
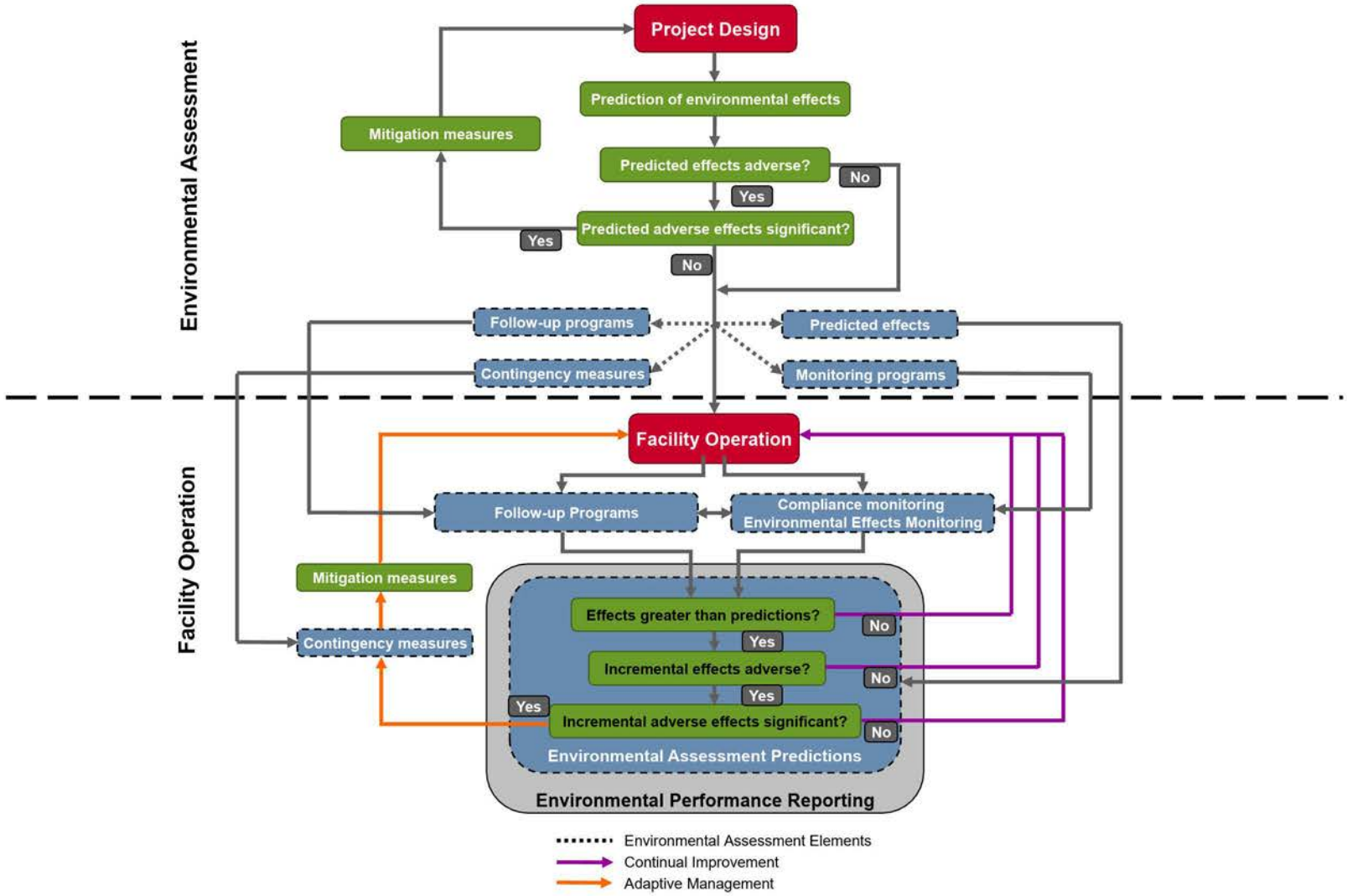


Figure 1.3-2: Simplified Sue Site Water Balance

Does not include water addition via purchased reagents (eg. Lime, ferric sulphate)
Note: All values are in m^3



Projection: NA
Compiled: T.Lohman
Drawn: T.Lohman
Date: 2025-05-28 4:06 PM
Scale: N/A
Data Sources: ORANO Canada Inc.

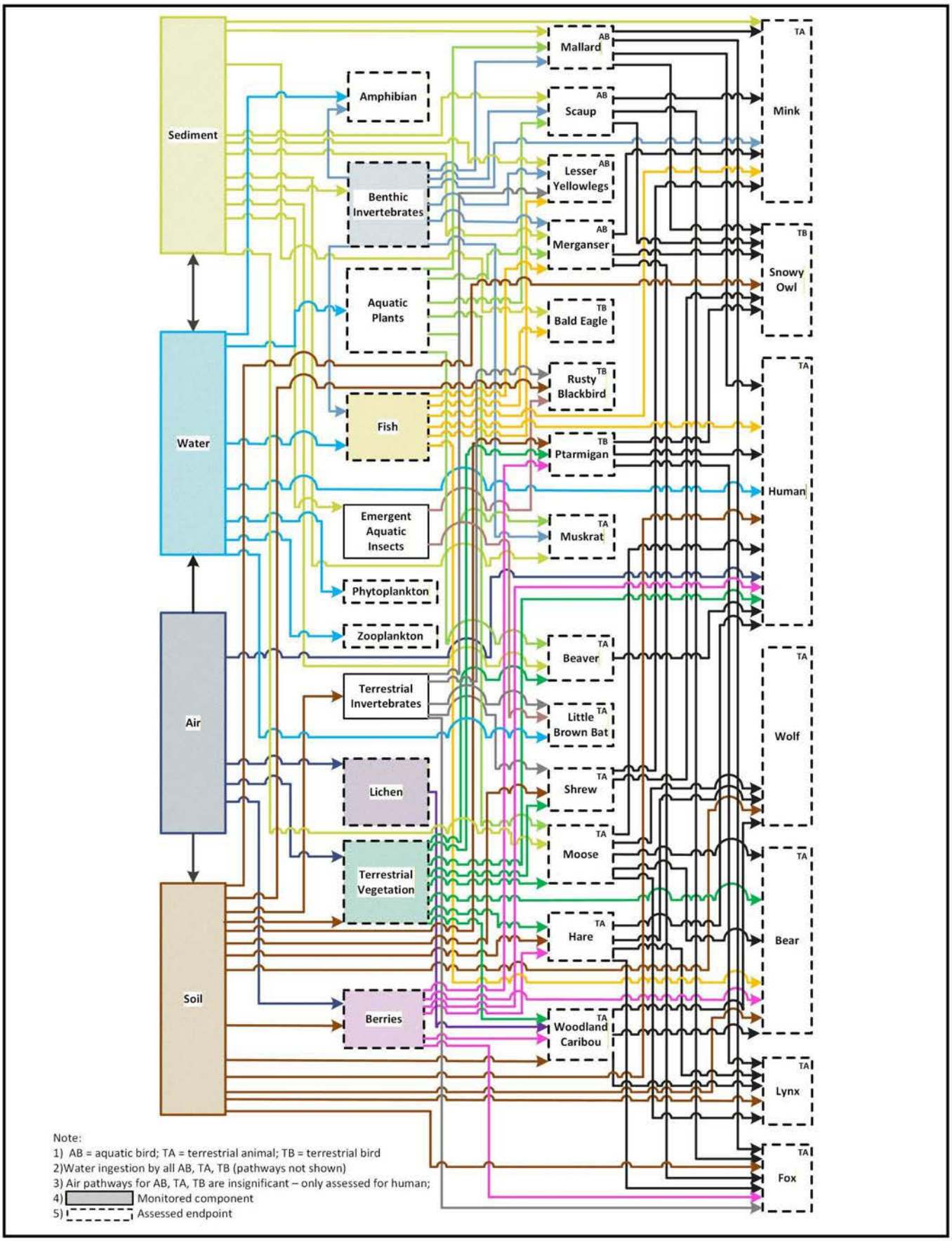
McCLEAN LAKE OPERATION

FIGURE 1.5-1
SUSTAINABLE DEVELOPMENT FRAMEWORK

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 1\EPTID Section 1.aprx



Projection: N/A
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-11-25 1:19 PM Scale: N/A
Data Sources: ORANO Canada Inc.

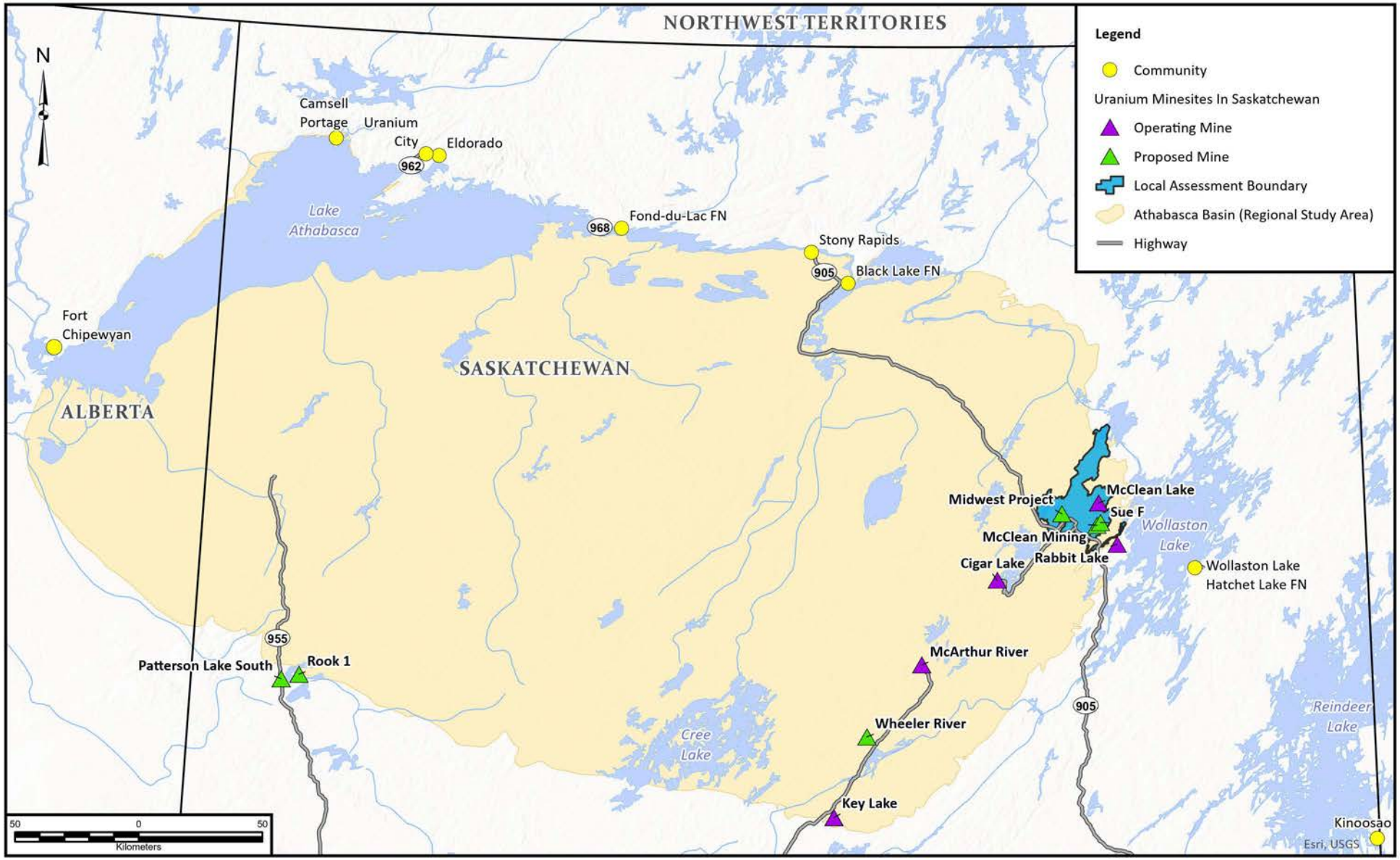
McCLEAN LAKE OPERATION

FIGURE 1.6-1
DIAGRAM OF LINKAGES AMONG
VALUED COMPONENTS AND MONITORING ENDPOINTS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 1\EPTID Section 1.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-08-20 2:34 PM Scale: 1:2,210,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

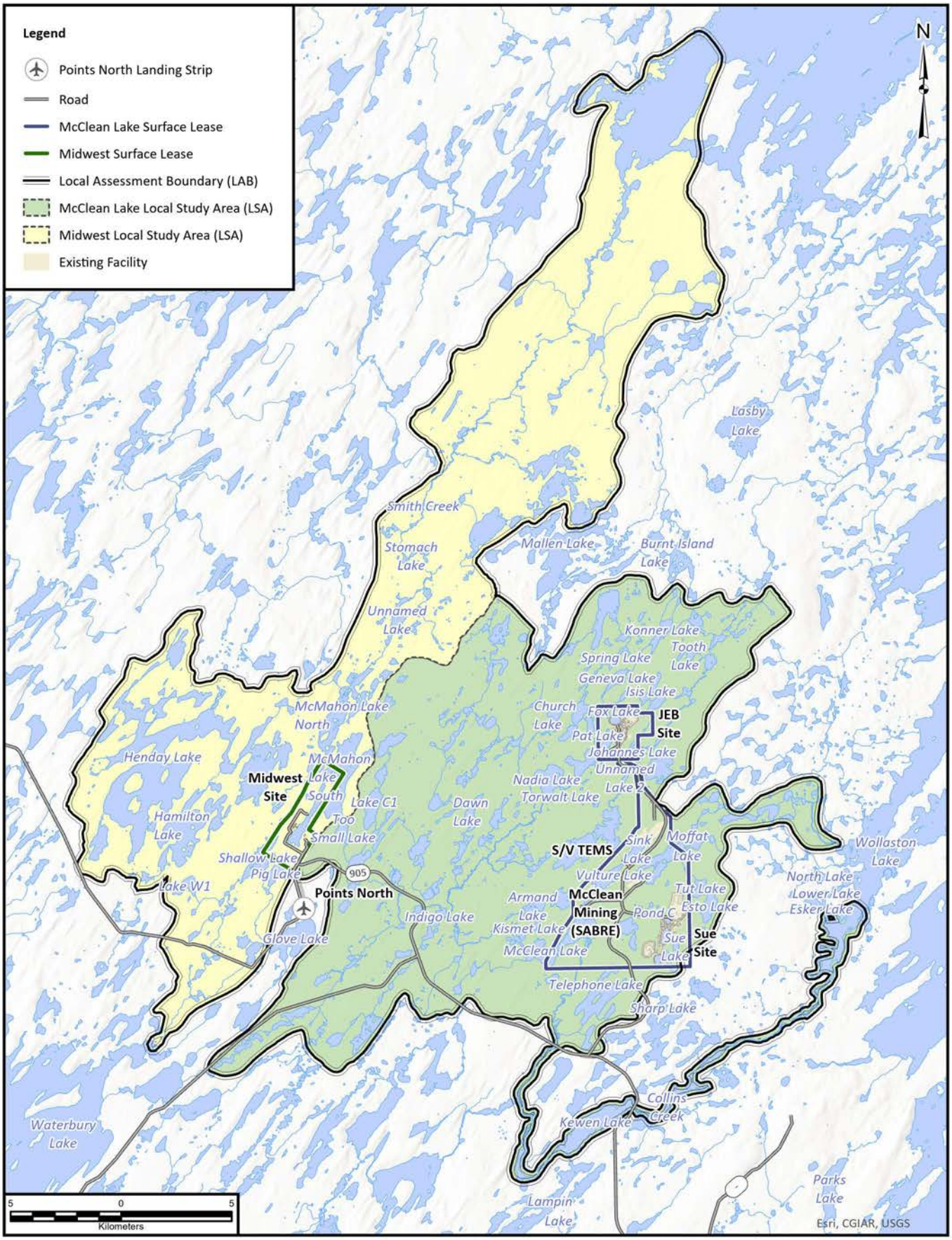
McCLEAN LAKE OPERATION

FIGURE 1.6-2
REGIONAL STUDY AREA OF THE McCLEAN LAKE OPERATION

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 1\EPTID Section 1.aprx



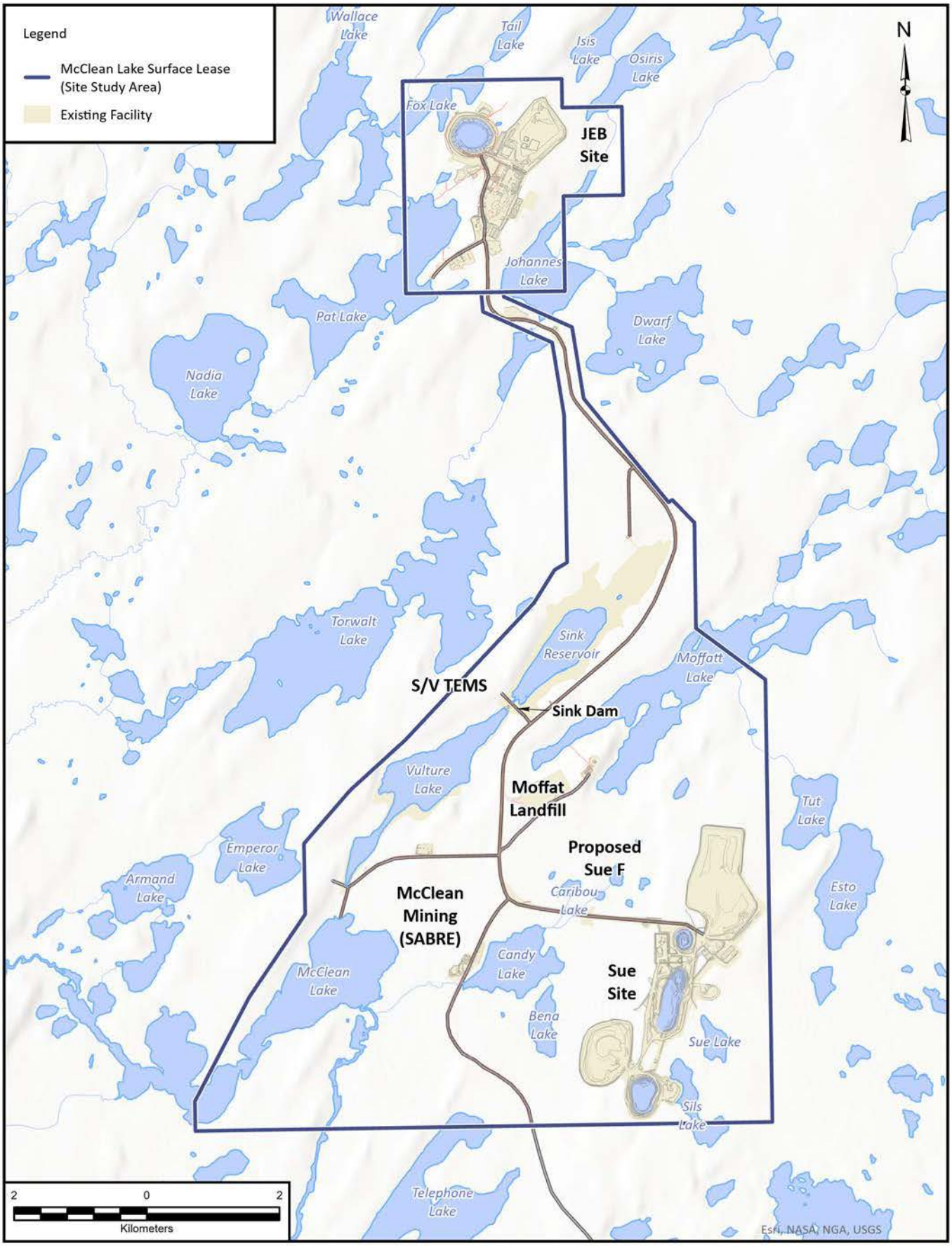
Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-10-22 10:13 AM Scale: 1:240,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 1.6-3
McCLEAN LAKE LOCAL STUDY AREA (LSA),
MIDWEST PROJECT LOCAL STUDY AREA (LSA),
AND McCLEAN LAKE OPERATION
LOCAL ASSESSMENT BOUNDARY (LAB)
2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 1\EPTID Section 1.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-02 8:57 AM Scale: 1:60,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

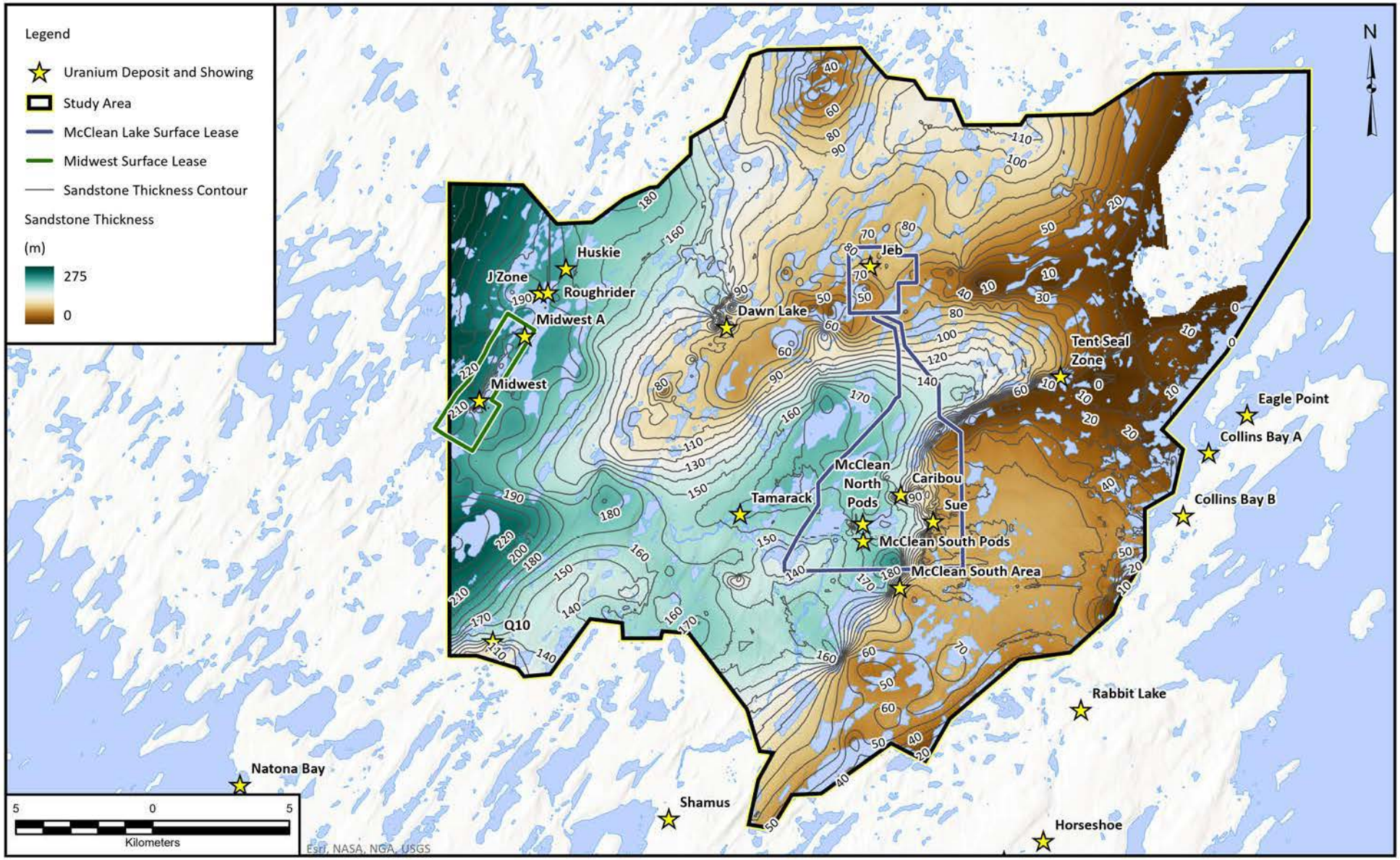
McCLEAN LAKE OPERATION

FIGURE 2.2-1
McCLEAN LAKE OPERATION GROUNDWATER MONITORING SITES

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\Section 2 Copy Dec 1, 2025.aprx



Projection: NAD 1983 UTM Zone 13N
Drawn: TL
Date: 2025-12-01 9:05 PM
Data Sources: *Natural Resources Canada, Geobase®, Saskatchewan Mining and Petroleum GeoAtlas, ORANO Canada Inc.*

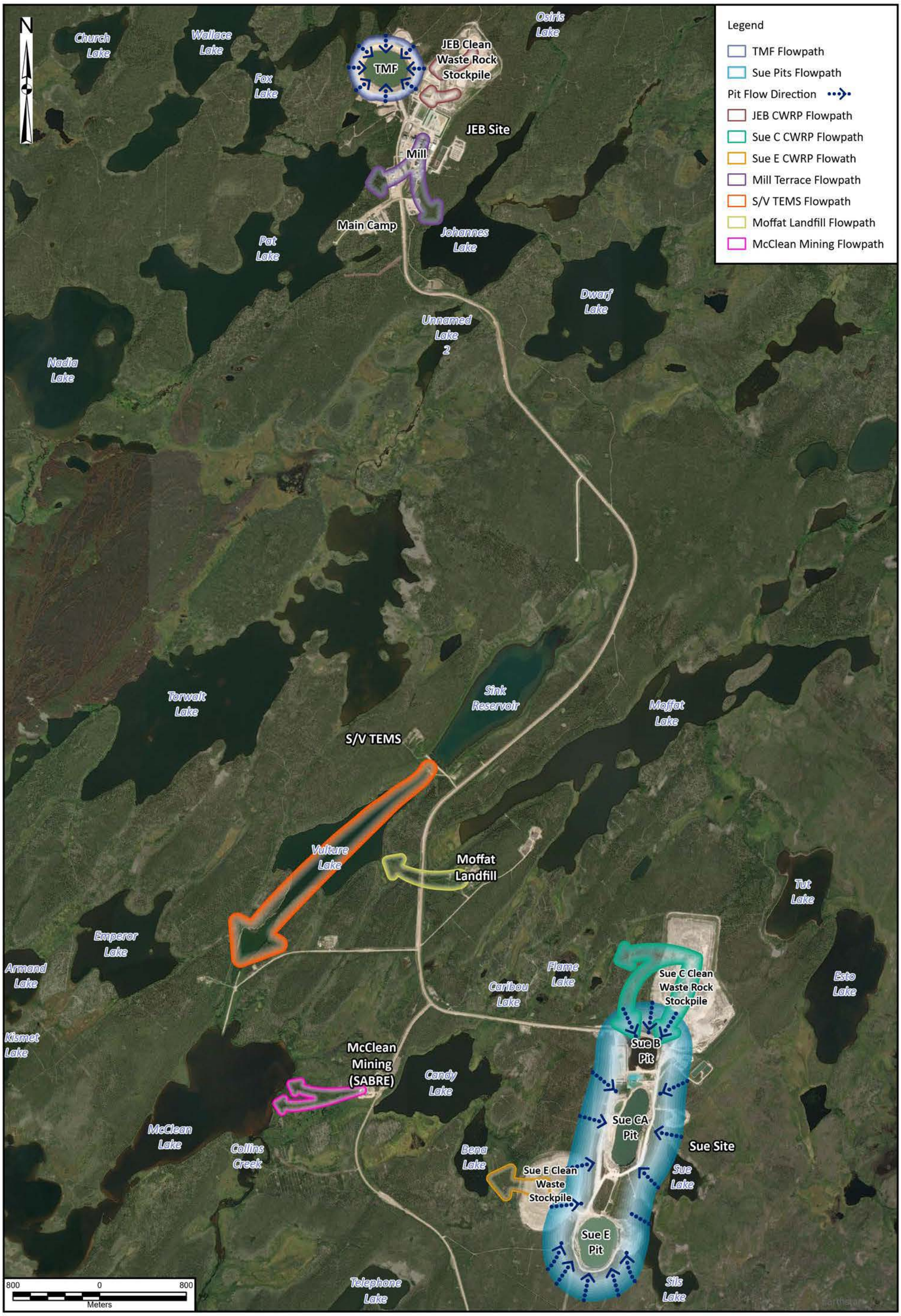
McCLEAN LAKE OPERATION

FIGURE 2.2-2
SANDSTONE ISOPACH

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\Section 2 Copy Dec 1, 2025.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-02 Scale: 1:32,500
Data Sources: , ORANO Canada Inc.

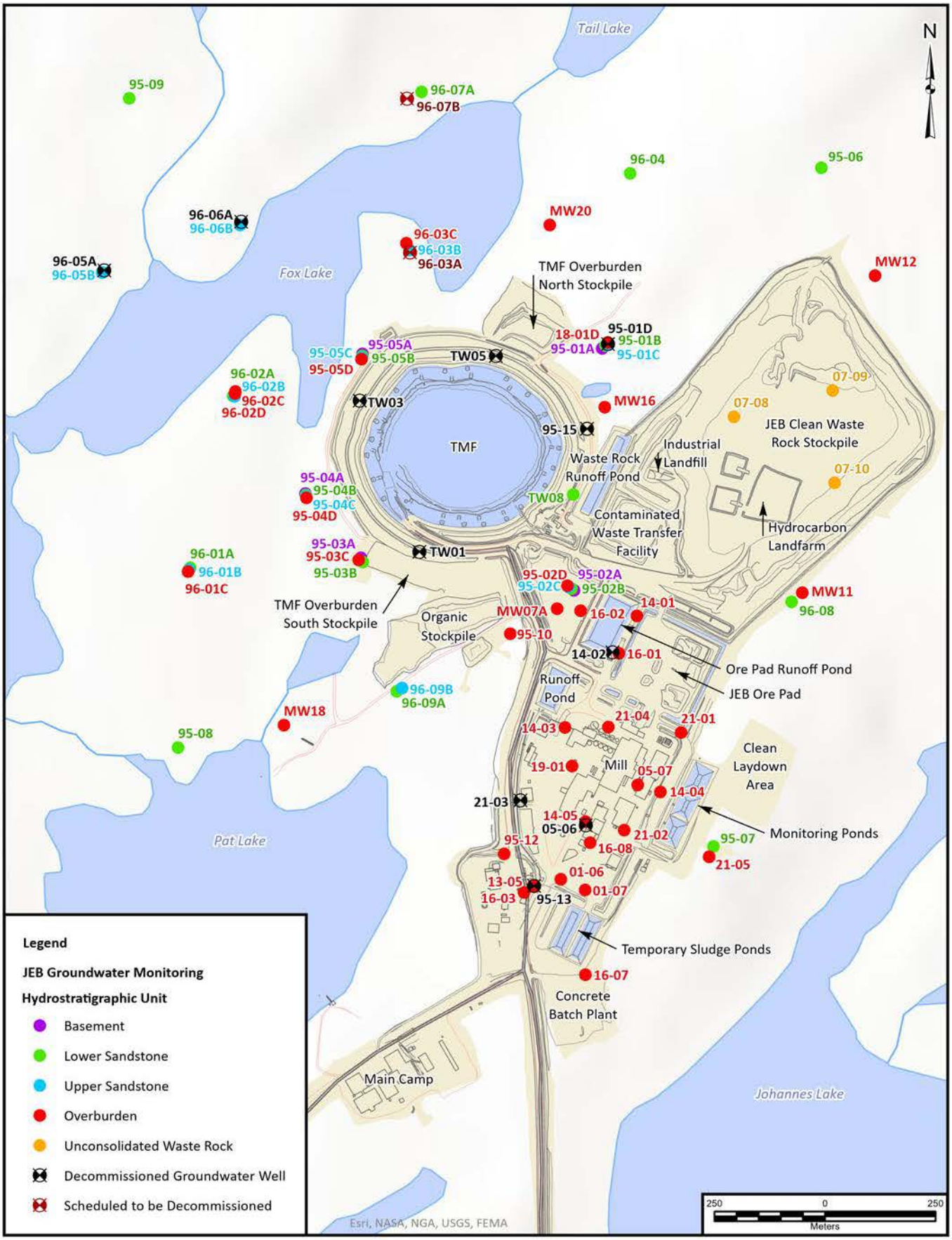
McCLEAN LAKE OPERATION

FIGURE 2.2-3
CONCEPTUAL SITE MODEL OF McCLEAN LAKE
OPERATIONAL FLOWS DURING THE OPERATIONAL PERIOD

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\Section 2 Copy Dec 1, 2025.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-01 9:05 PM Scale: 1:12,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

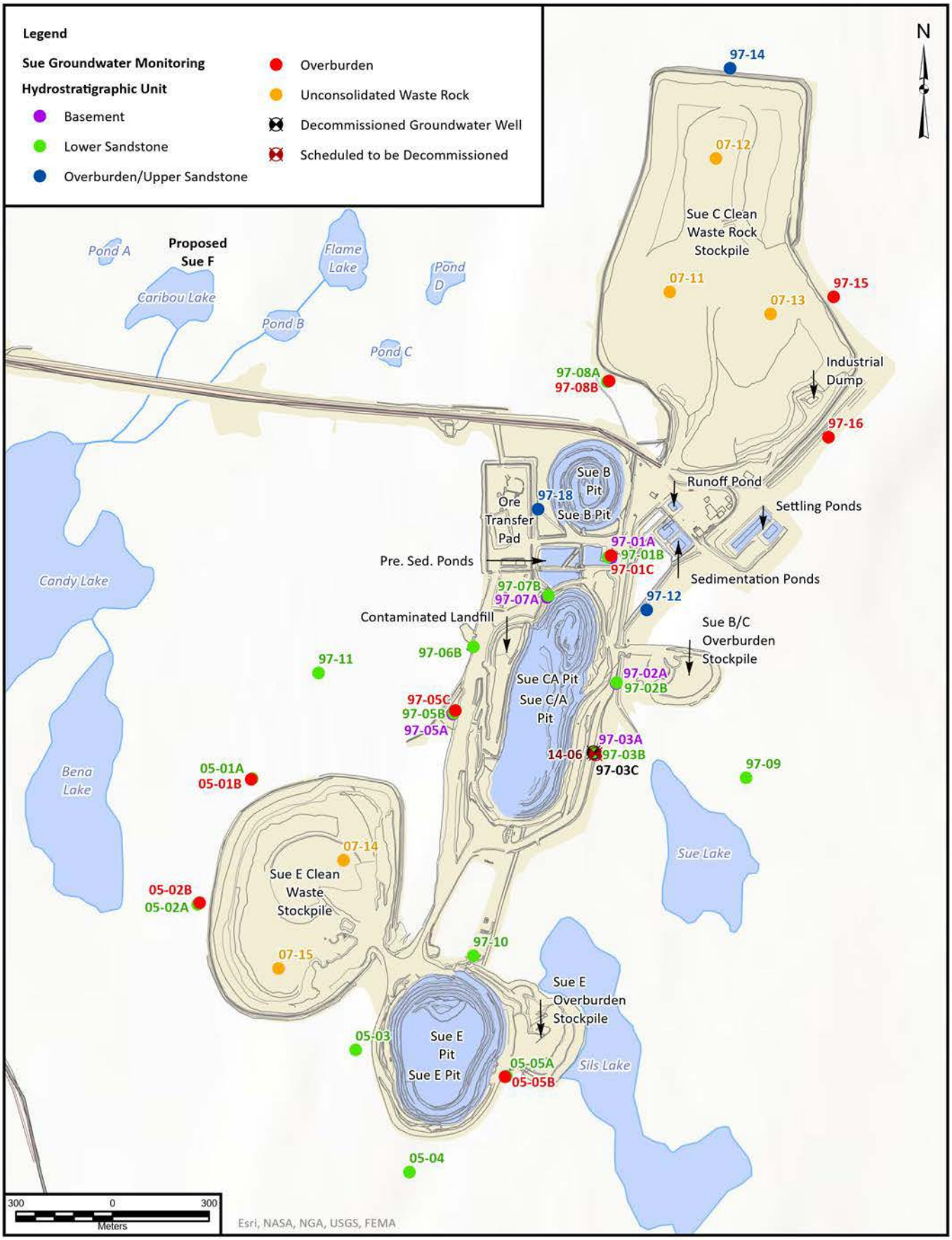
McCLEAN LAKE OPERATION

FIGURE 2.2-4
JEB SITE GROUNDWATER MONITORING LOCATIONS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\Section 2 Copy Dec 1, 2025.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-01 9:05 PM Scale: 1:16,500
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

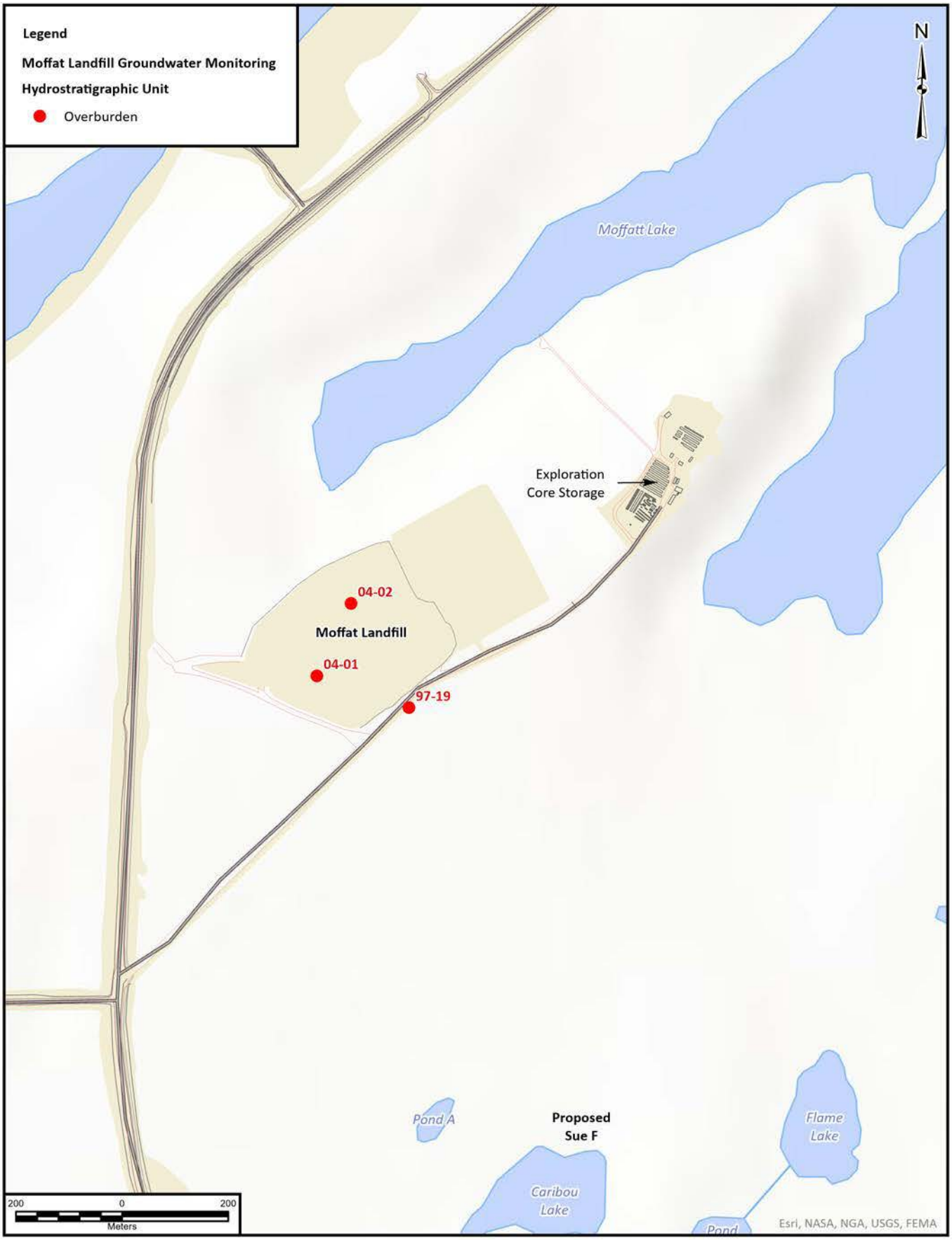
McCLEAN LAKE OPERATION

FIGURE 2.2-5
SUE SITE GROUNDWATER MONITORING LOCATIONS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\Section 2 Copy Dec 1, 2025.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-01 9:05 PM Scale: 1:10,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 2.2-6
MOFFAT DOMESTIC LANDFILL GROUNDWATER MONITORING LOCATIONS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\Section 2 Copy Dec 1, 2025.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-01 9:45 PM Scale: 1:25,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

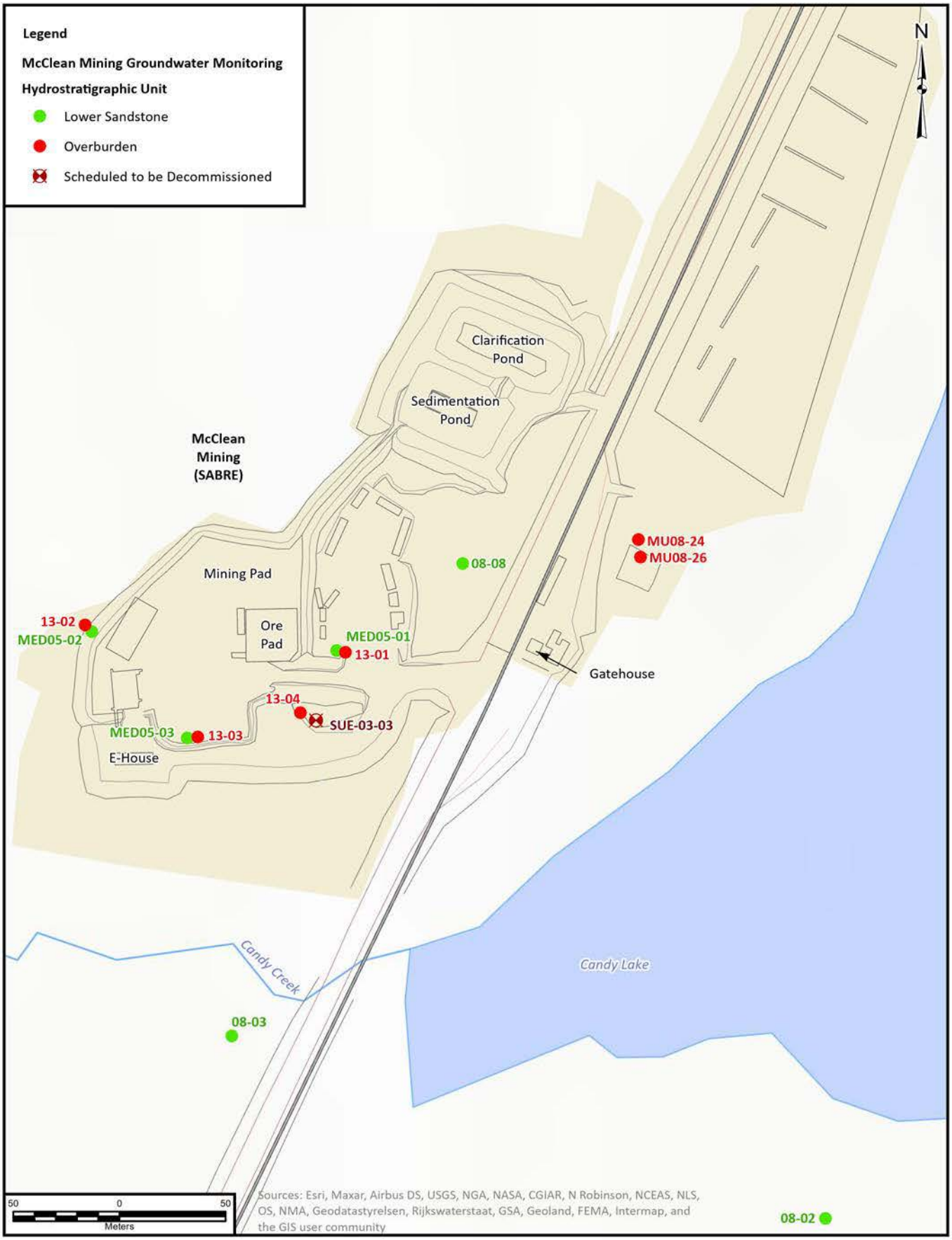
McCLEAN LAKE OPERATION

FIGURE 2.2-7
SINK DAM GROUNDWATER MONITORING LOCATIONS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\Section 2 Copy Dec 1, 2025.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-02 8:19 AM Scale: 1:2,500
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 2.2-8
McCLEAN MINING SITE (SABRE)
GROUNDWATER MONITORING LOCATIONS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\Section 2 Copy Dec 1, 2025.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-01 9:52 PM Scale: 1:15,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

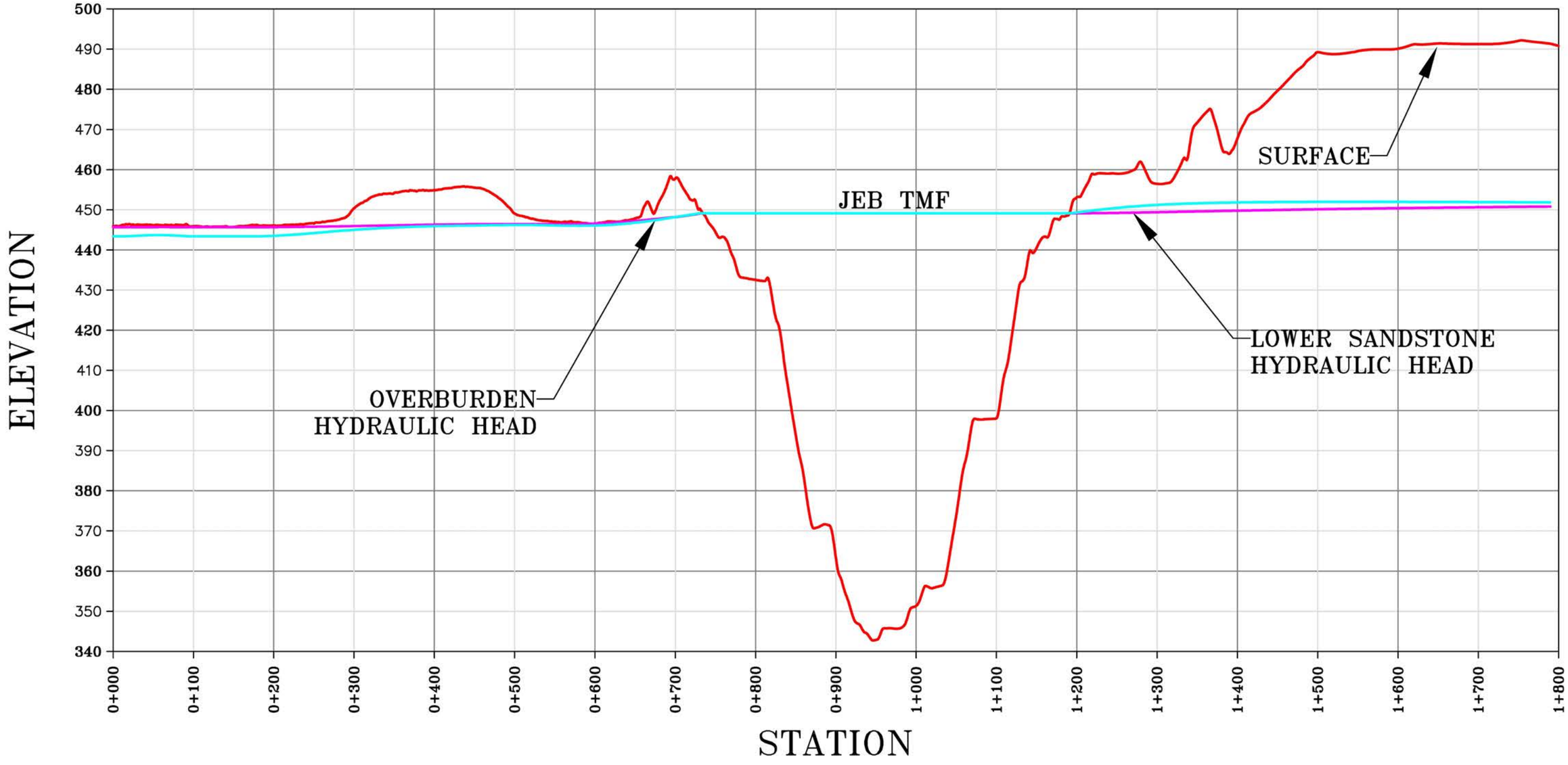
FIGURE 2.2-9
JEB AREA HYDRAULIC HEAD IN SANDSTONE FOR DEWATERED PIT

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\Section 2 Copy Dec 1, 2025.aprx

CROSS-SECTION - A-A'



LEGEND

- SURFACE
- OVERBURDEN WATER LEVEL
- LOWER SANDSTONE WATER LEVEL

NOTES: PROFILE VERTICAL SCALE 1:200

orano

SCALE:	AS SHOWN	DATE
DESIGNED:		
DRAWN:	T.L	26/02/25
CHECKED:		
APPROVED:		
REF. DWGS		
REV. A:		
REV. B:		
DIR:		

FIGURE 2.2-10

JEB SITE

HYDRAULIC HEAD CROSS SECTION A-A' - 2024

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

DWG NO.: 550C232 | REV. NO.: 0



Figure 2.2-11 Water Levels in the Overburden, Athabasca Sandstone, and Basement units relative to baseline

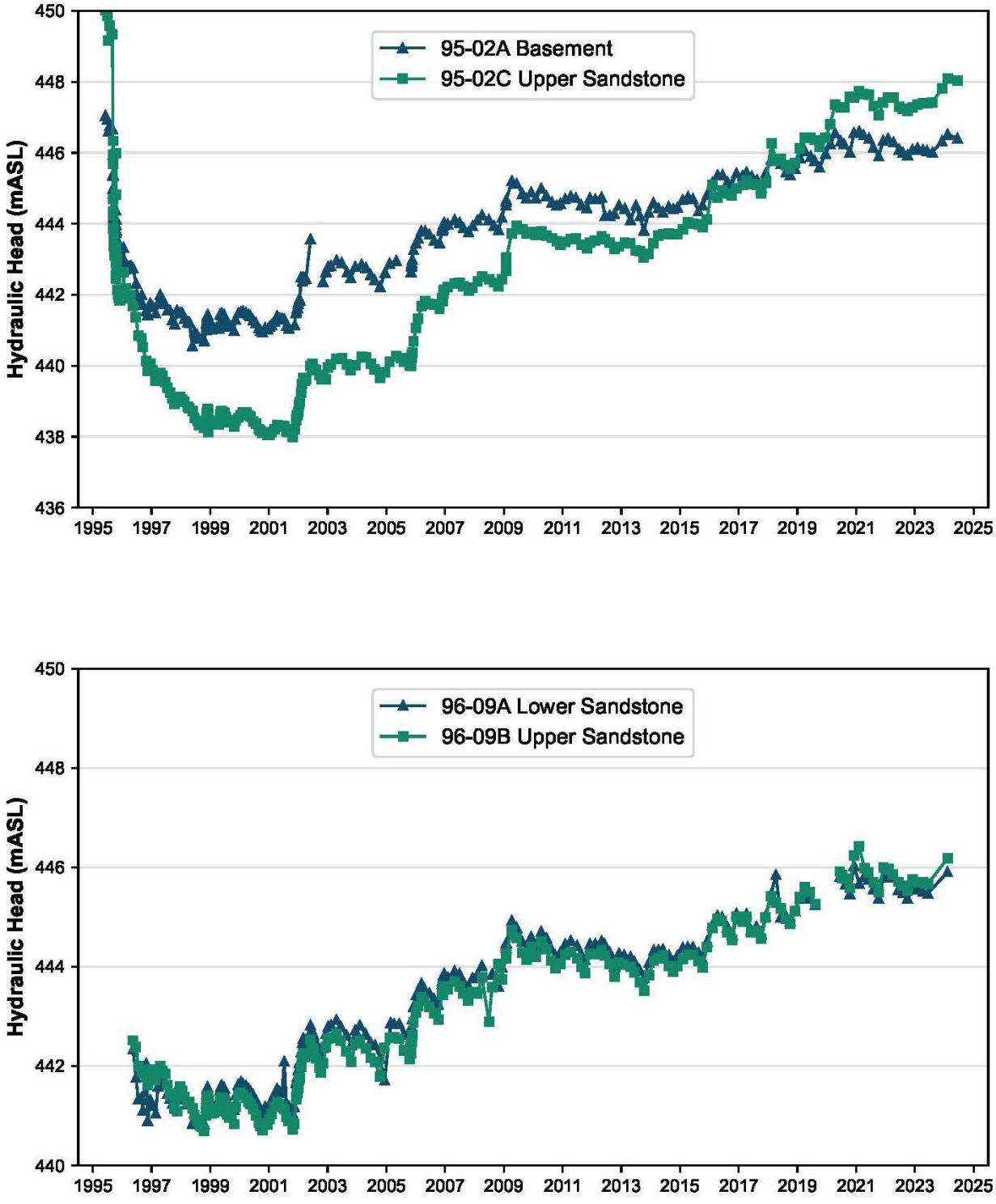
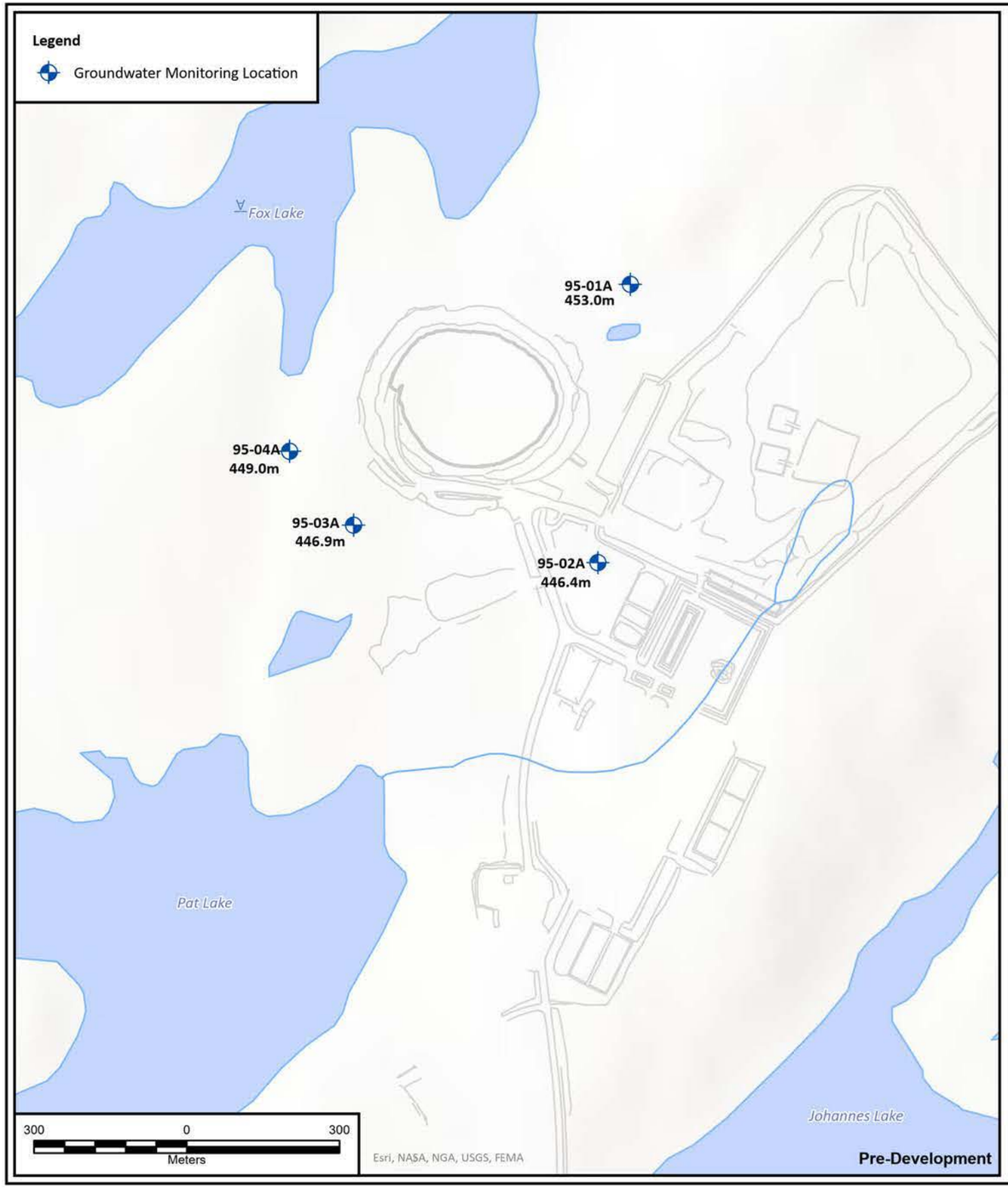


Figure 2.2-12 Upward Groundwater Flow Trends in JEB Monitoring Wells





Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-02 9:05 AM Scale: 1:10,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 2.2-13
JEB SITE PRE-DEVELOPMENT POTENTIOMETRIC AND 2024 HYDRAULIC HEAD CONTOURS MAP FOR BASEMENT

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\Section 2 Copy Dec 1, 2025.aprx



Projection: NAD 1983 UTM Zone 13N
Drawn: TL
Date: 2025-12-02 Scale: 1:15,000
Data Sources: *Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.*

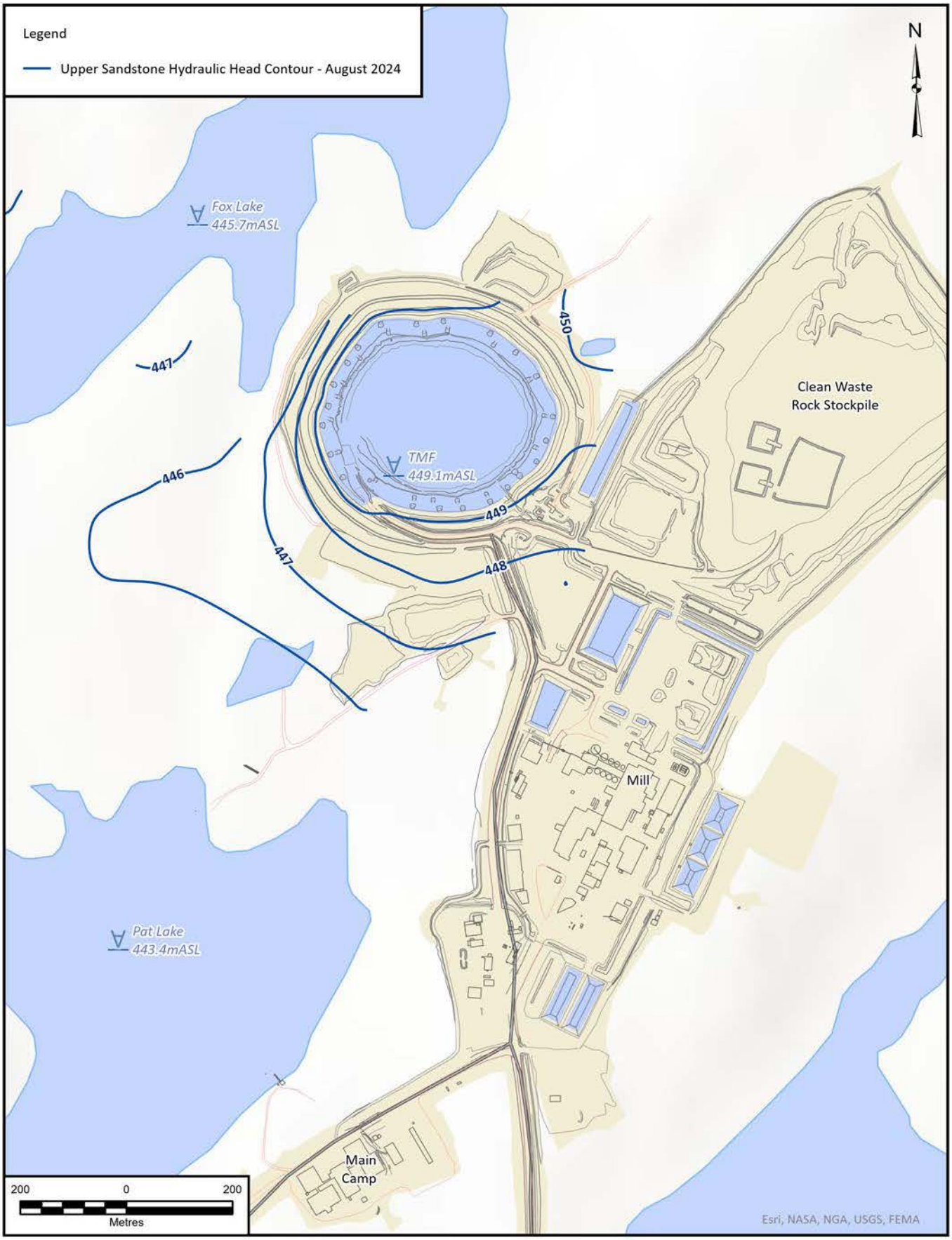
McCLEAN LAKE OPERATION

FIGURE 2.2-14
PRE-DEVELOPMENT POTENTIOMETRIC MAP FOR JEB SITE SANDSTONE

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\Section 2 Copy Dec 1, 2025.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-02 9:07 AM Scale: 1:10,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

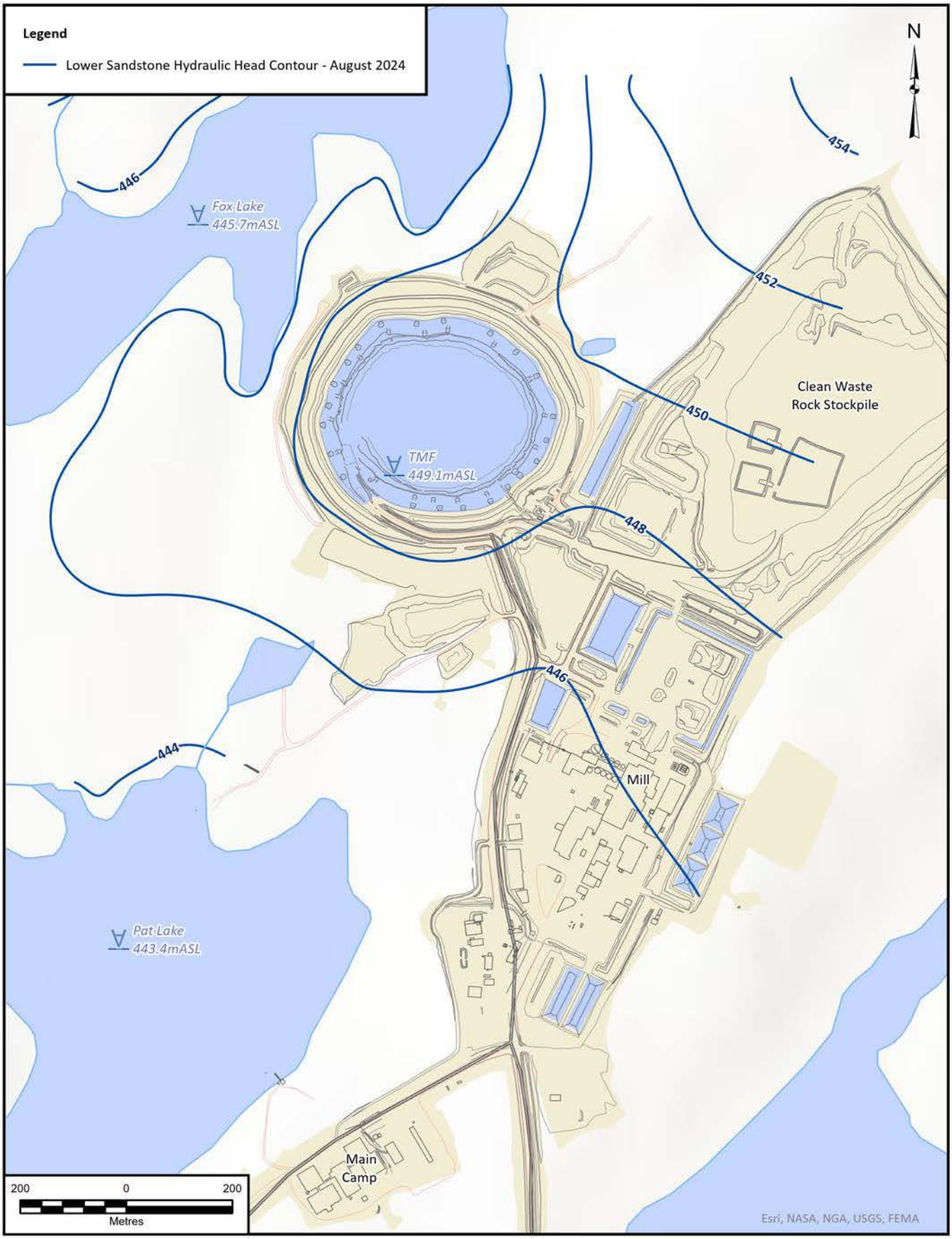
McCLEAN LAKE OPERATION

FIGURE 2.2-15
JEB SITE UPPER SANDSTONE HYDRAULIC HEAD CONTOURS - 2024

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\Section 2 Copy Dec 1, 2025.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-02 9:10 AM Scale: 1:10,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

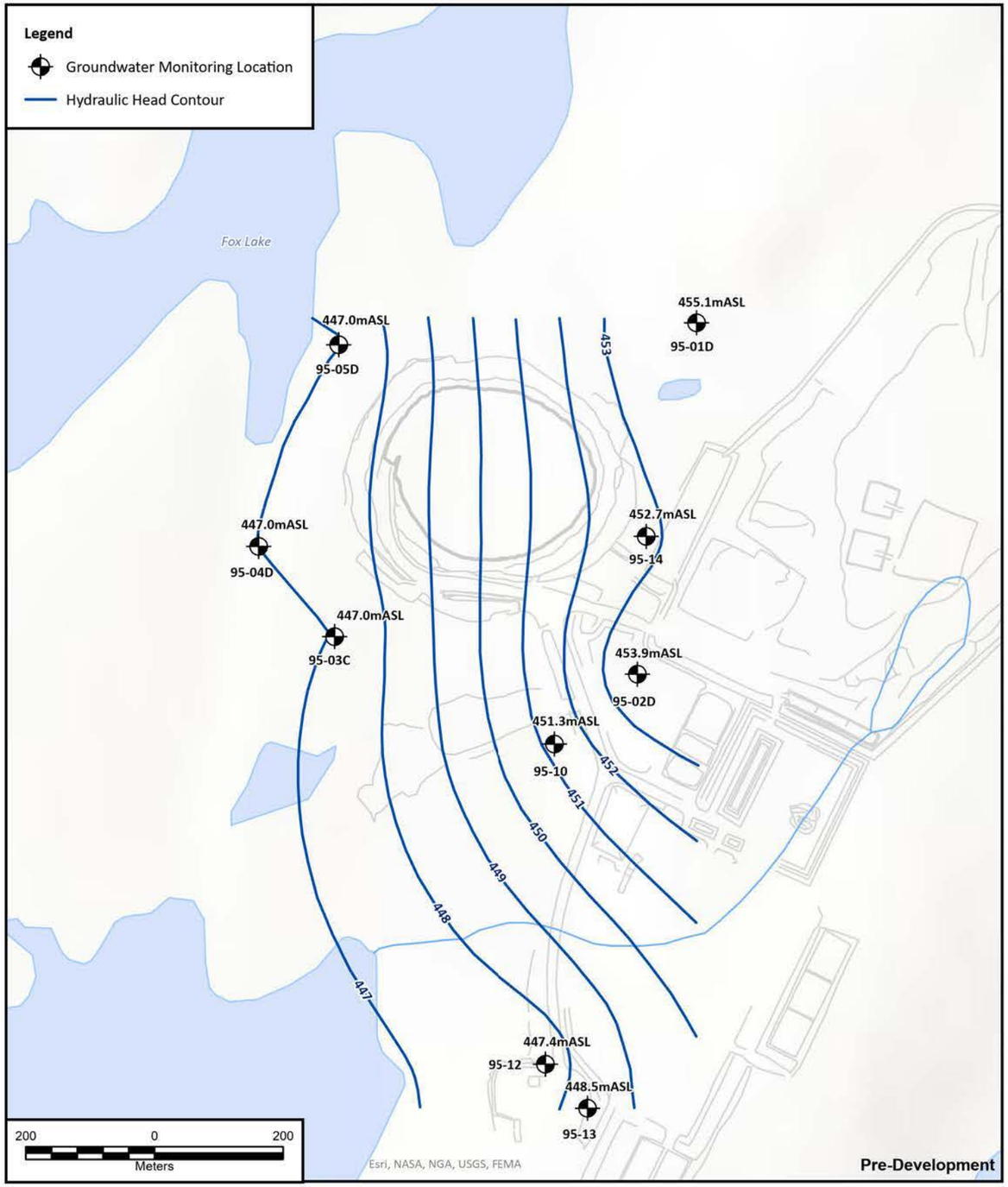
McCLEAN LAKE OPERATION

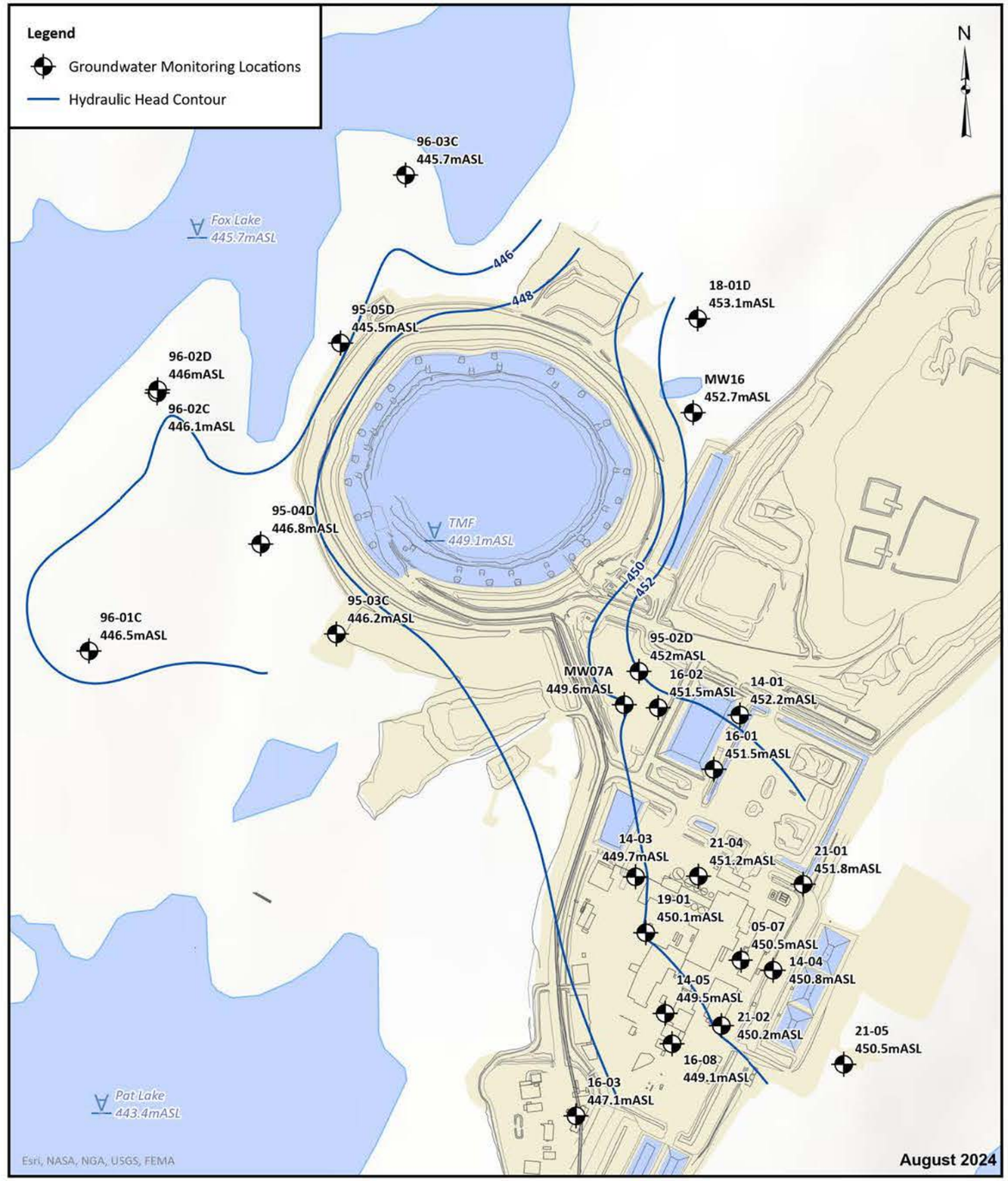
FIGURE 2.2-16
JEB SITE LOWER SANDSTONE HYDRAULIC HEAD CONTOURS - 2024

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\Section 2 Copy Dec 1, 2025.aprx





Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-02 4:43 PM Scale: 1:8,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 2.2-17
JEB SITE PRE-DEVELOPMENT POTENTIOMETRIC AND 2024 HYDRAULIC HEAD CONTOURS MAP FOR OVERBURDEN

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\Section 2 Copy Dec 1, 2025.aprx

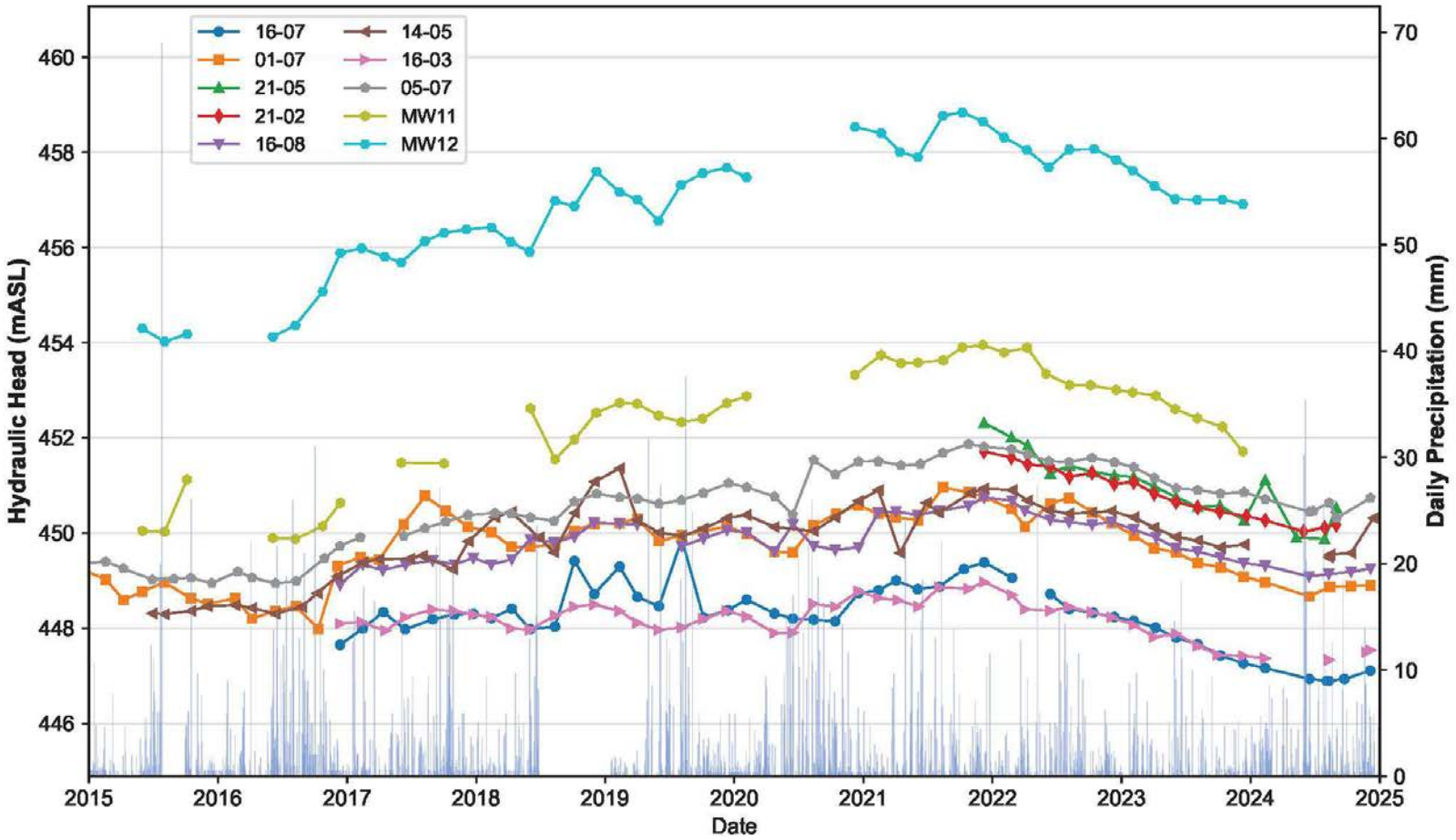


Figure 2.2-18 Downward Groundwater Flow Trend in JEB Overburden Monitoring Wells with Daily Precipitation

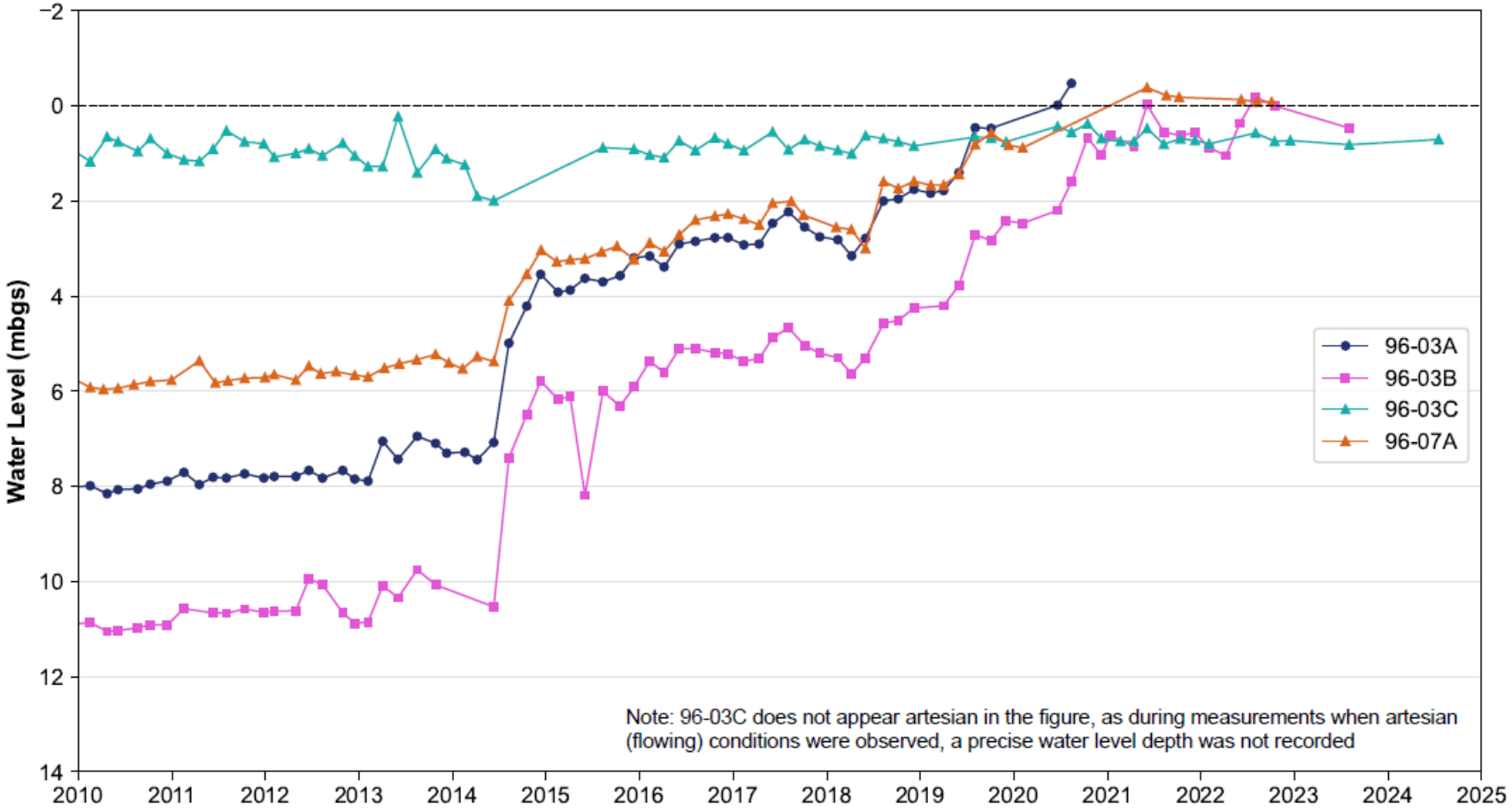
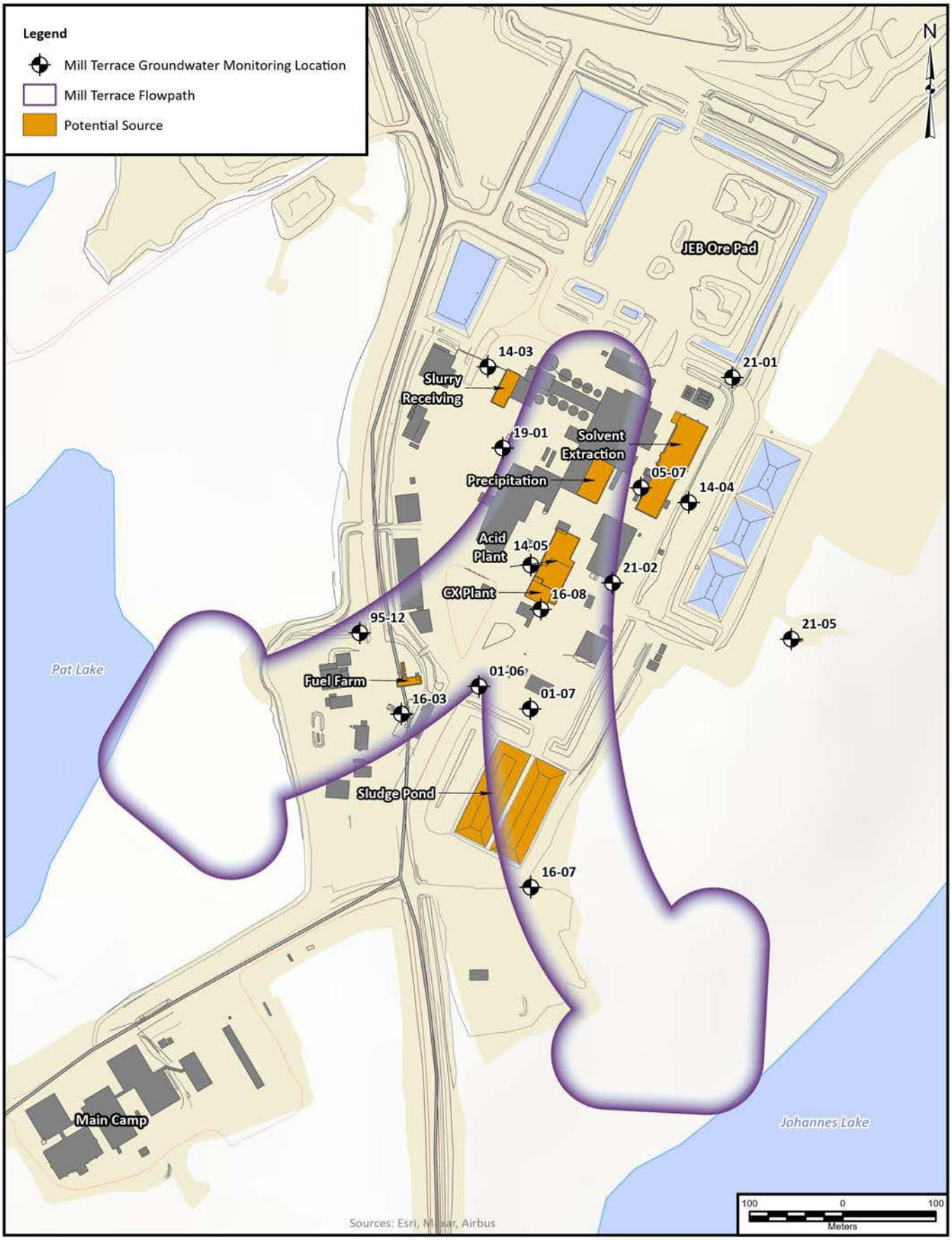


Figure 2.2-19 Hydrograph for Multi-Level Monitoring Well 96-03 and 96-07A



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-03 8:00 AM Scale: 1:5,700
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

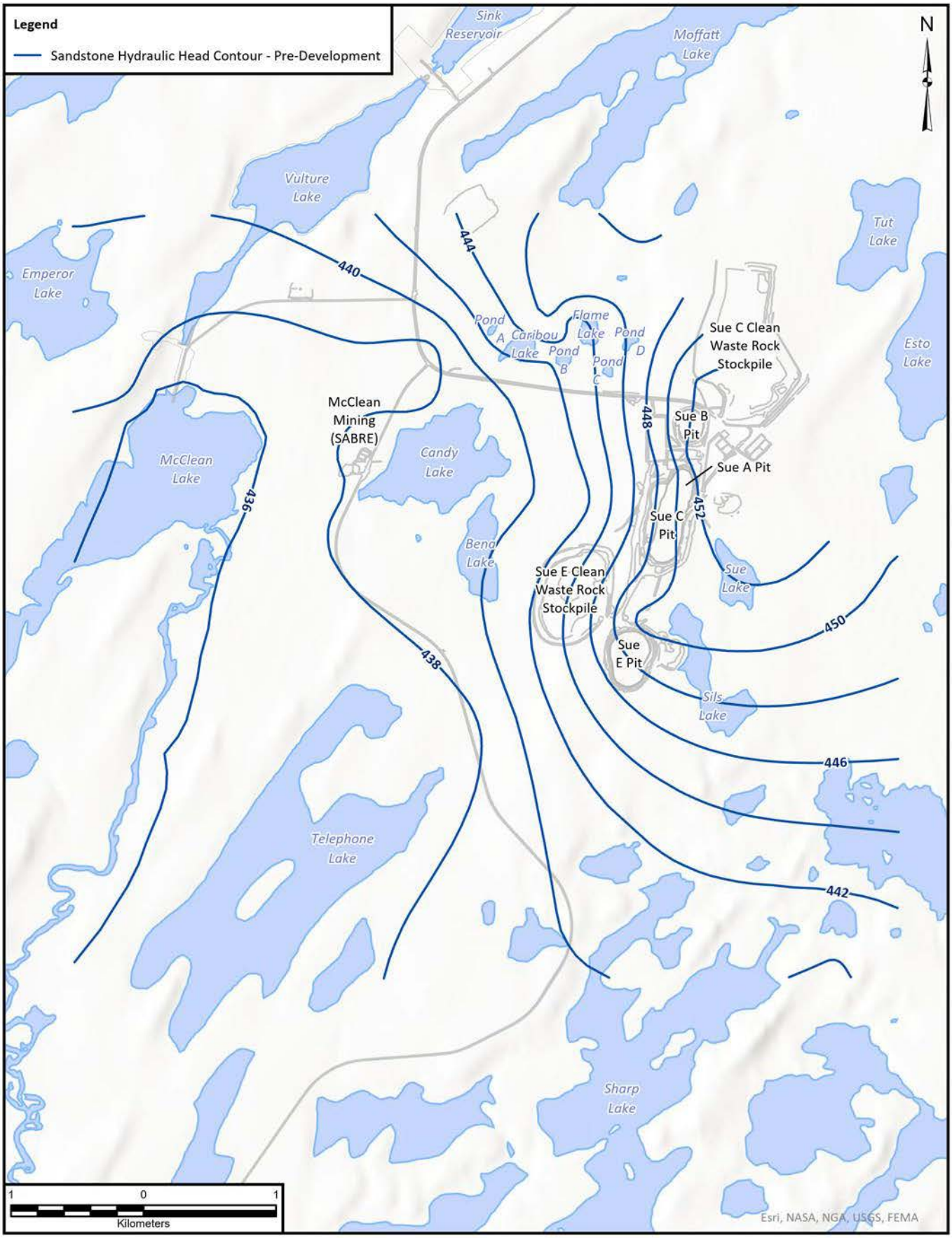
McCLEAN LAKE OPERATION

FIGURE 2.2-20
GROUNDWATER DIRECTIONAL FLOW FROM MILL TERRACE AND ORE PAD TOWARDS JOHANNES AND PAT LAKES

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\Section 2 Copy Dec 1, 2025.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-05 10:20 AM Scale:1:40,000
Data Sources: *Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.*

McCLEAN LAKE OPERATION

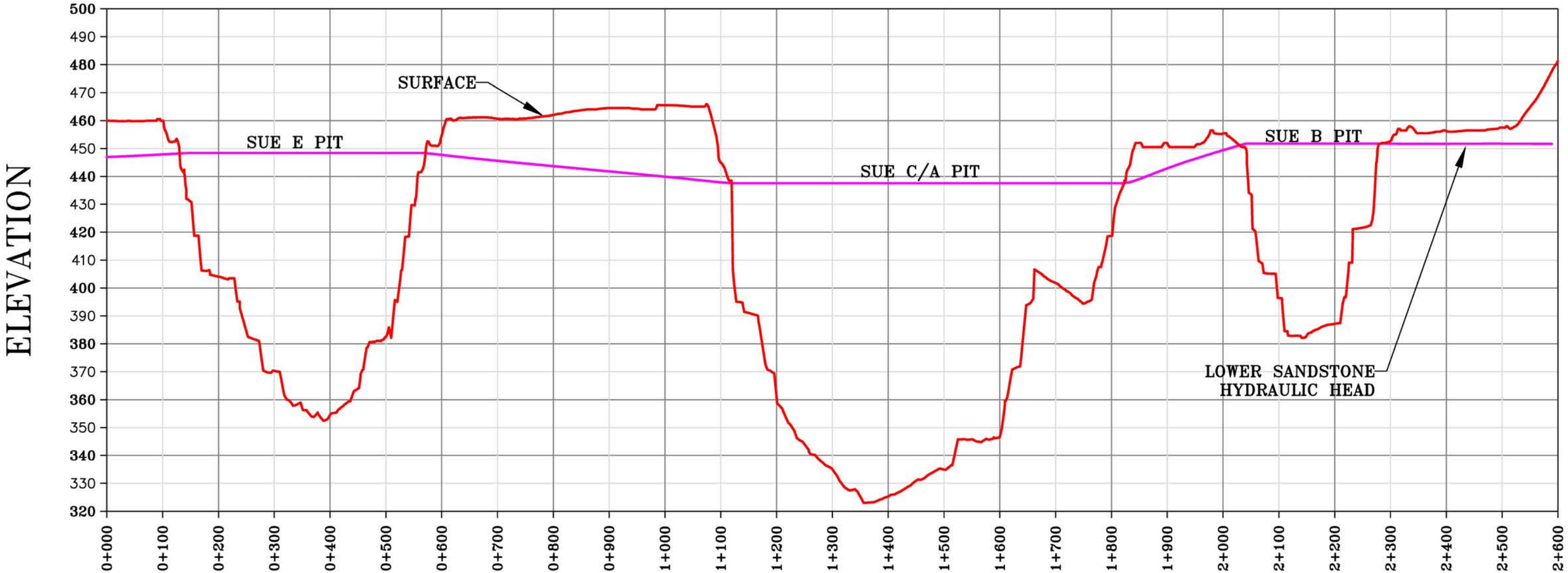
FIGURE 2.2-21
SUE SITE PRE-DEVELOPMENT POTENTIOMETRIC SURFACE MAP FOR SANDSTONE

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 2\EPTID Section 2_FINAL.aprx

CROSS-SECTION - B-B'



LEGEND

SURFACE

LOWER SANDSTONE WATER LEVEL

NOTES: PROFILE VERTICAL SCALE 1:200

orano

SCALE:	AS SHOWN	DATE
DESIGNED:		
DRAWN:	T.L	26/02/25
CHECKED:		
APPROVED:		
REF. DWGS		
REV. A:		
REV. B:		
DIR:	Q:\SHEQ\GIS\2025\ANNUAL	

FIGURE 2.2-22

SUE SITE

HYDRAULIC HEAD CROSS SECTION B-B' - 2024

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

DWG NO.: 550C236 | REV. NO.: 0

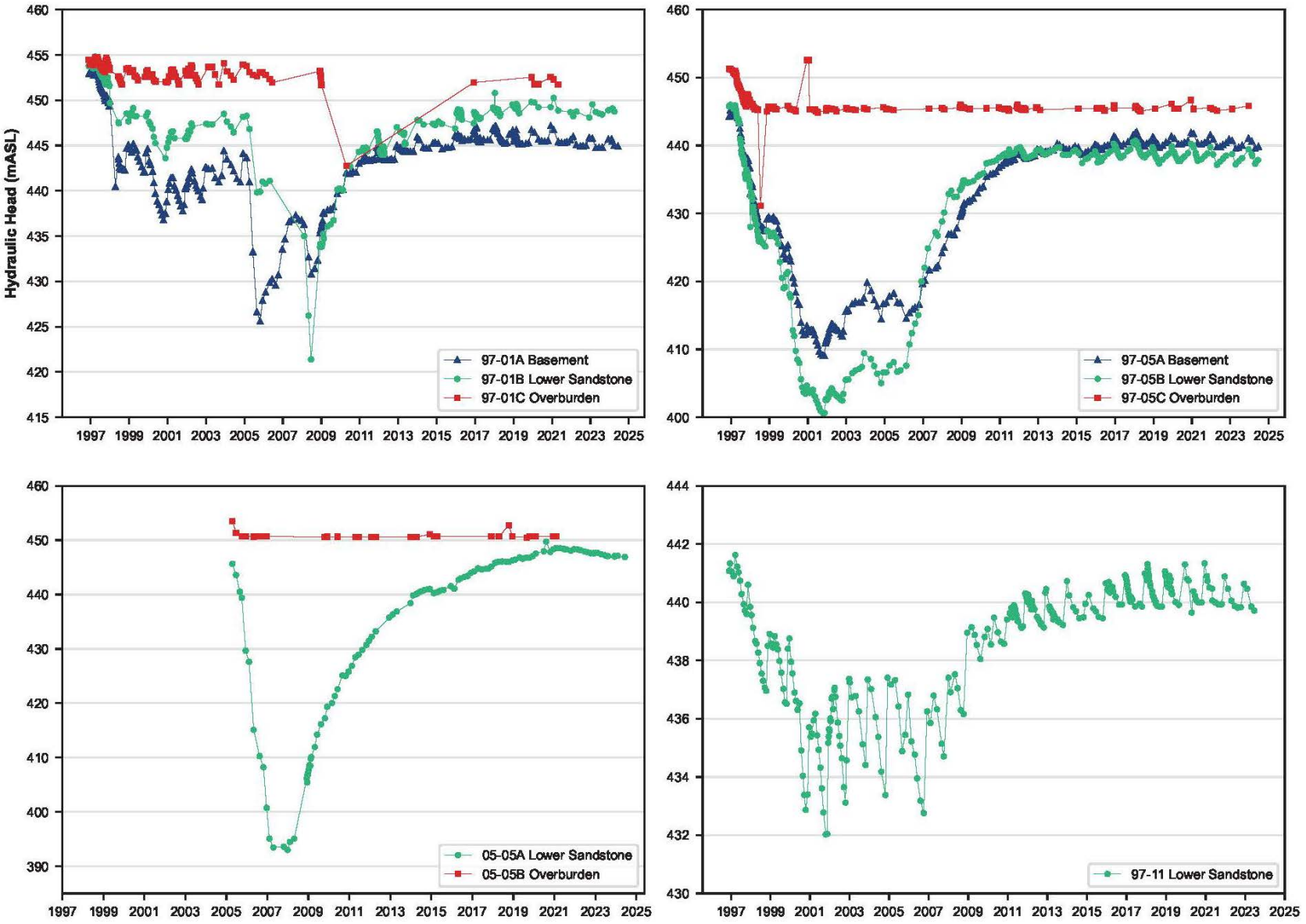
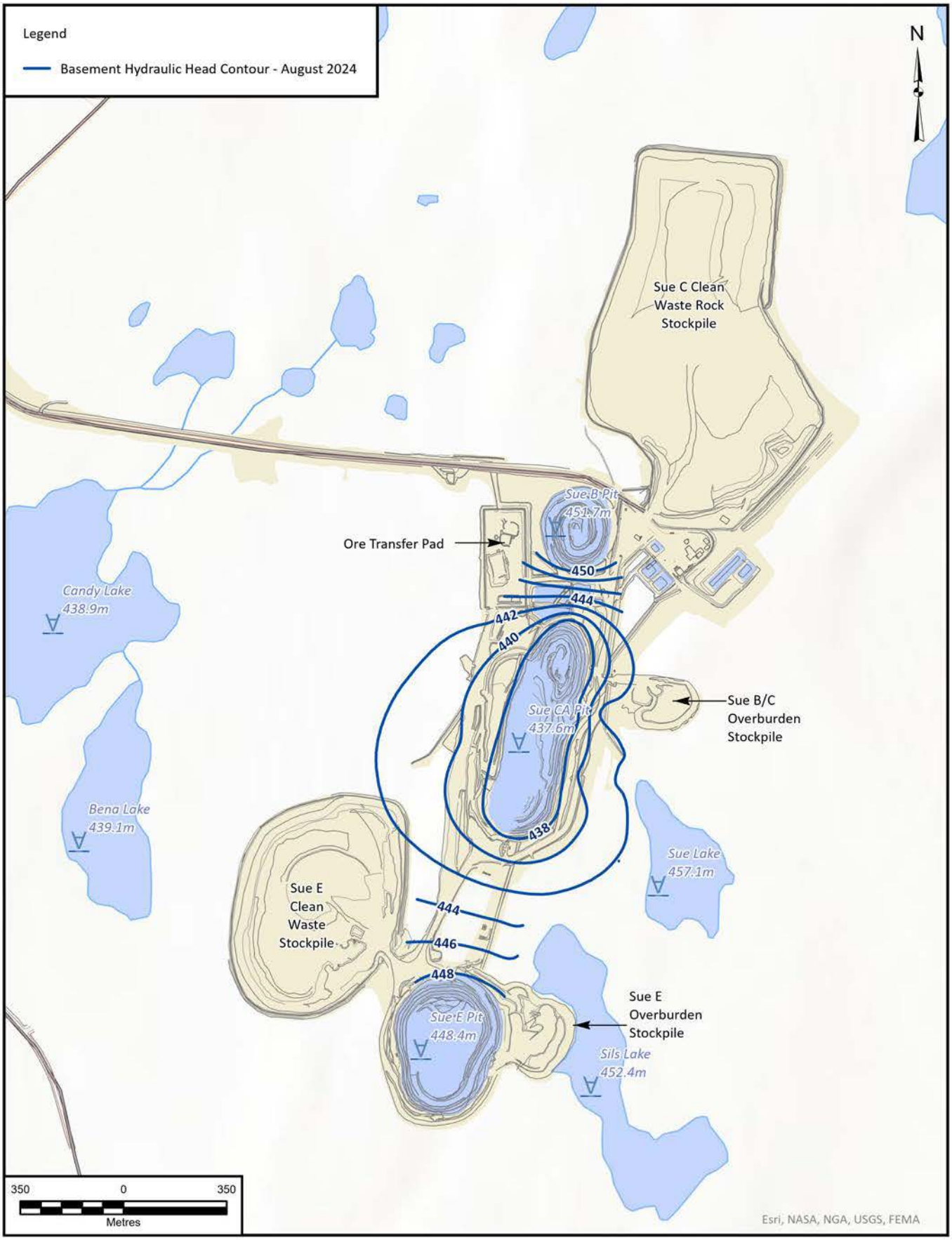


Figure 2.2-23 Downward Groundwater Flow Trend in Sue Monitoring Wells



Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-02 1:29 PM Scale:
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

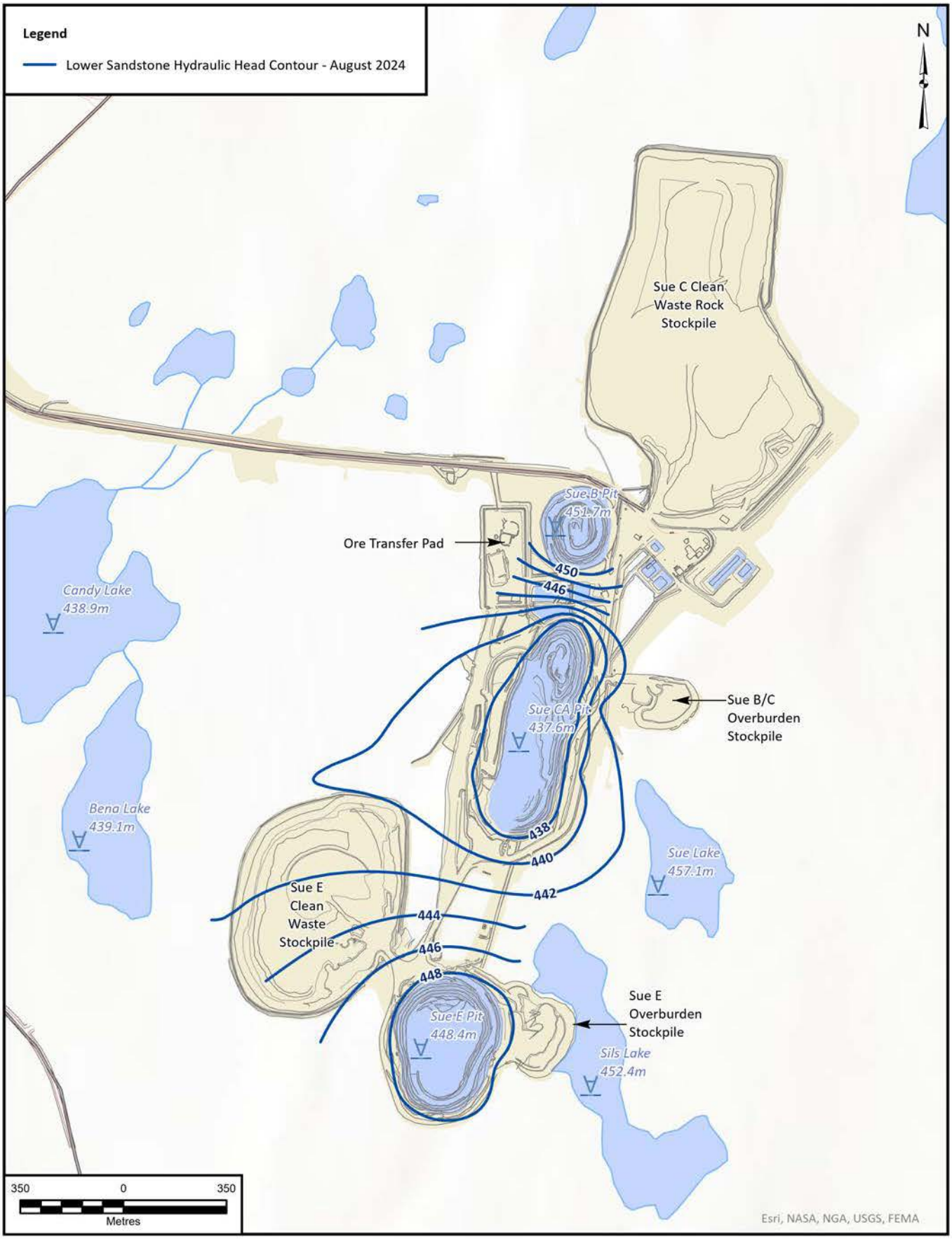
McCLEAN LAKE OPERATION

FIGURE 2.2-24
SUE SITE BASEMENT HYDRAULIC HEAD CONTOURS - 2024

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\Section 2 Copy Dec 1, 2025.aprx



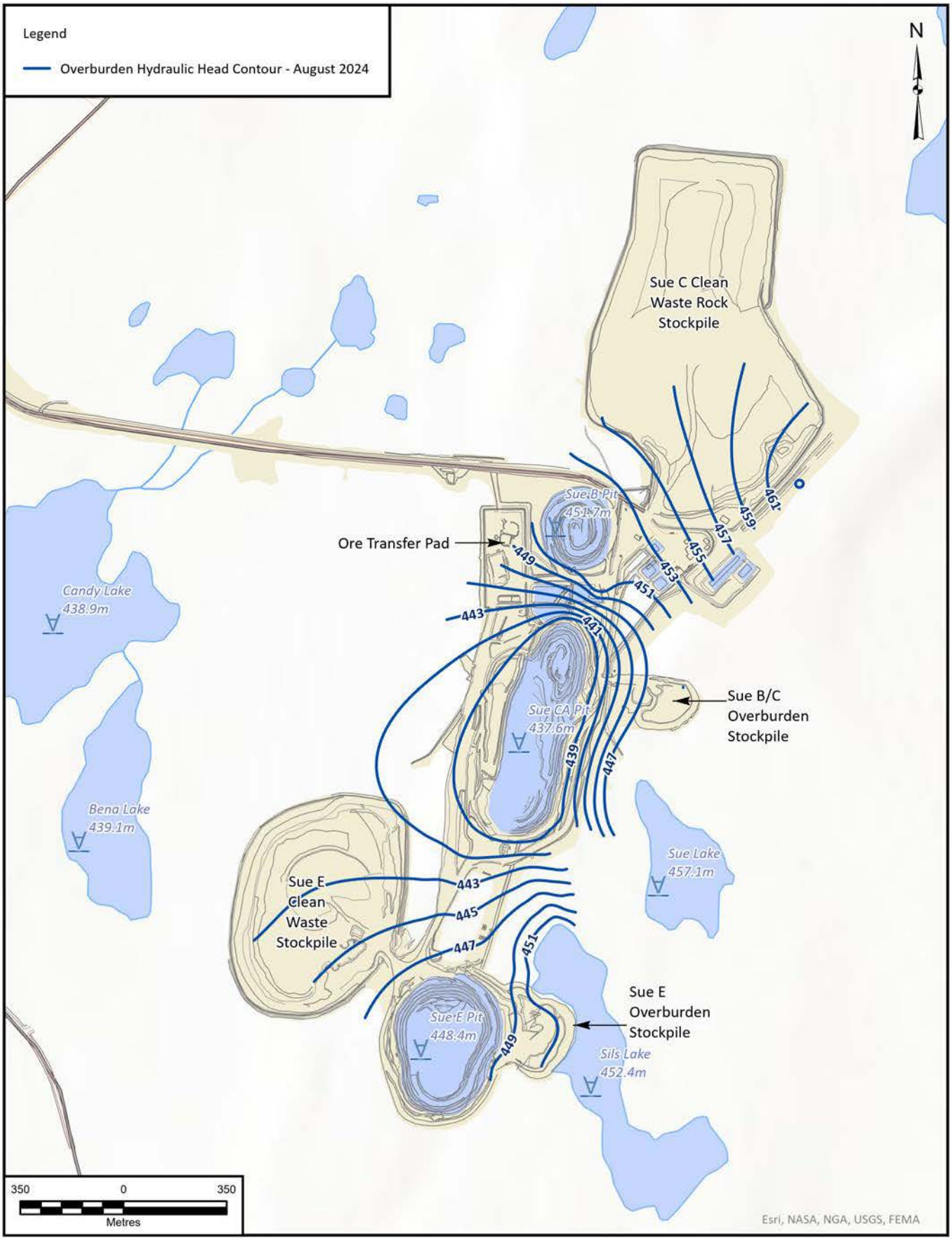
Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-02 1:38 PM Scale: 1:18,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 2.2-25
SUE SITE LOWER SANDSTONE HYDRAULIC HEAD CONTOURS - 2024

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\Section 2 Copy Dec 1, 2025.aprx



Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-02 1:38 PM Scale:
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 2.2-26
SUE SITE OVERBURDEN HYDRAULIC HEAD CONTOURS - 2024

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\Section 2 Copy Dec 1, 2025.aprx

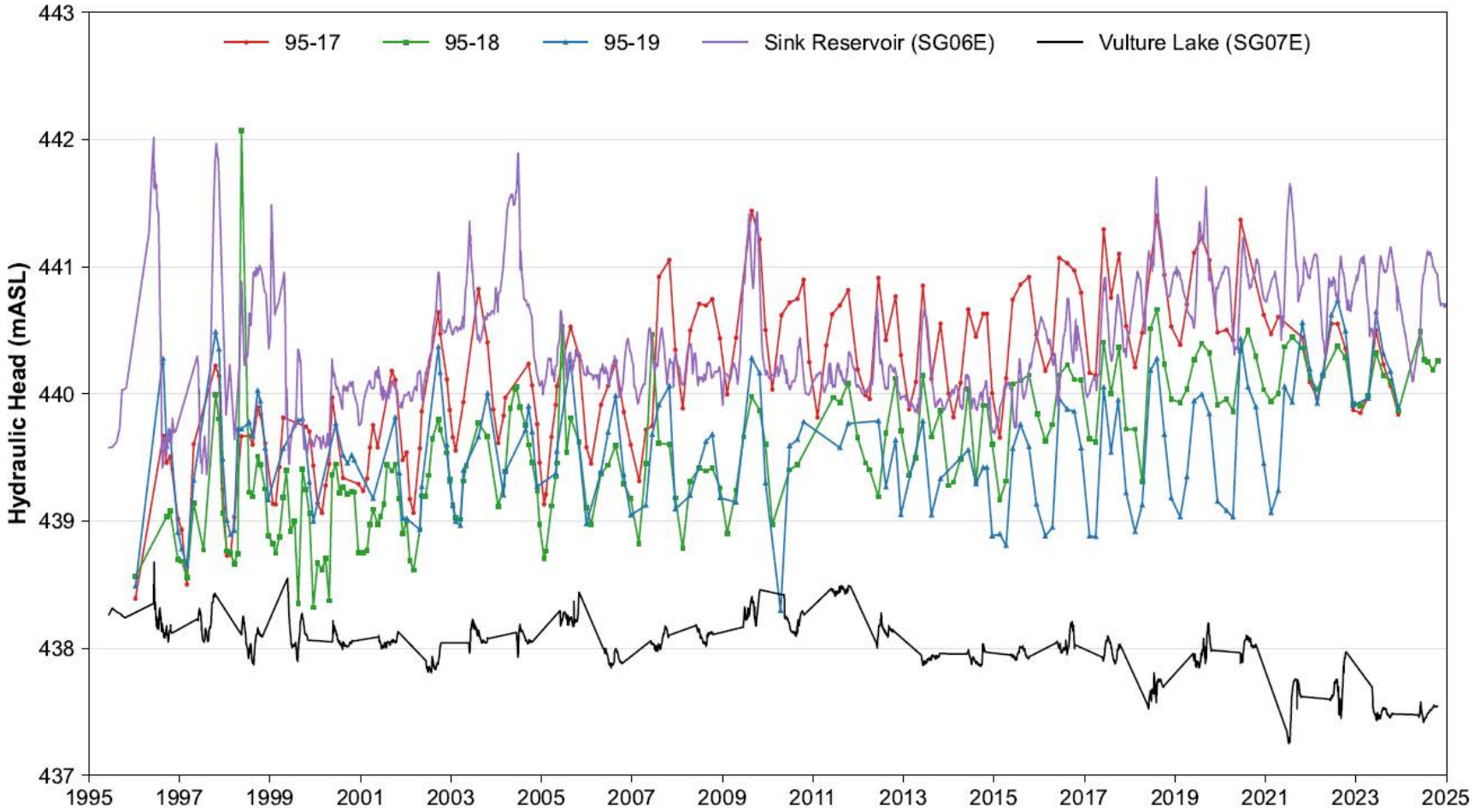


Figure 2.2-27 Sink Dam Groundwater Levels

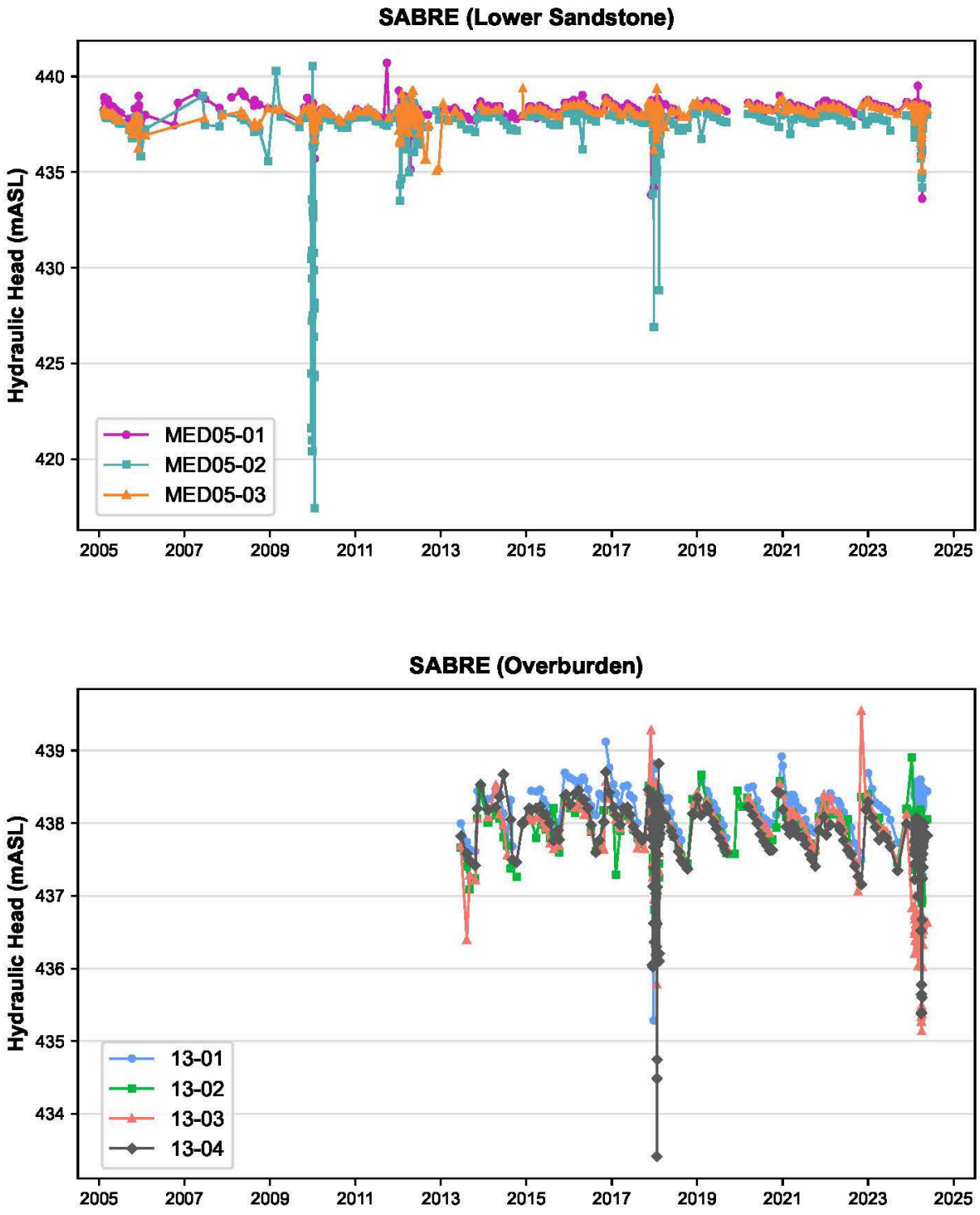
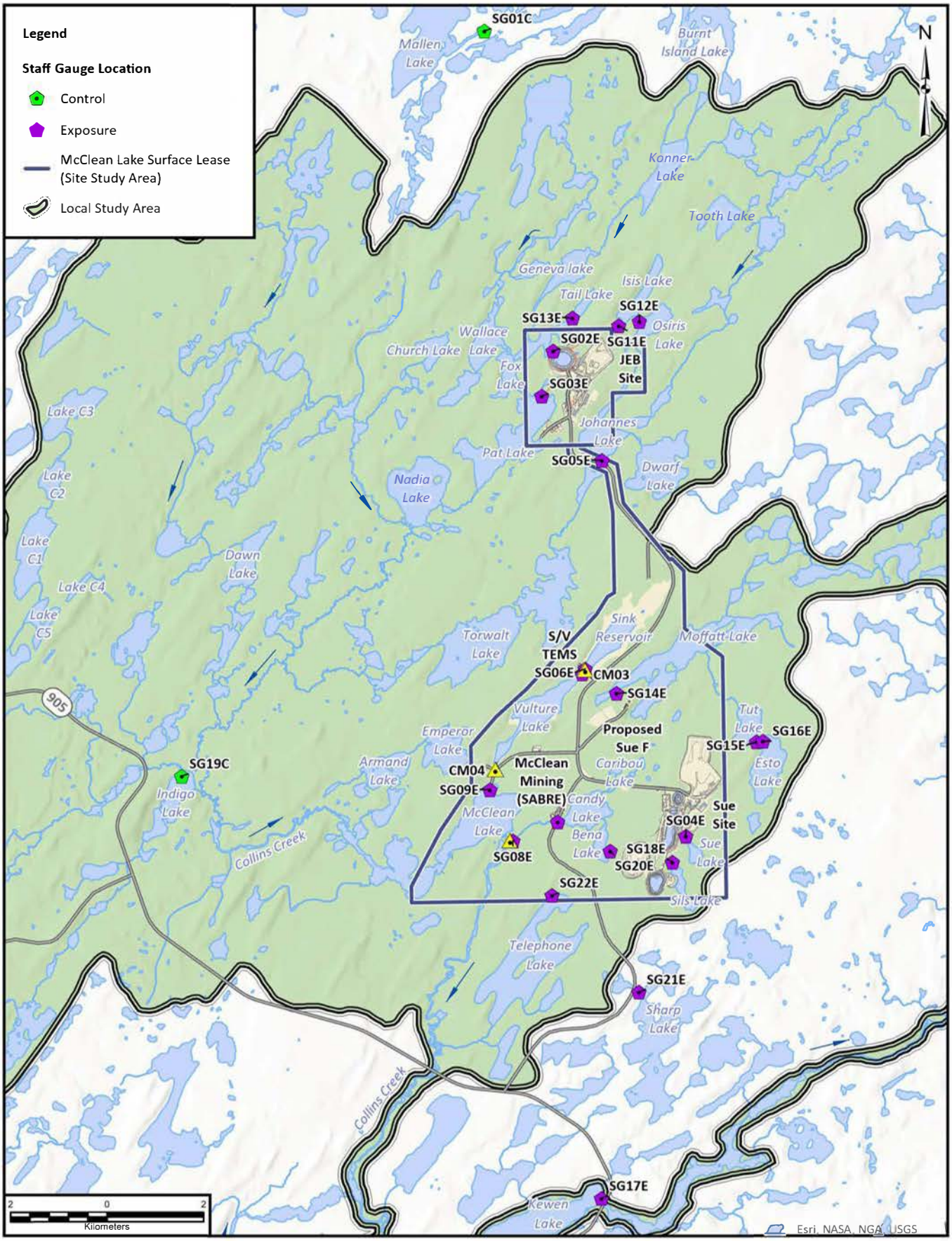


Figure 2.2-28 McClean Mining Groundwater Levels



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-02-27 3:39 PM Scale: 1:110,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

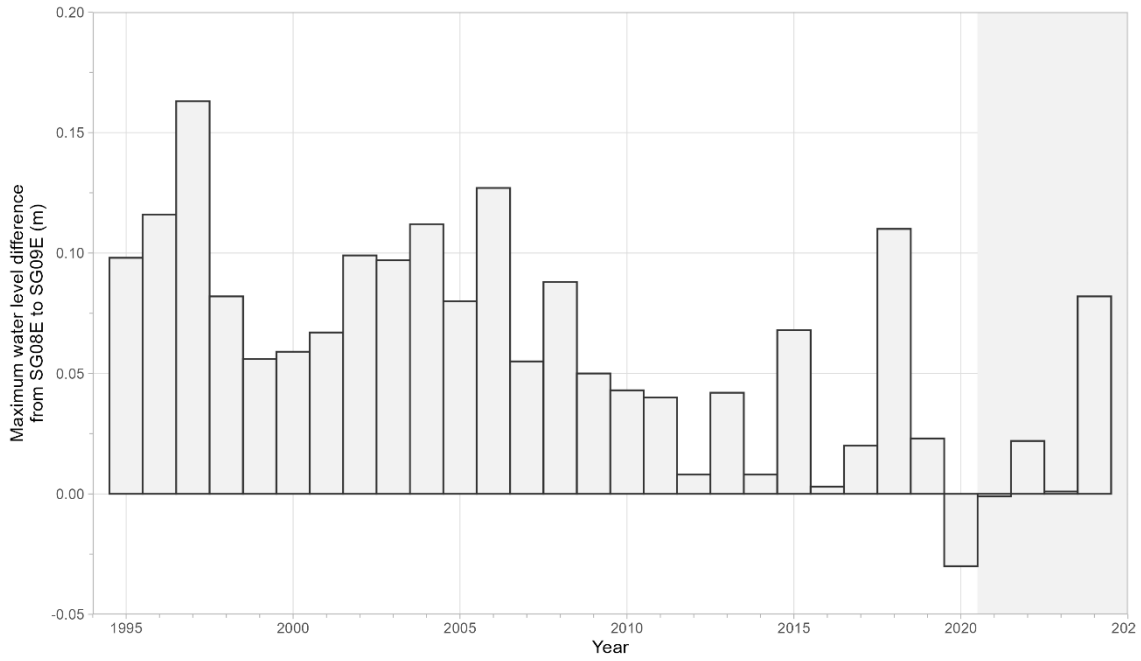
McCLEAN LAKE OPERATION

FIGURE 2.3-1
HYDROLOGICAL MONITORING STATIONS AT McCLEAN LAKE OPERATION

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 2\EPTID Section 2.aprx



Note: positive values indicate that the water level was higher at SG08E

Figure 2.3-2 Maximum water level difference from SG08E to SG09E

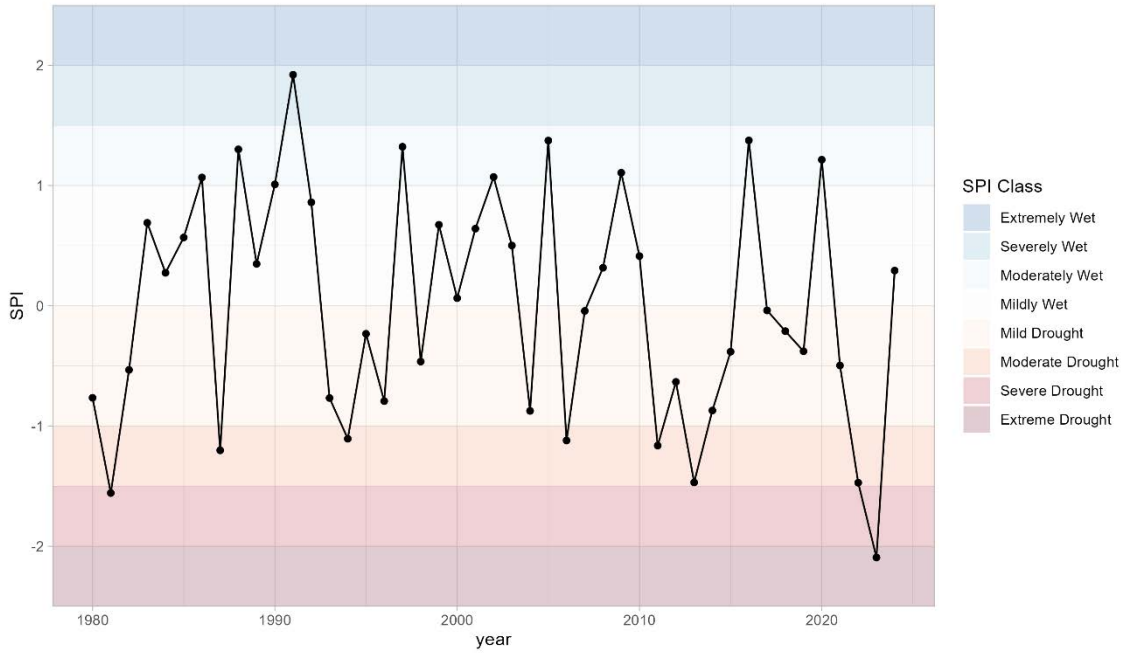


Figure 2.3-3 Standard Precipitation Index (SPI) at McClean Lake Operation

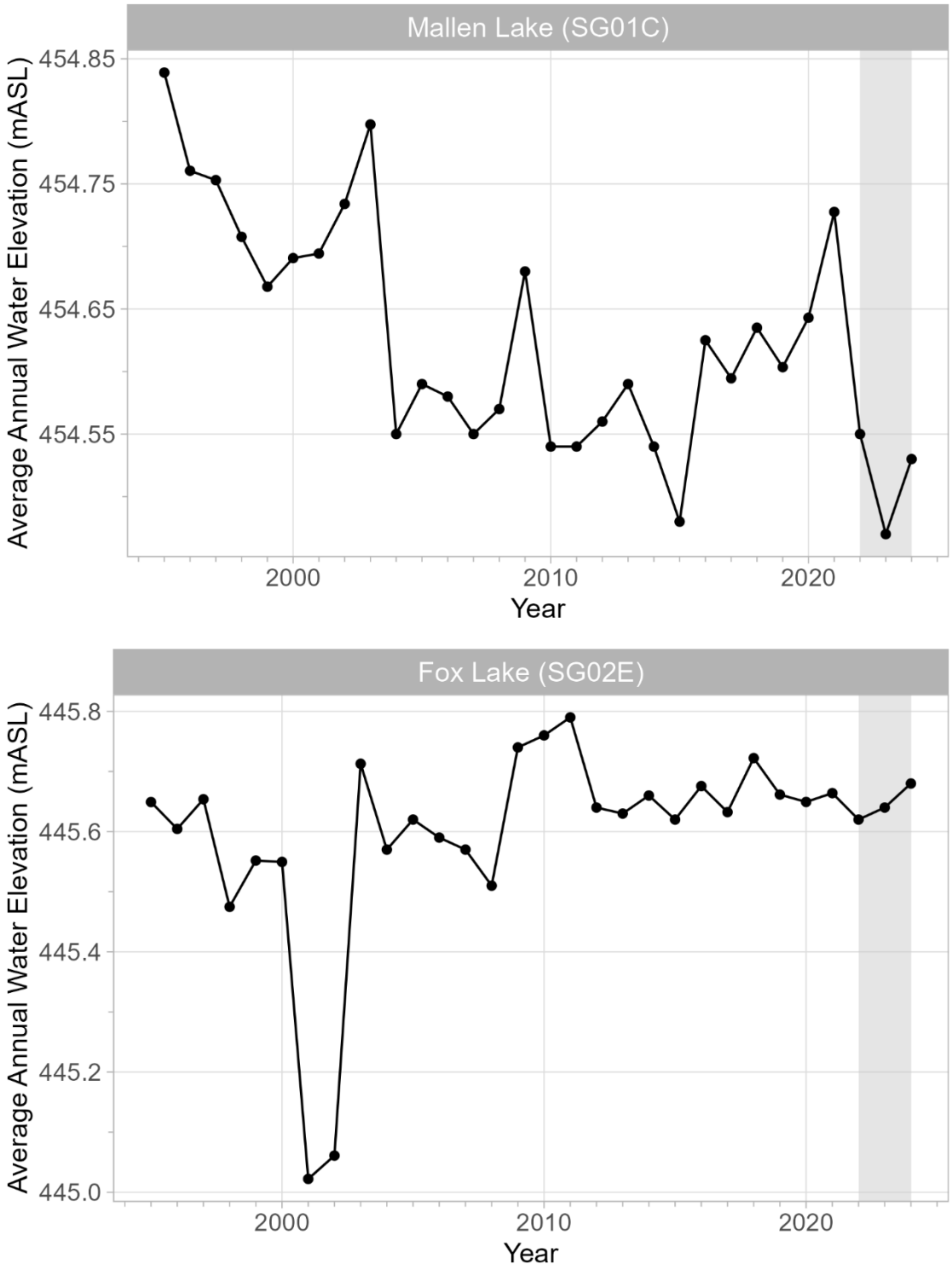


Figure 2.3-4 Average Annual Water Elevation - top) Mallen Lake (SG01C) and bottom) Fox Lake (SG02E) 1995 to 2024

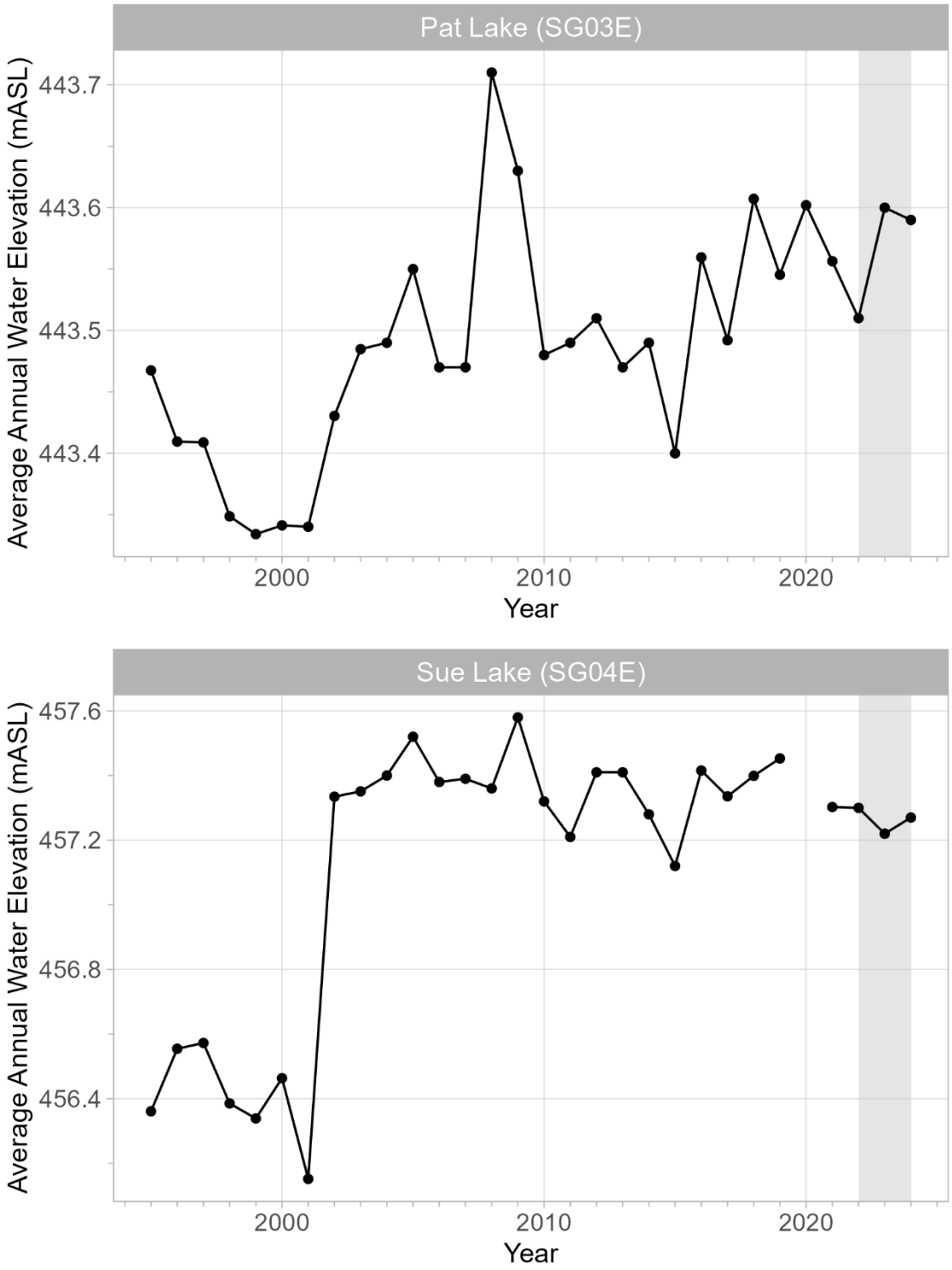


Figure 2.3-5 Average Annual Water Elevation - top) Pat Lake (SG03E) and bottom) Sue Lake (SG04E) 1995 to 2024

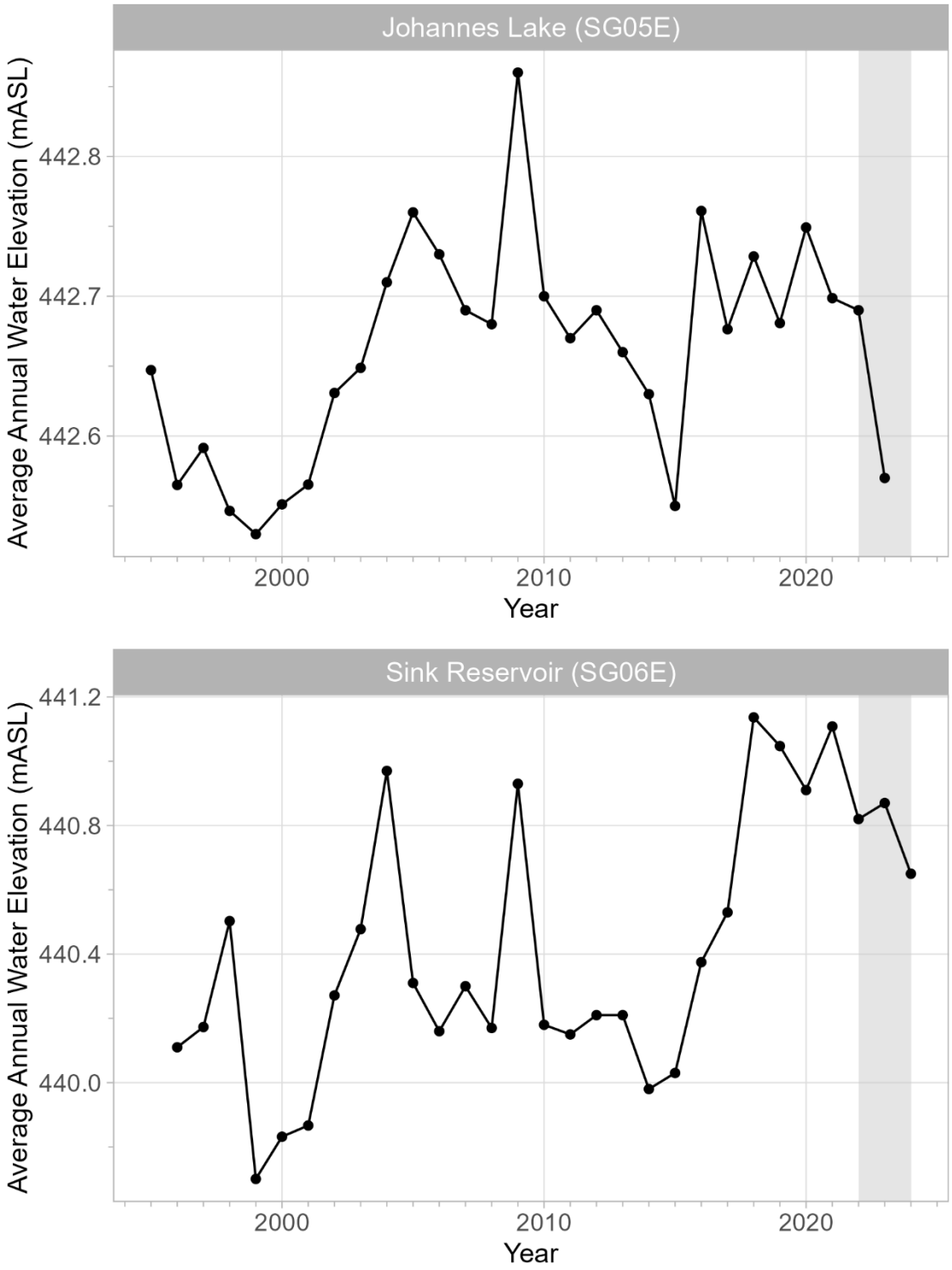


Figure 2.3-6 Average Annual Water Elevation - top) Johannes Lake (SG05E) and bottom) Sink Reservoir (SG06E) 1995 to 2024

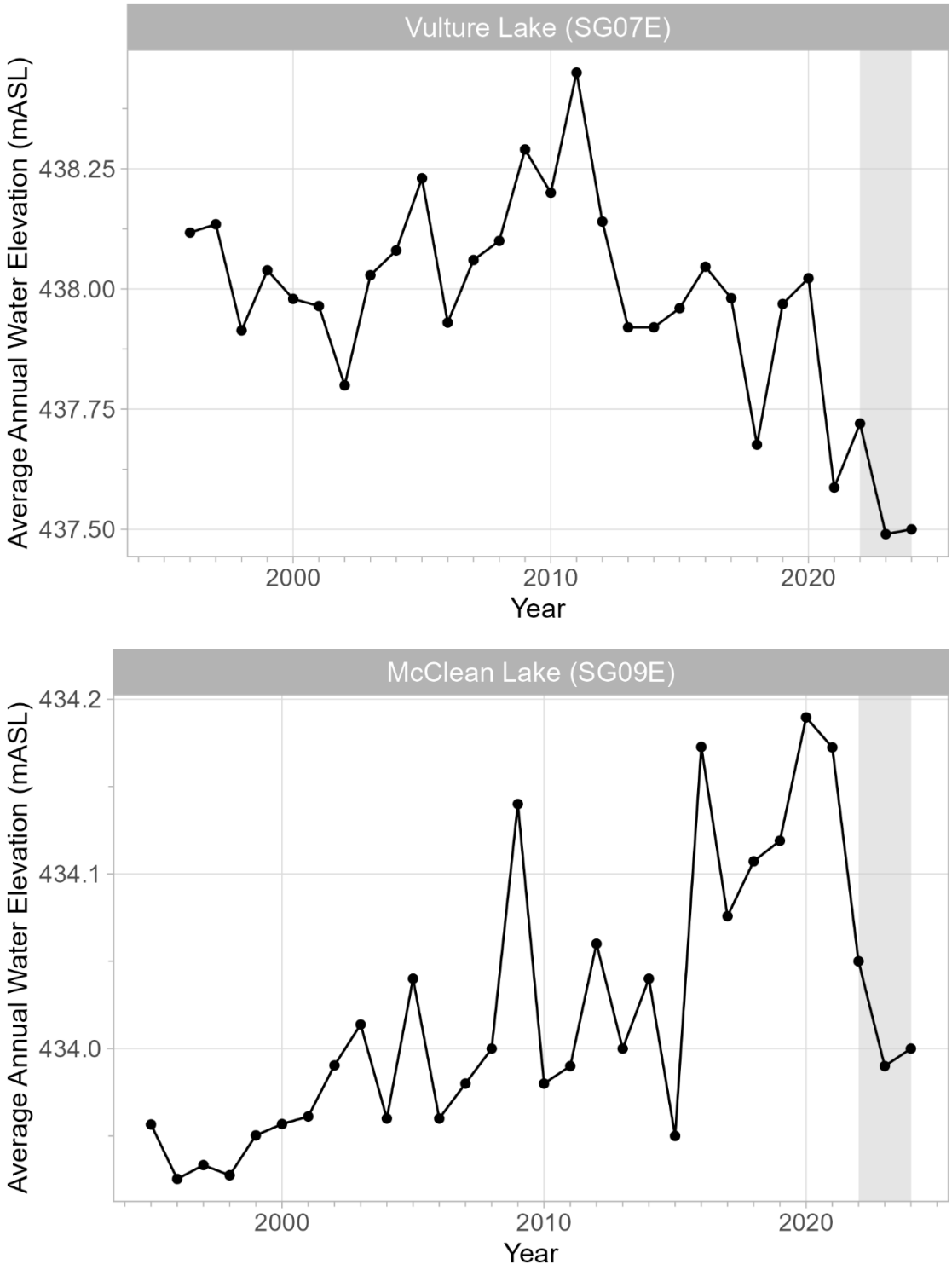


Figure 2.3-7 Average Annual Water Elevation - top) Vulture Lake (SG07E) and bottom) McClean Lake (SG09E) 1995 to 2024

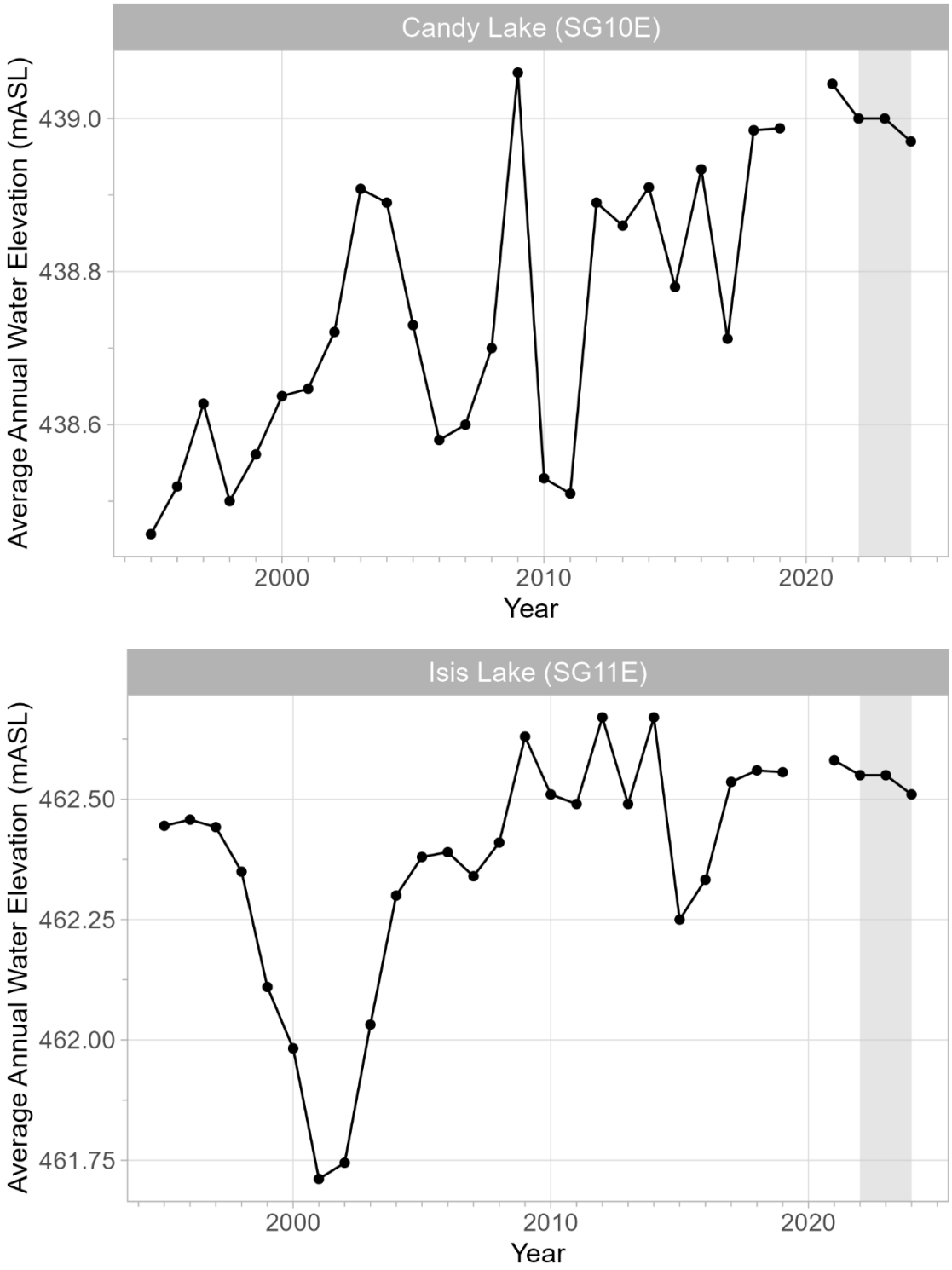


Figure 2.3-8 Average Annual Water Elevation - top) Candy Lake (SG10E) and bottom) Isis Lake (SG11E) 1995 to 2024

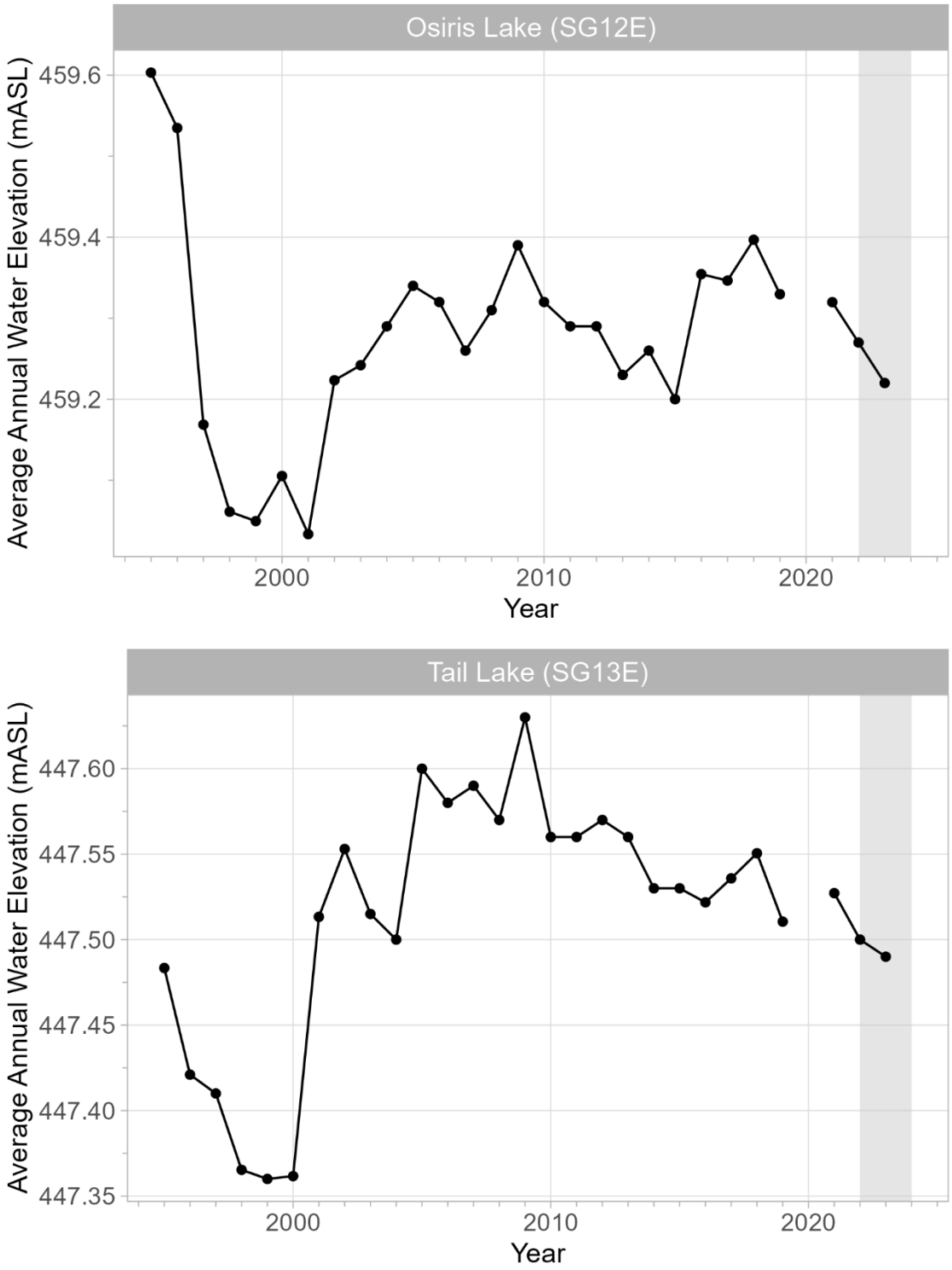


Figure 2.3-9 Average Annual Water Elevation - top) Osiris Lake (SG12E) and bottom) Tail Lake (SG13E) 1995 to 2024

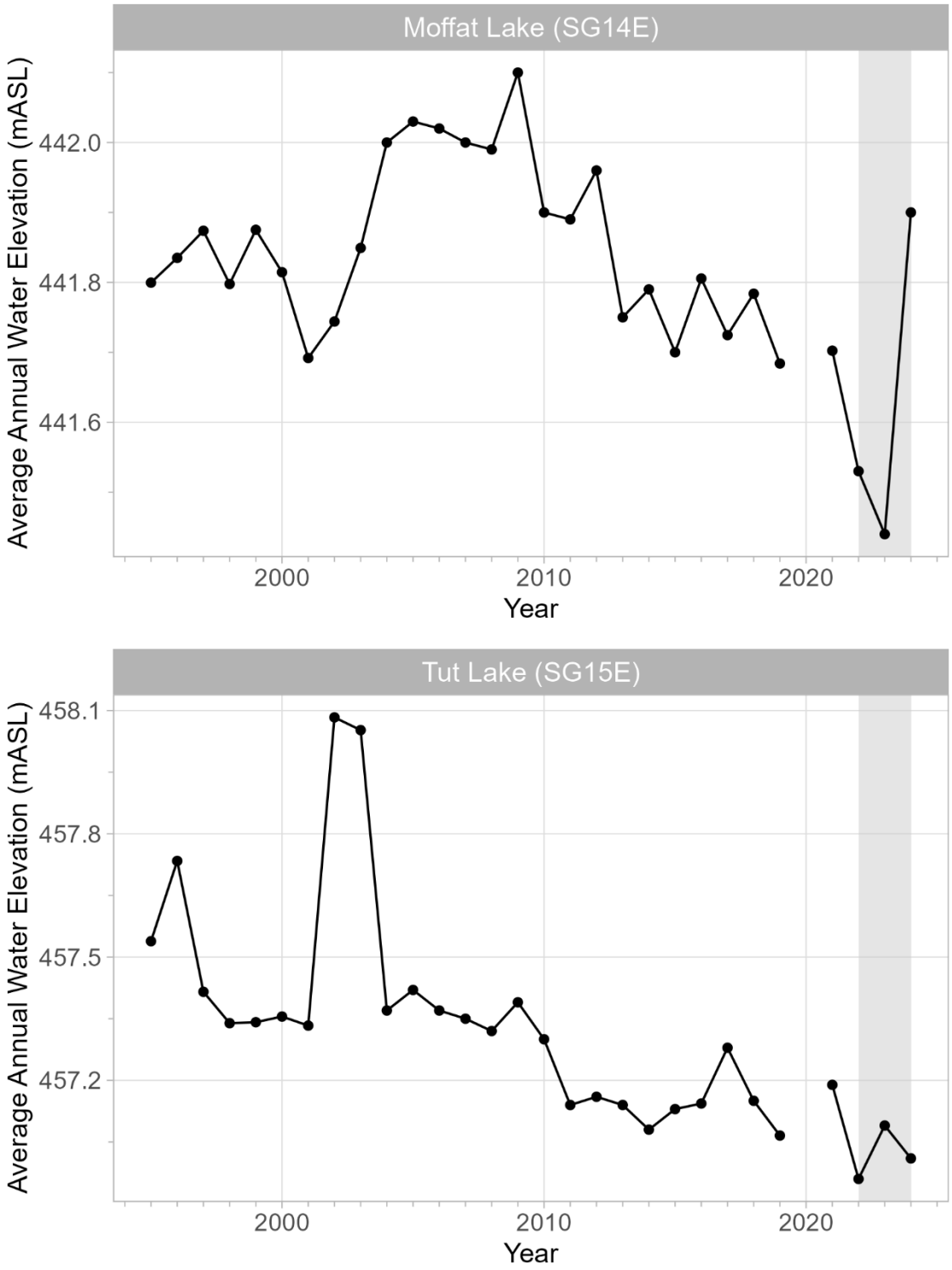


Figure 2.3-10 Average Annual Water Elevation - top) Moffat Lake (SG14E) and bottom) Tut Lake (SG15E) 1995 to 2024

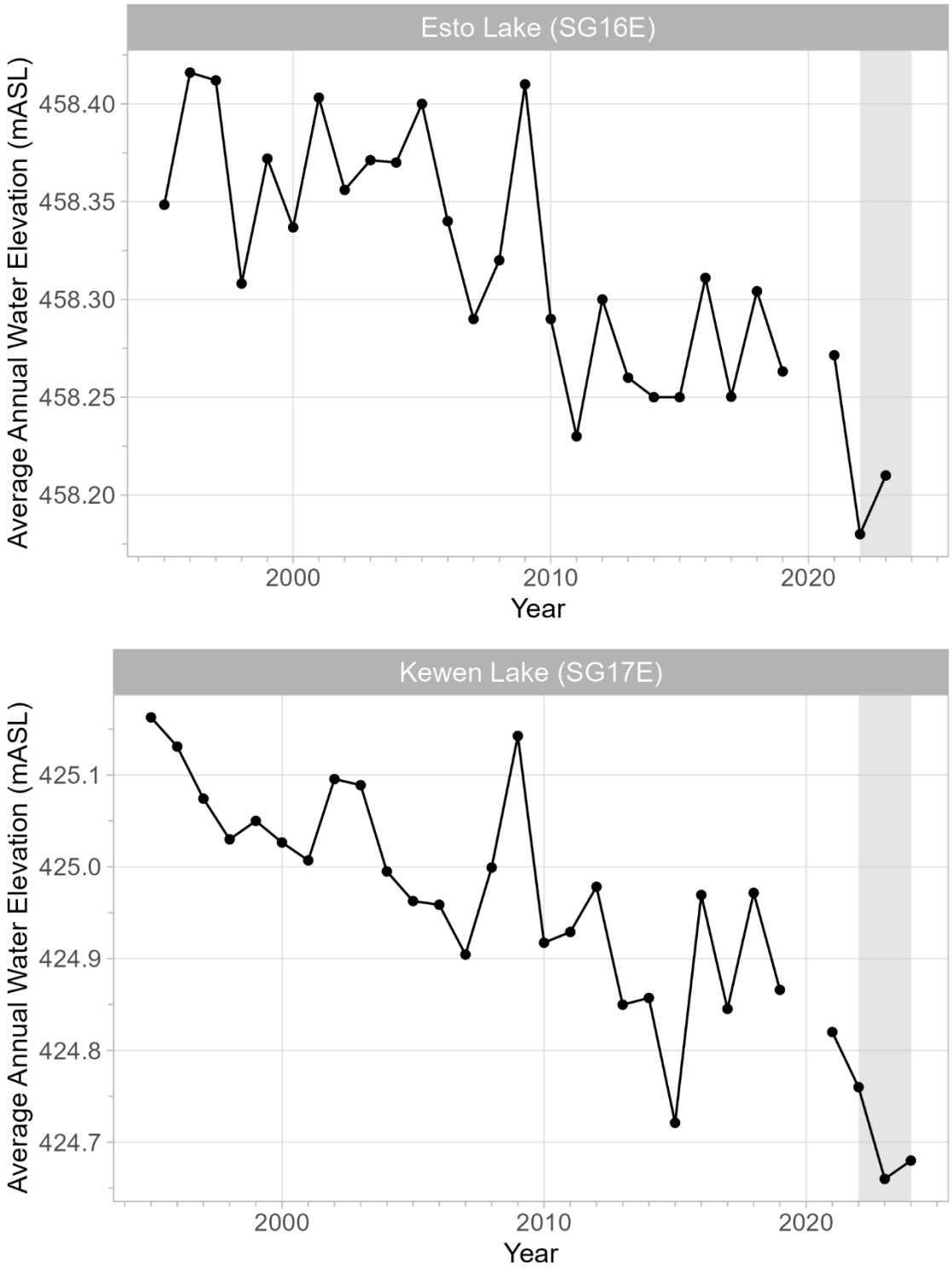


Figure 2.3-11 Average Annual Water Elevation - top) Esto Lake (SG16E) and bottom) Kewen Lake (SG17E) 1995 to 2024

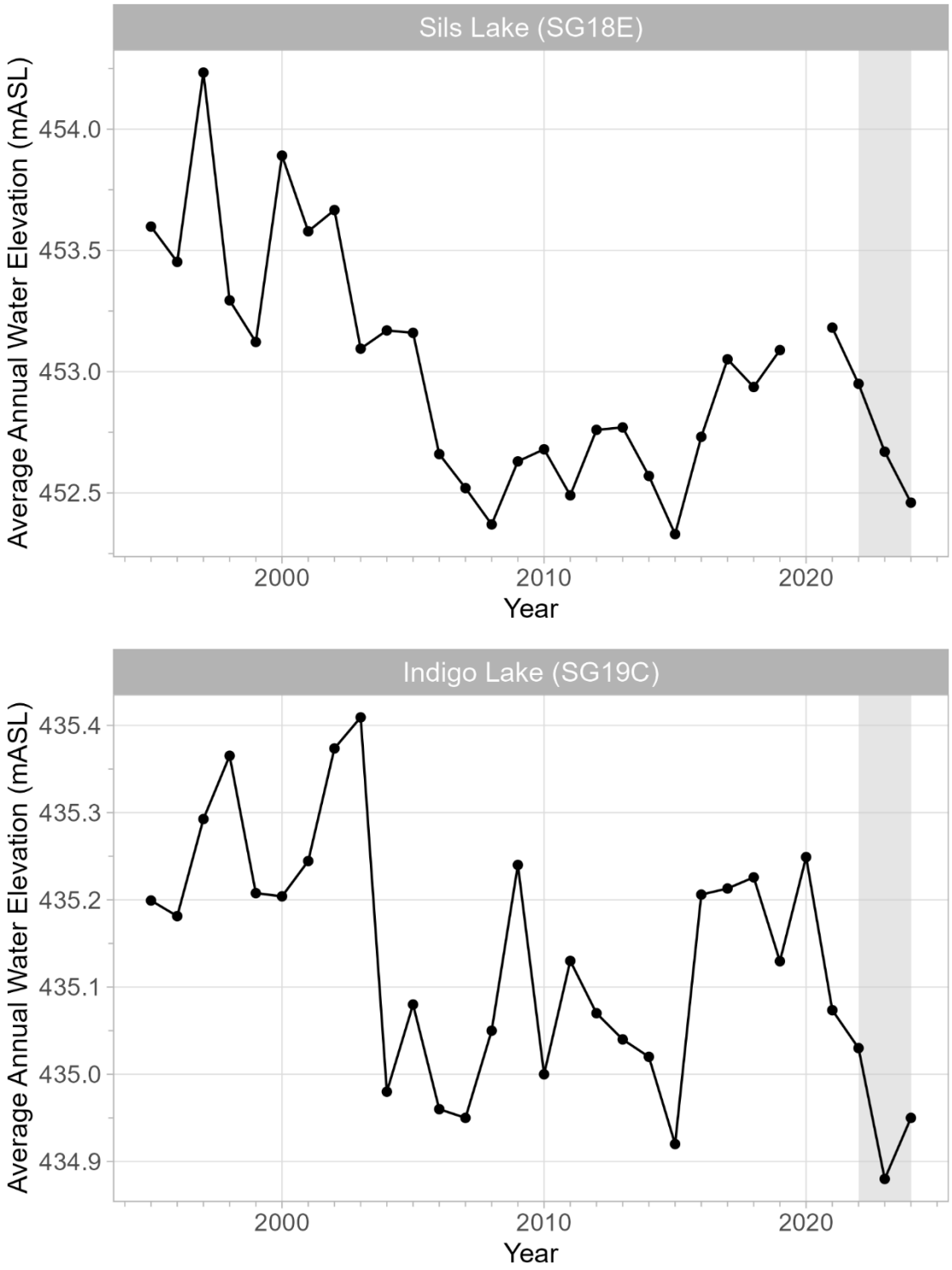


Figure 2.3-12 Average Annual Water Elevation - top) Sils Lake (SG18E) and bottom) Indigo Lake (SG19C) 1995 to 2024

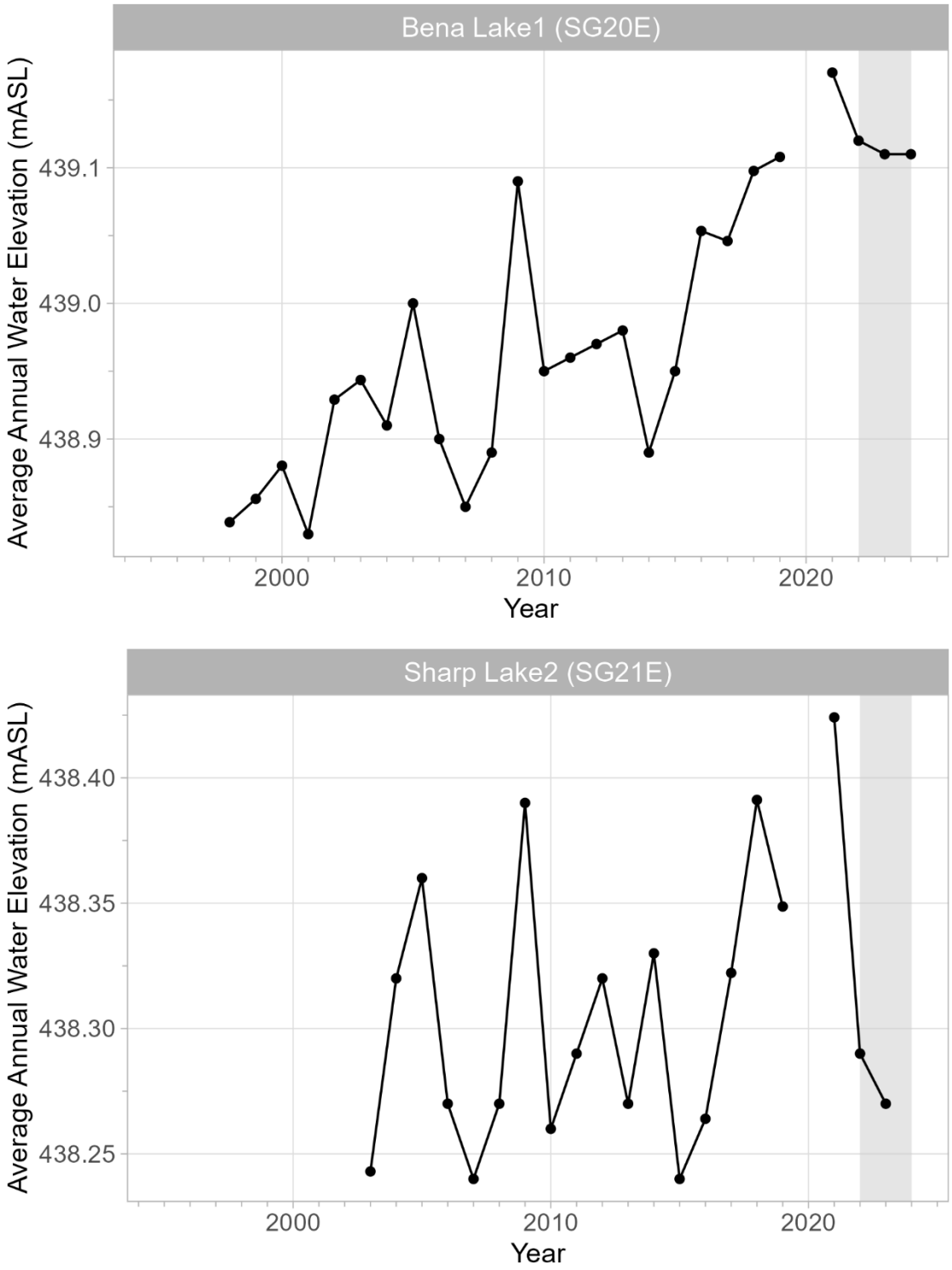


Figure 2.3-13 Average Annual Water Elevation - top) Bena Lake (SG20E) and bottom) Sharp Lake (SG21E) 1995 to 2024

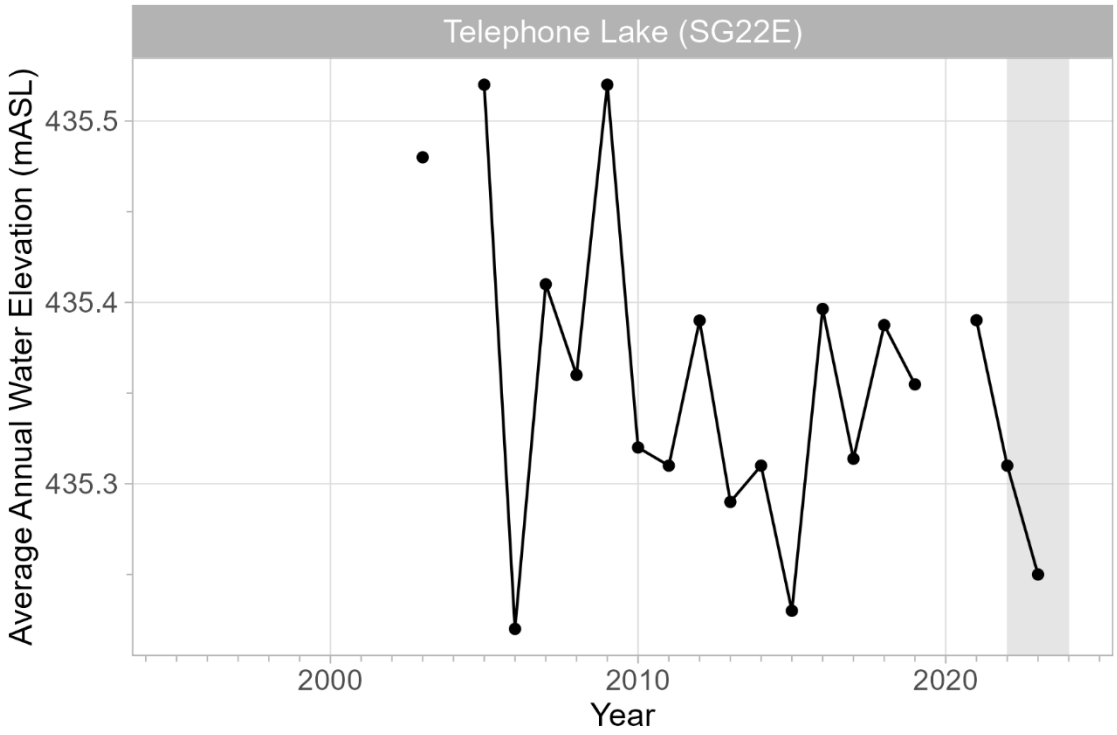
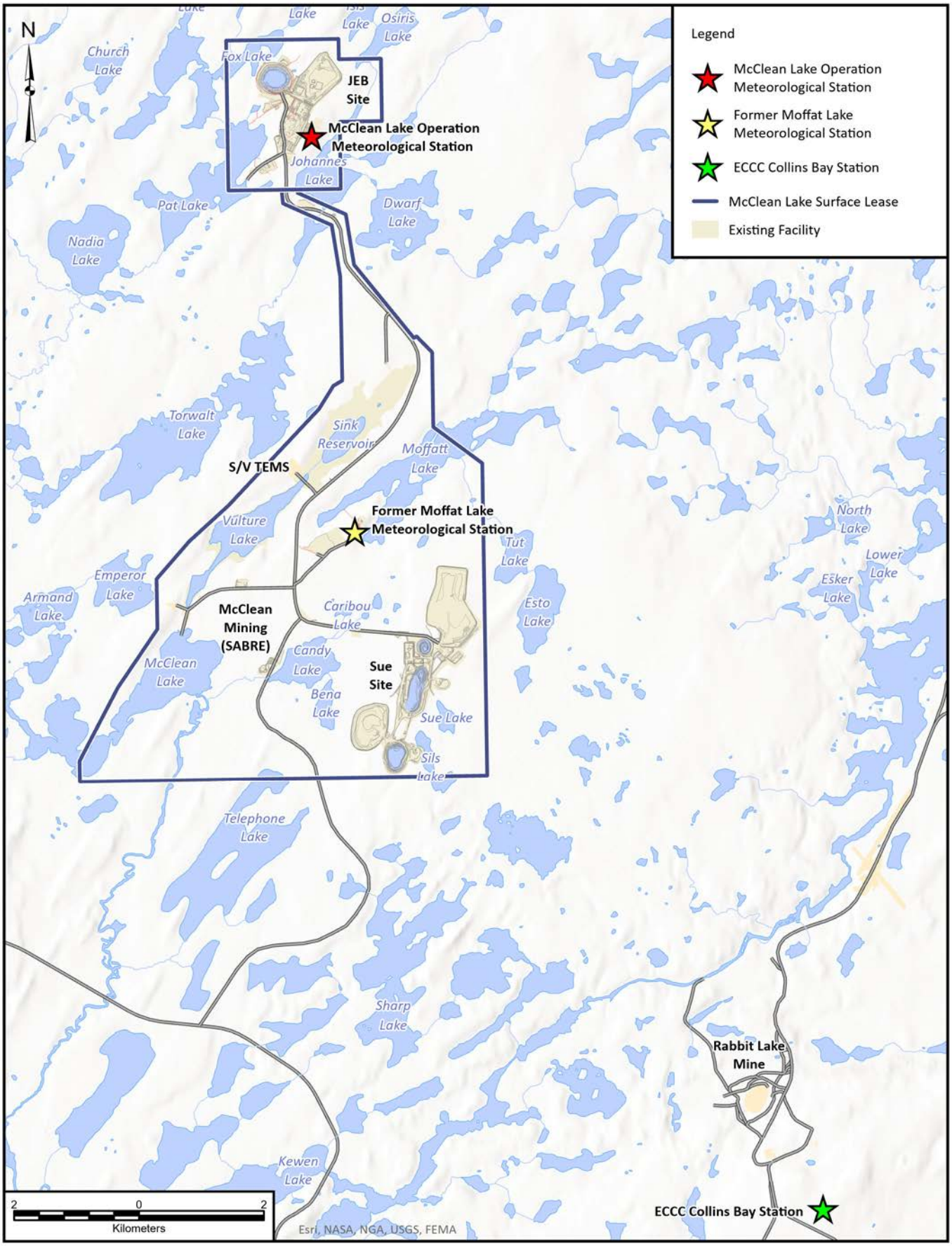


Figure 2.3-14 Average Annual Water Elevation - Telephone Lake (SG22E) 1995 to 2024



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-11-07 11:34 AM Scale: 1:85,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

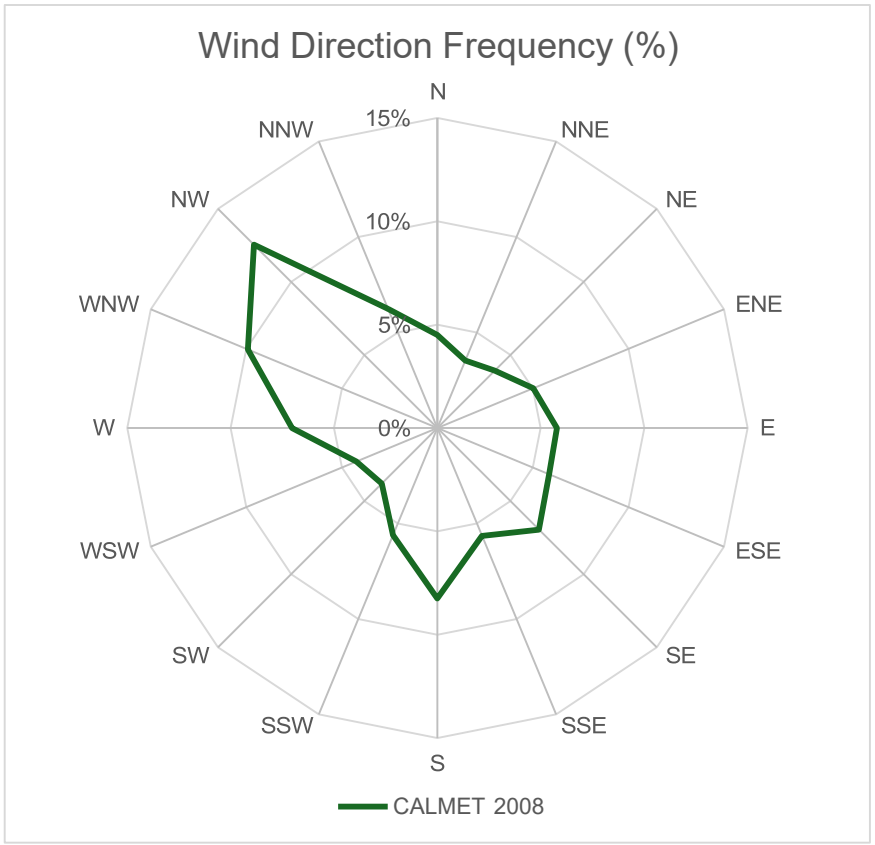
McCLEAN LAKE OPERATION

FIGURE 3.1-1
METEOROLOGICAL STATIONS WITHIN THE McCLEAN LAKE OPERATION LSA

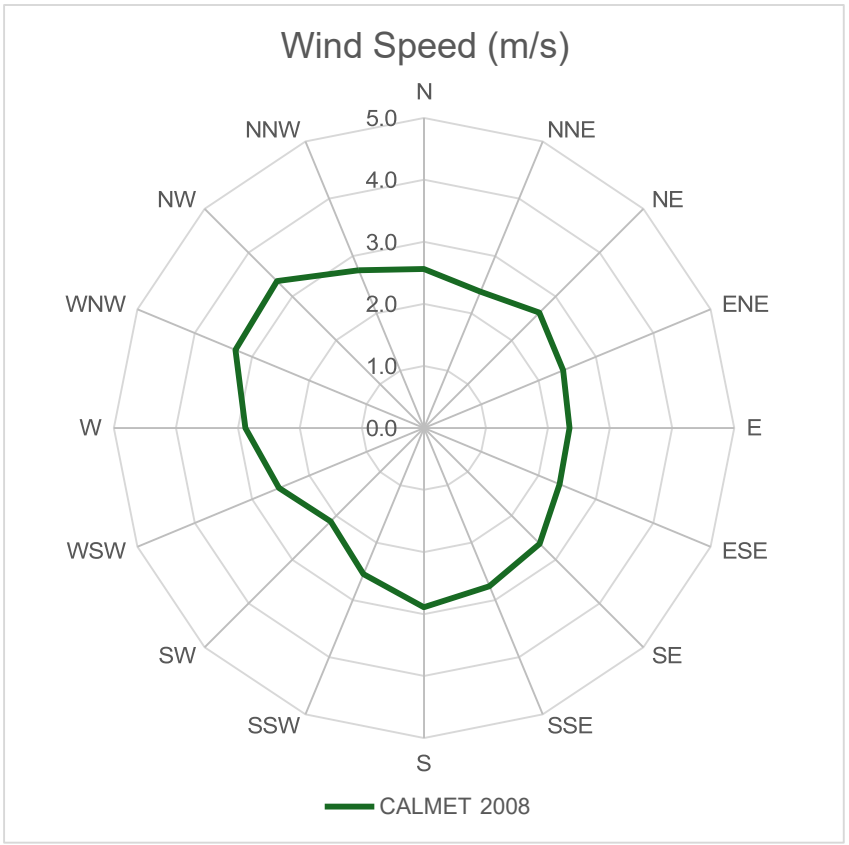
2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 3\EPTID Section 3.aprx



Note: winds blowing from



% Calms: 1.14%

Projection: NA
Drawn: TL Compiled: IEC
Date:2025-12-10 Scale: NA
Data Sources: IEC

McCLEAN LAKE OPERATION

FIGURE 3.1-2
2016 ERA CALMET WIND ROSE

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 3\EPTID Section 3.aprx

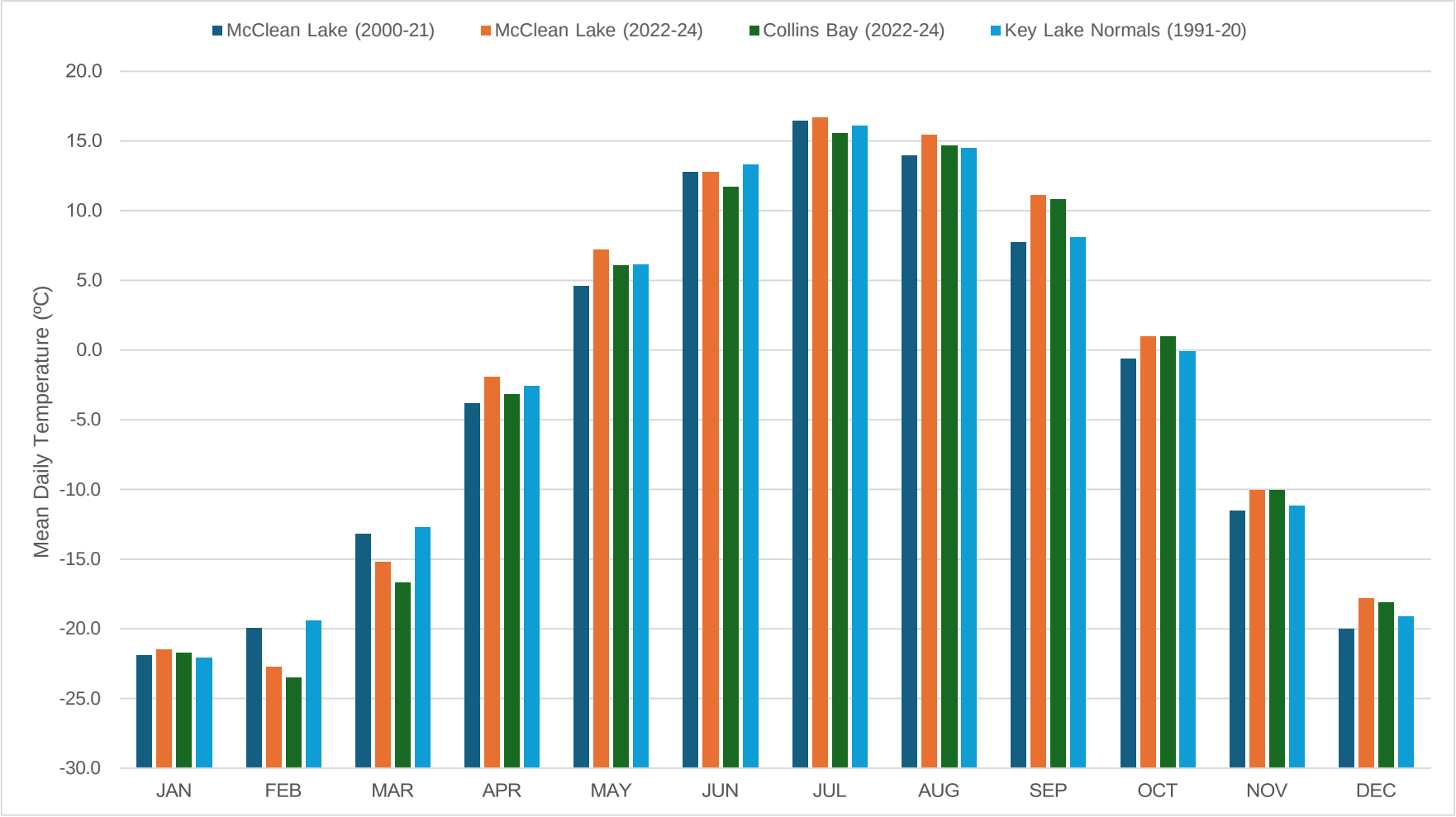


Figure 3.1-3 Mean Daily Temperature at McClean Lake Compared to Collins Bay and Key Lake Climate Normals.

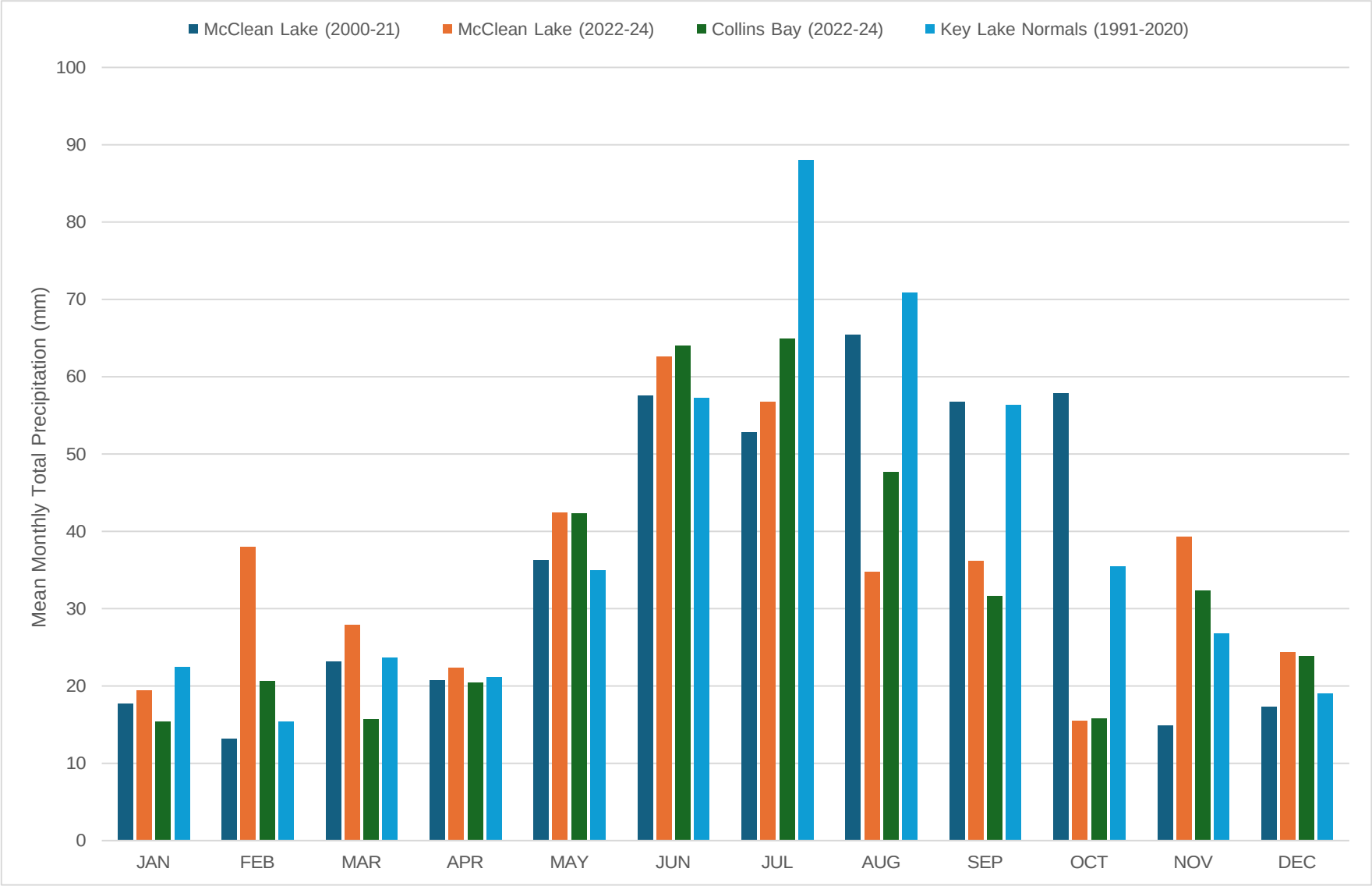
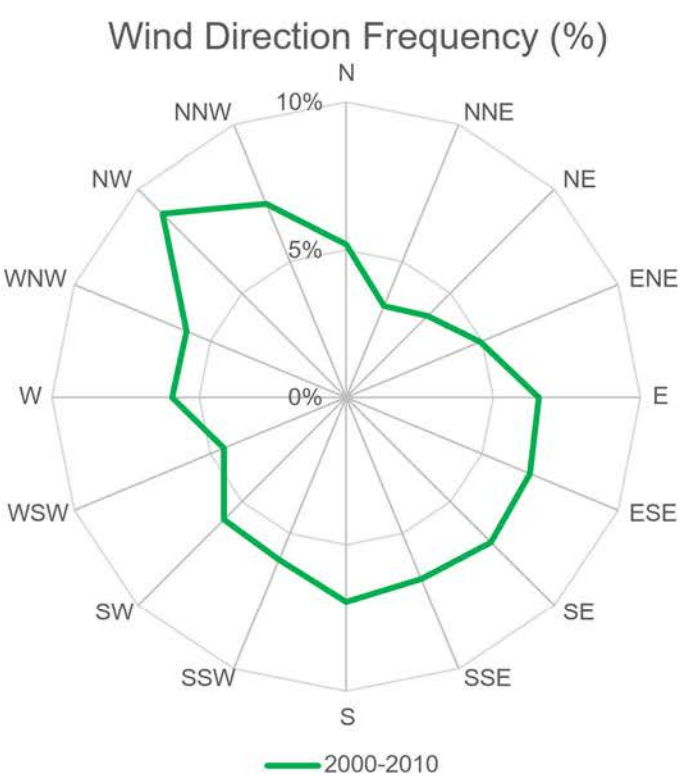
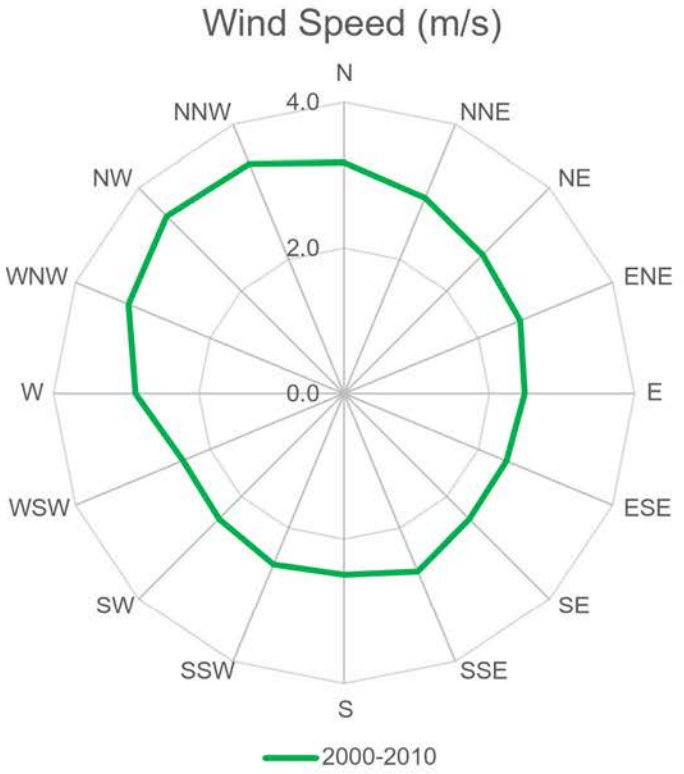


Figure 3.1-4 Mean Monthly Precipitation at McClean Lake Compared to Collins Bay and Key Lake Climate Normals.



NOTE: winds blowing from



NOTE: winds blowing from
Calms: 0.5%

Projection: NA
Drawn: TL
Compiled: AV
Date:2025-11-07
Scale: NA
Data Sources: NA

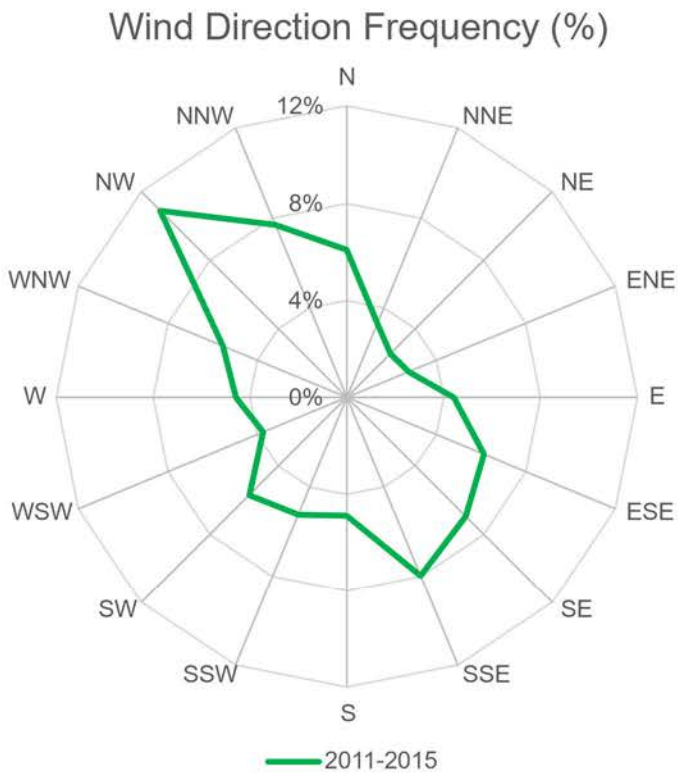
McCLEAN LAKE OPERATION

FIGURE 3.1-5
WIND ROSE AT McCLEAN LAKE OPERATION, 2000 TO 2010

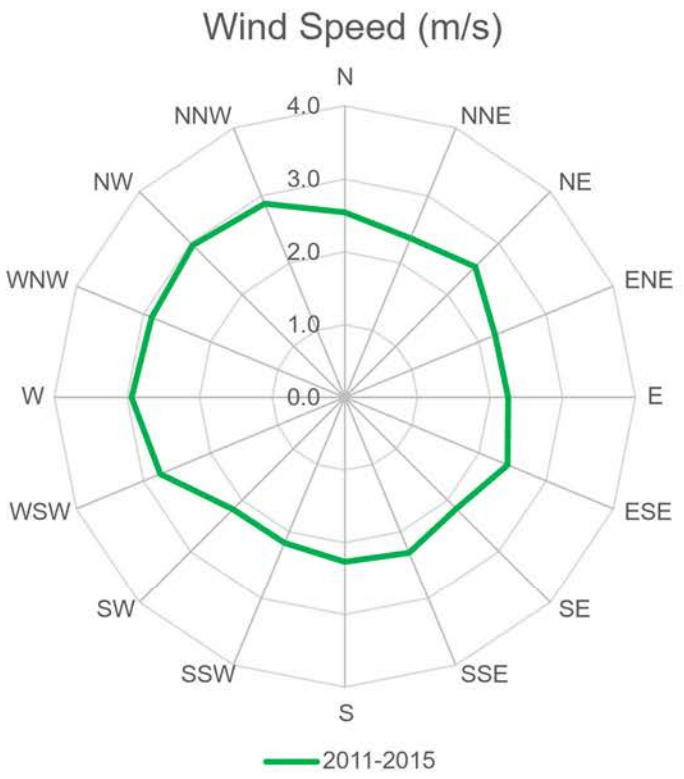
2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: O:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 3\EPTID Section 3.aprx



NOTE: winds blowing from



NOTE: winds blowing from
Calms: 5.53%

Projection: NA
Drawn: TL Compiled: AV
Date:2025-11-07 Scale: NA
Data Sources: EQUIS DATABASE

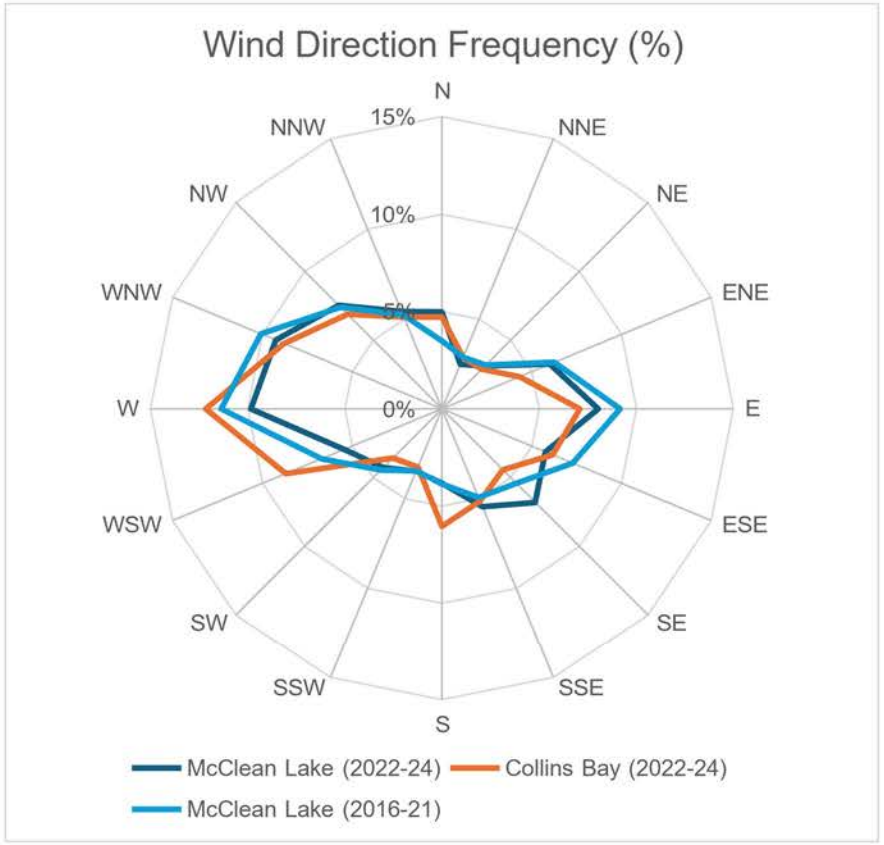
McCLEAN LAKE OPERATION

FIGURE 3.1-6
WIND ROSE AT McCLEAN LAKE OPERATION, 2011 TO 2015

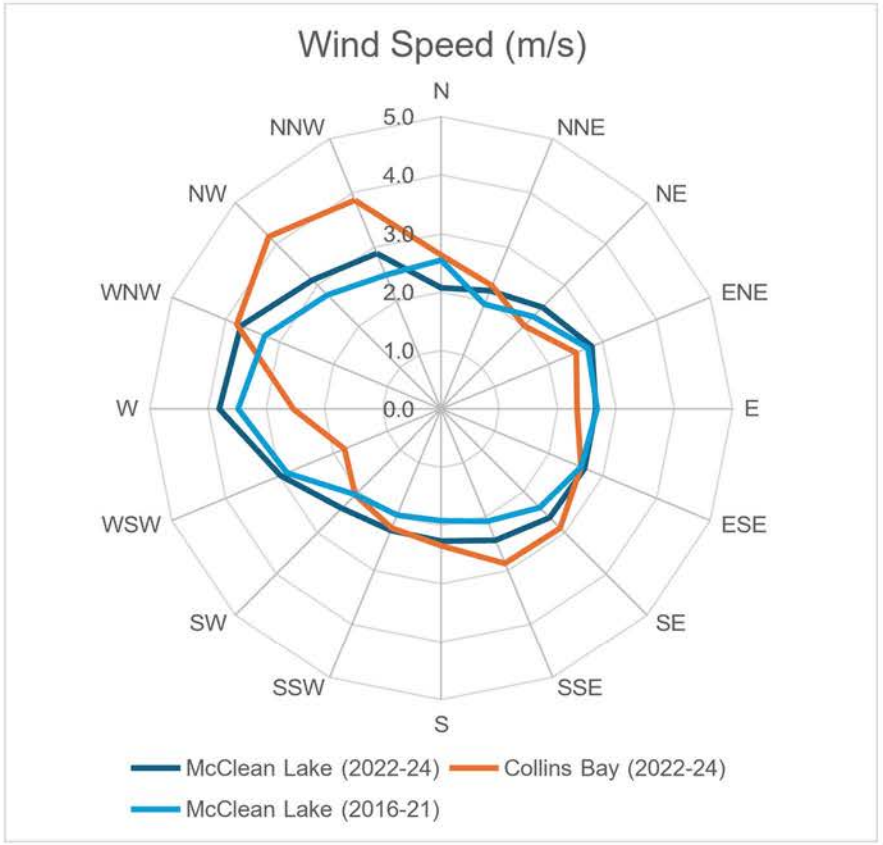
2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: O:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 3\EPTID Section 3.aprx



NOTE: winds blowing from



NOTE: winds blowing from
% Calms: McClean 2016-21 (1.9%)
McClean 2022-24 (1.1%)
Collins Bay 2022-24 (the instrument threshold is 0.83m/s, therefore, calms are zero)

Projection: NA
Drawn: TL Compiled: IEC
Date:2025-11-07 Scale: NA
Data Sources: EQUIS DATABASE, IEC, Env. Canada

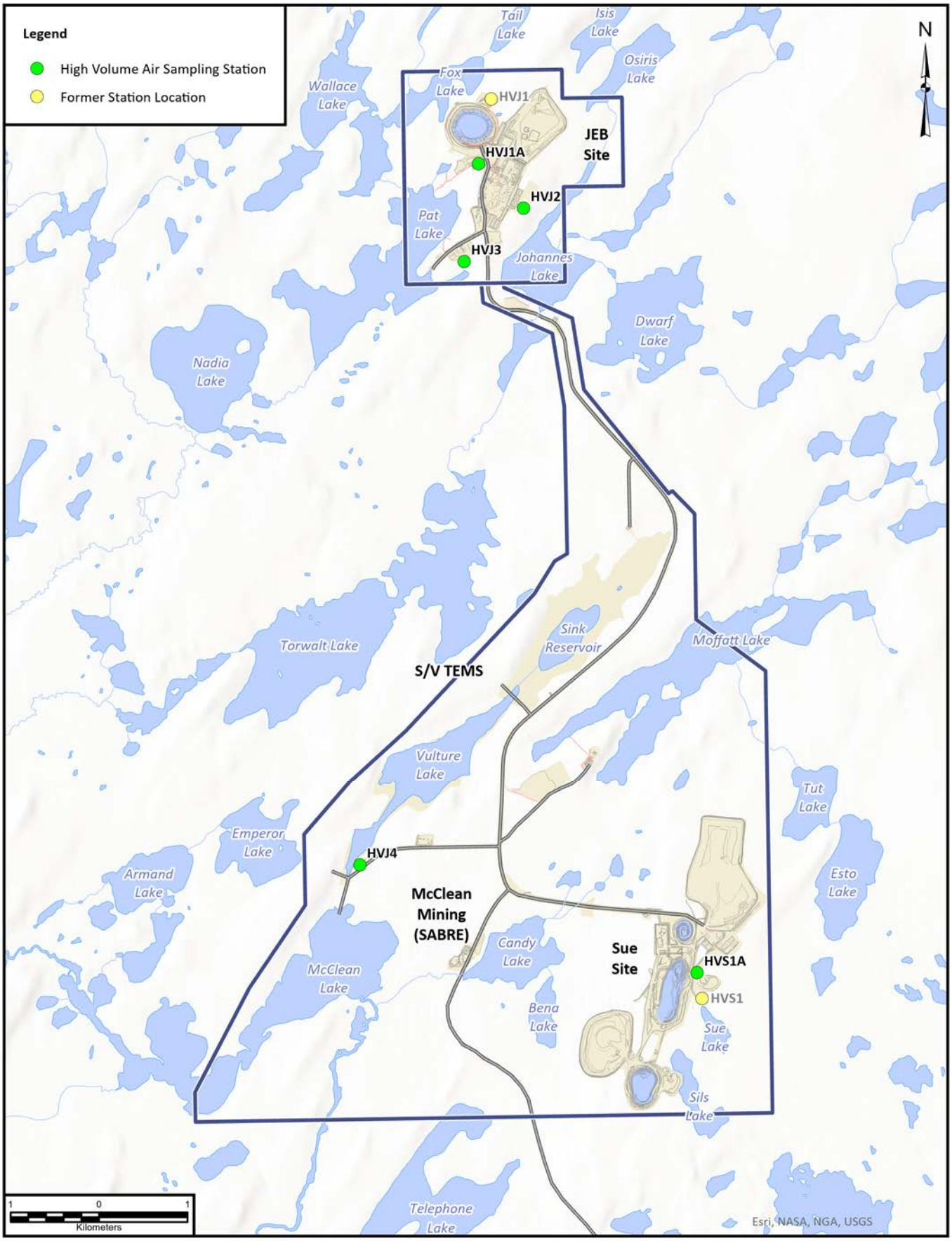
McCLEAN LAKE OPERATION

FIGURE 3.1-7
WIND ROSE AT McCLEAN LAKE OPERATION (2016 TO 2021, 2022 TO 2024) COMPARED TO COLLINS BAY 2022 TO 2024

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 3\EPTID Section 3.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-11-07 12:32 PM Scale: 1:60,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 3.2-1
HIGH VOLUME AIR SAMPLING STATIONS
WITHIN THE McCLEAN LAKE OPERATION LSA

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 3\EPTID Section 3.aprx

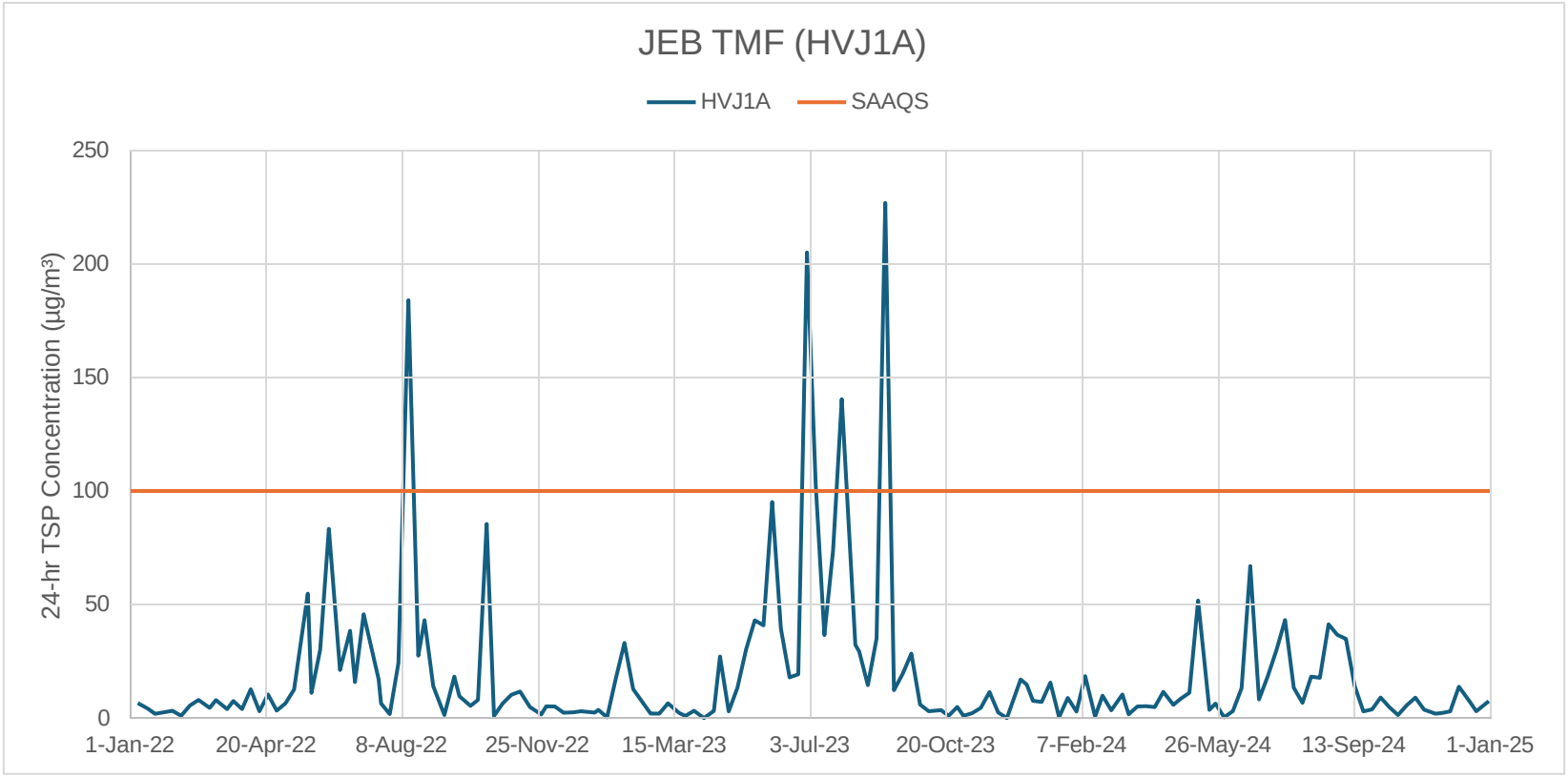


Figure 3.2-2 Measured 24-hour TSP Concentrations at the JEB TMF (HVJ1A), 2022 to 2024

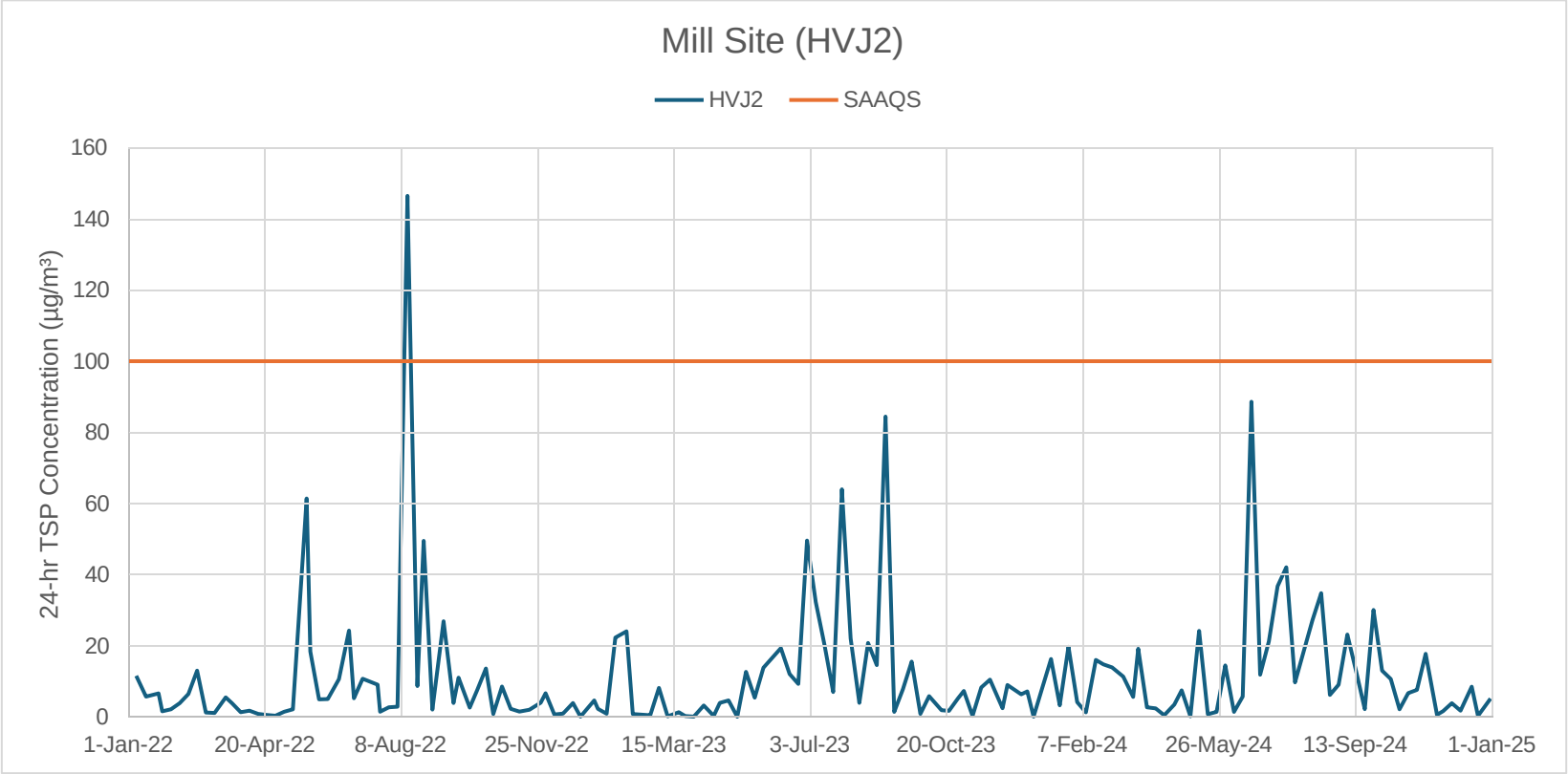


Figure 3.2-3 Measured 24-hour TSP Concentrations at the Mill Site (HVJ2), 2022 to 2024

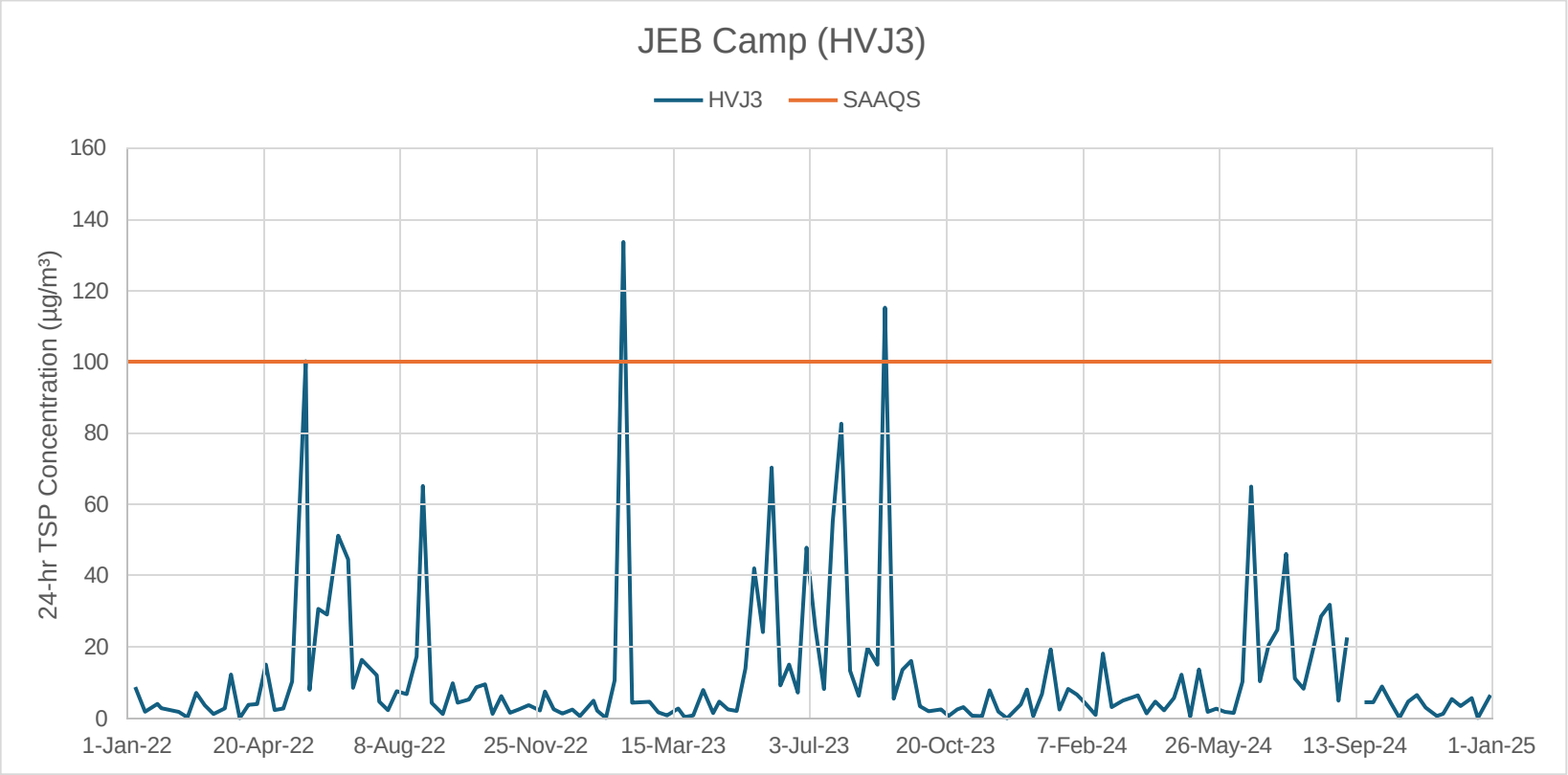


Figure 3.2-4 Measured 24-hour TSP Concentrations at the JEB Camp (HVJ3), 2022 to 2024

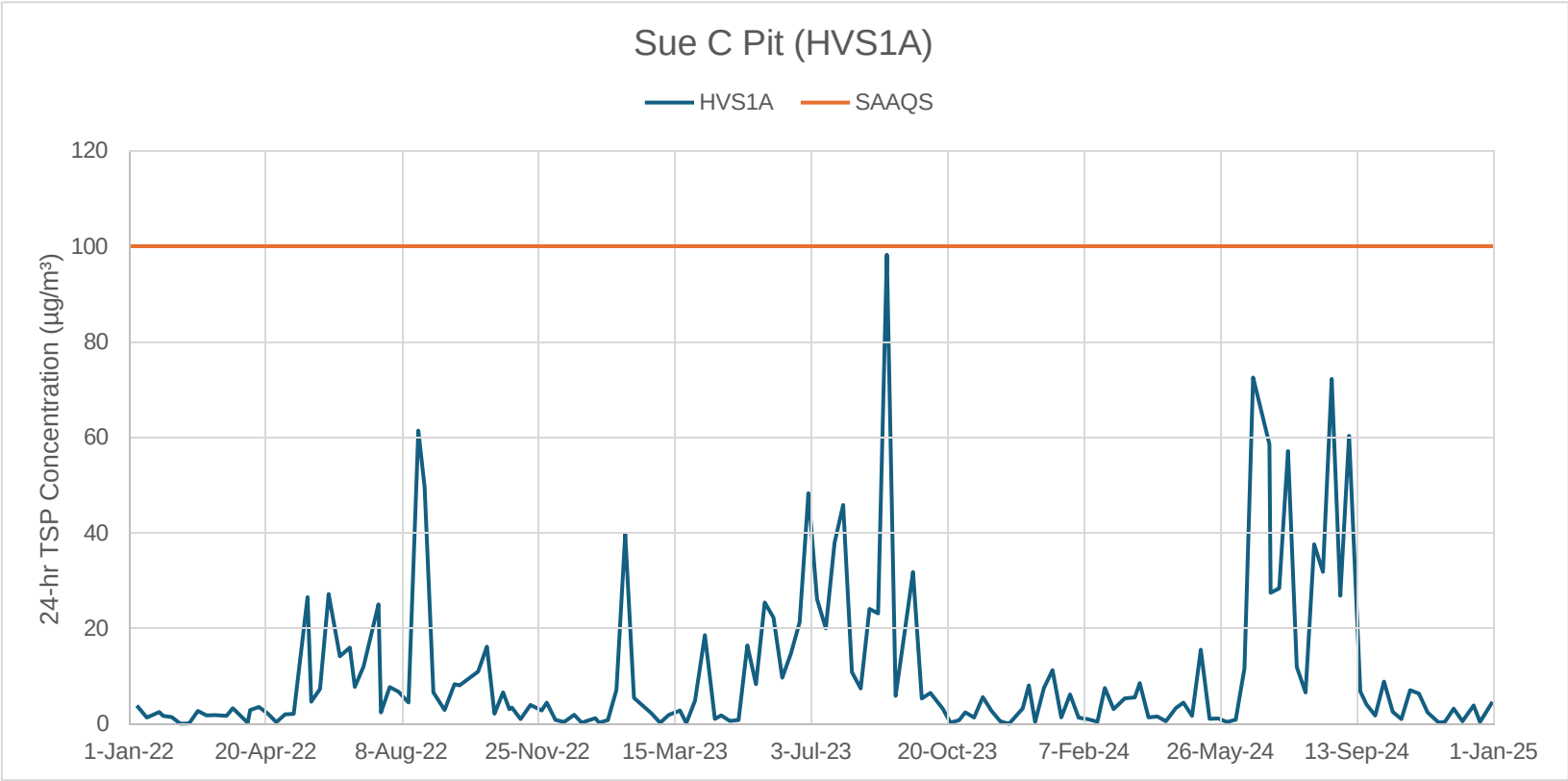


Figure 3.2-5 Measured 24-hour TSP Concentrations at the Sue C Pit (HVS1A), 2022 to 2024

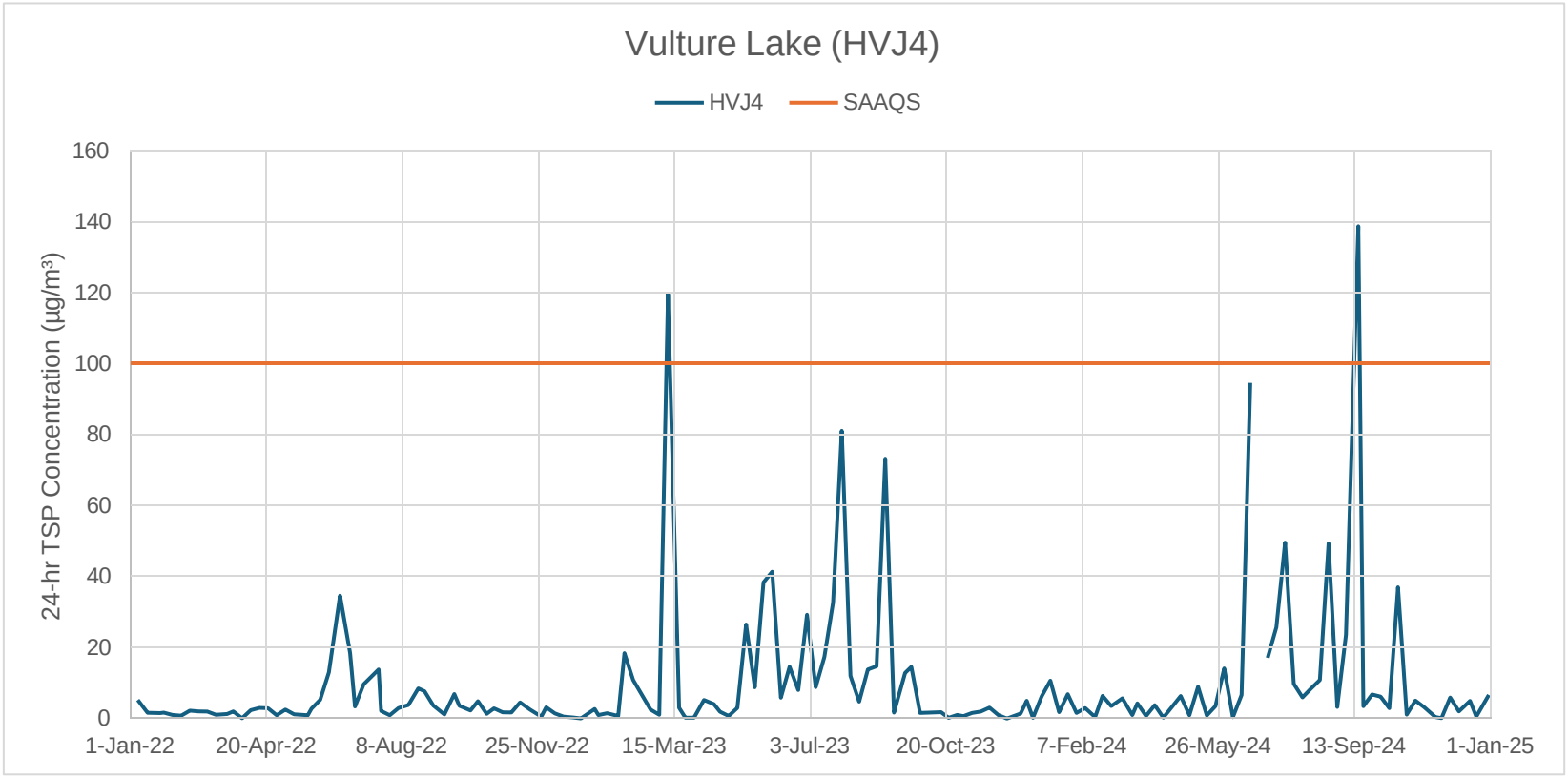


Figure 3.2-6 Measured 24-hour TSP Concentrations at Vulture Lake (HVJ4), 2022 to 2024

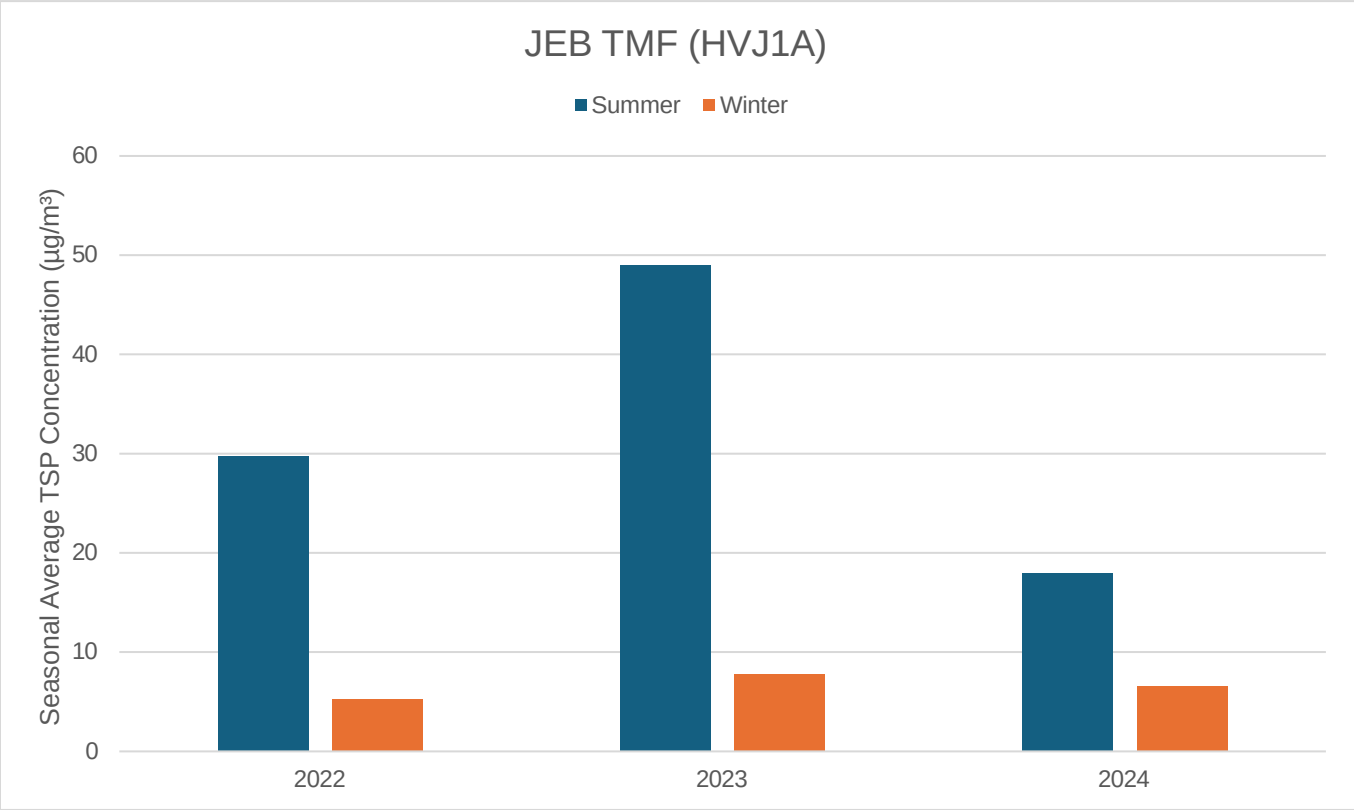
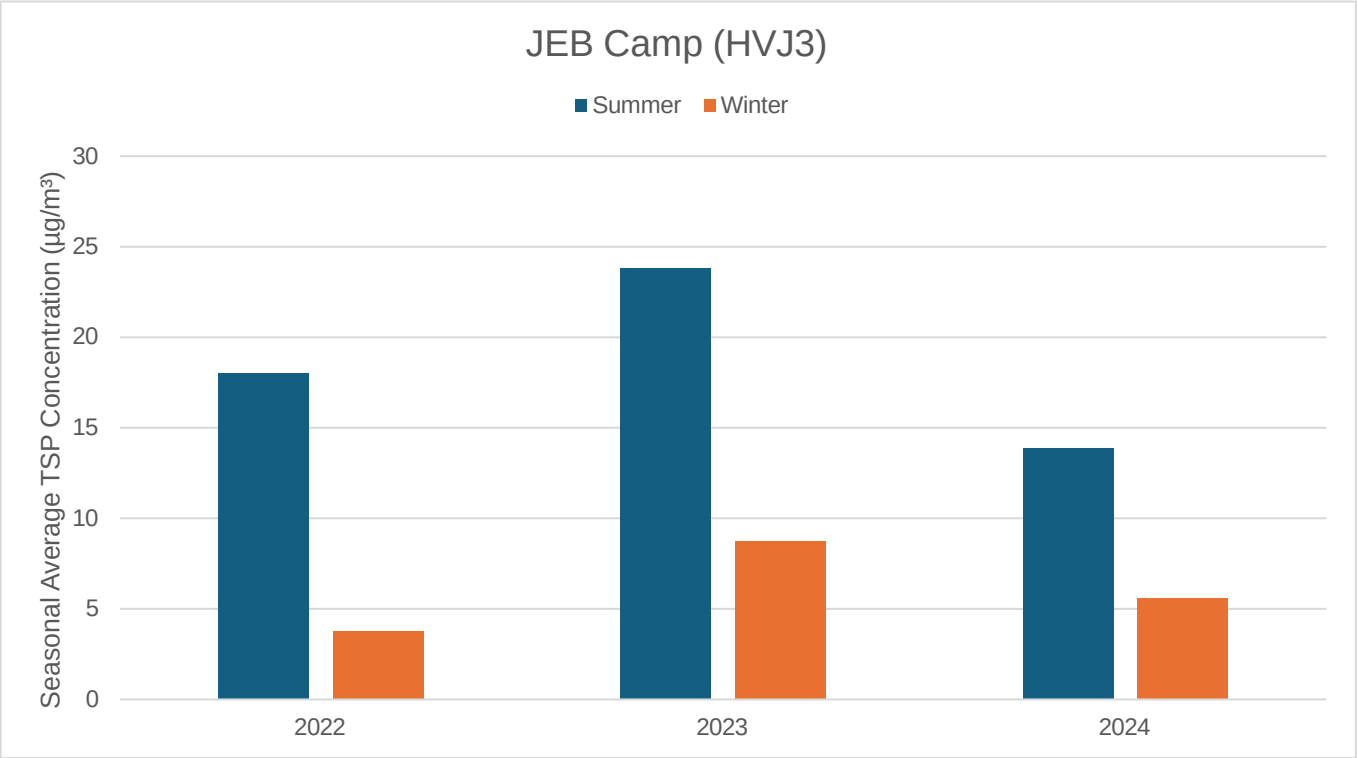


Figure 3.2-7 Seasonal Average TSP Concentrations at the JEB TMF (HVJ1A), 2022 to 2024

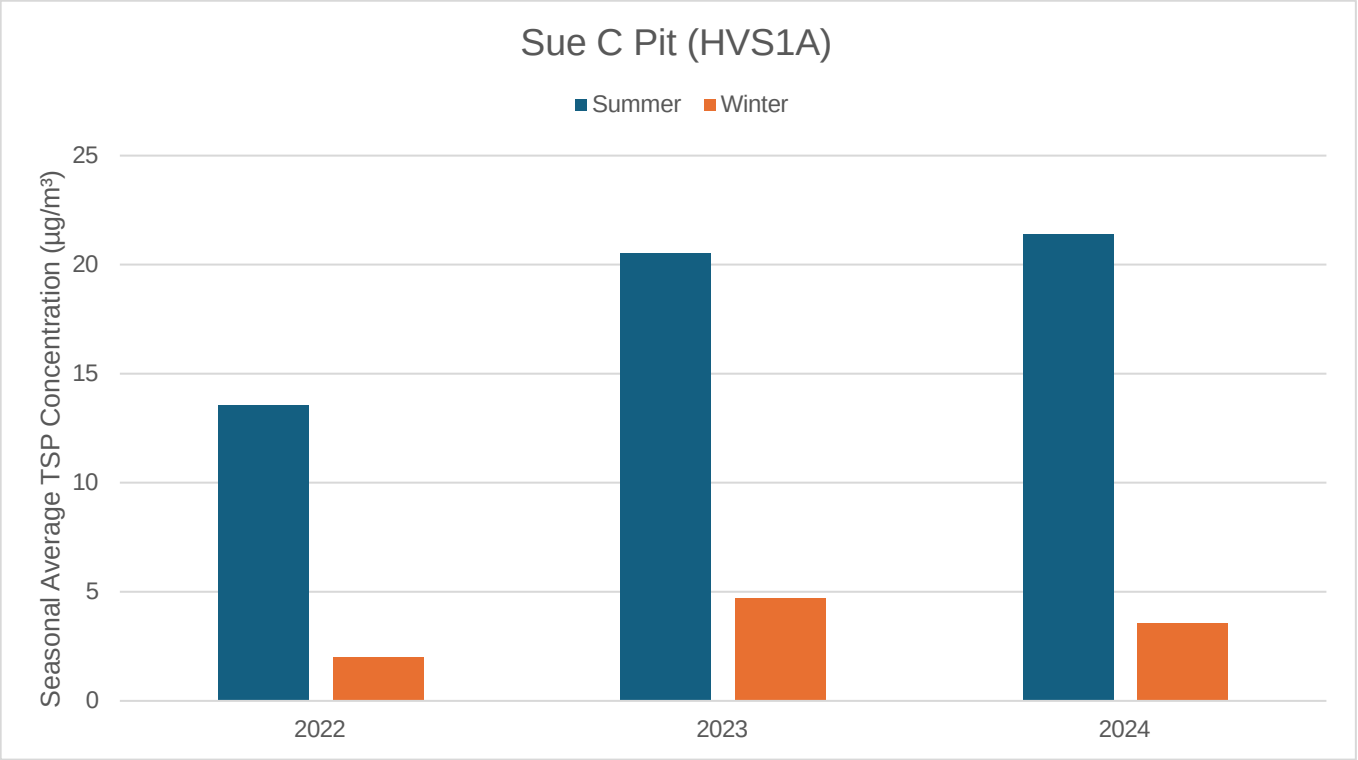


Figure 3.2-8 Seasonal Average TSP Concentrations at the Mill Site (HVJ2), 2022 to 2024



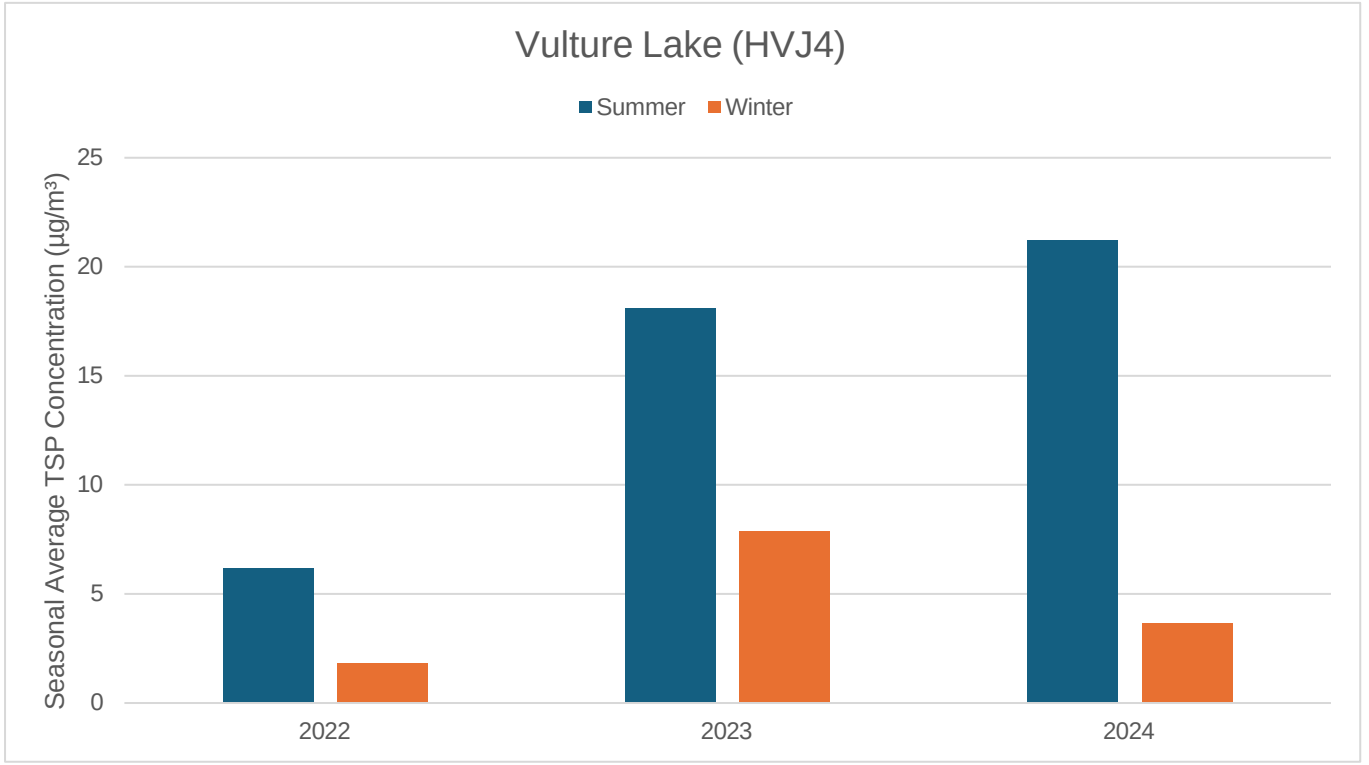
Note: Summer is defined as May to October when the mean monthly temperature is above zero (see Table 3.1-2).

Figure 3.2-9 Seasonal Average TSP Concentrations at the JEB Camp (HVJ3), 2022 to 2024



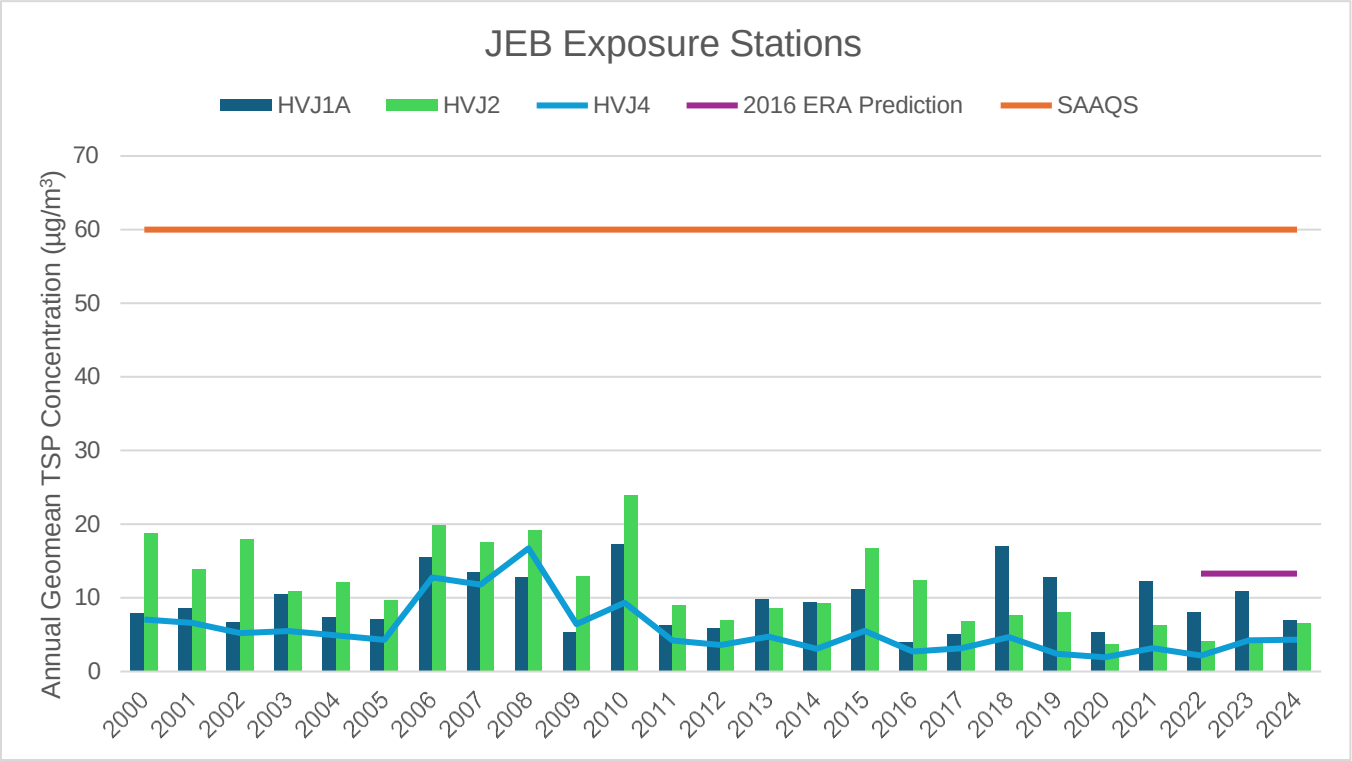
Note: Summer is defined as May to October when the mean monthly temperature is above zero (see Table 3.1-2).

Figure 3.2-10 Seasonal Average TSP Concentrations at the Sue C Pit (HVS1A), 2022 to 2024



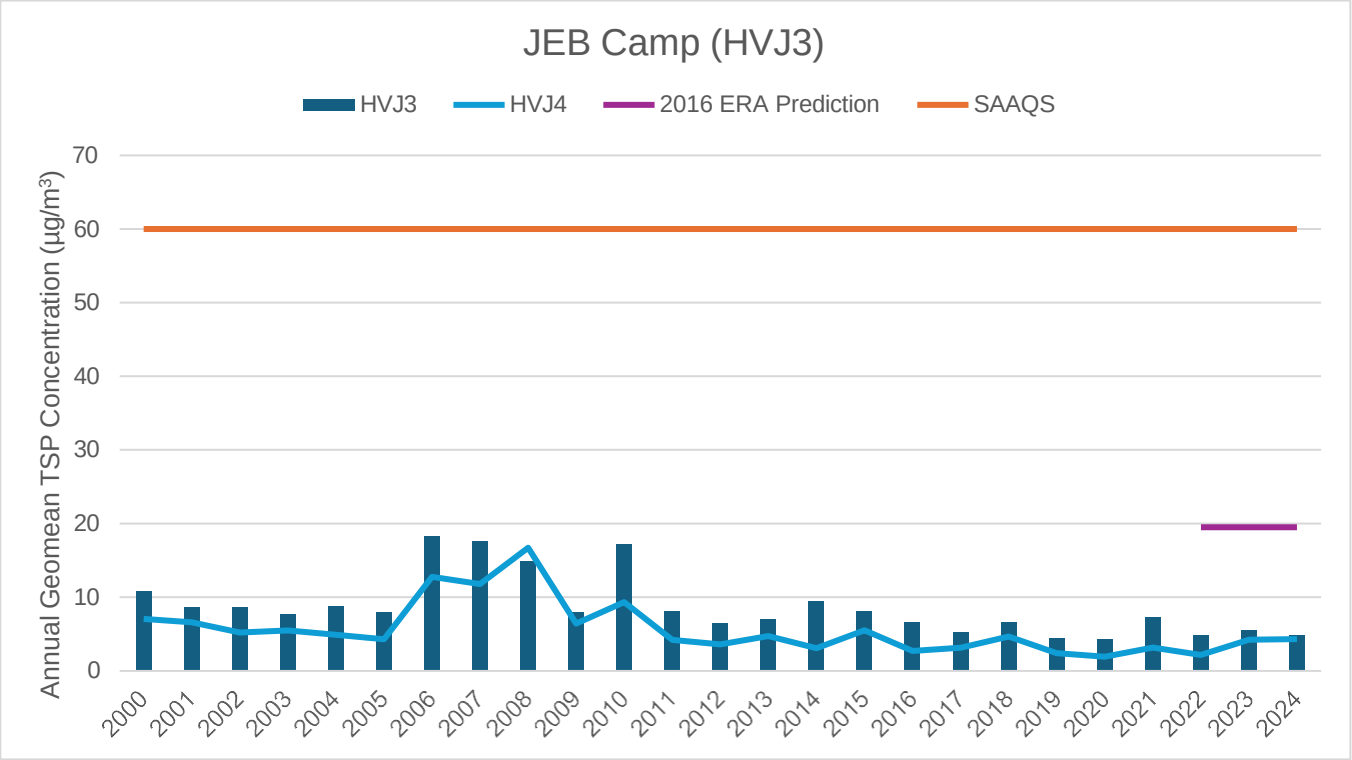
Note: Summer is defined as May to October when the mean monthly temperature is above zero (see Table 3.1-2).

Figure 3.2-11 Seasonal Average TSP Concentrations at Vulture Lake (HVJ4), 2022 to 2024



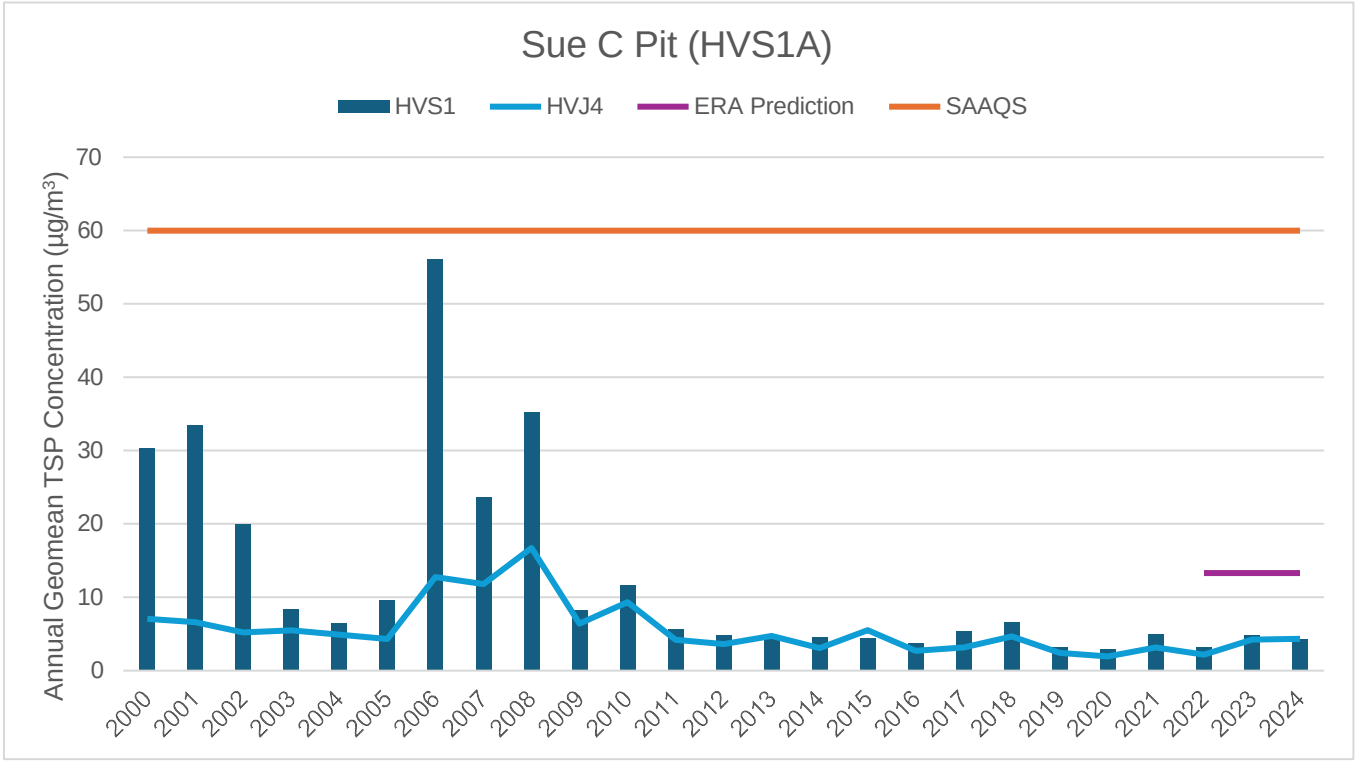
Note: ERA prediction is an arithmetic mean.

Figure 3.2-12 Annual Geomean TSP Concentrations at the JEB Exposure Stations, 2000 to 2024



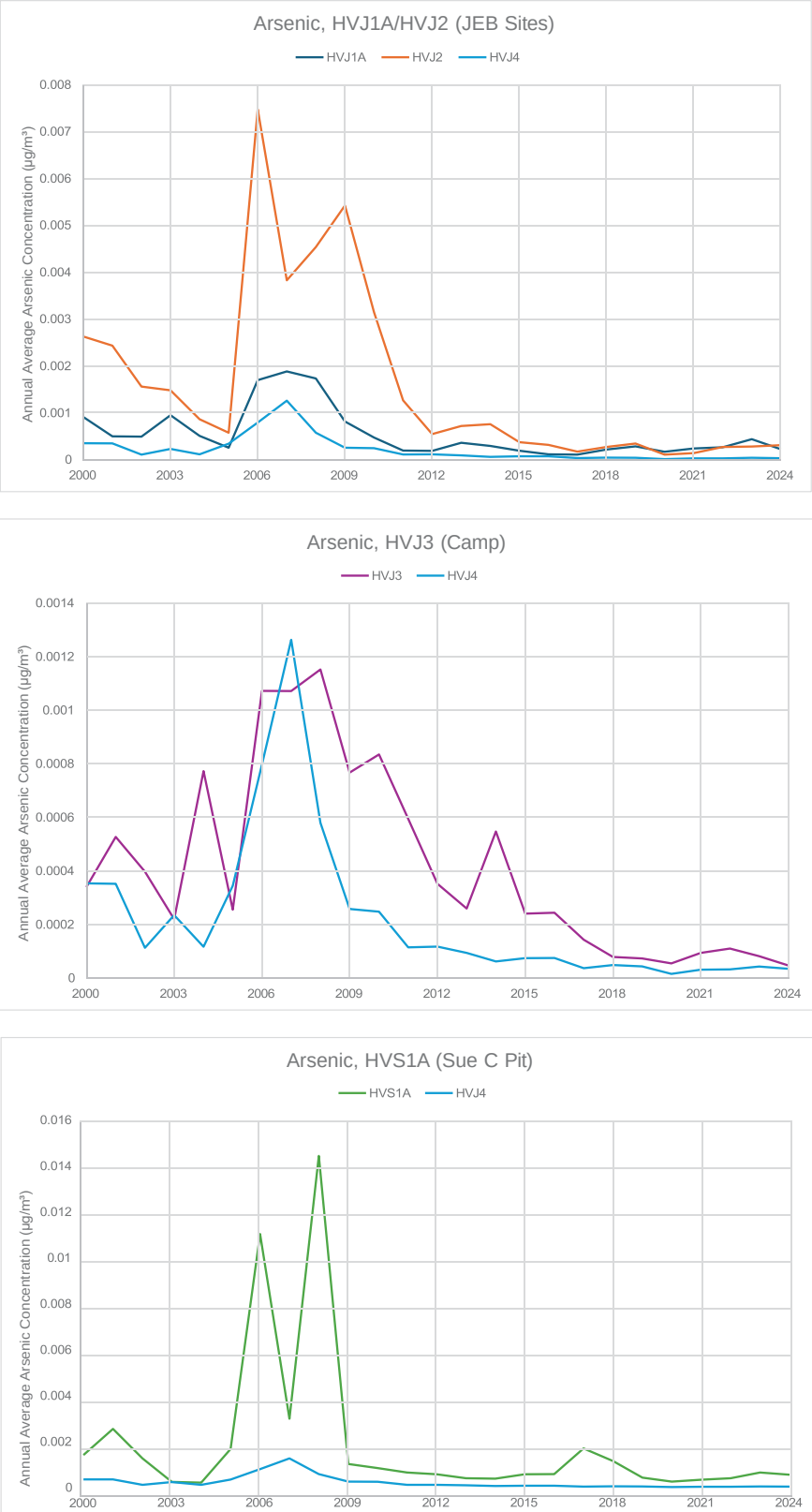
Note: ERA prediction is an arithmetic mean.

Figure 3.2-13 Annual Geomean TSP Concentrations at the JEB Camp, 2000 to 2024



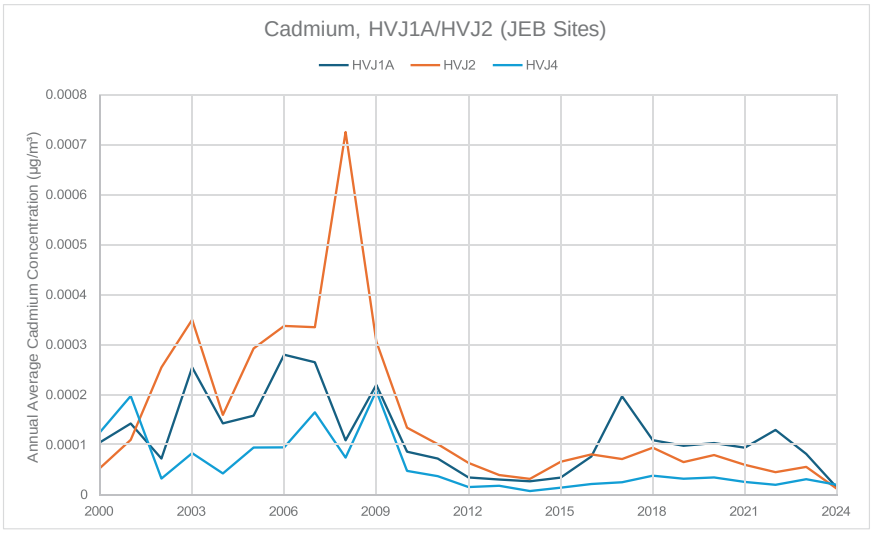
Note: ERA prediction is an arithmetic mean.

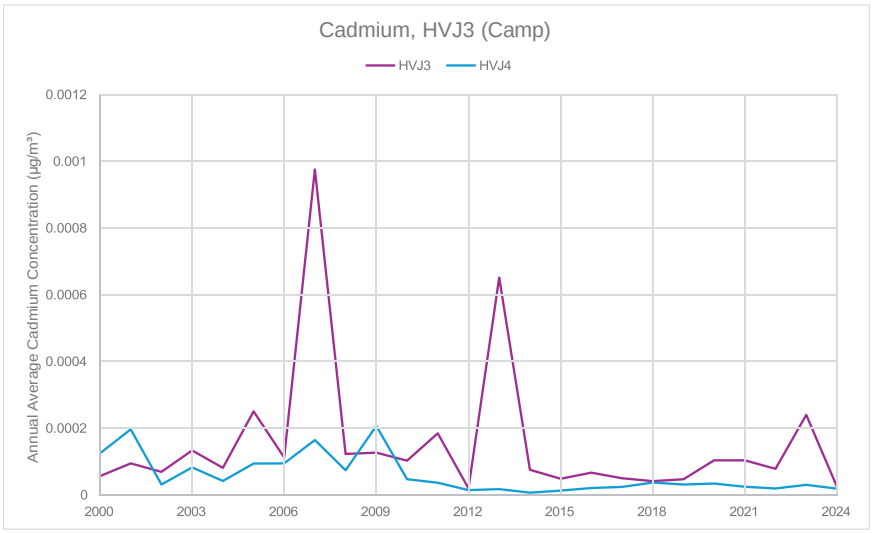
Figure 3.2-14 Annual Geomean TSP Concentrations at the Sue C Pit, 2000 to 2024

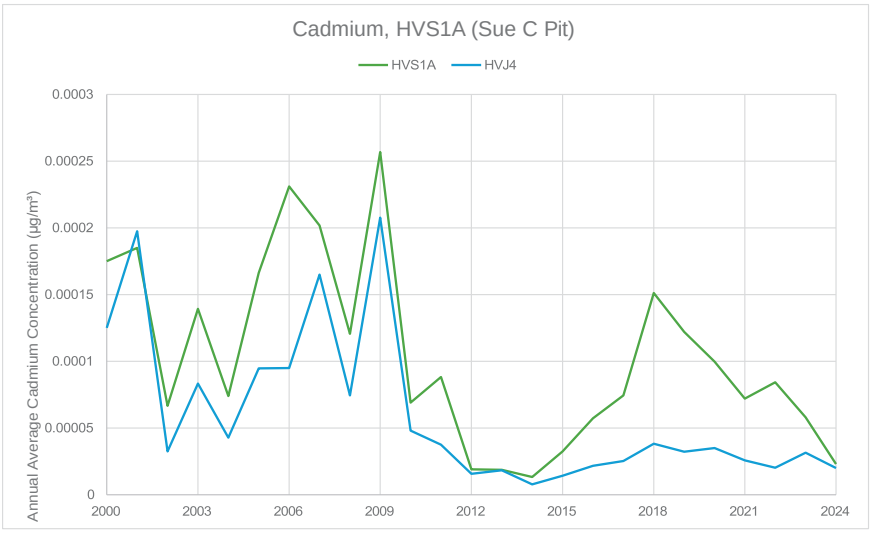


Note: The 2016 ERA prediction (0.1 µg/m³) and AAQC (0.06 µg/m³) are not shown to maintain readability.

Figure 3.2-15 Measured Annual Average Arsenic Concentrations, 2000 to 2024

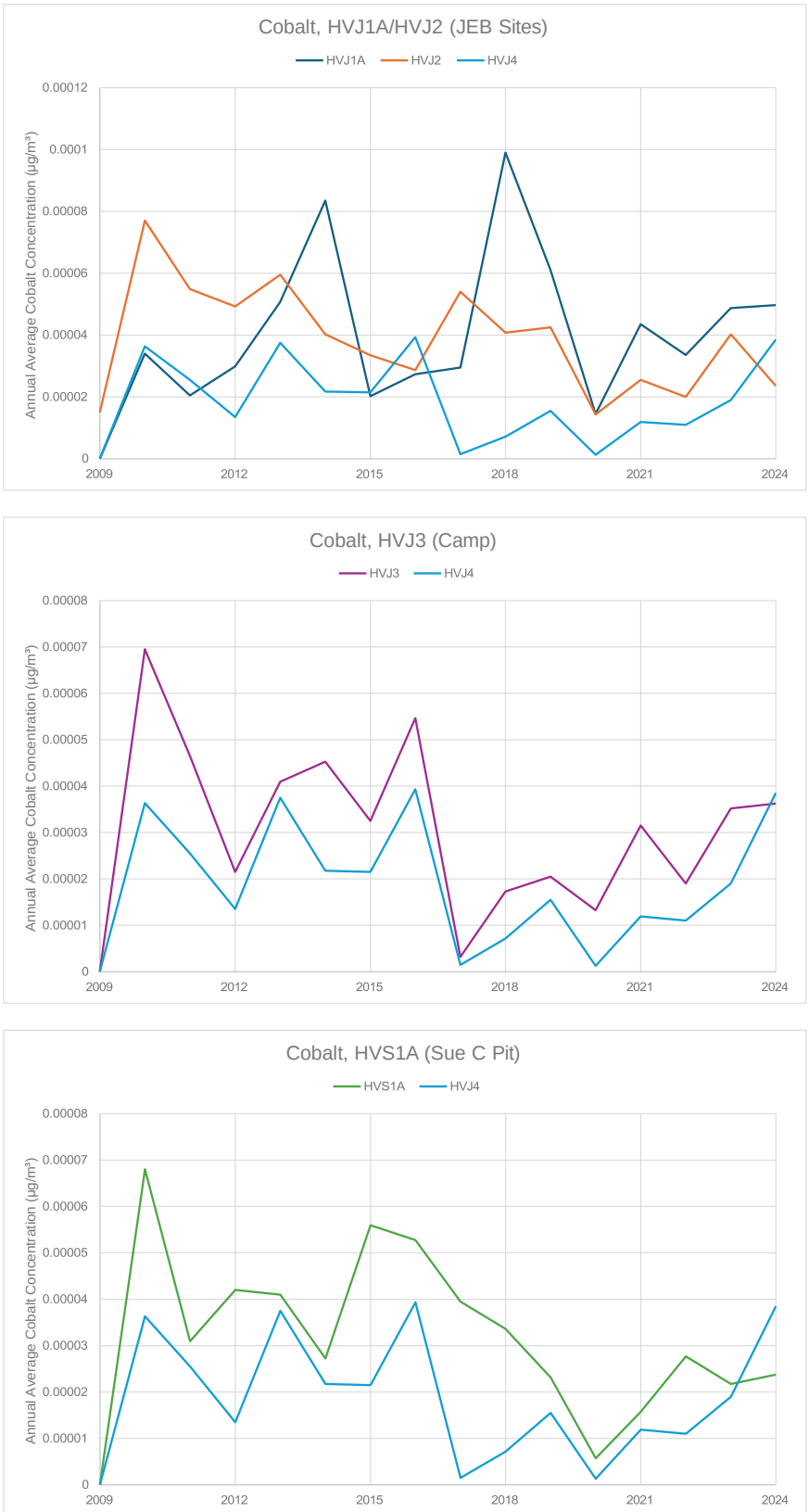






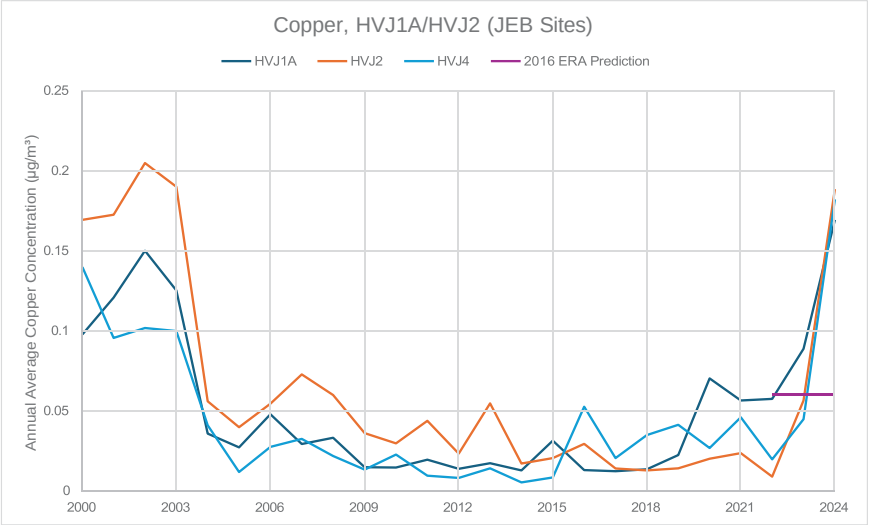
Note: The AAQC (0.005 µg/m³) is not shown to maintain readability. There is no 2016 ERA prediction.

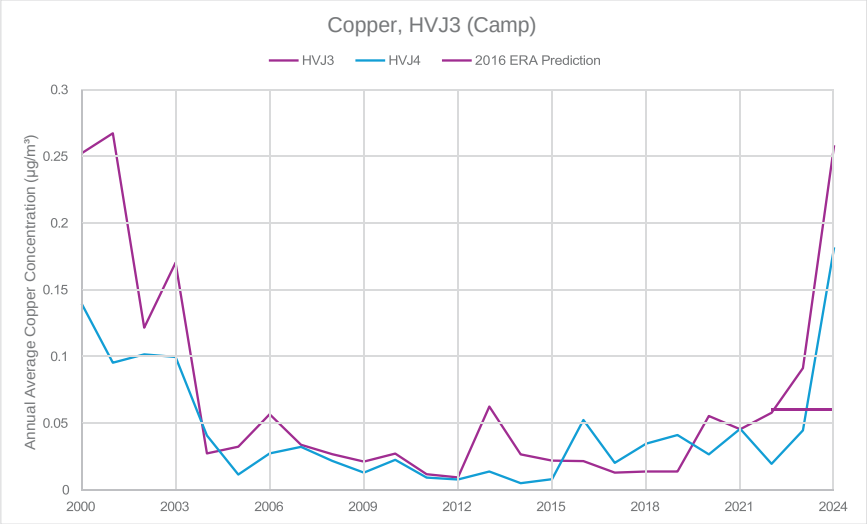
Figure 3.2-16 Measured Annual Average Cadmium Concentrations, 2000 to 2024

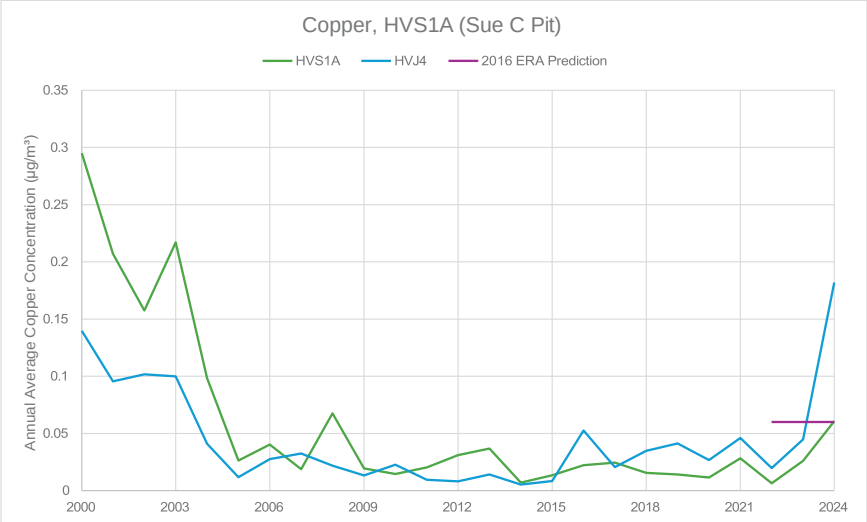


Note: The 2016 ERA prediction (0.01 µg/m³) and AAQC (0.02 µg/m³) are not shown to maintain readability.

Figure 3.2-17 Measured Annual Average Cobalt Concentrations, 2000 to 2024

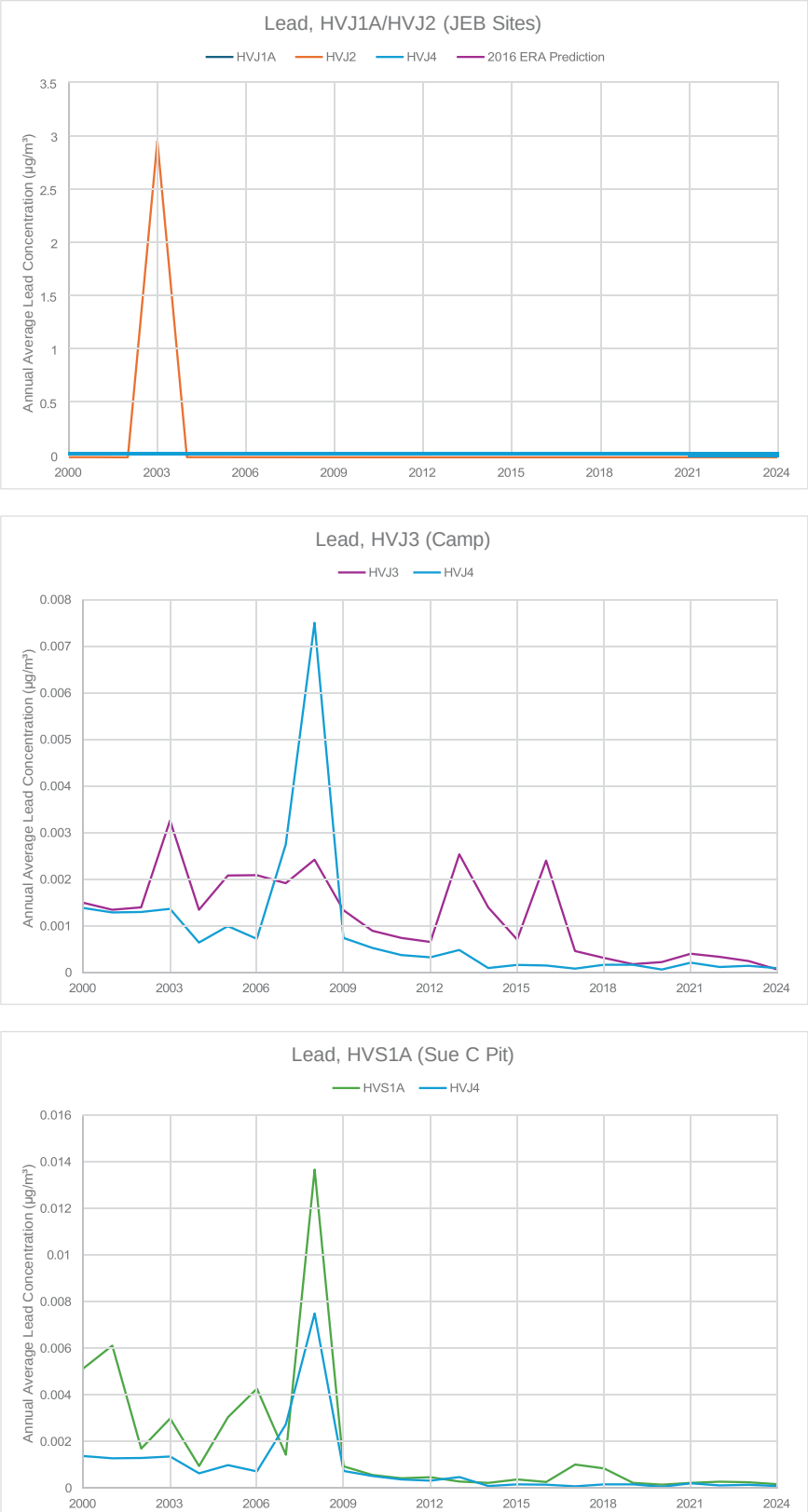






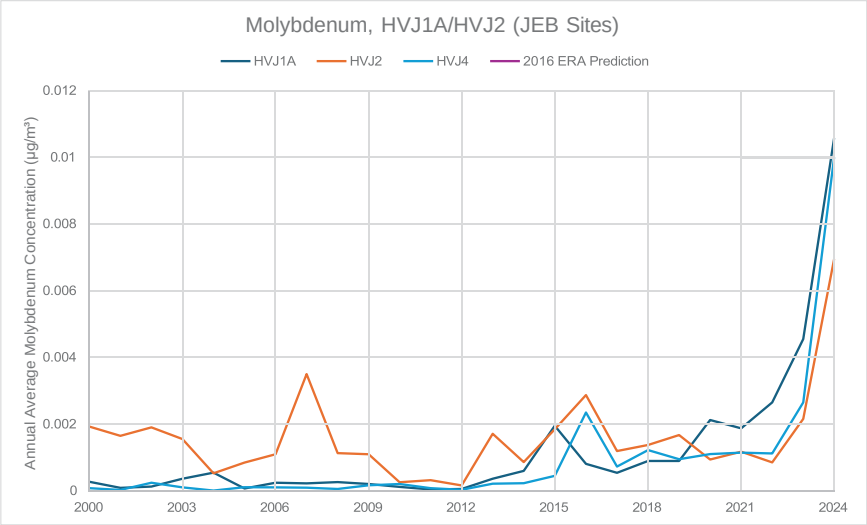
Note: The 2016 ERA prediction (0.06 µg/m³) and AAQC (9.6 µg/m³) are not shown to maintain readability.

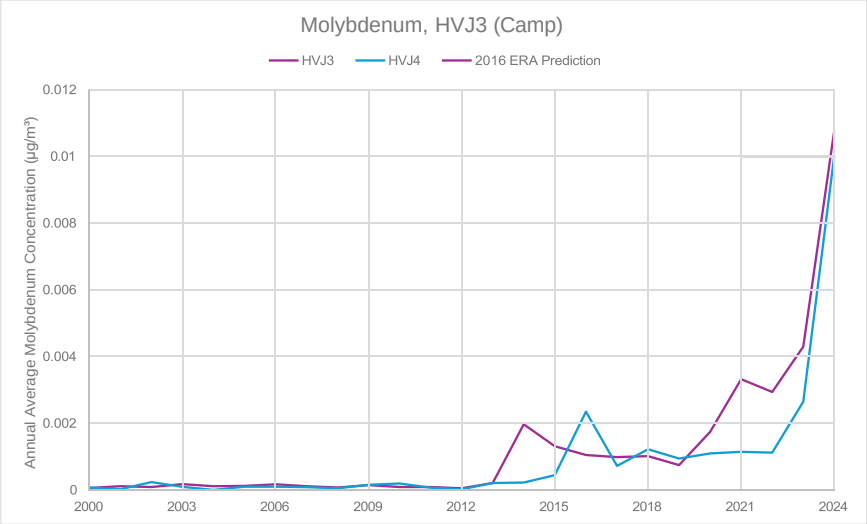
Figure 3.2-18 Measured Annual Average Copper Concentrations, 2000 to 2024

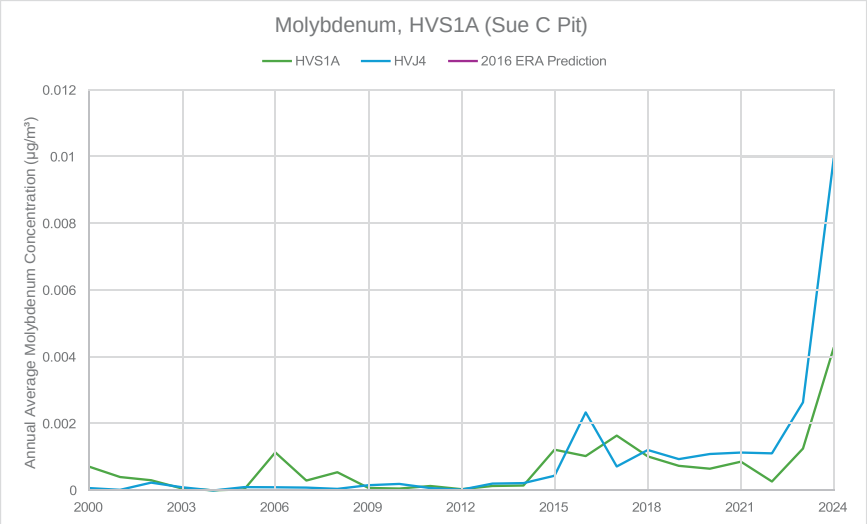


Note: The 2016 ERA predictions (0.03 µg/m³ and 0.031 µg/m³ [JEB camp]) and AAQC (0.1 µg/m³) are not shown to maintain readability.

Figure 3.2-19 Measured Annual Average Lead Concentrations, 2000 to 2024

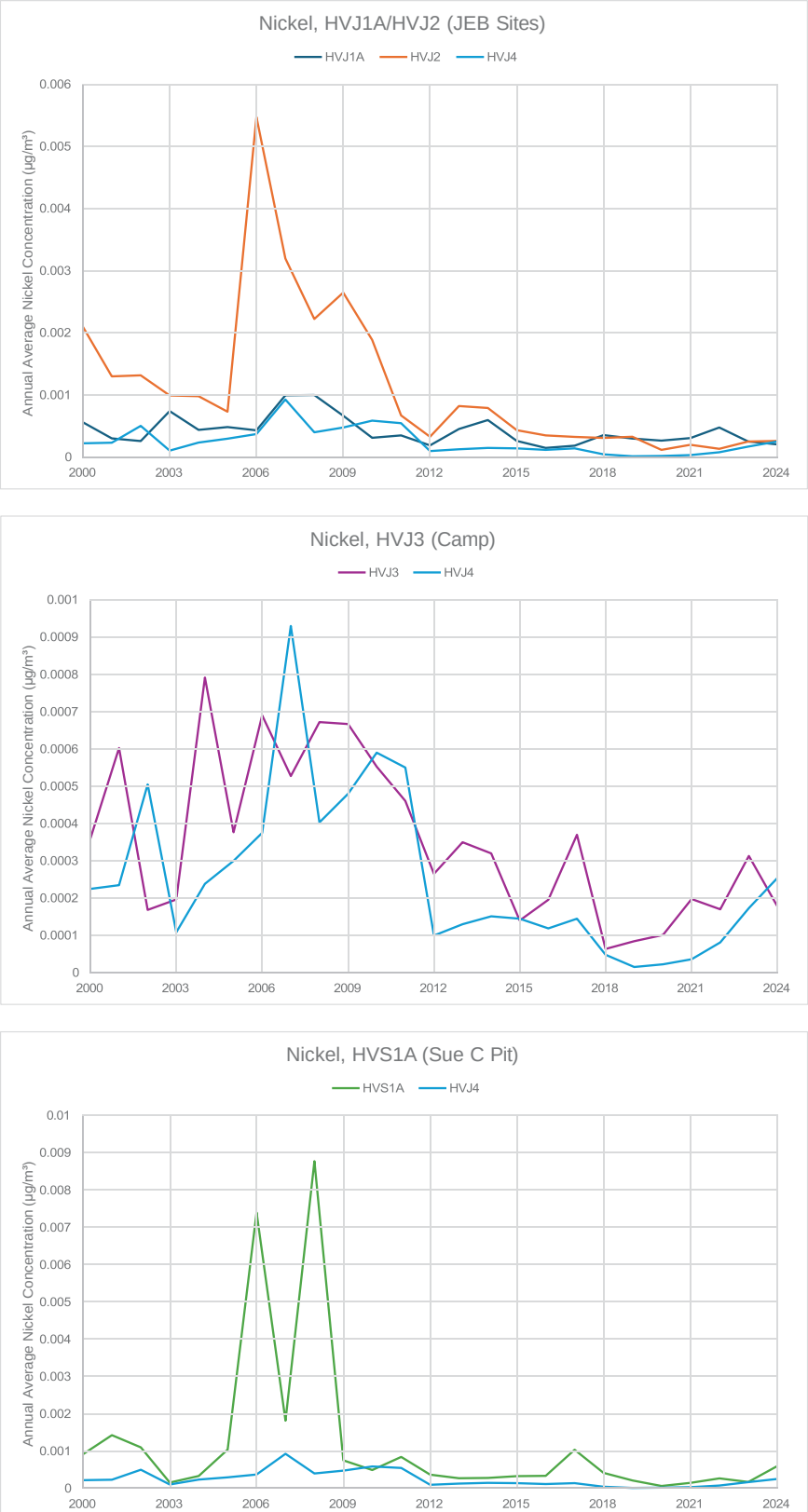






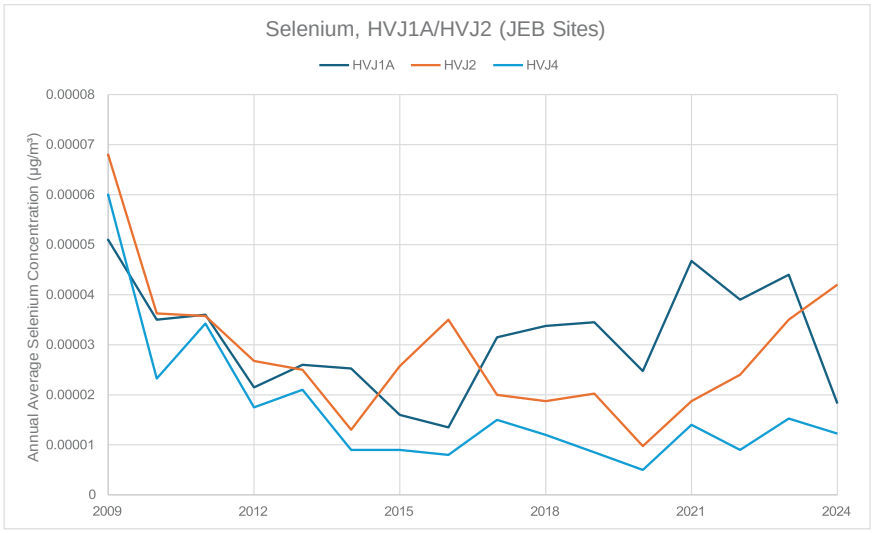
Note: The 2016 ERA prediction (0.01 µg/m³) and AAQC (23 µg/m³) are not shown to maintain readability.

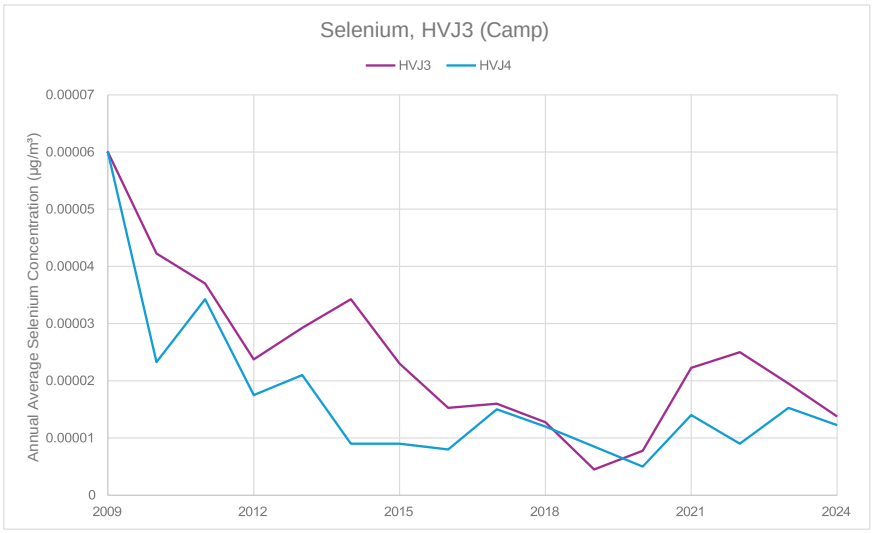
Figure 3.2-20 Measured Annual Average Molybdenum Concentrations, 2000 to 2024

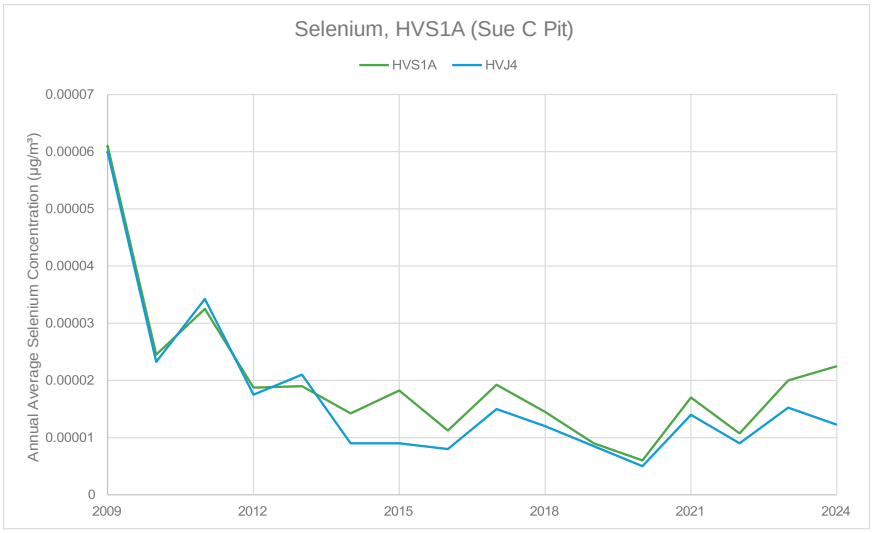


Note: The 2016 ERA prediction (0.06 µg/m³) and AAQC (0.02 µg/m³) are not shown to maintain readability.

Figure 3.2-21 Measured Annual Average Nickel Concentrations, 2000 to 2024

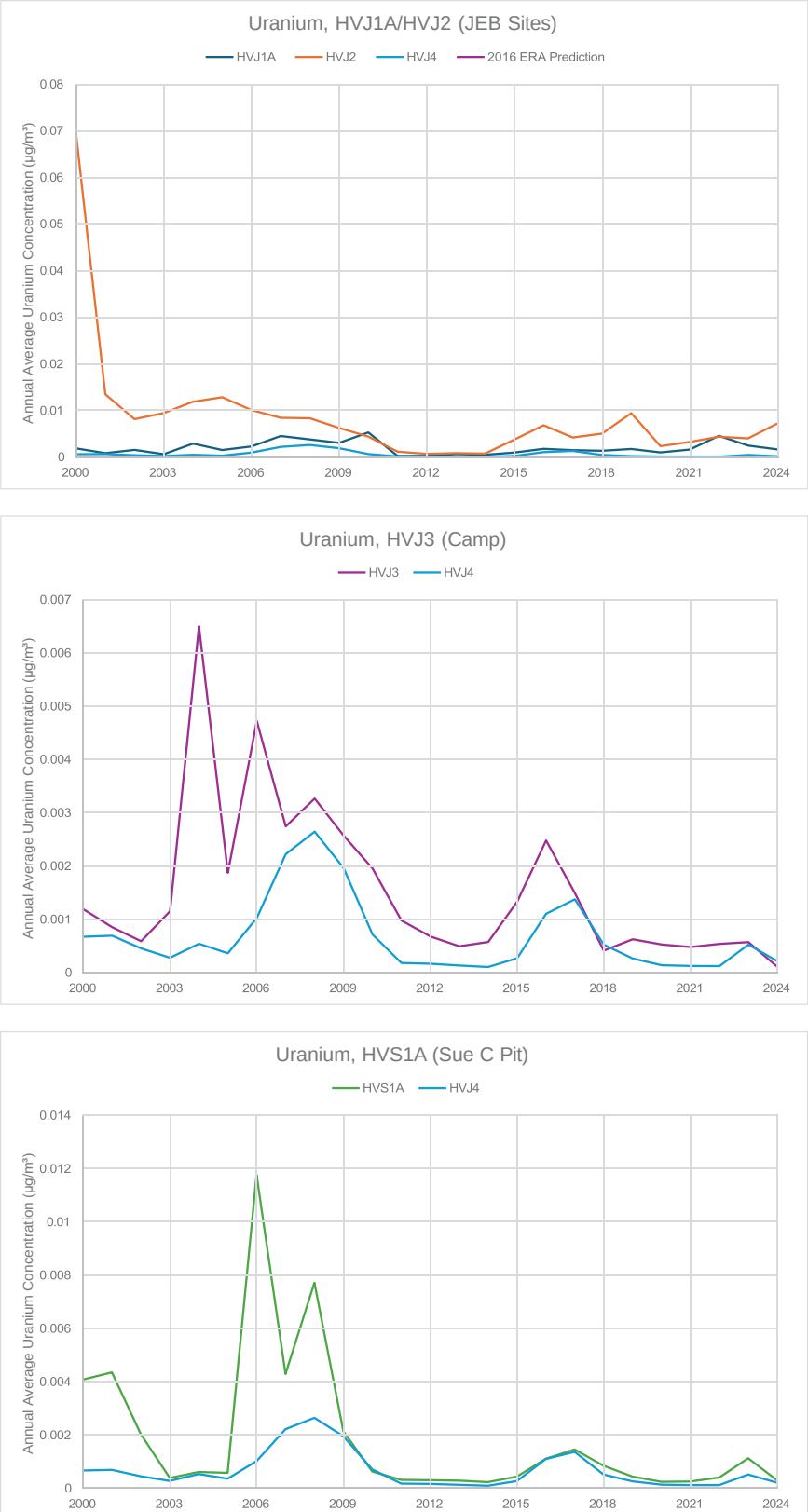






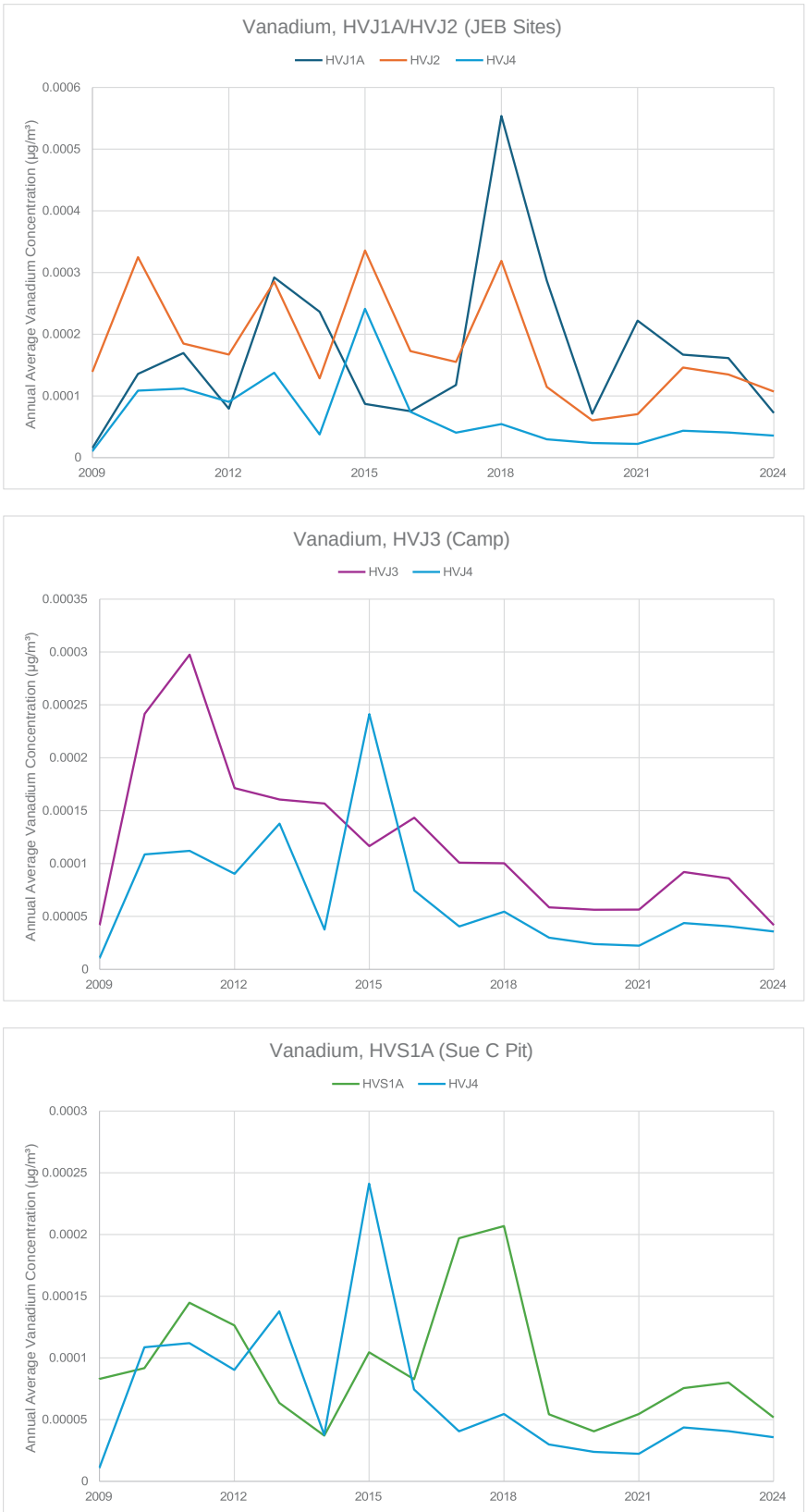
Note: The 2016 ERA predictions (0.005 µg/m³ and 0.01 µg/m³ [JEB camp]) and AAQC (1.92 µg/m³) are not shown to maintain readability.

Figure 3.2-22 Measured Annual Average Selenium Concentrations, 2000 to 2024



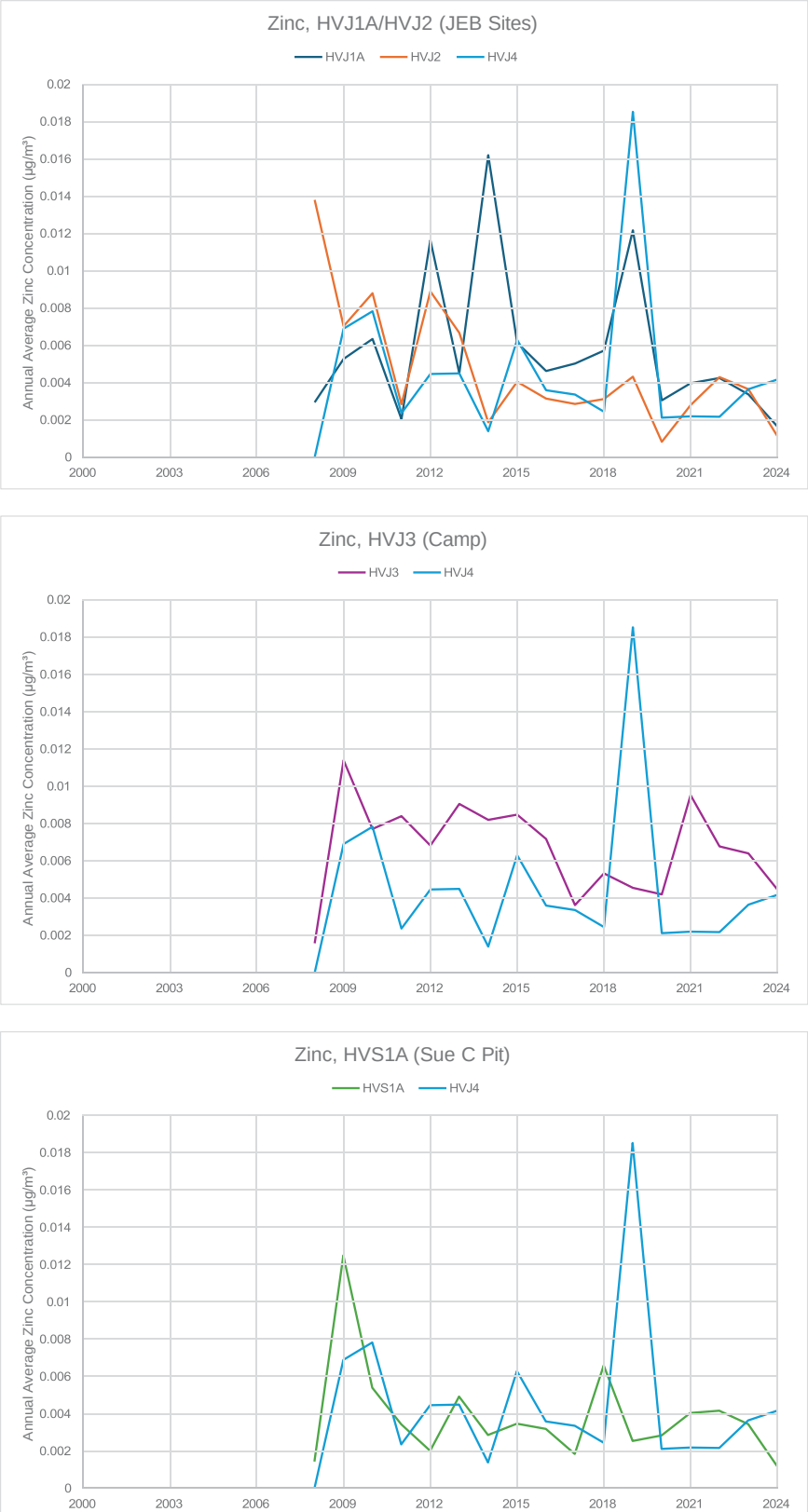
Note: The 2016 ERA predictions (0.05 µg/m³ and 0.054 µg/m³ [JEB camp]) and AAQC (0.03 µg/m³) are not shown to maintain readability.

Figure 3.2-23 Measured Annual Average Uranium Concentrations, 2000 to 2024



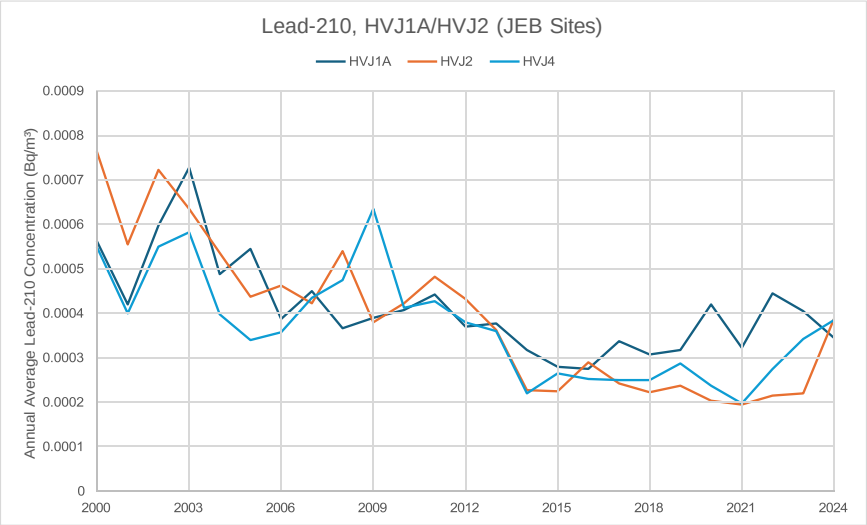
Note: The AAQC (0.4 µg/m³) is not shown to maintain readability. There is no 2016 ERA prediction.

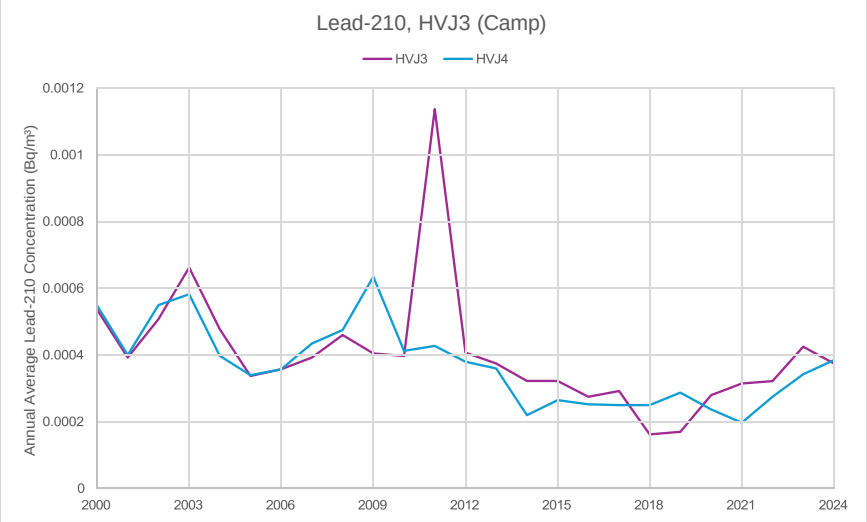
Figure 3.2-24 Measured Annual Average Vanadium Concentrations, 2000 to 2024

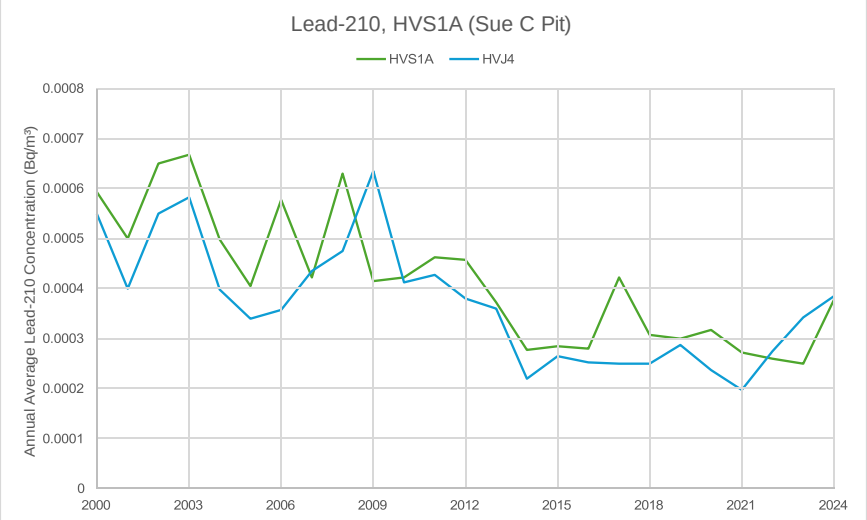


Note: Data prior to 2008 are not presented because of unrealistic values provided due to high zinc content in filter paper (Orano 2024b). The 2016 ERA prediction (0.55 µg/m³) and AAQC (23 µg/m³) are not shown to maintain readability.

Figure 3.2-25 Measured Annual Average Zinc Concentrations, 2000 to 2024

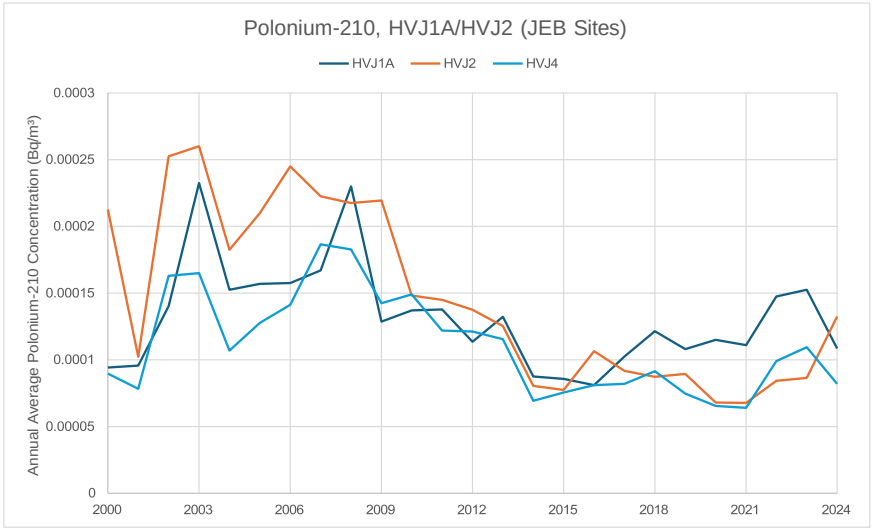


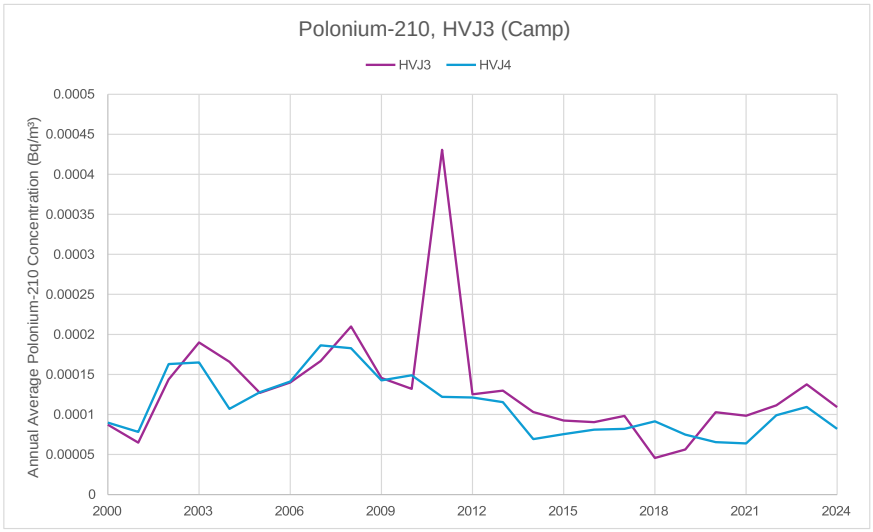


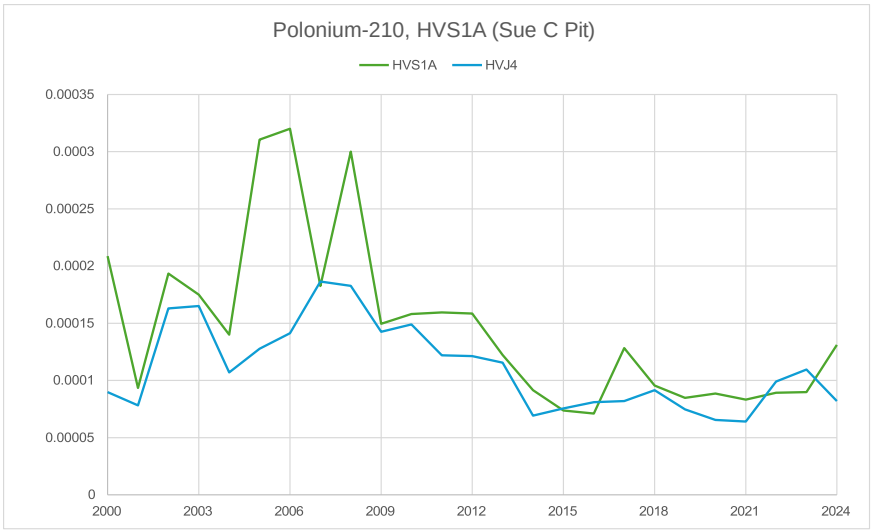


Note: The 2016 ERA prediction (0.012 Bq/m³) is not shown to maintain readability. There is no AAQC.

Figure 3.2-26 Measured Annual Average Lead-210 Concentrations, 2000 to 2024

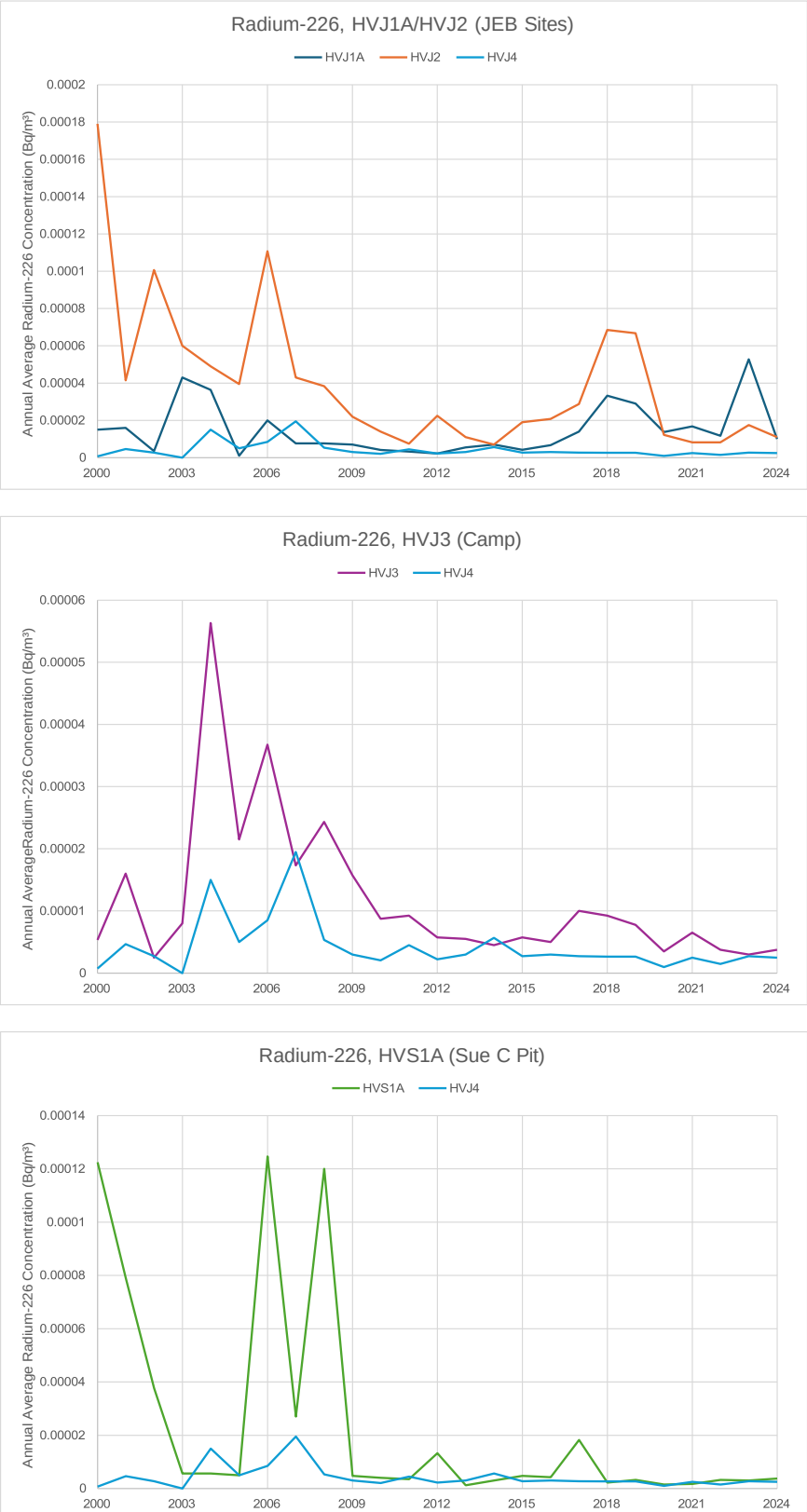






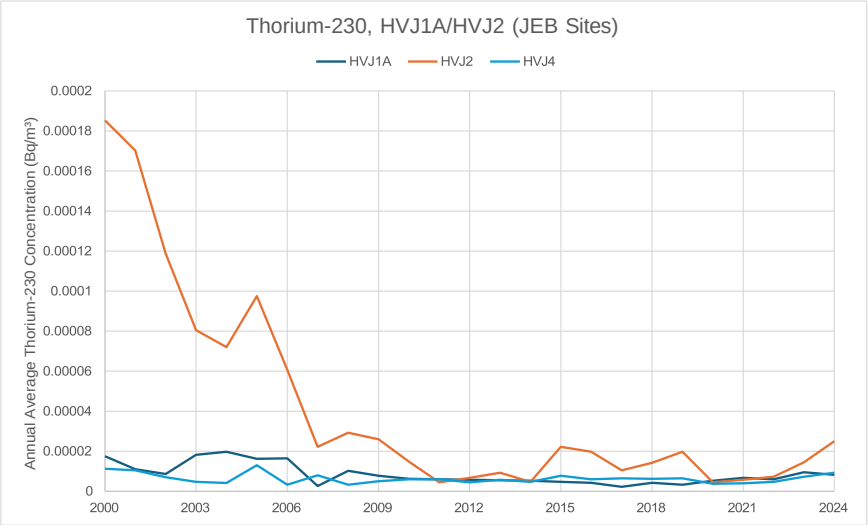
Note: The 2016 ERA prediction (0.012 Bq/m³) is not shown to maintain readability. There is no AAQC.

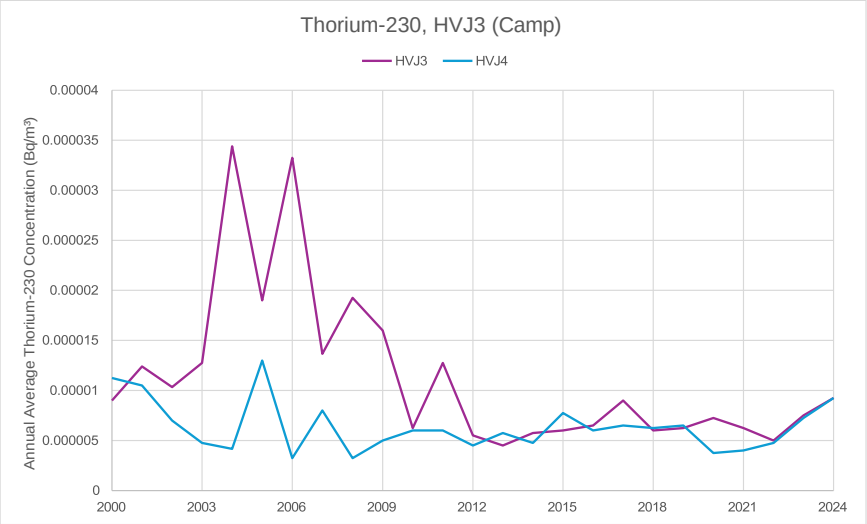
Figure 3.2-27 Measured Annual Average Polonium-210 Concentrations, 2000 to 2024

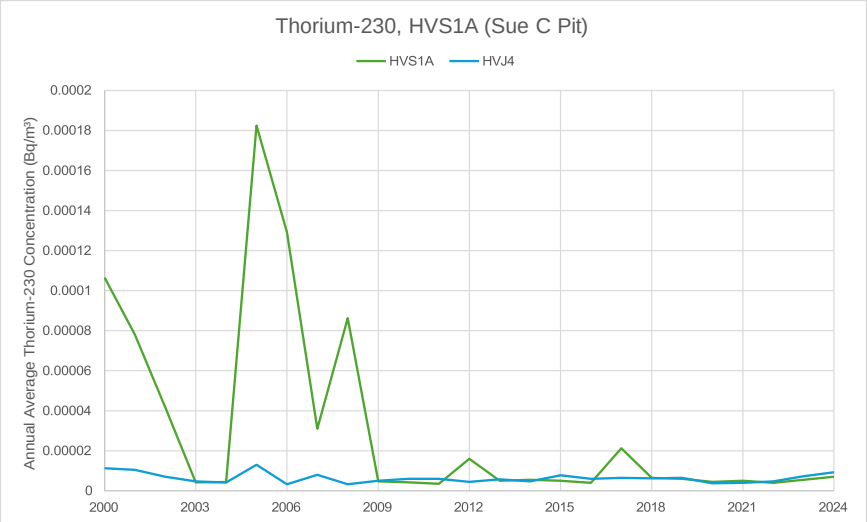


Note: The 2016 ERA predictions (0.00062 Bq/m³ and 0.00067 Bq/m³ [JEB Camp]) are not shown to maintain readability. There is no AAQC.

Figure 3.2-28 Measured Annual Average Radium-226 Concentrations, 2000 to 2024







Note: The 2016 ERA predictions (0.00062 Bq/m³ and 0.00067 Bq/m³ [JEB Camp]) are not shown to maintain readability. There is no AAQC.

Figure 3.2-29 Measured Annual Average Thorium-230 Concentrations, 2000 to 2024

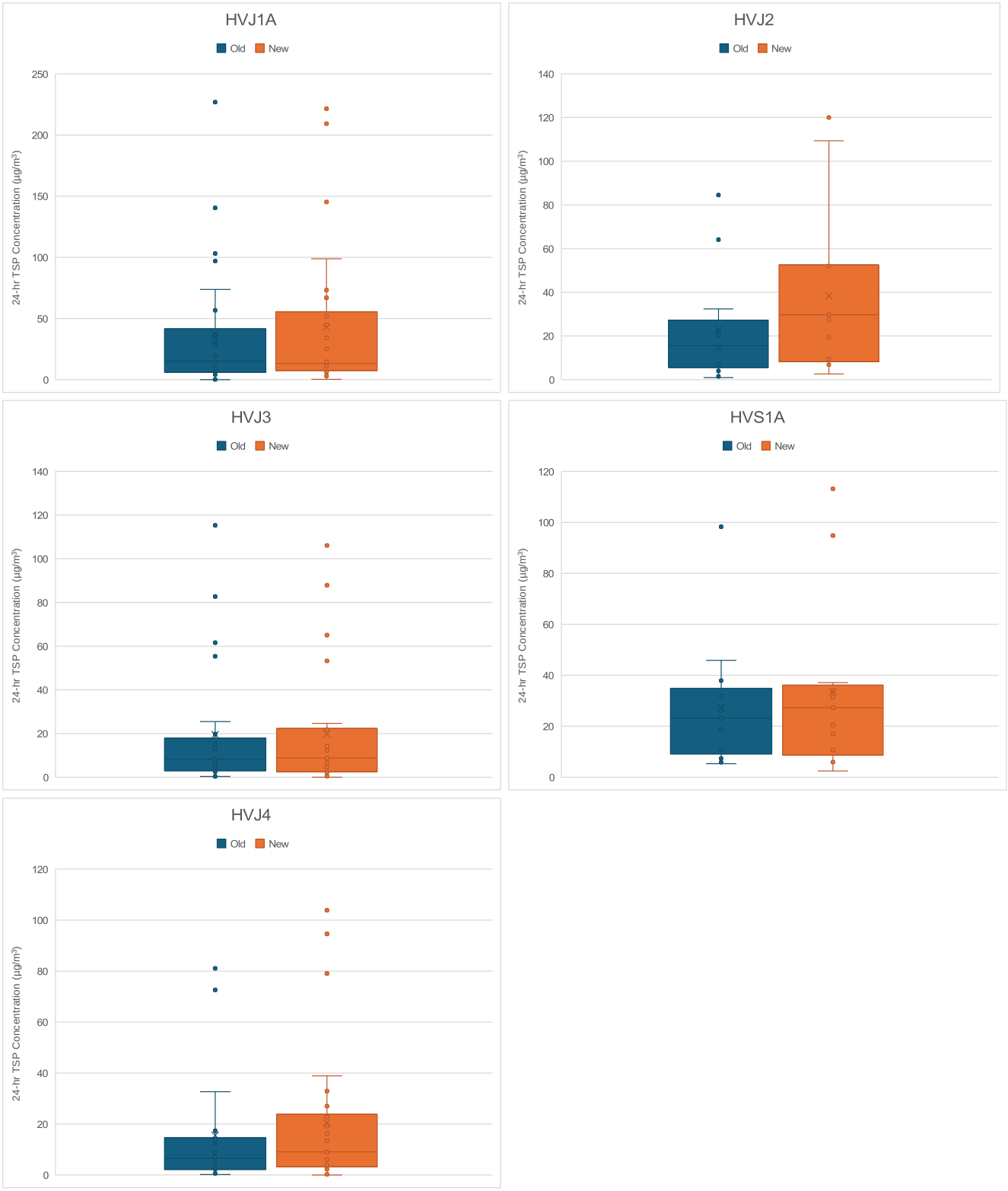
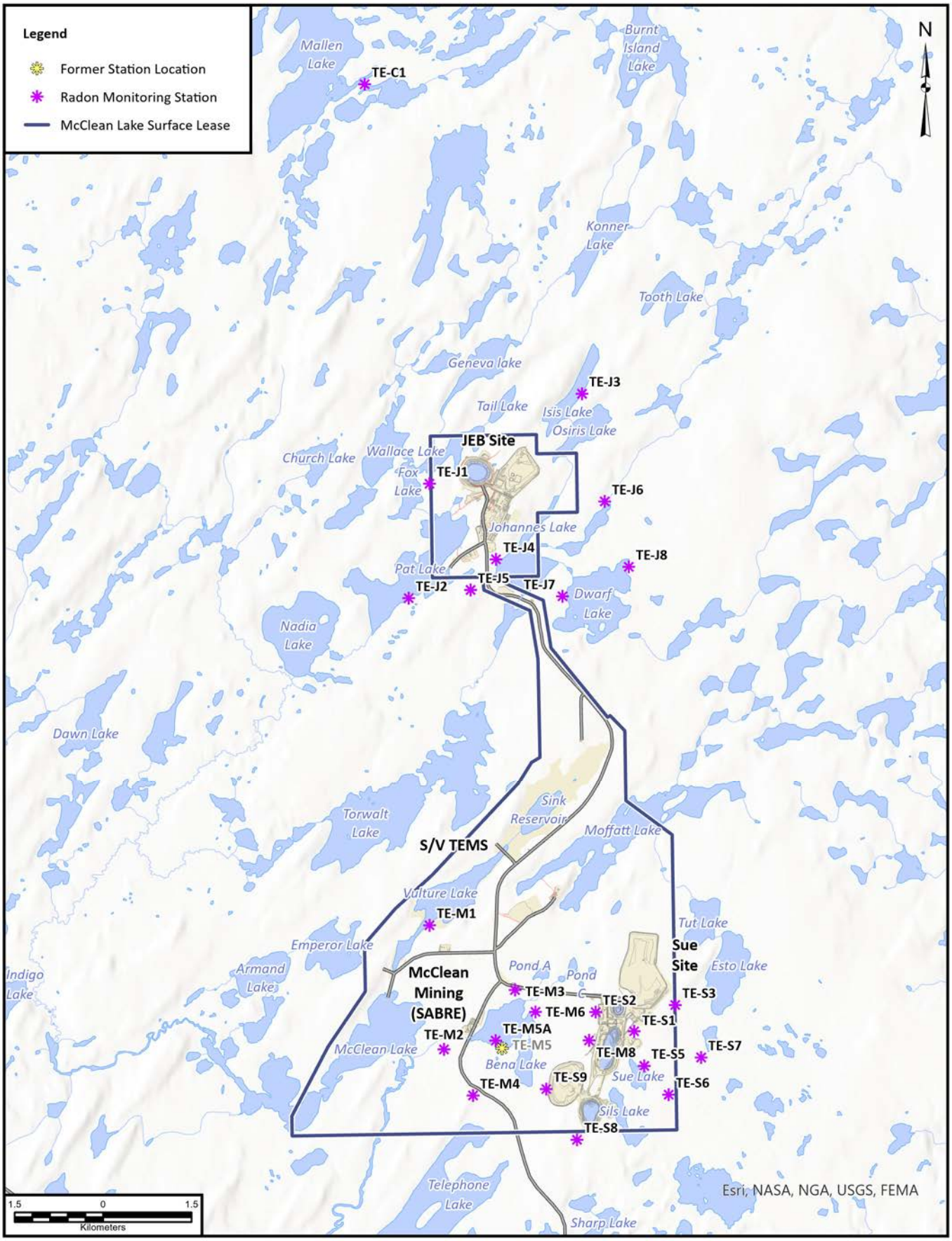


Figure 3.2-30 Special Projects Box Plots for Total Suspended Particulate (TSP) Concentrations from New and Old HVAS Units



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-11-07 Scale: 1:90,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 3.2-31
RADON MONITORING STATIONS WITHIN THE McCLEAN LAKE OPERATION LSA

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 3\EPTID Section 3.aprx

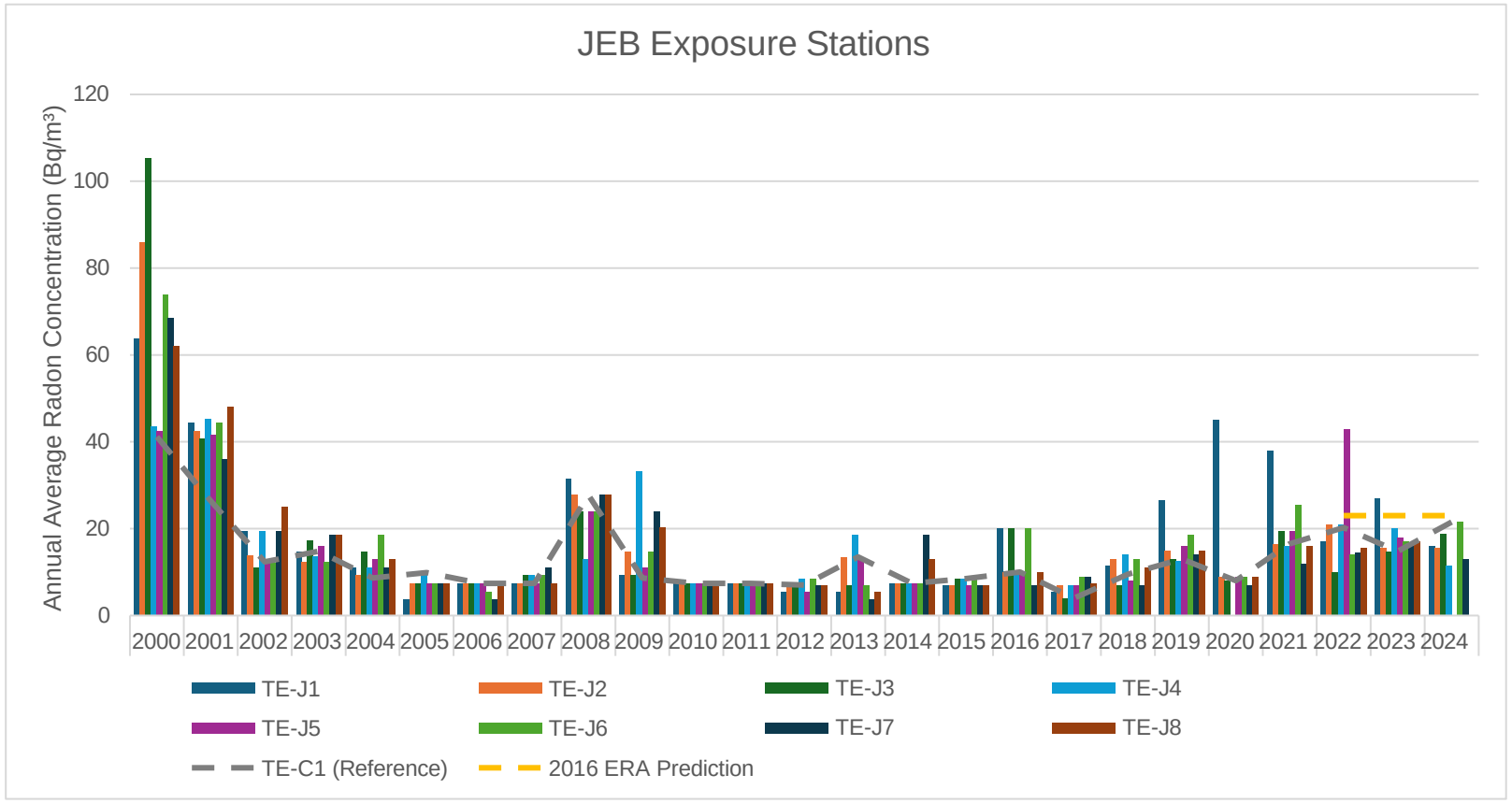


Figure 3.2-32 Measured Annual Average Radon Concentrations at the JEB Exposure Stations, 2000 to 2024

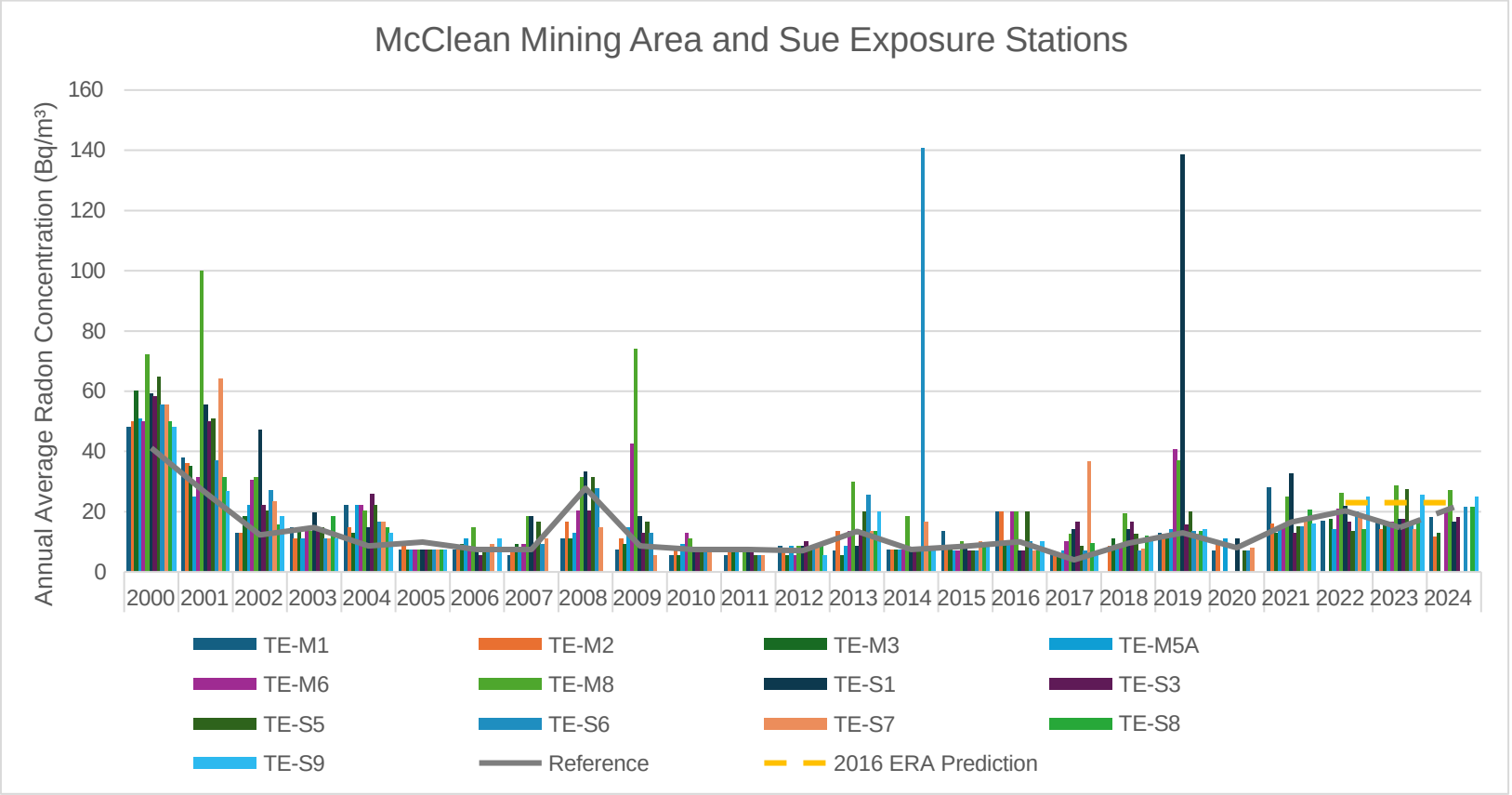


Figure 3.2-33 Measured Annual Average Radon Concentrations at the McClean Mining Area and Sue Exposure Stations, 2000 to 2024

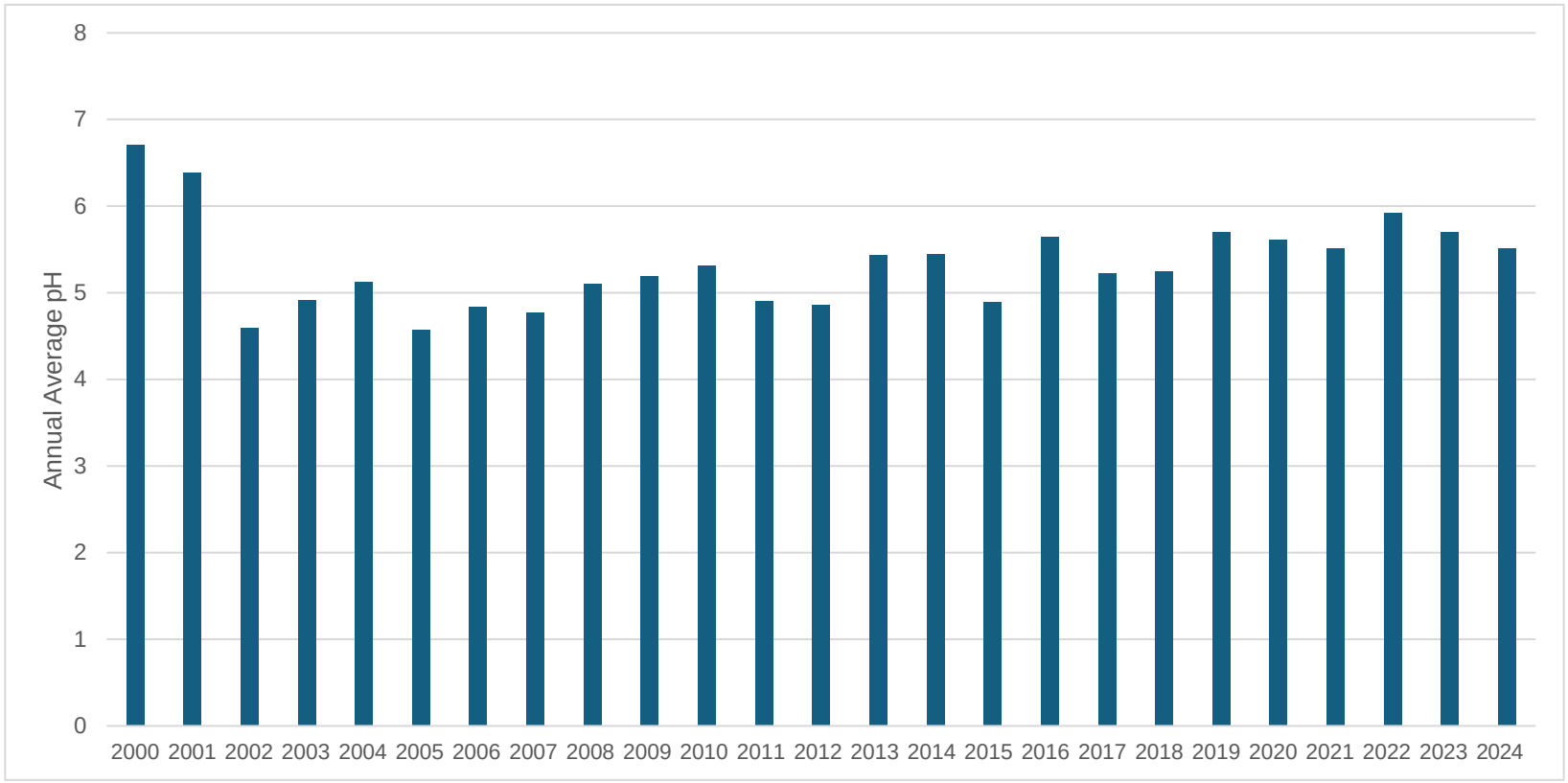


Figure 3.2-34 Annual Average pH from Acid Precipitation Monitoring at the McClean Lake Operation Meteorological Station, AR02, 2000 to 2024



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-11-07 12:37 PM Scale: 1:10,000
Data Sources: Natural Resources Canada, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 3.2-35
EXHAUST STACK EMISSIONS AND SULPHUR DIOXIDE STATIONS WITHIN THE McCLEAN LAKE OPERATION LSA

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 3\EPTID Section 3.aprx

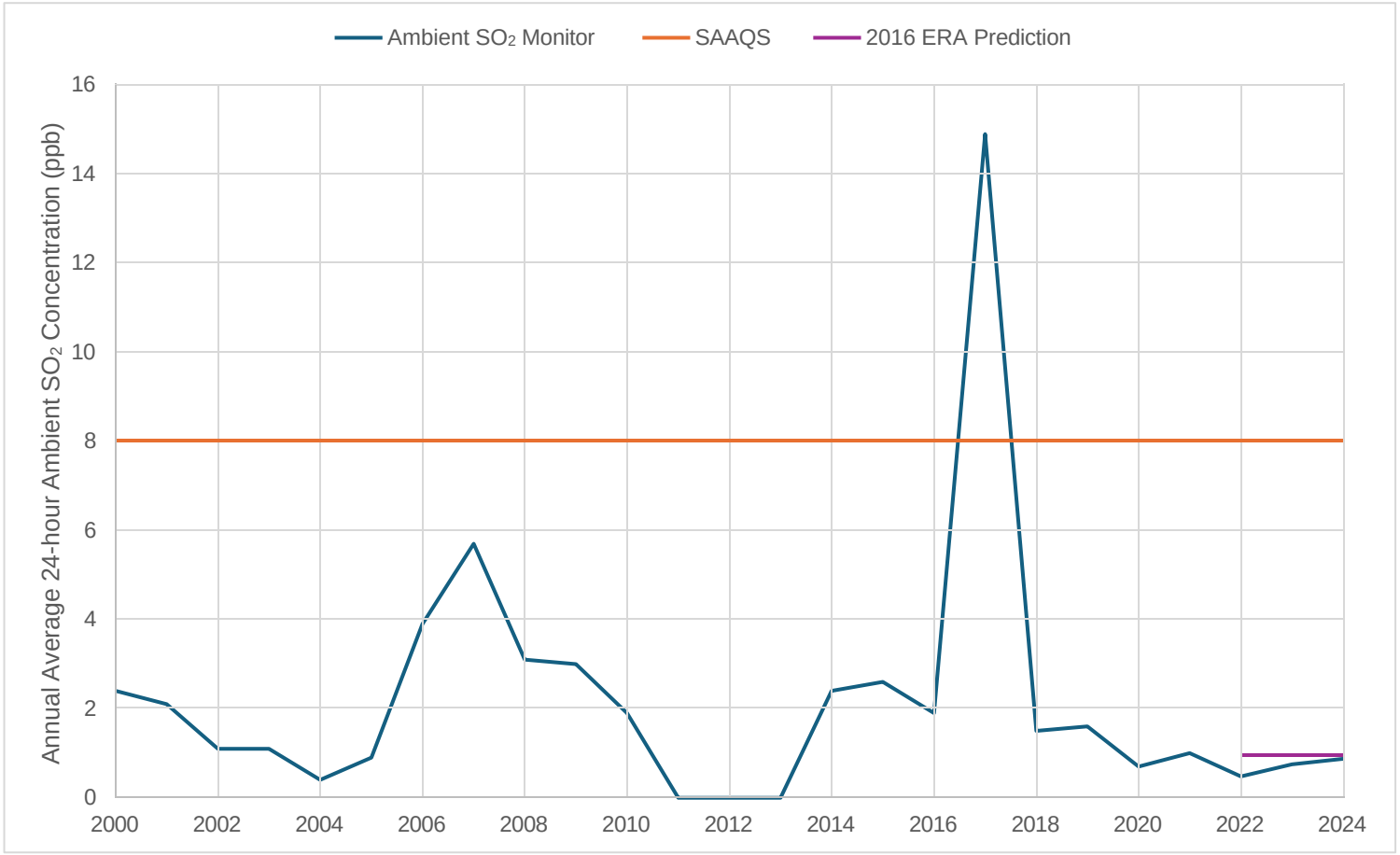


Figure 3.2-36 Historical Ambient Annual Average SO_2 Concentrations, 2000 to 2024

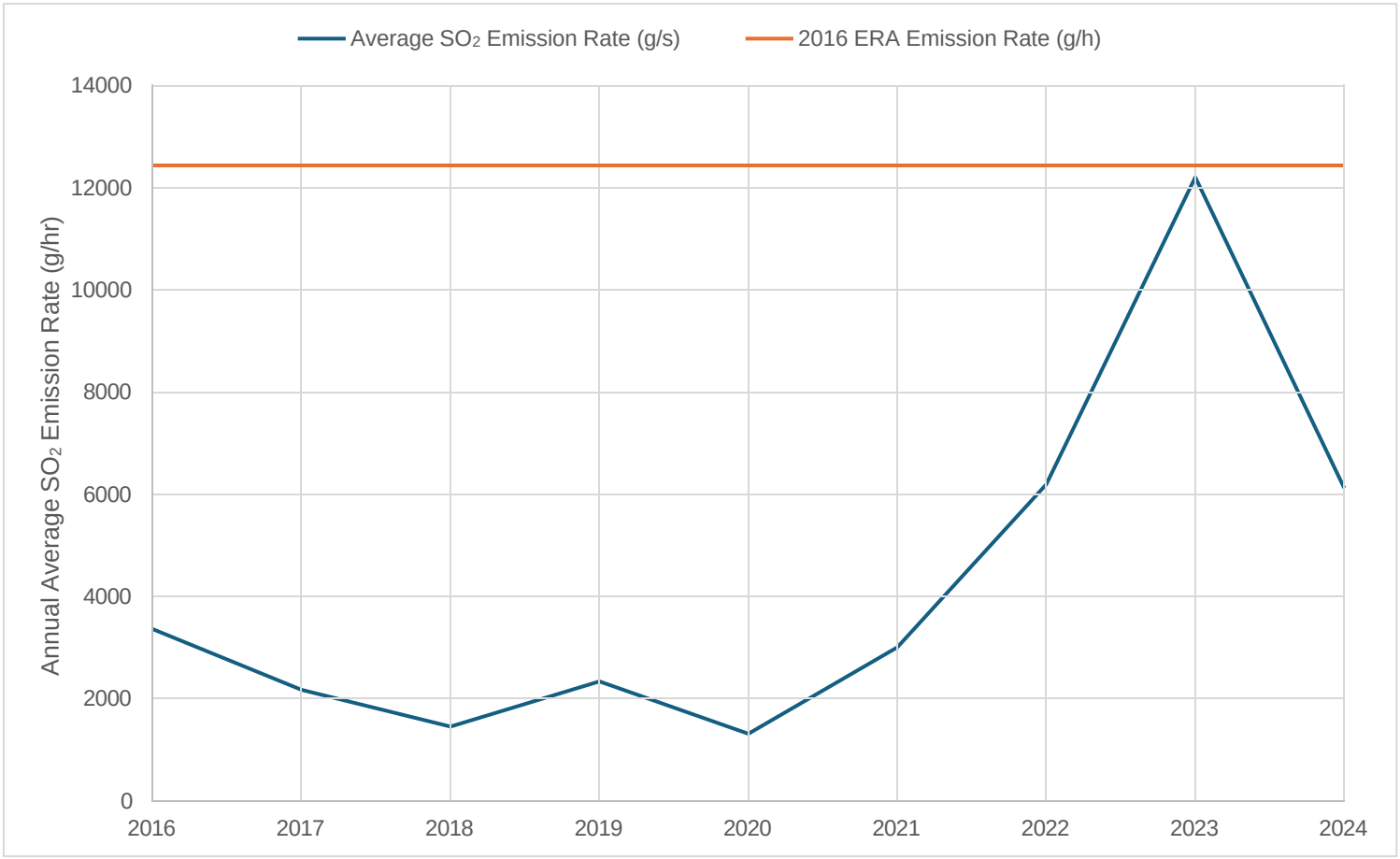
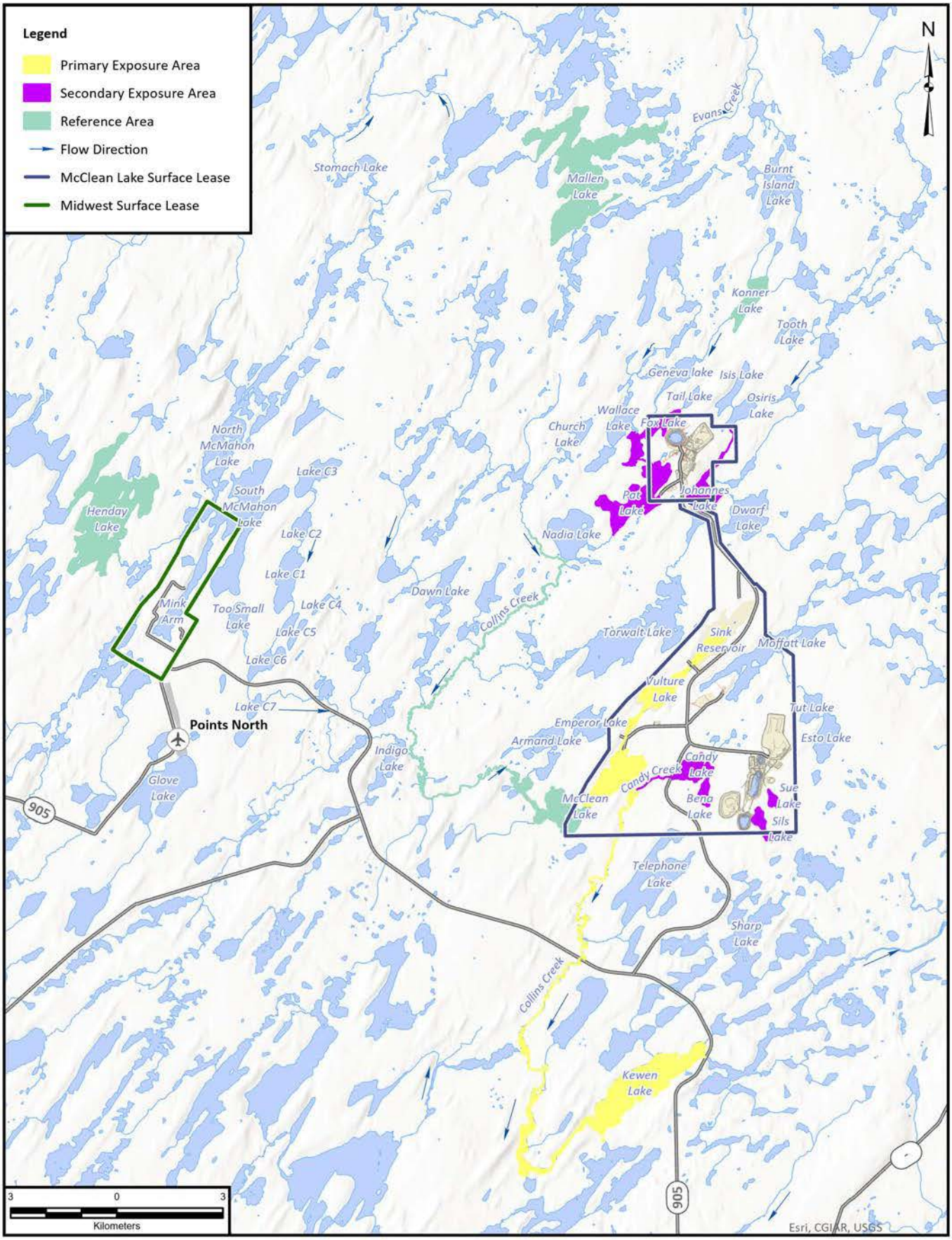


Figure 3.2-37 Historical SO_2 Annual Average Emission Rates from the Acid Plant Stack, 2016 to 2024



Projection: NAD 1983 UTM Zone 13N
Drawn: TL
Date: 2025-07-10 9:21 AM Scale: 1:150,000
Data Sources: Natural Resources Canada, ORANO Canada Inc.

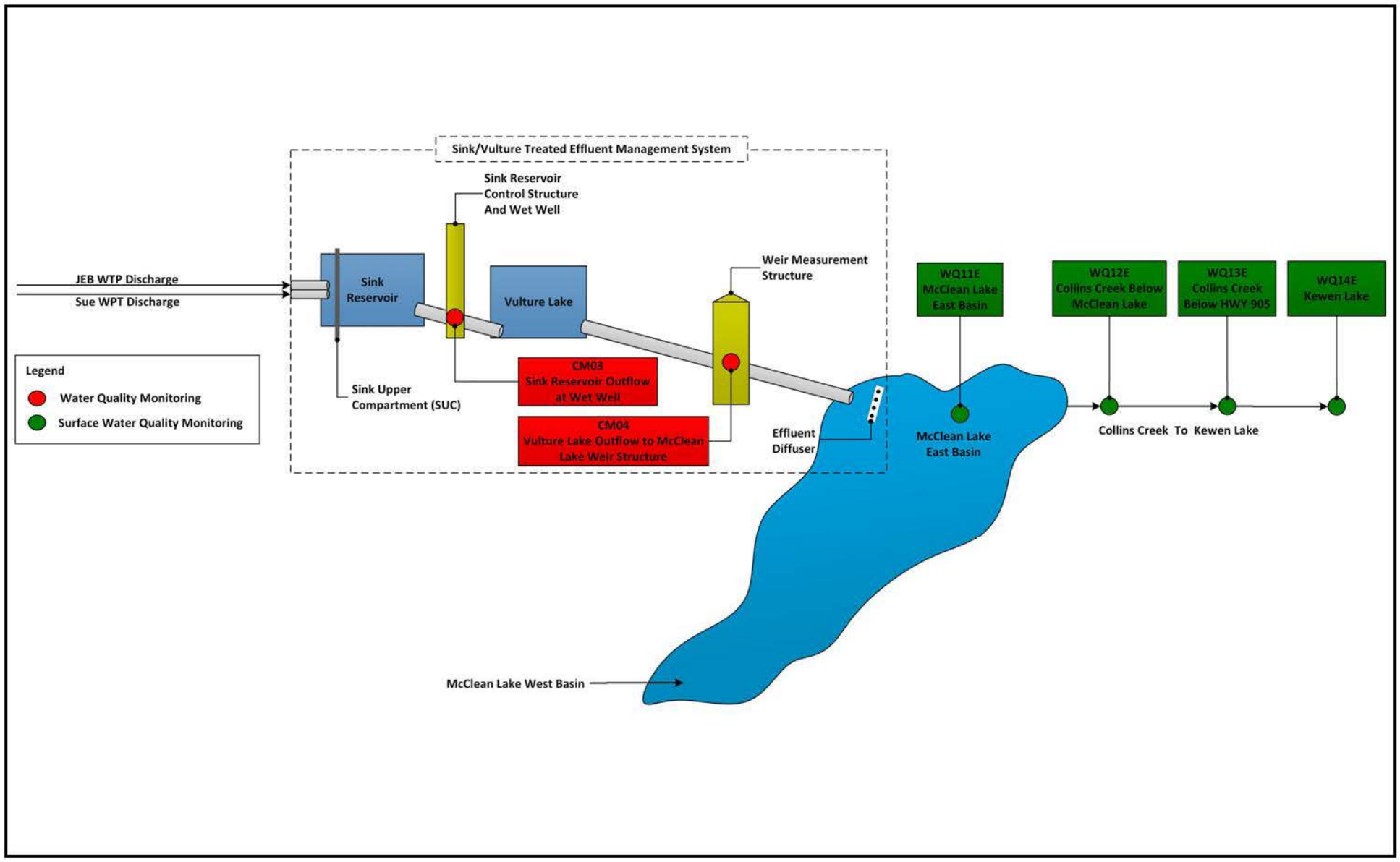
McCLEAN LAKE OPERATION

FIGURE 4.2-1
THE LOCATION OF REFERENCE, PRIMARY EXPOSURE AND SECONDARY EXPOSURE WATERBODIES IN 2022 TO 2024

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 4\EPTID Section 4.aprx



Projection: NA
Compiled: T.Lohman
Drawn: T.Lohman
Date: 2025-07-10 9:36 AM
Scale: NA
Data Sources: Orano Canada

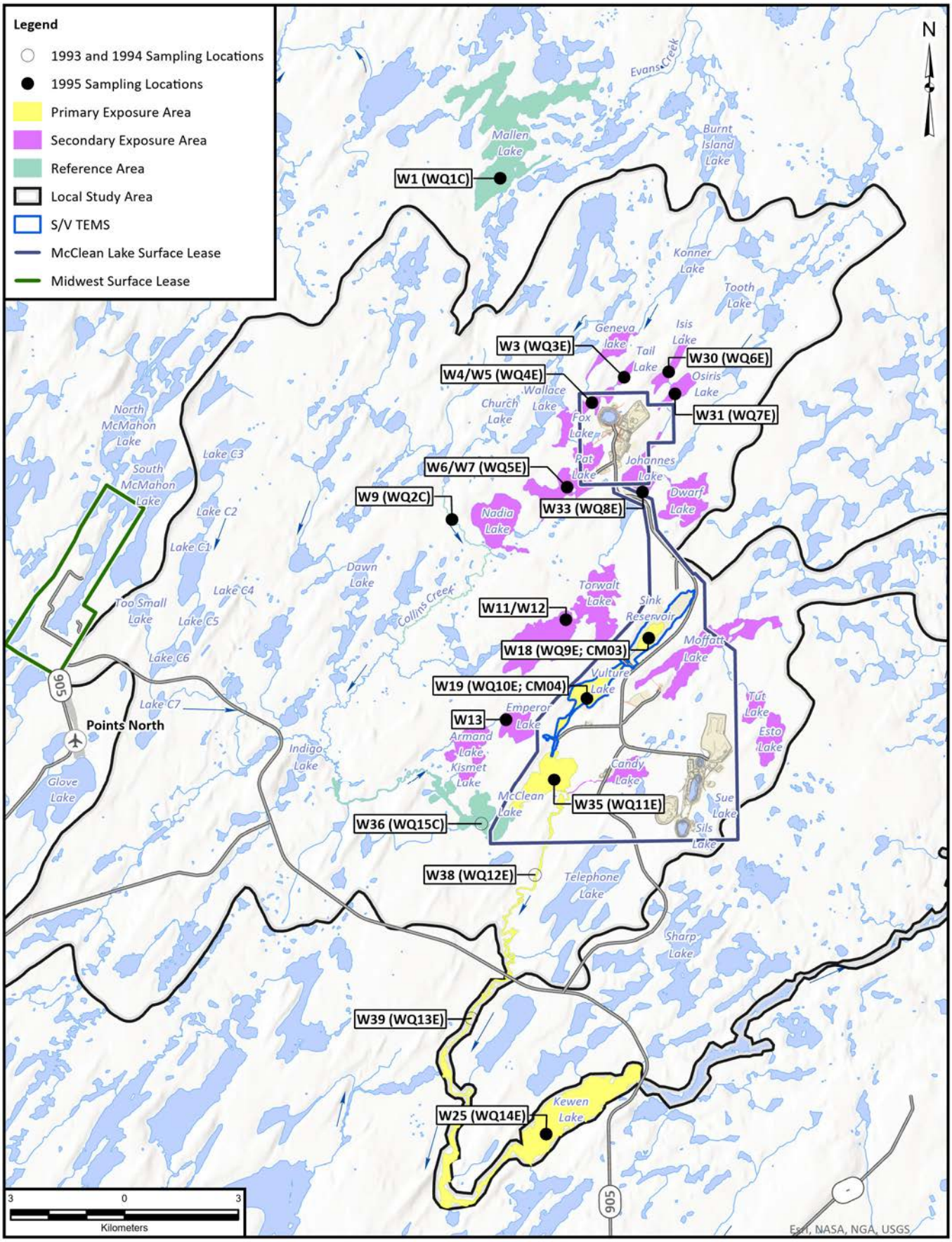
McCLEAN LAKE OPERATION

FIGURE 4.2-2
SINK AND VULTURE TREATED EFFLUENT
MANAGEMENT SYSTEM SCHEMATIC

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 4\EPTID Section 4.aprx



Projection: NAD 1983 UTM Zone 13N
Drawn: TL
Date: 2025-10-22 Scale: 1:140,000
Data Sources: Natural Resources Canada, ORANO Canada Inc.

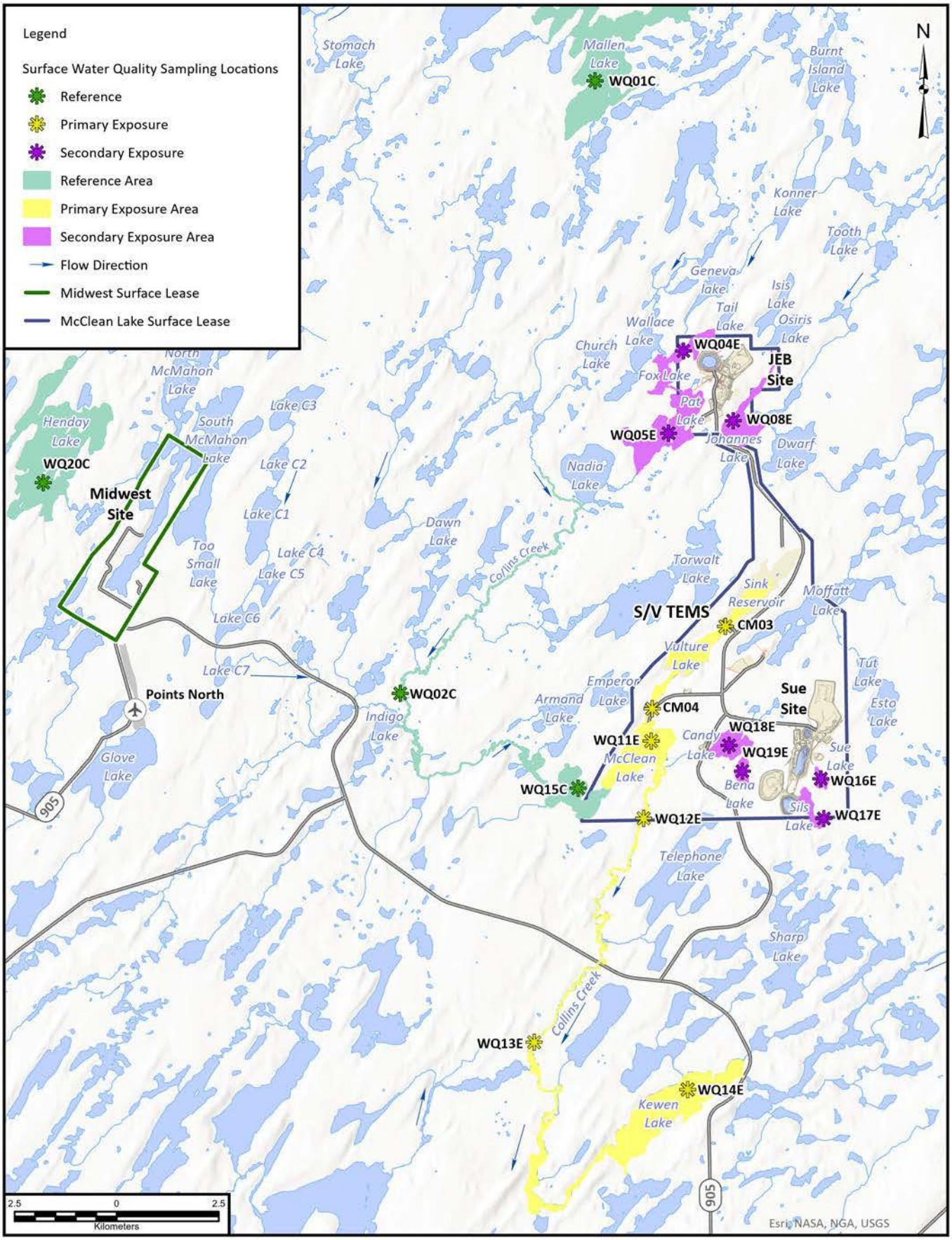
McCLEAN LAKE OPERATION

FIGURE 4.3-1
BASELINE WATER QUALITY SAMPLING AREAS FOR THE McCLEAN LAKE OPERATION

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 4\EPTID Section 4.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-10-22 2:09 PM Scale: 1:130,000
Data Sources: Natural Resources Canada, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 4.3-2
LOCATION OF SURFACE WATER QUALITY MONITORING STATIONS IN 2022 TO 2024

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 4\EPTID Section 4.aprx

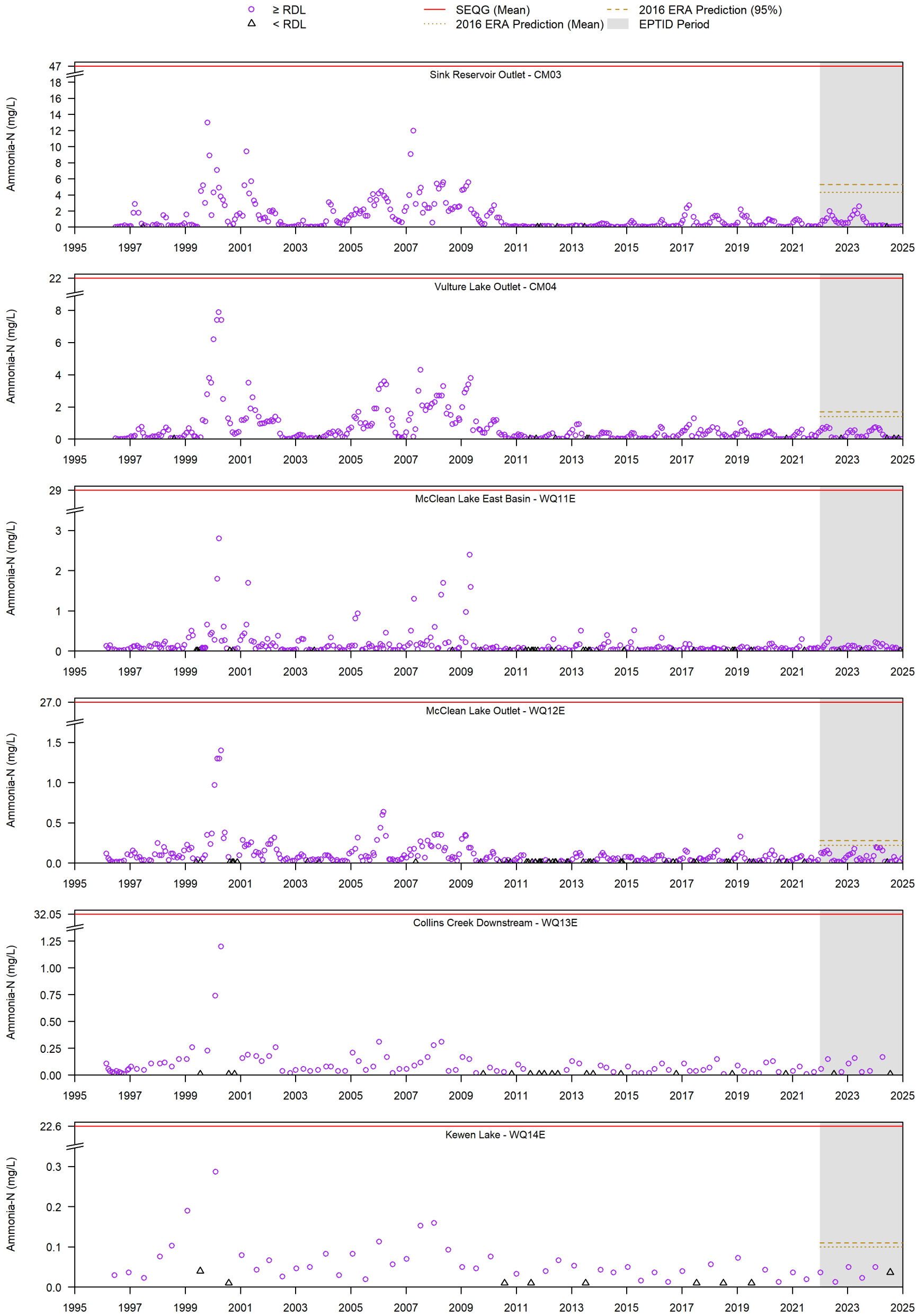


Figure 4.3-3 (1 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

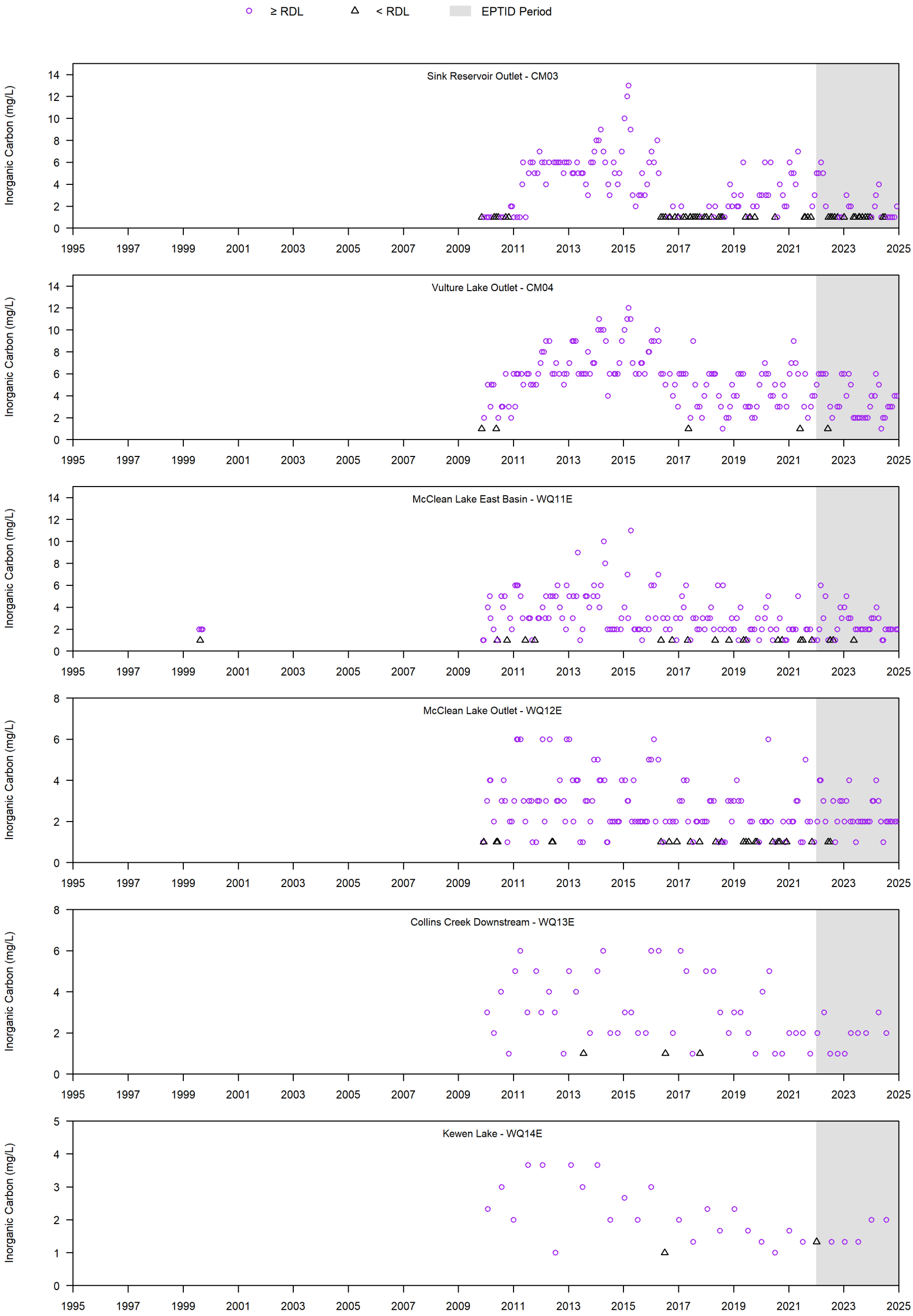


Figure 4.3-3 (2 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

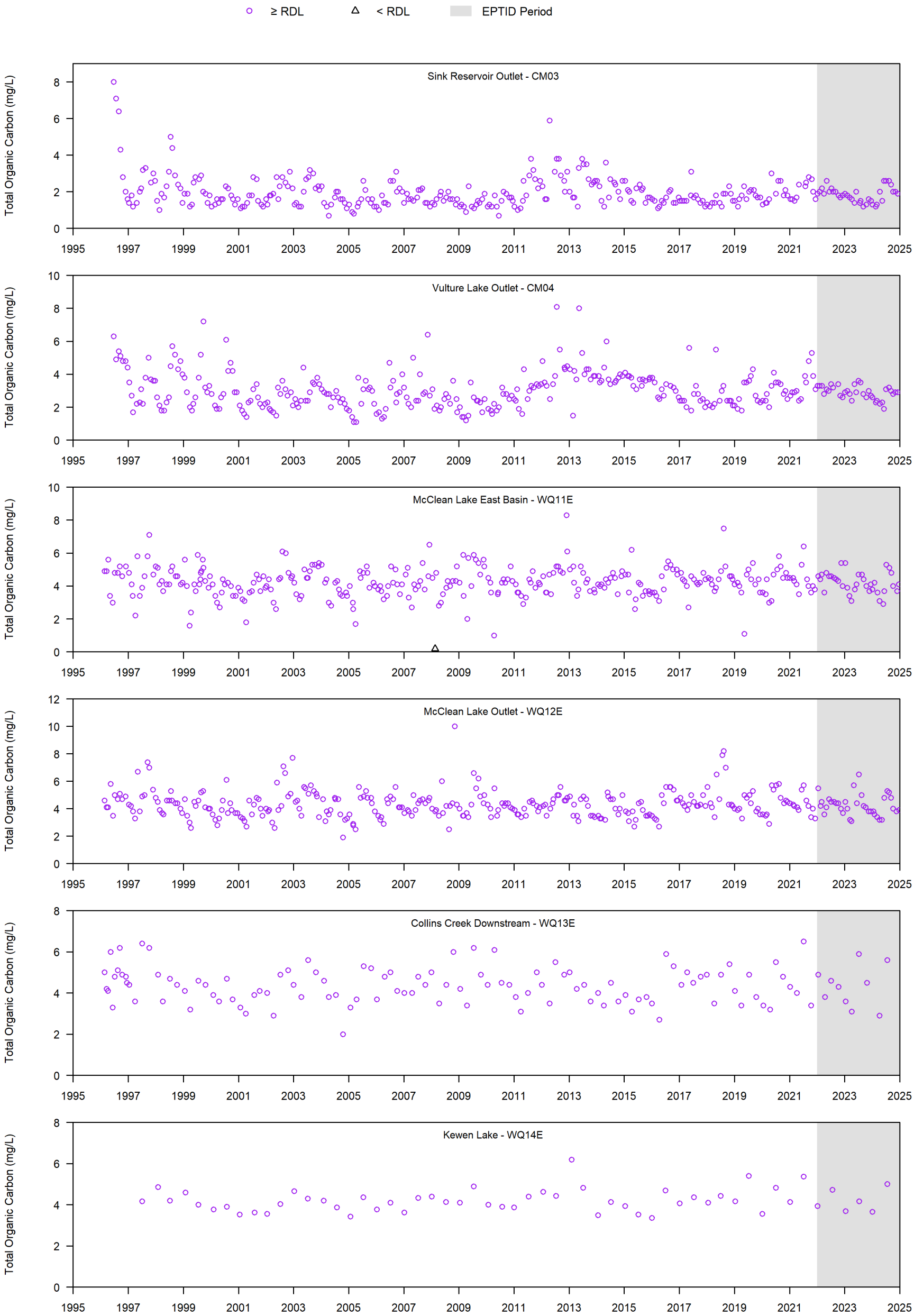


Figure 4.3-3 (3 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

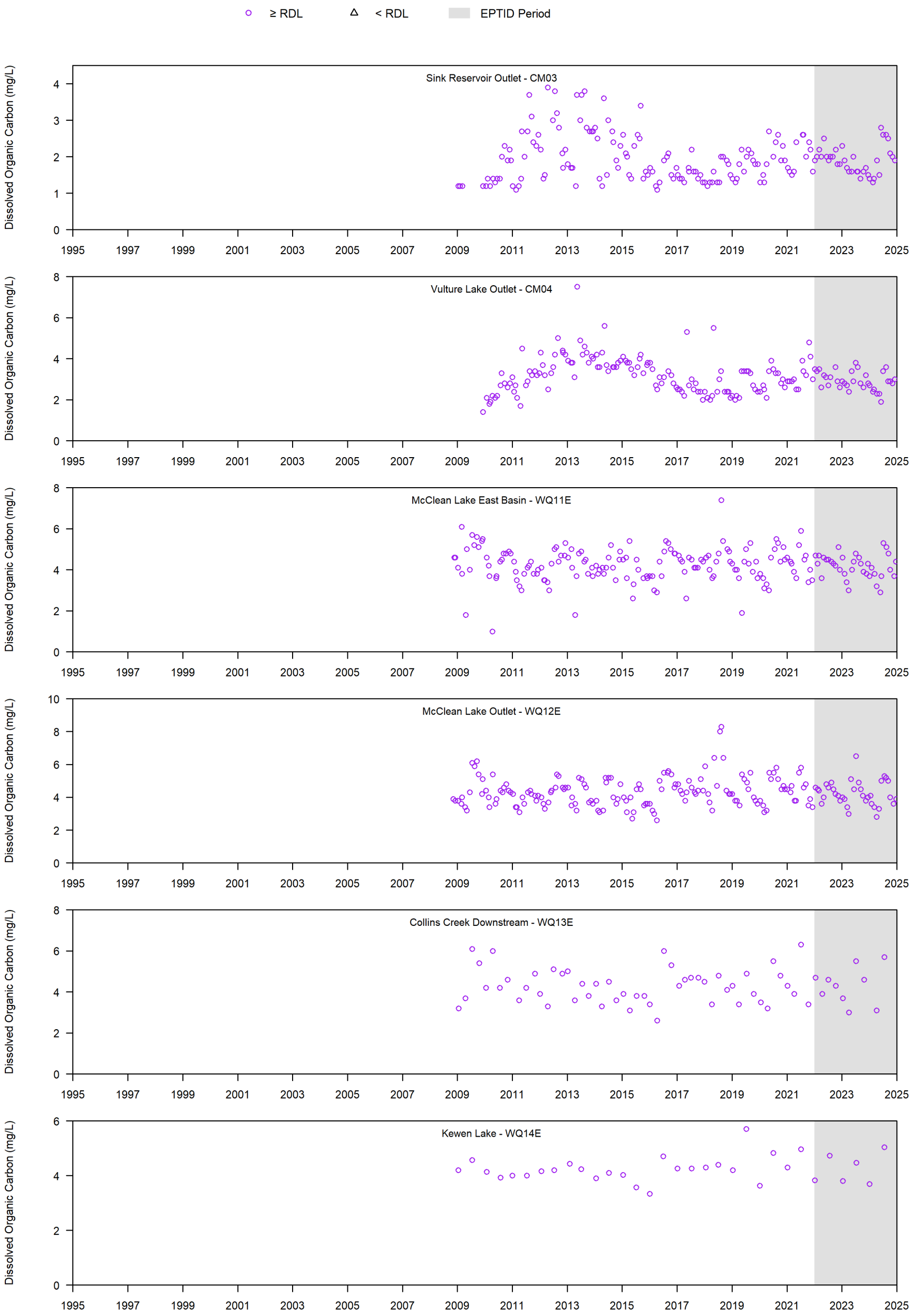


Figure 4.3-3 (4 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

Note: This parameter was added to the monitoring program in 2008.

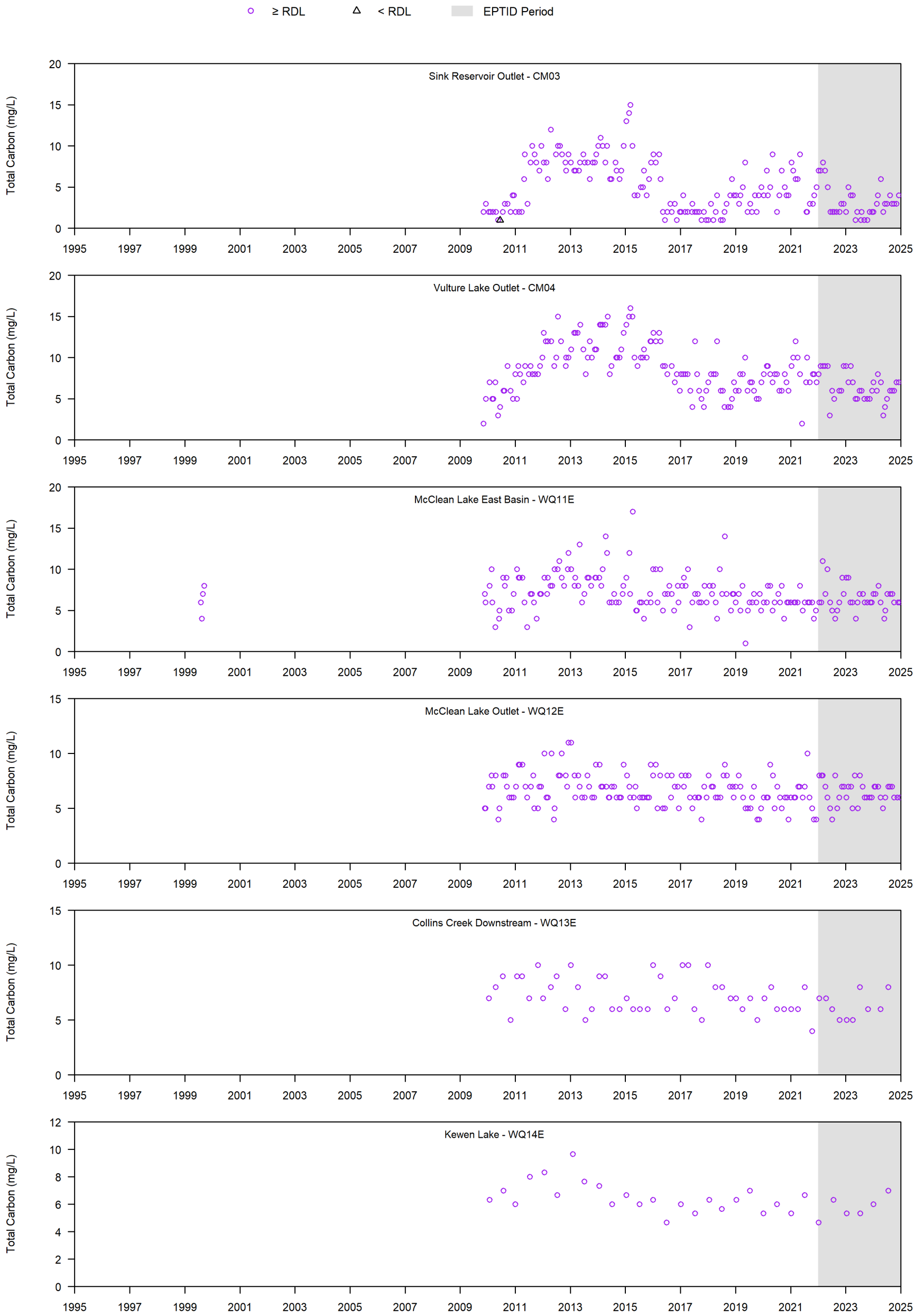


Figure 4.3-3 (5 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

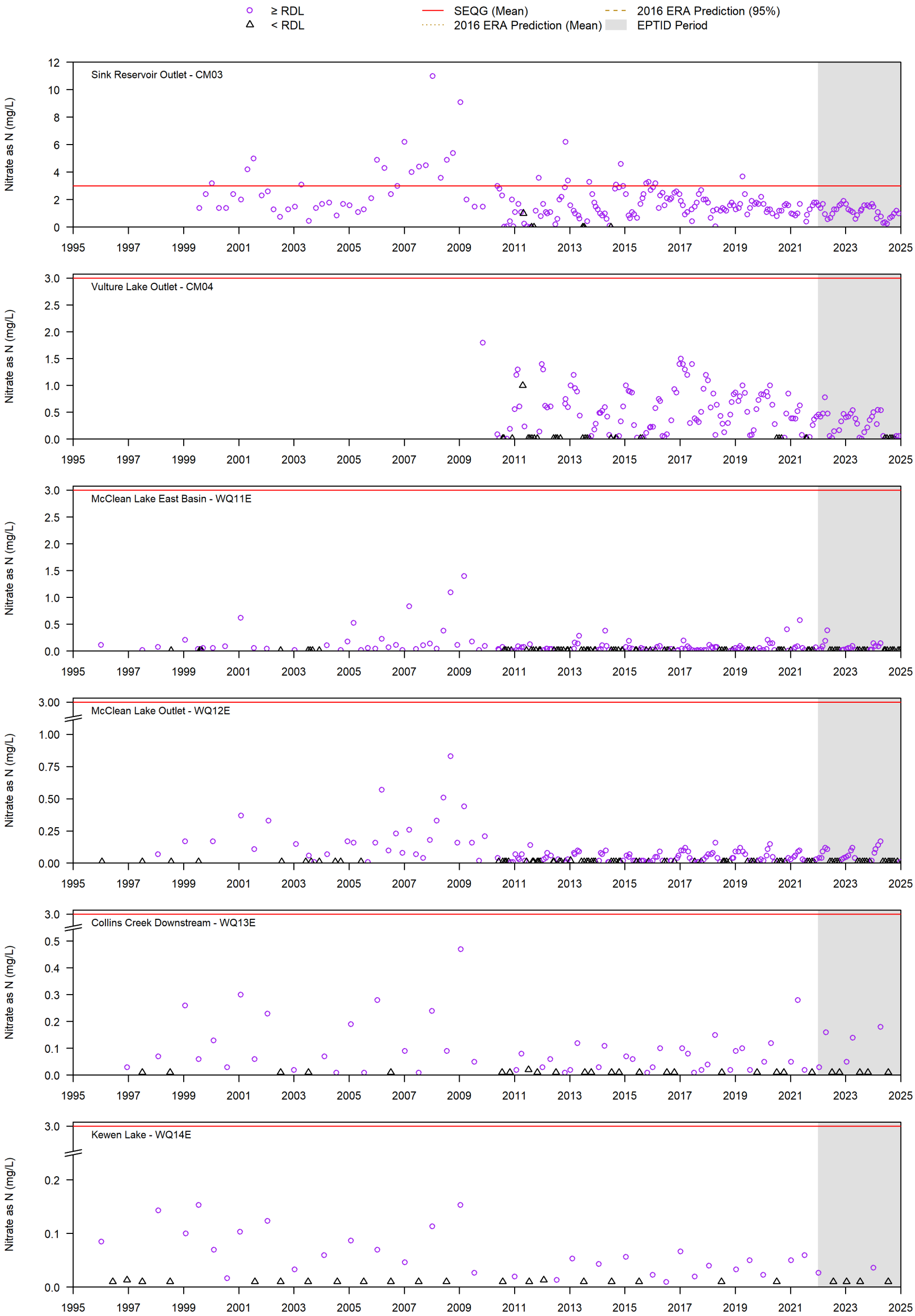


Figure 4.3-3 (6 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

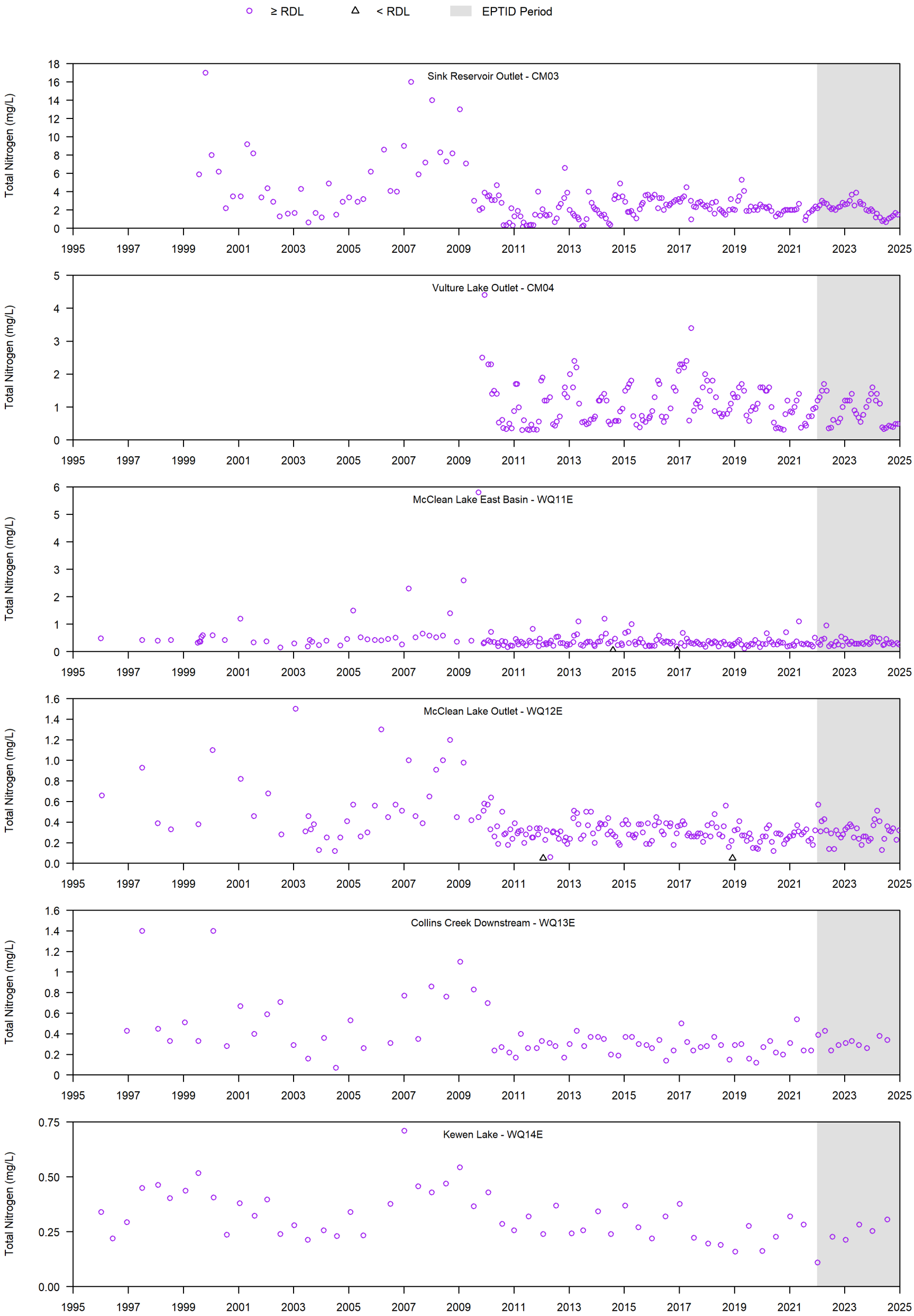


Figure 4.3-3 (7 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

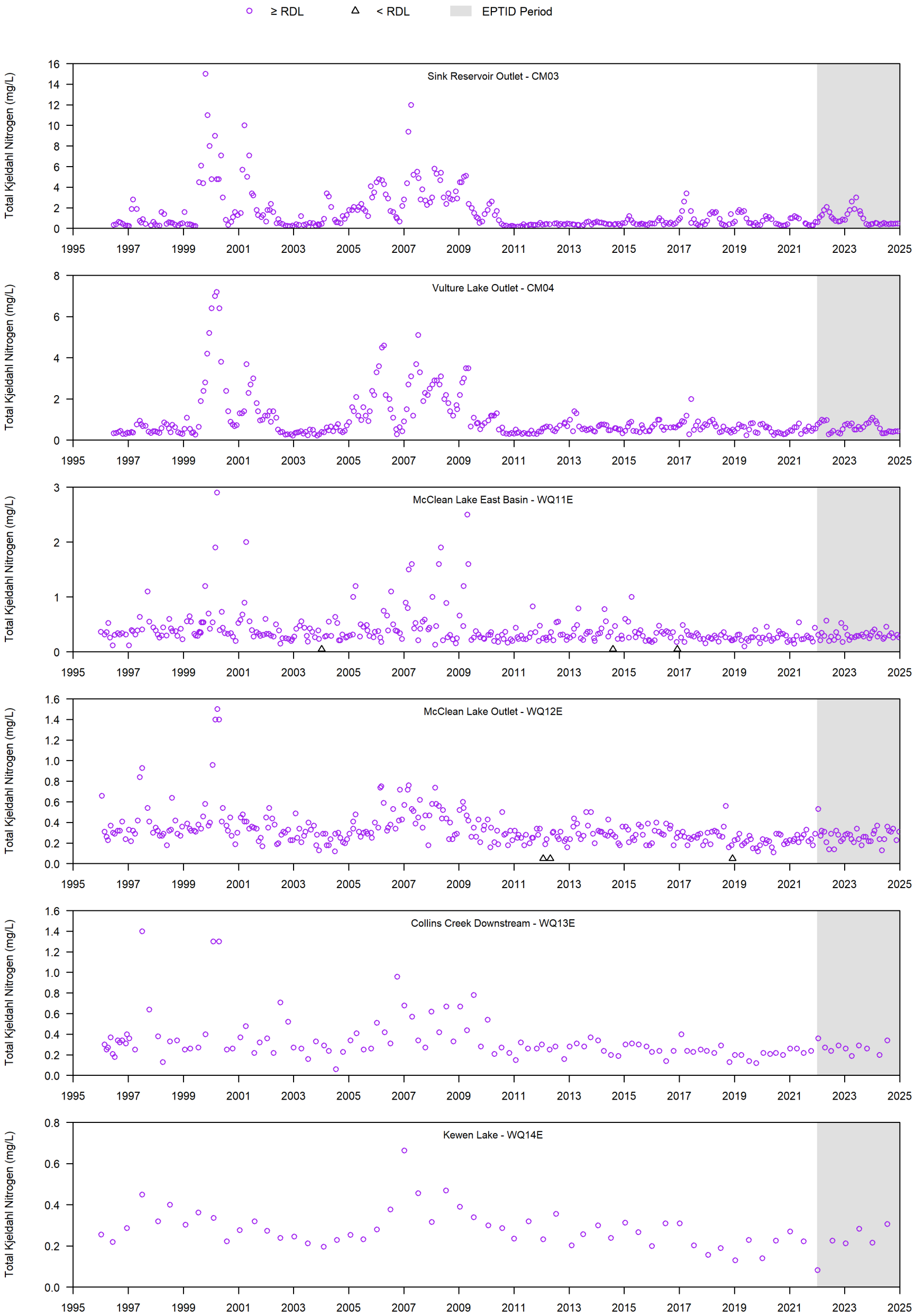


Figure 4.3-3 (8 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

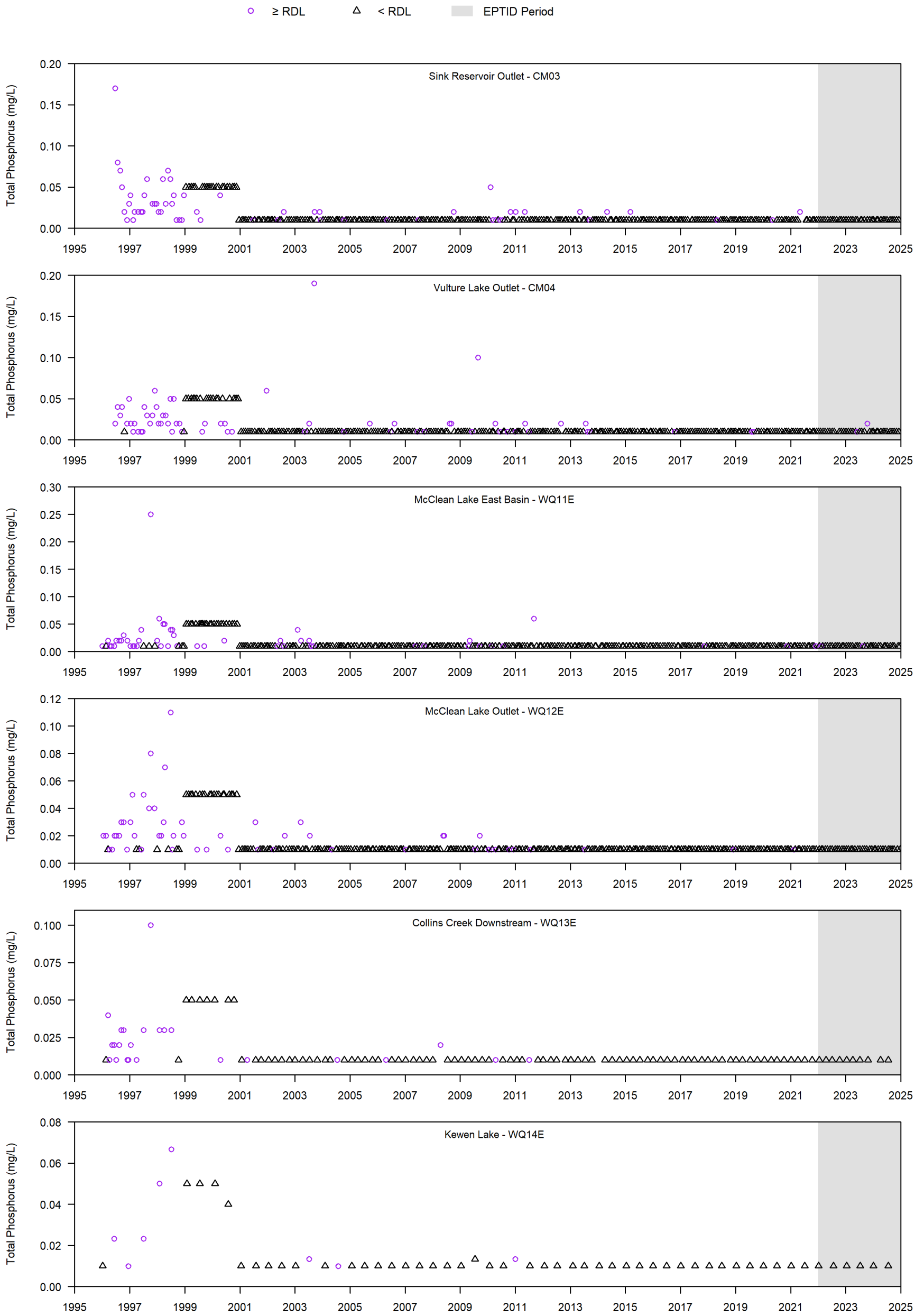


Figure 4.3-3 (9 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

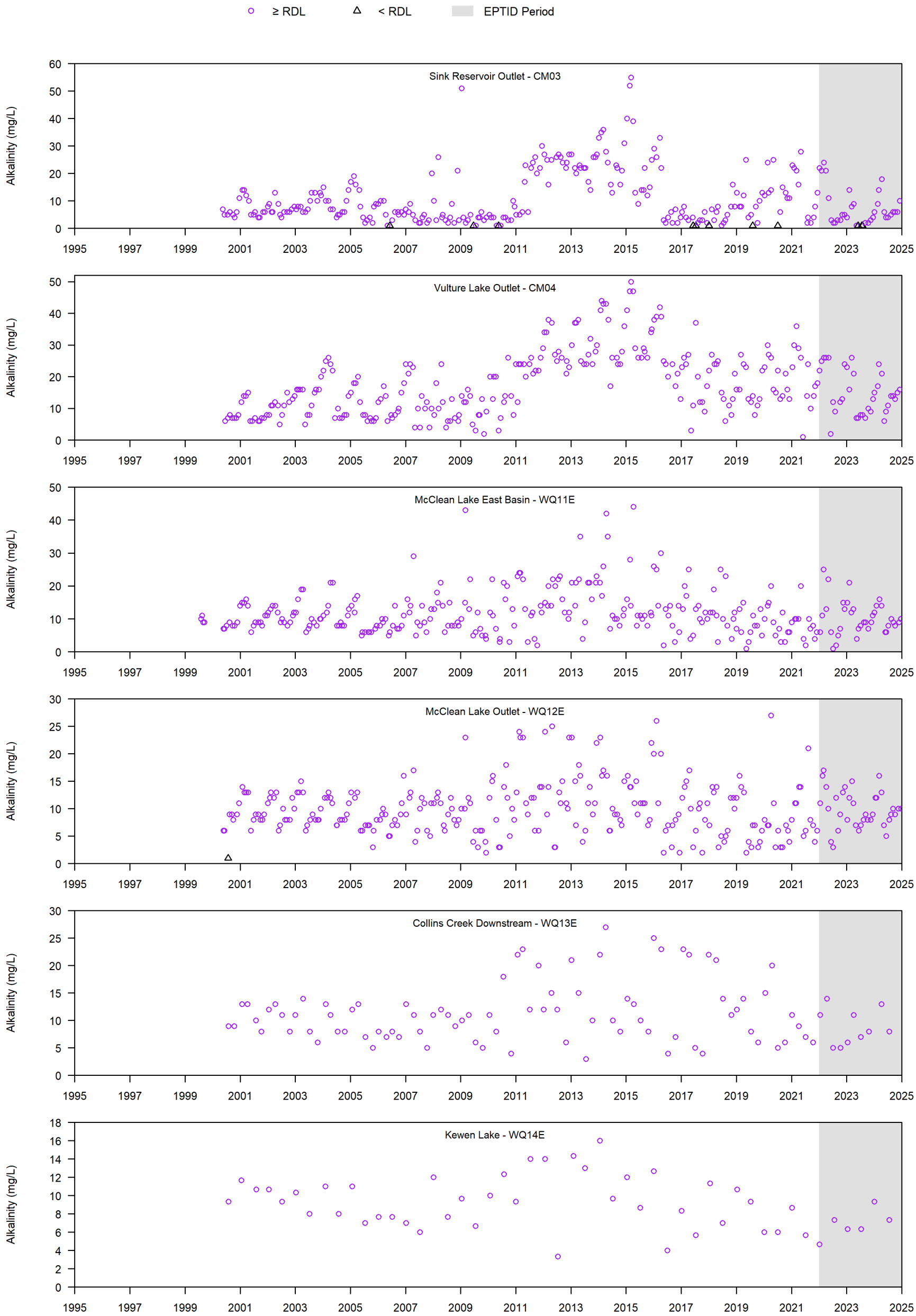


Figure 4.3-3 (10 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

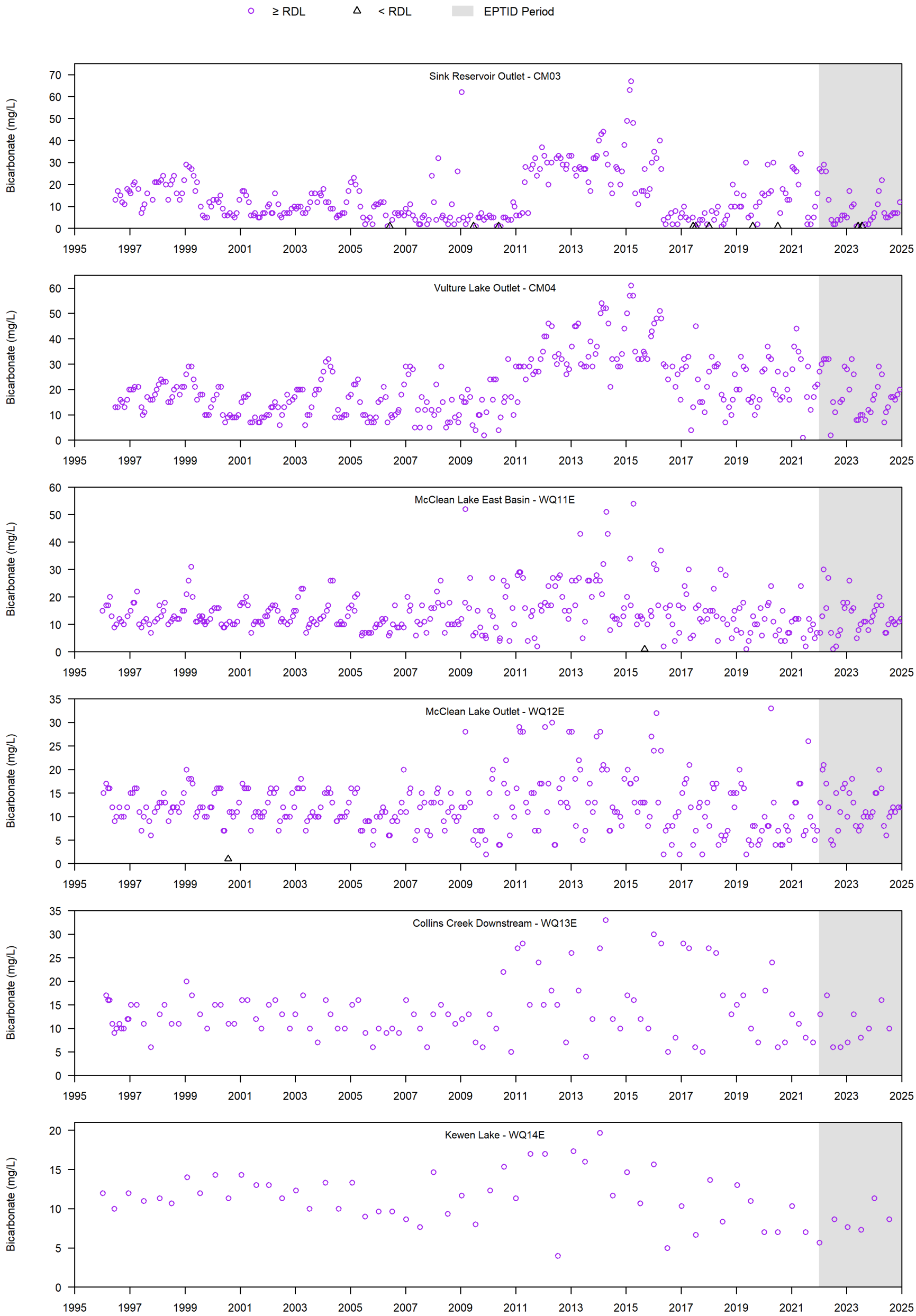


Figure 4.3-3 (11 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

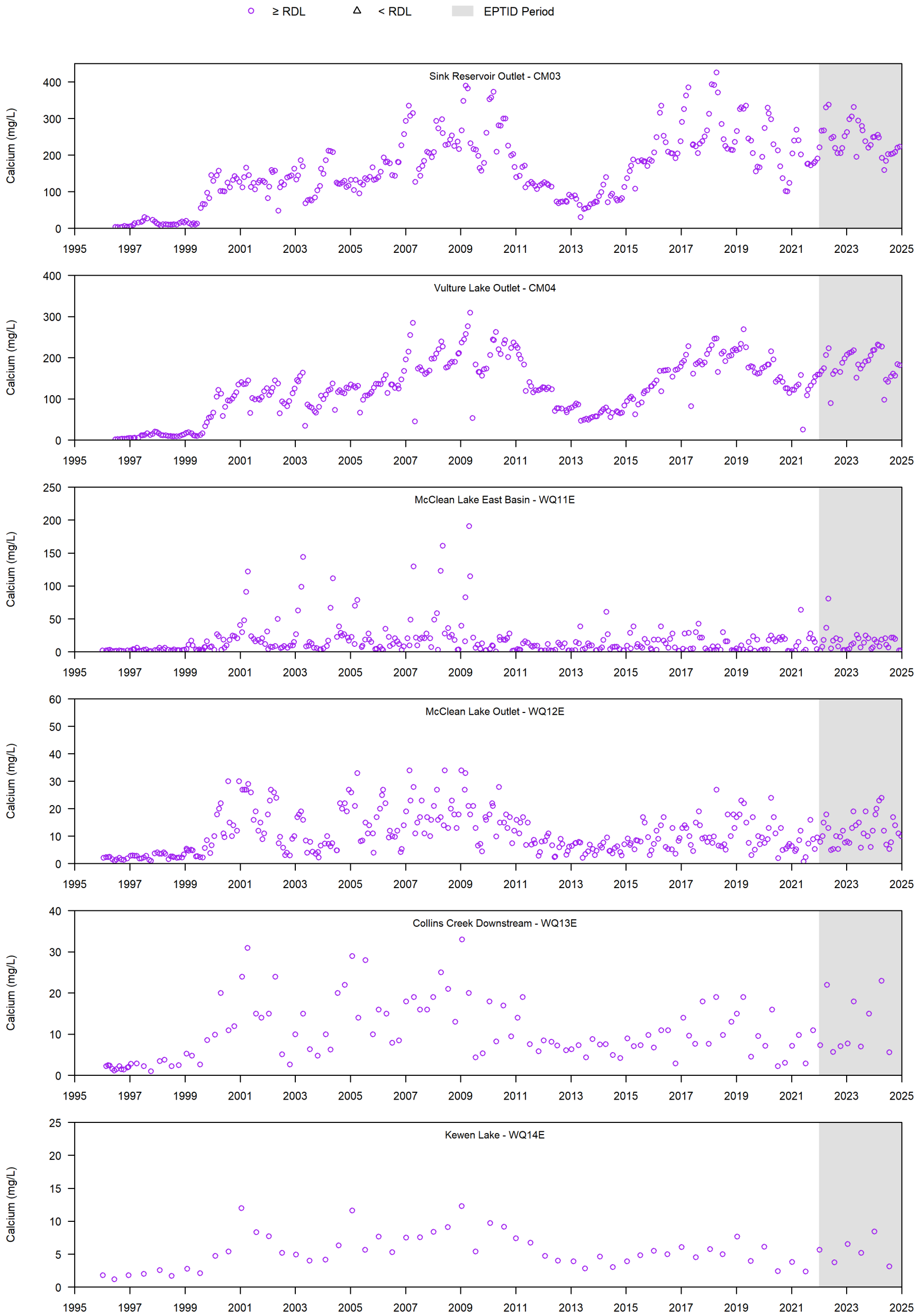


Figure 4.3-3 (12 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

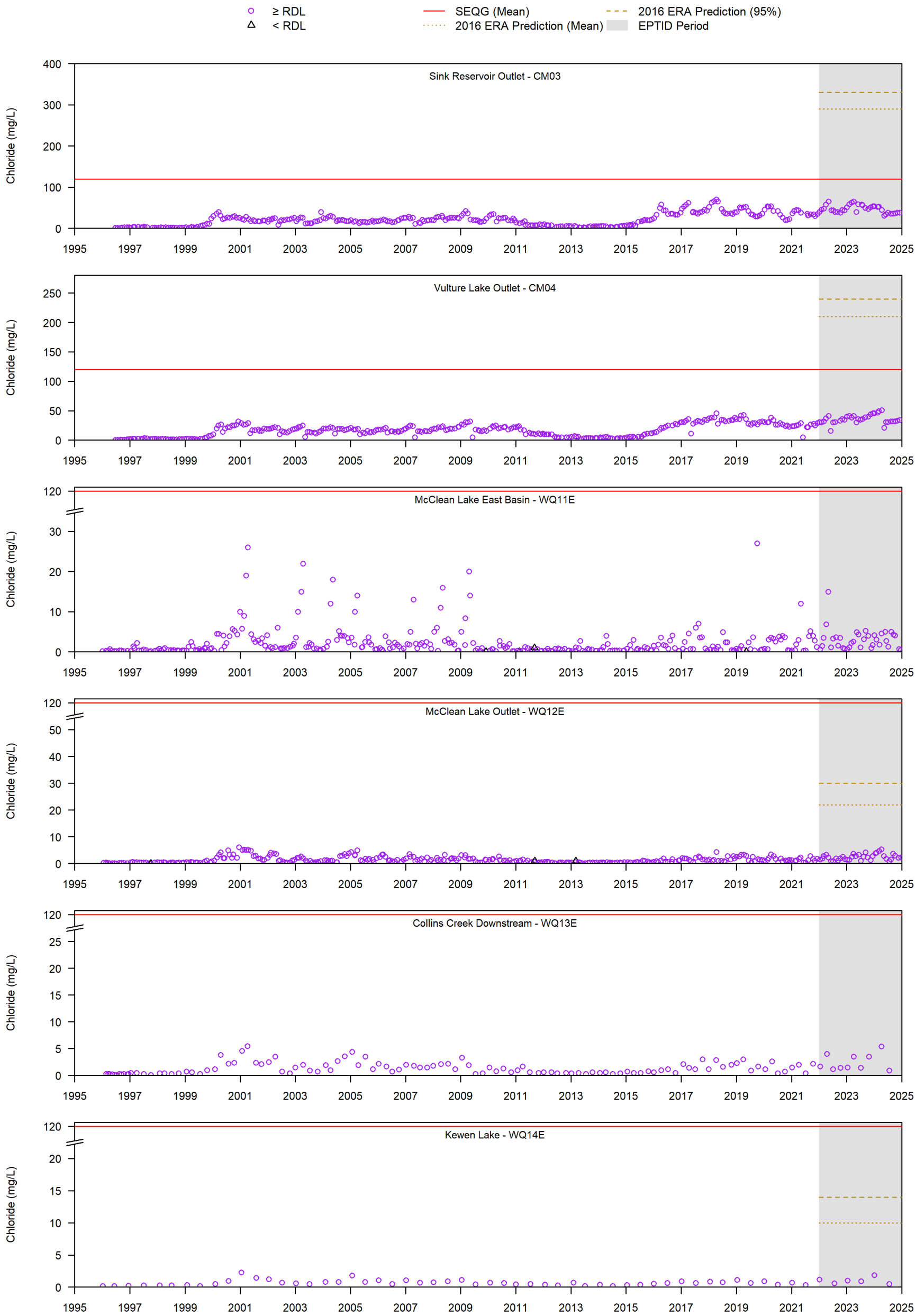


Figure 4.3-3 (13 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

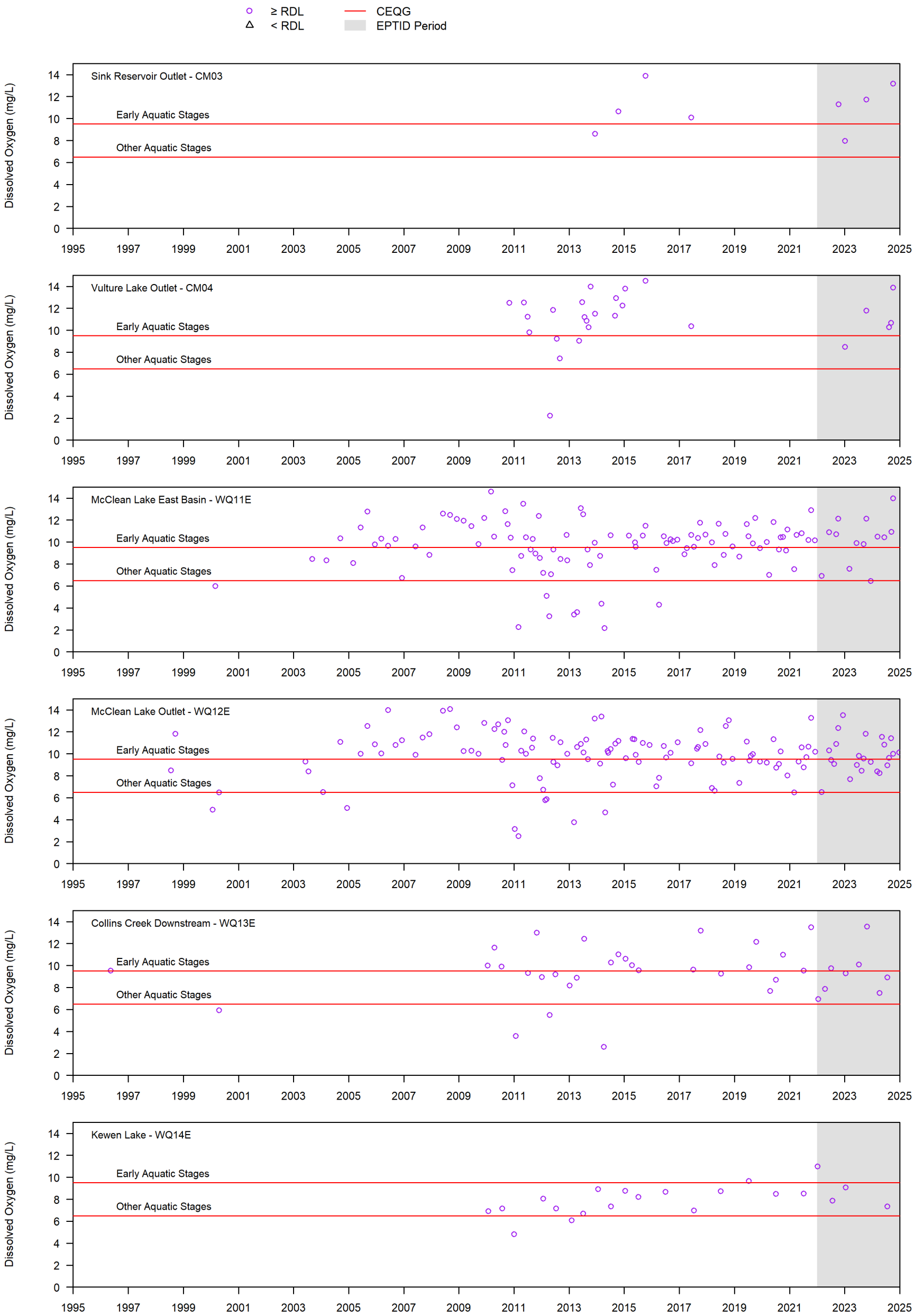


Figure 4.3-3 (14 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

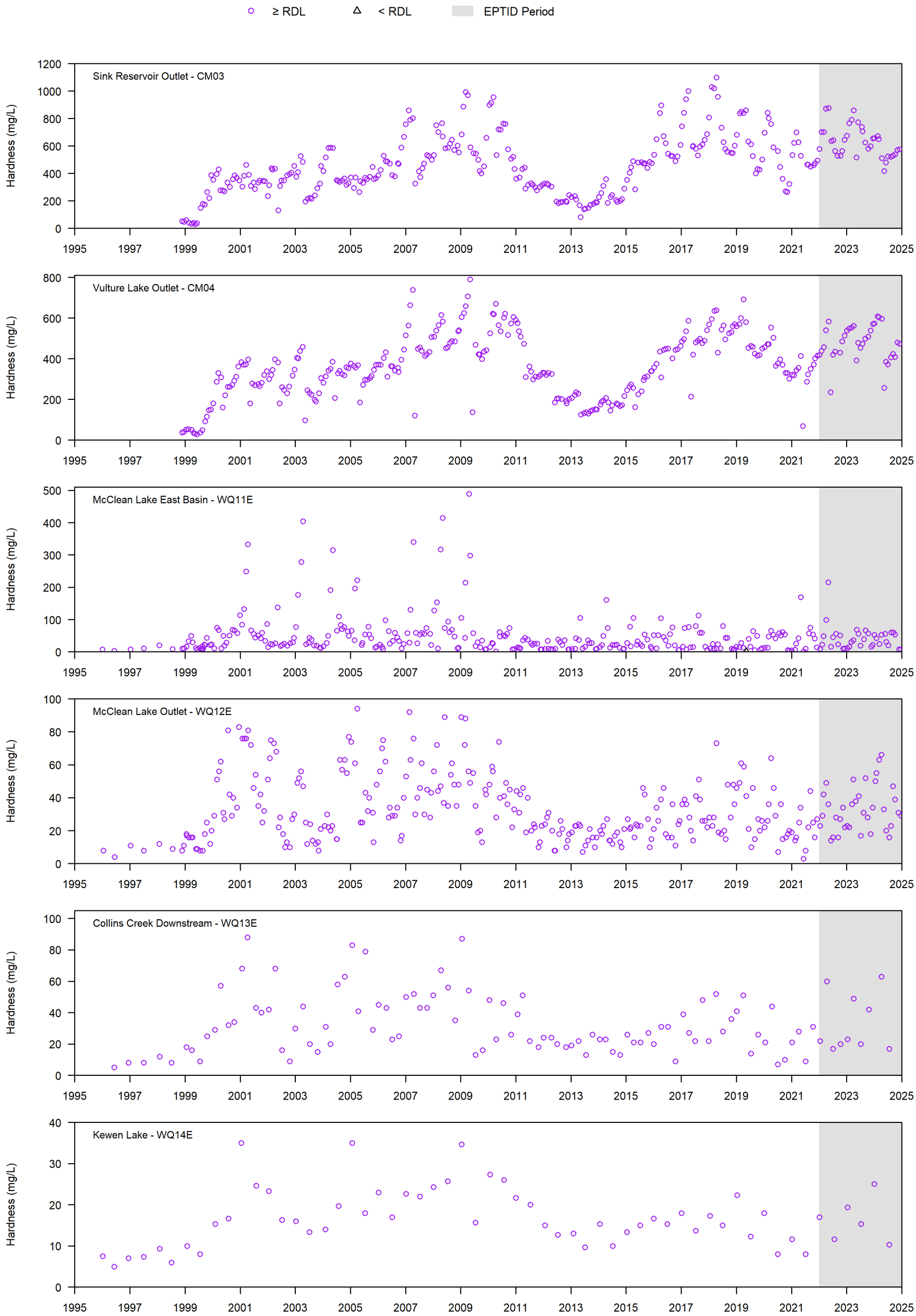


Figure 4.3-3 (15 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

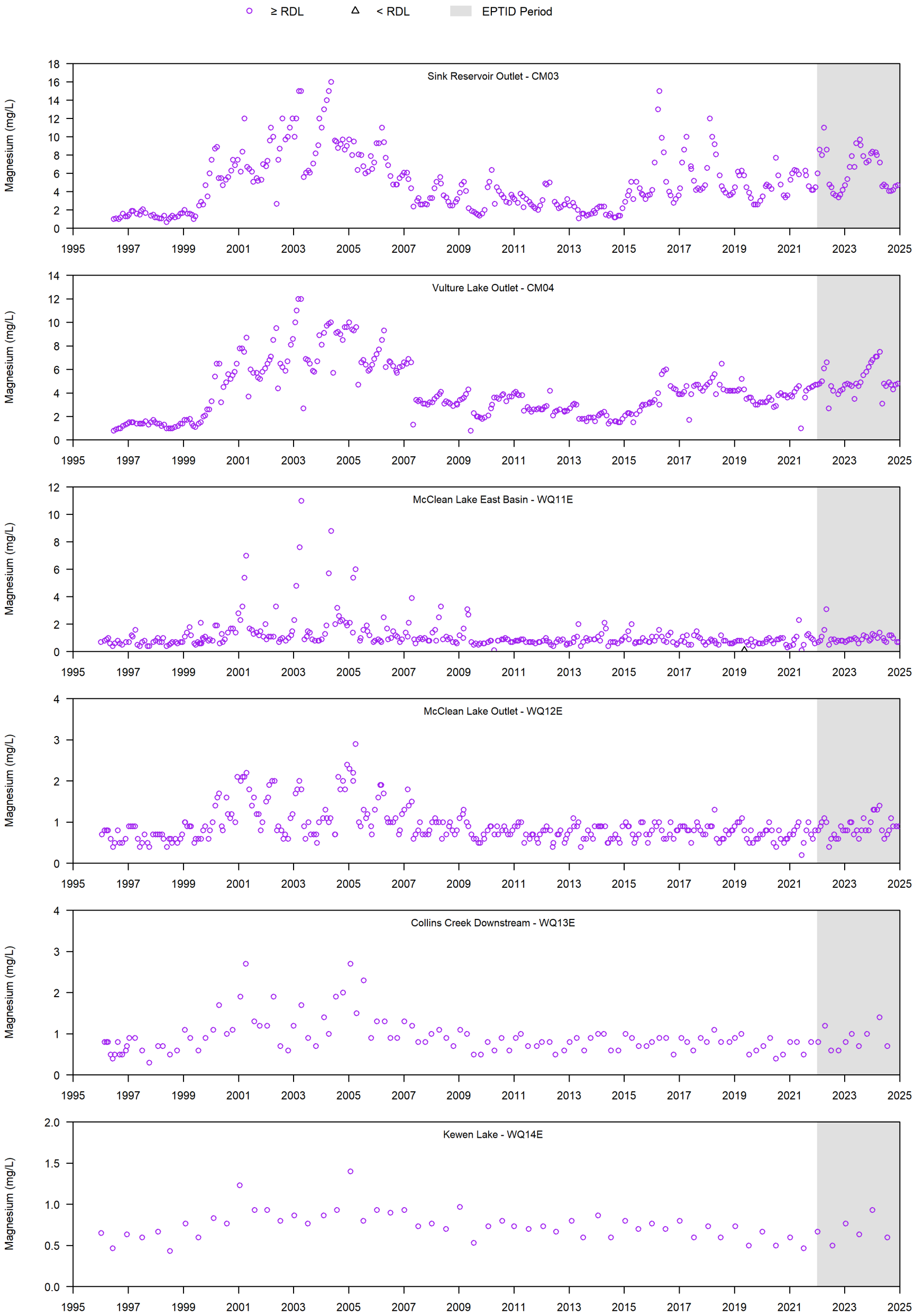


Figure 4.3-3 (16 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

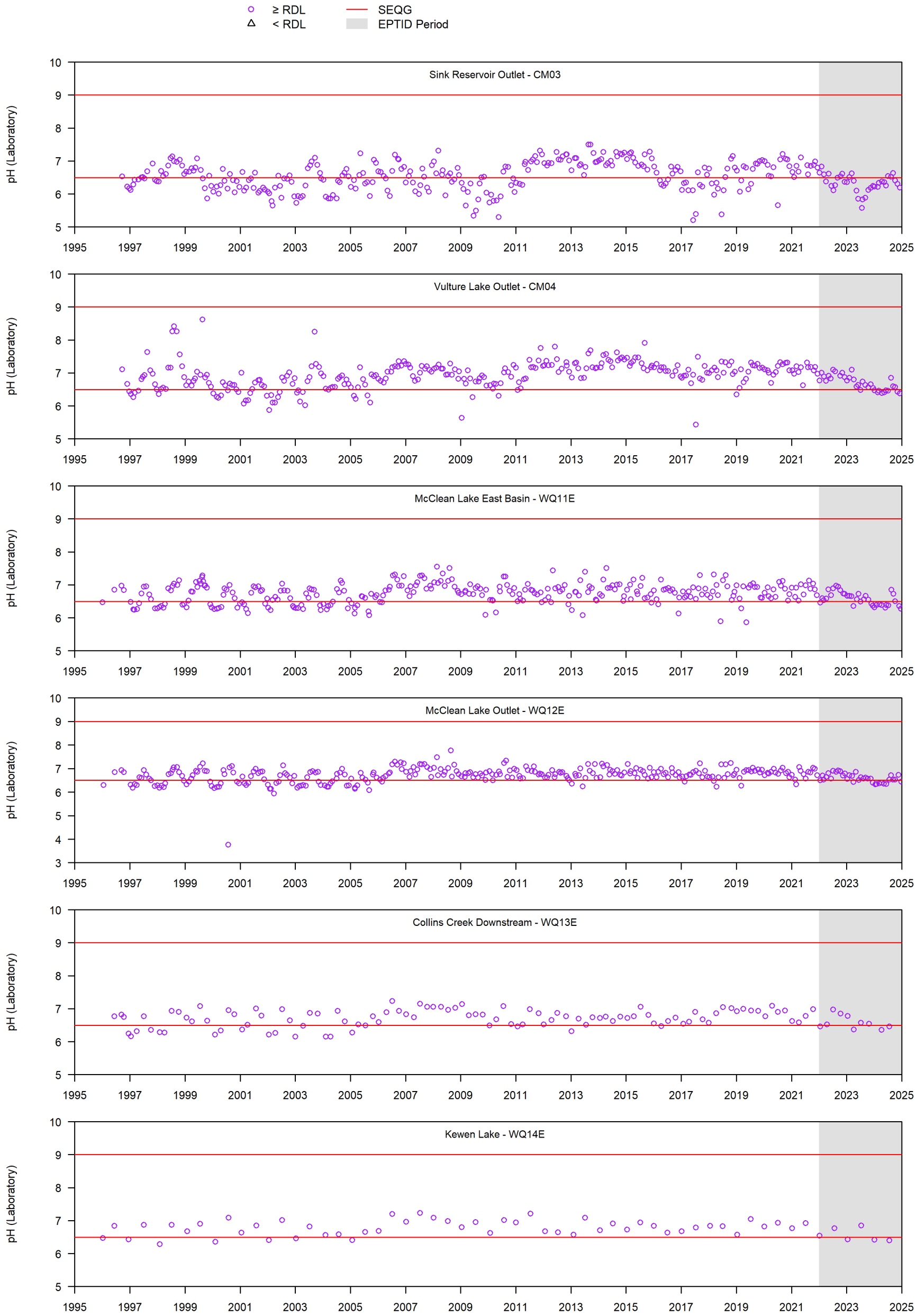


Figure 4.3-3 (17 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

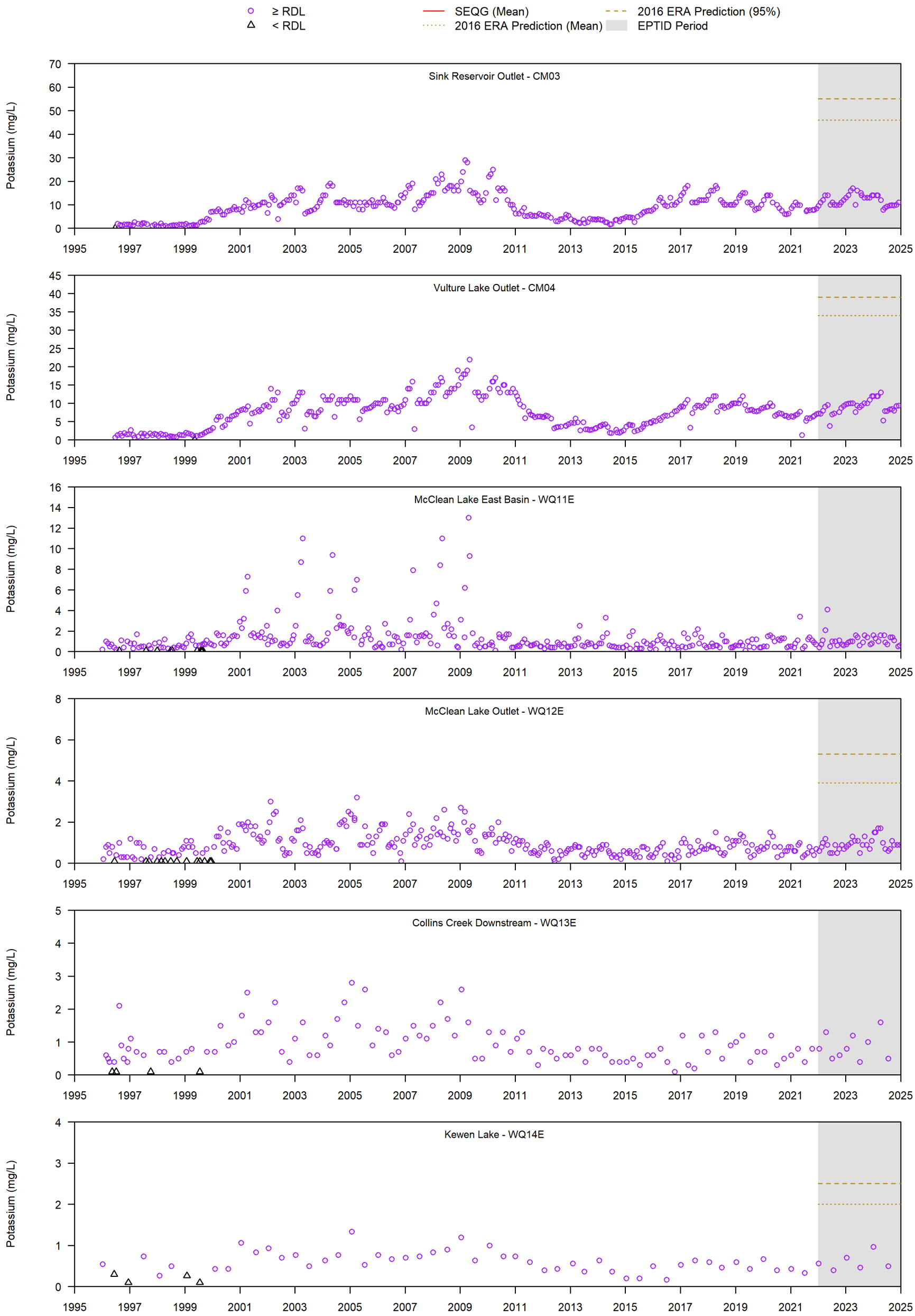


Figure 4.3-3 (18 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

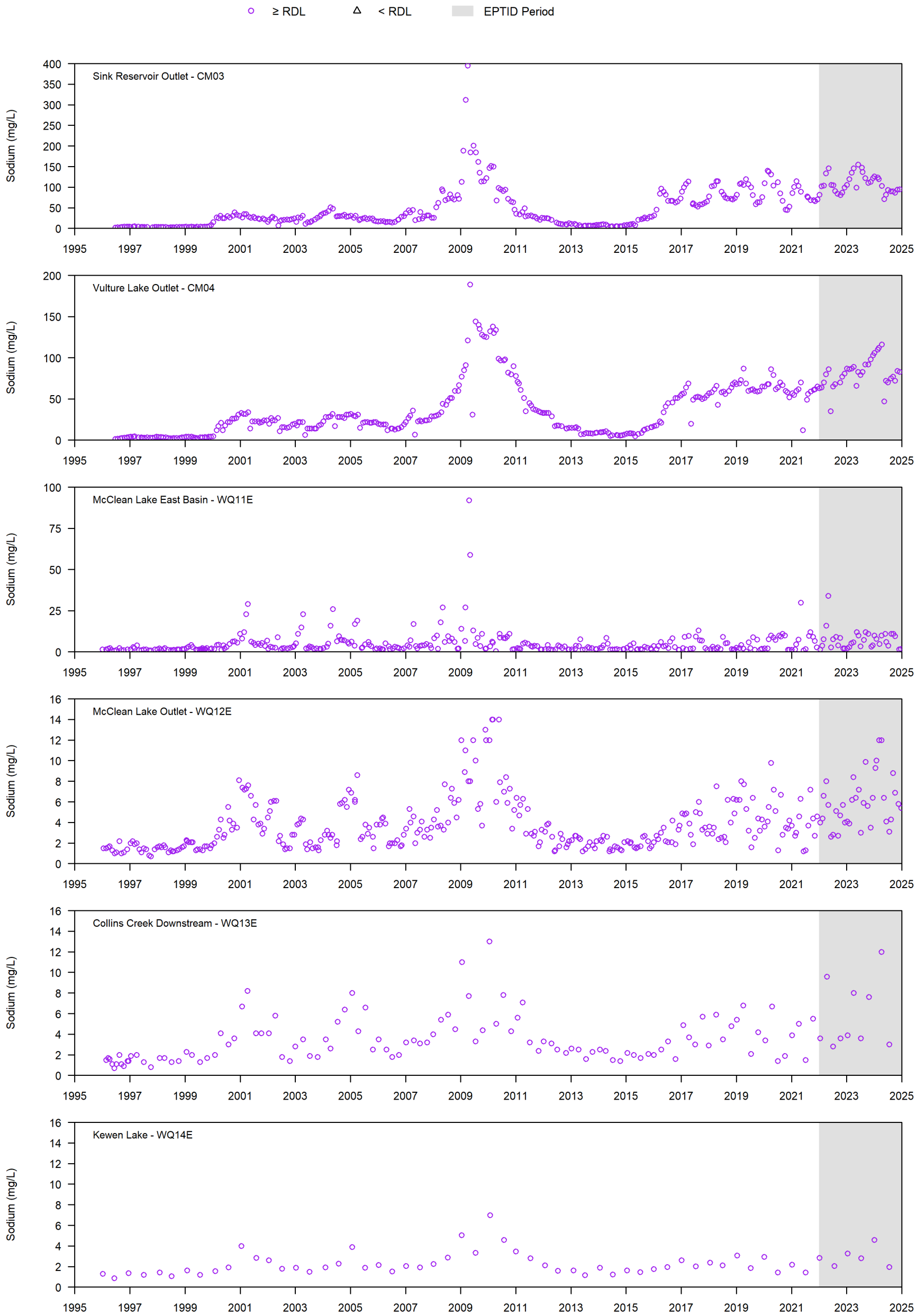


Figure 4.3-3 (19 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

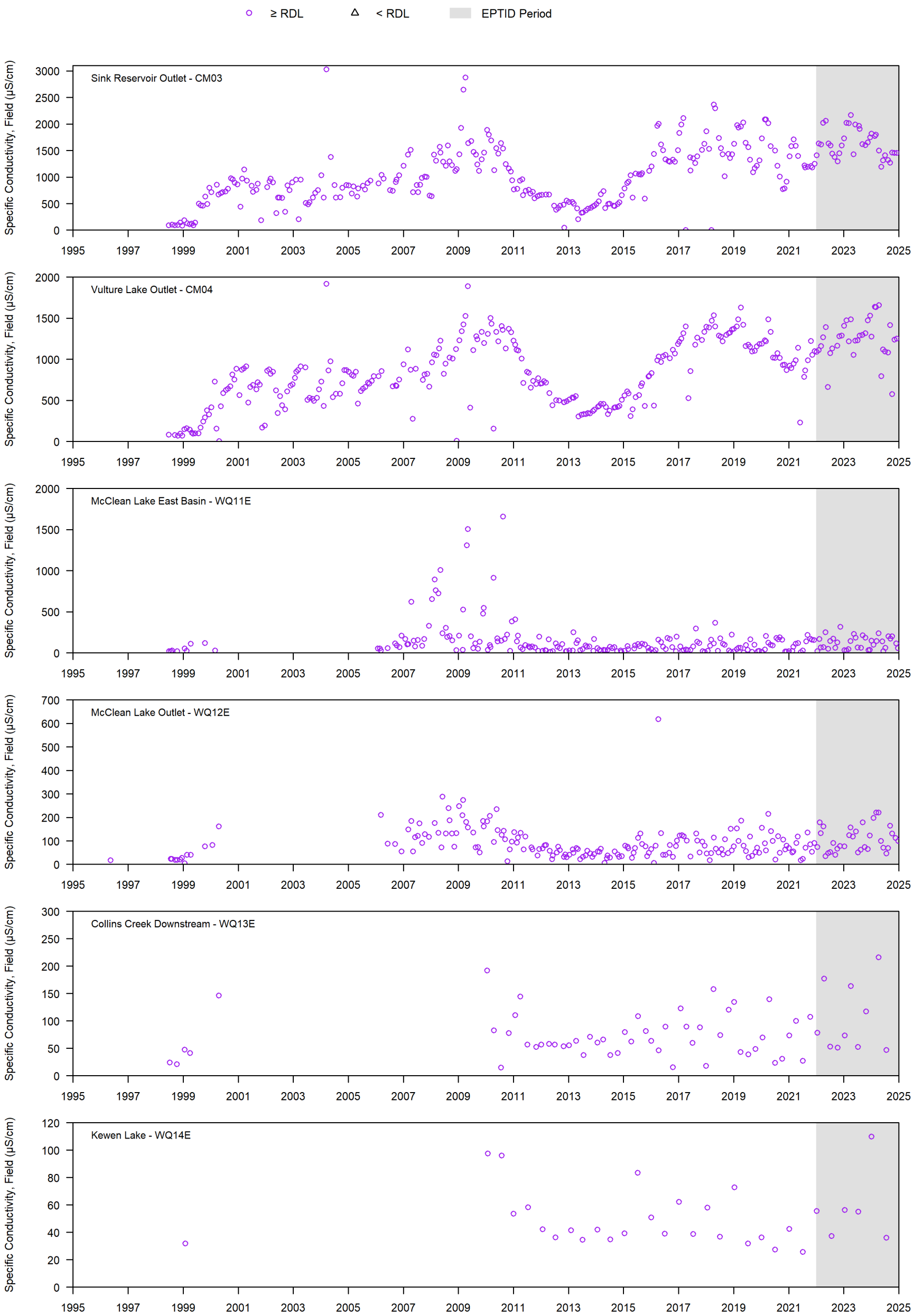


Figure 4.3-3 (20 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

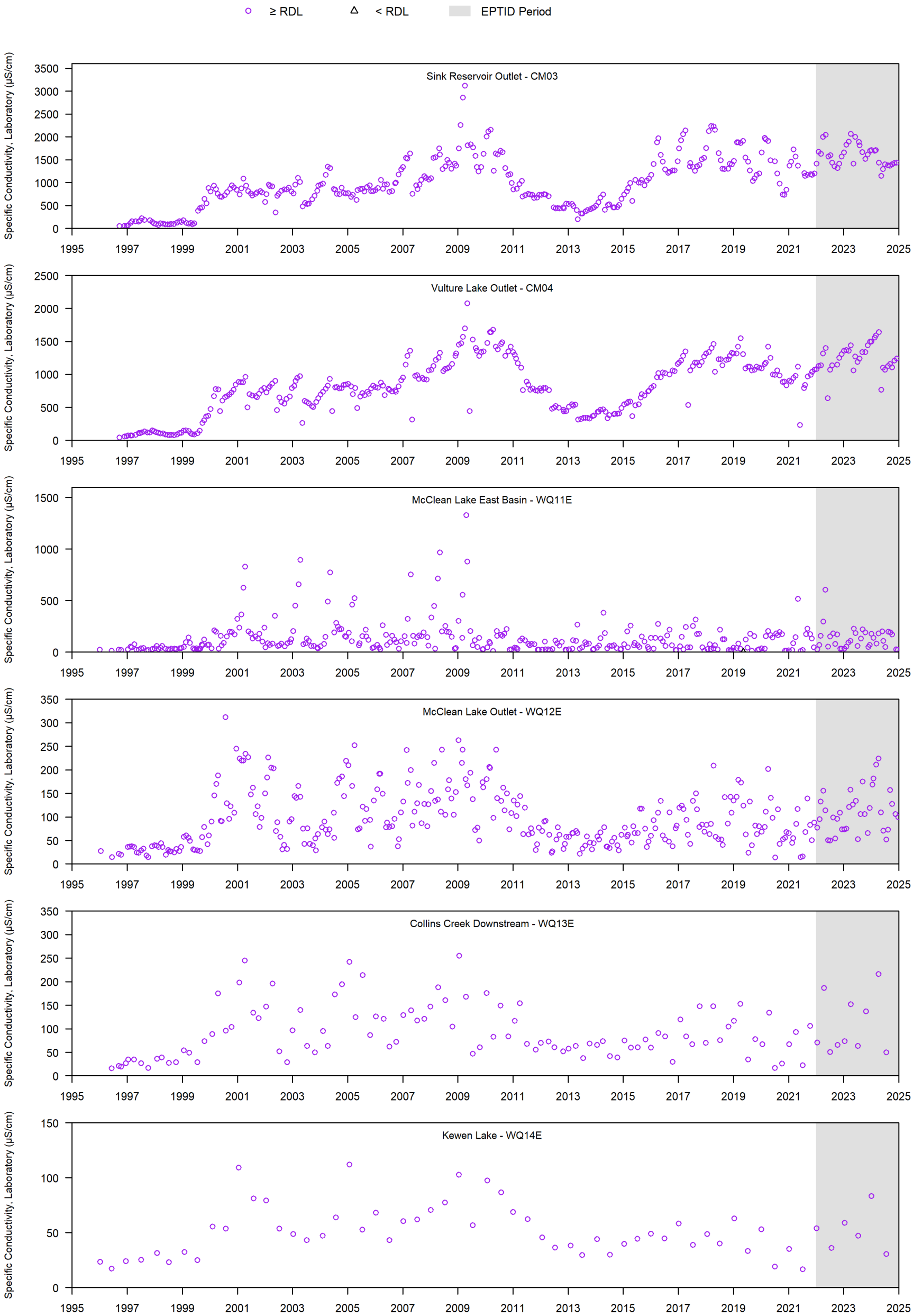


Figure 4.3-3 (21 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

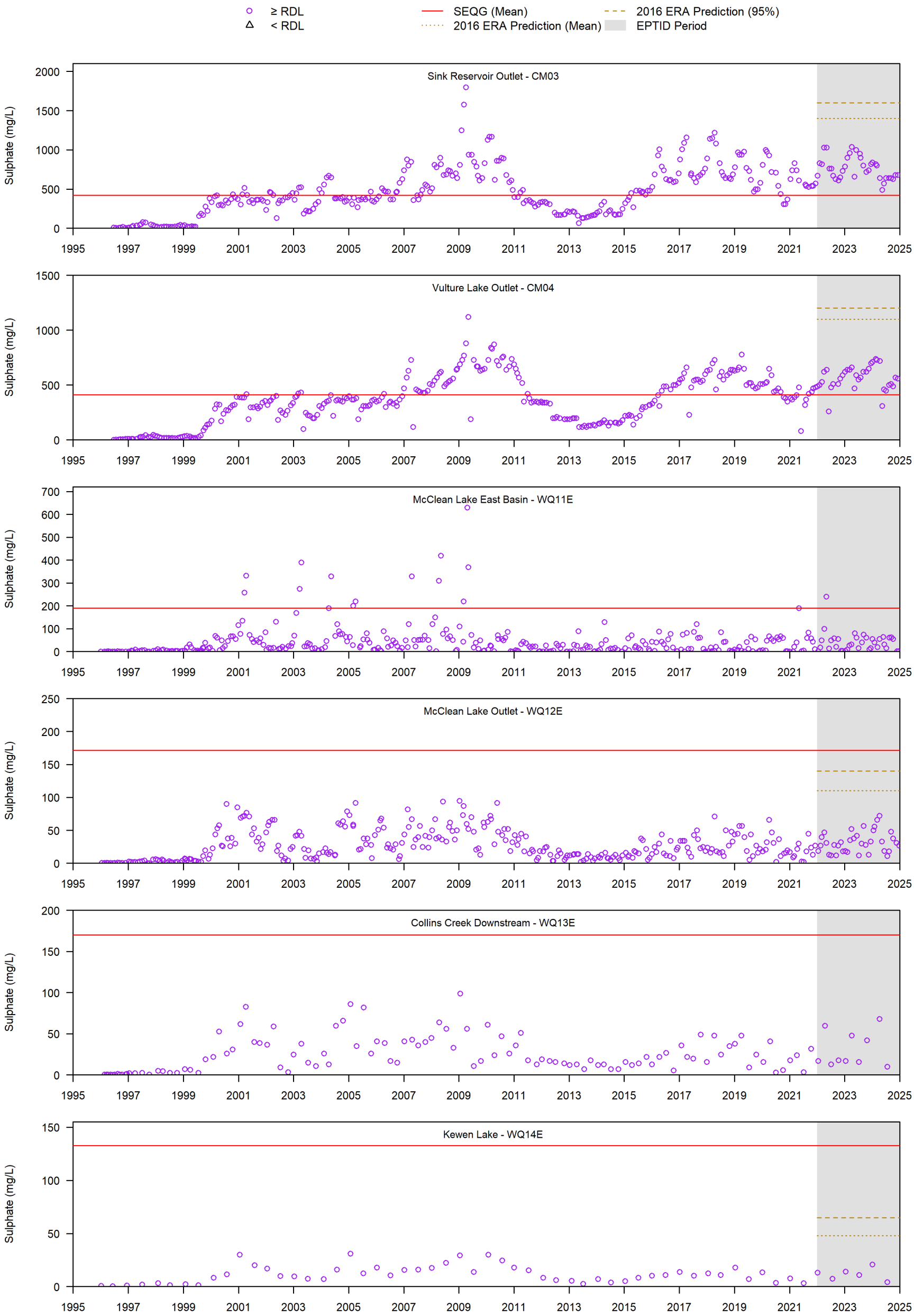


Figure 4.3-3 (22 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

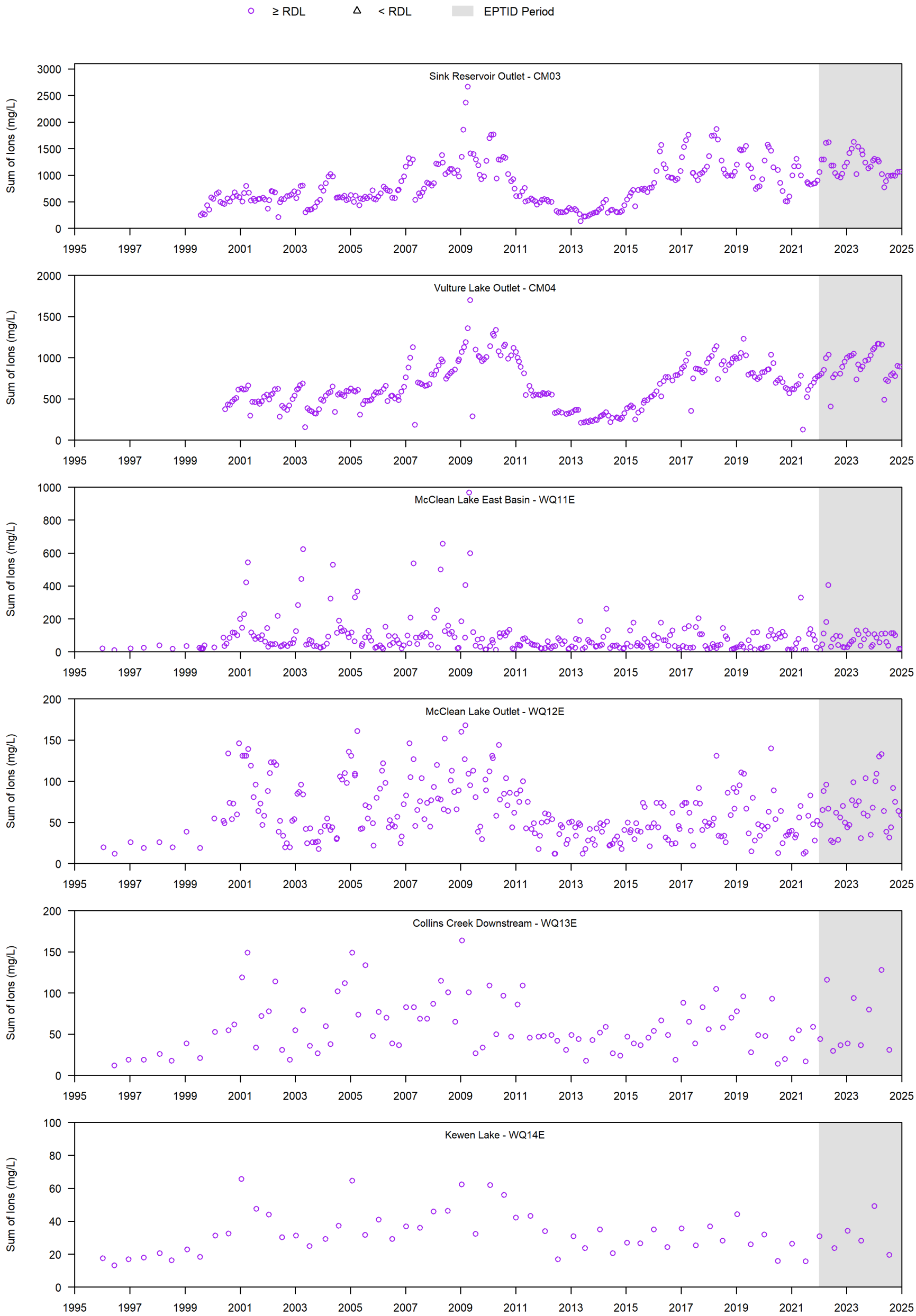


Figure 4.3-3 (23 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

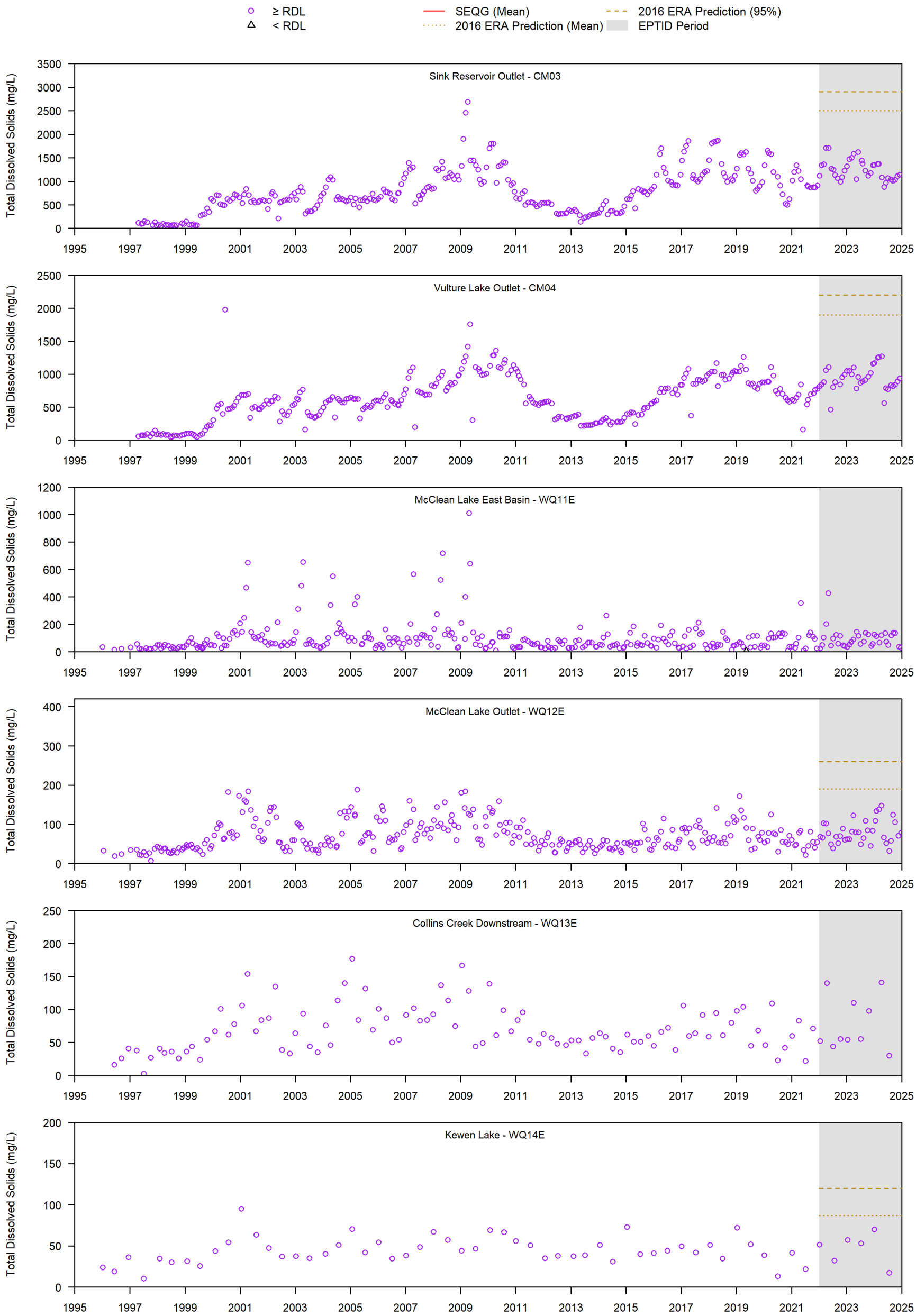


Figure 4.3-3 (24 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

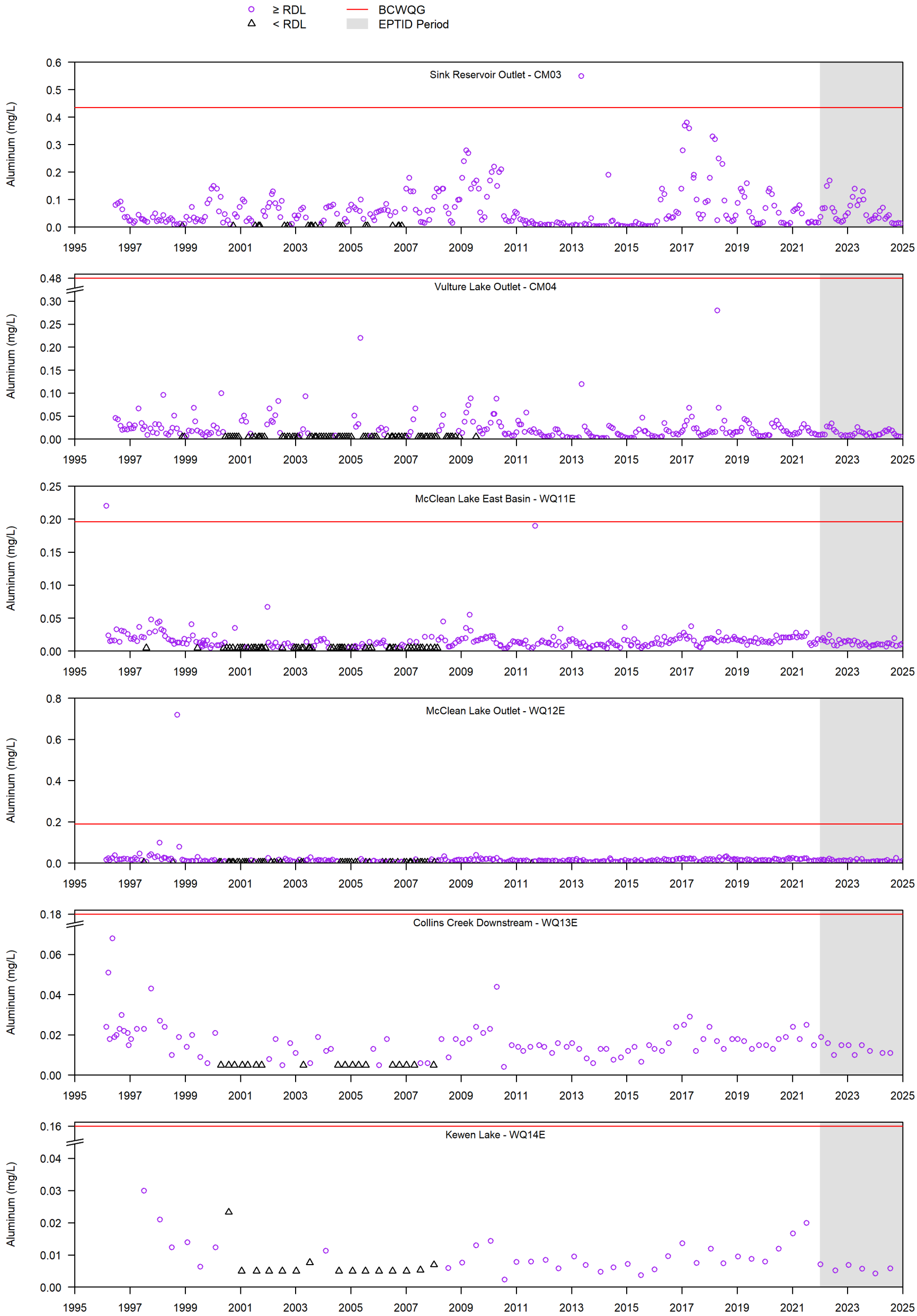


Figure 4.3-3 (25 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

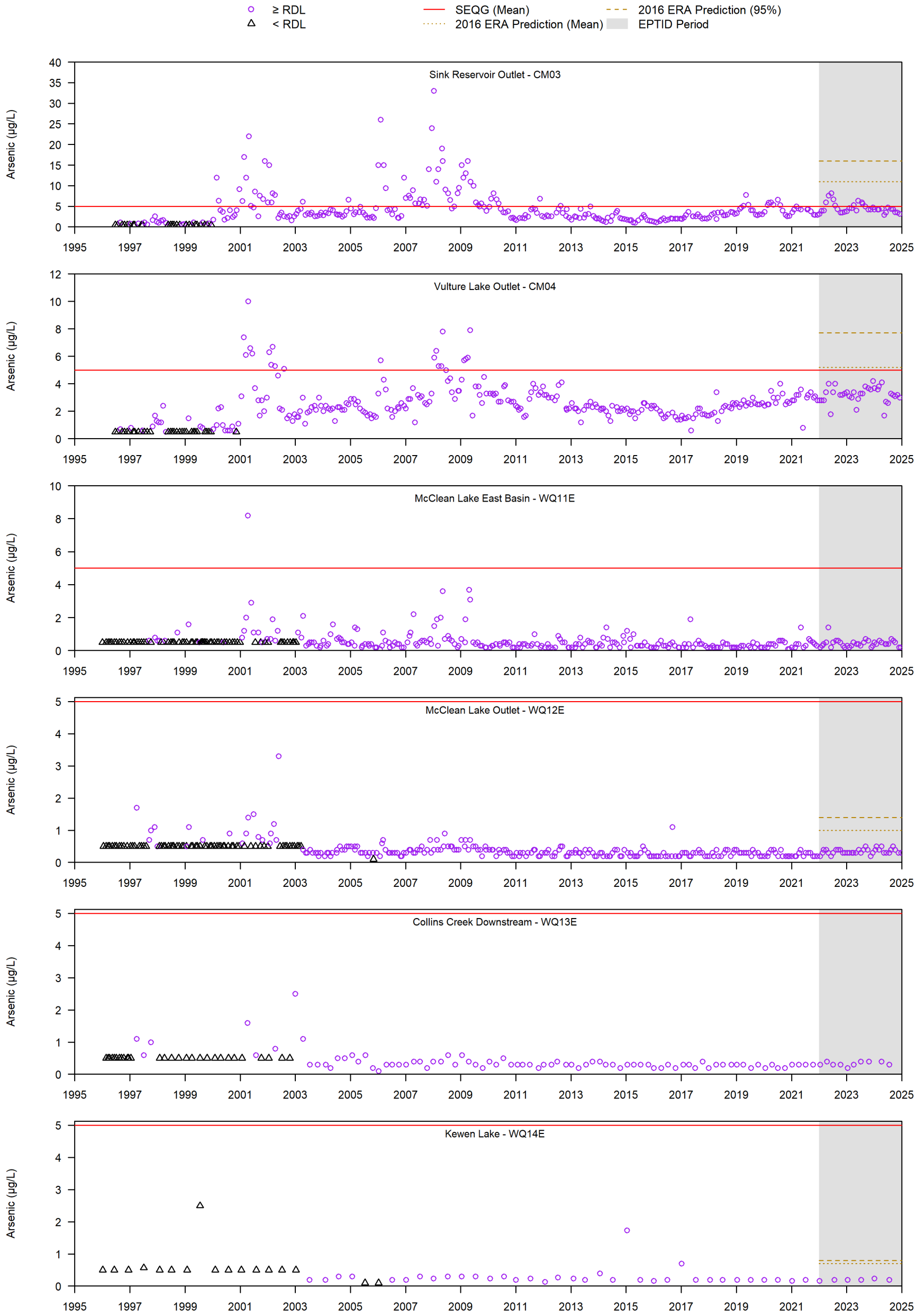


Figure 4.3-3 (26 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

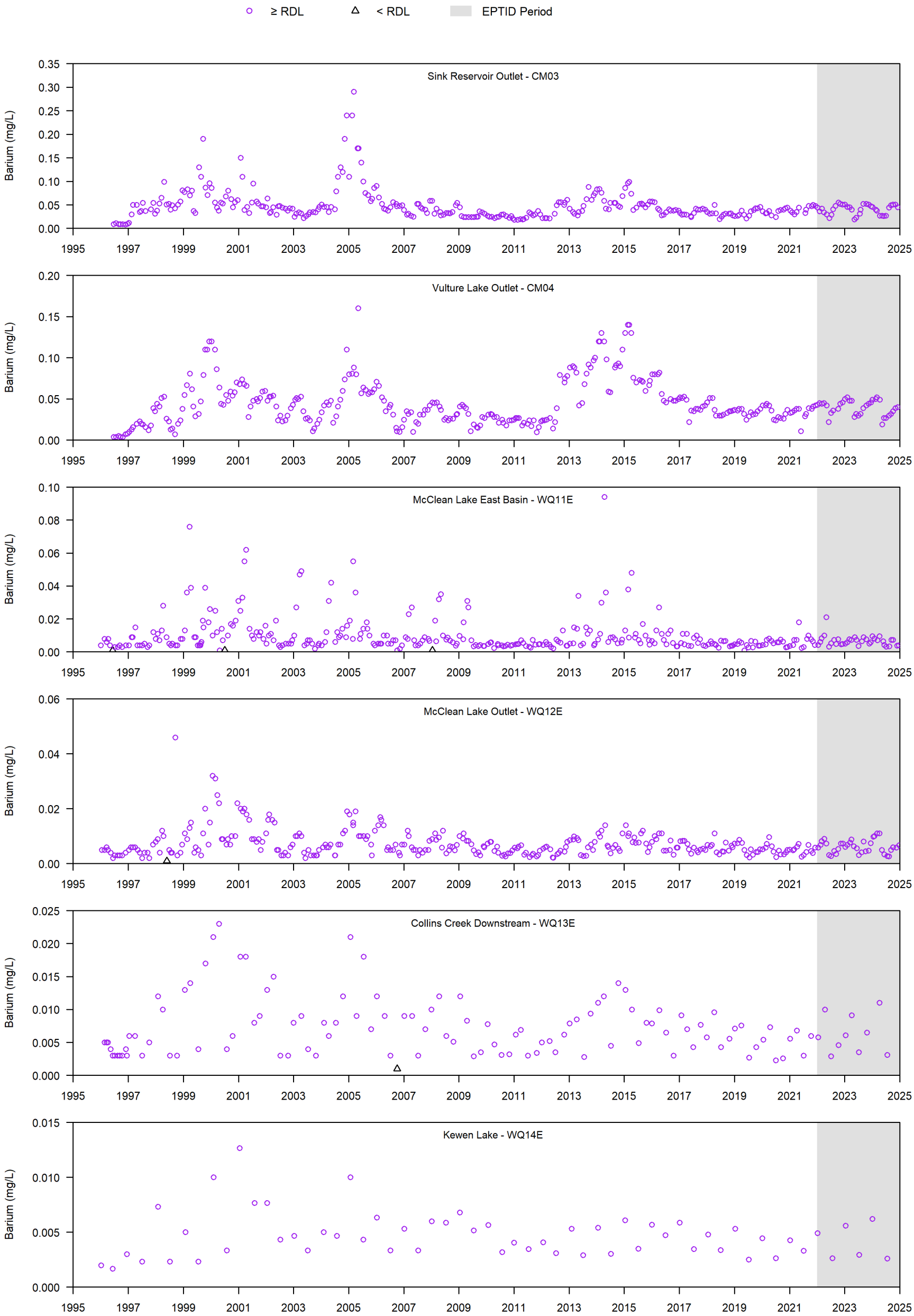


Figure 4.3-3 (27 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

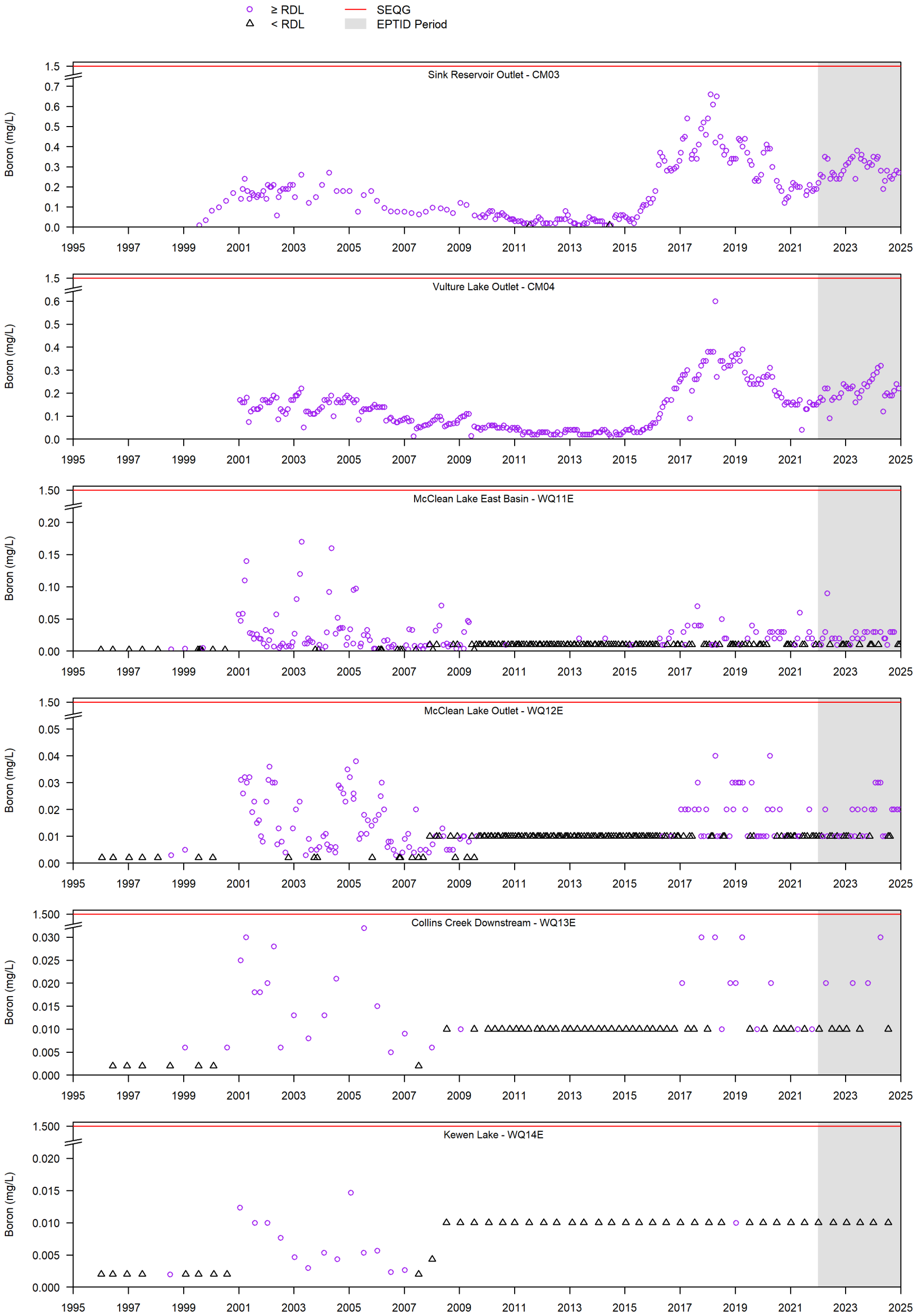


Figure 4.3-3 (28 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

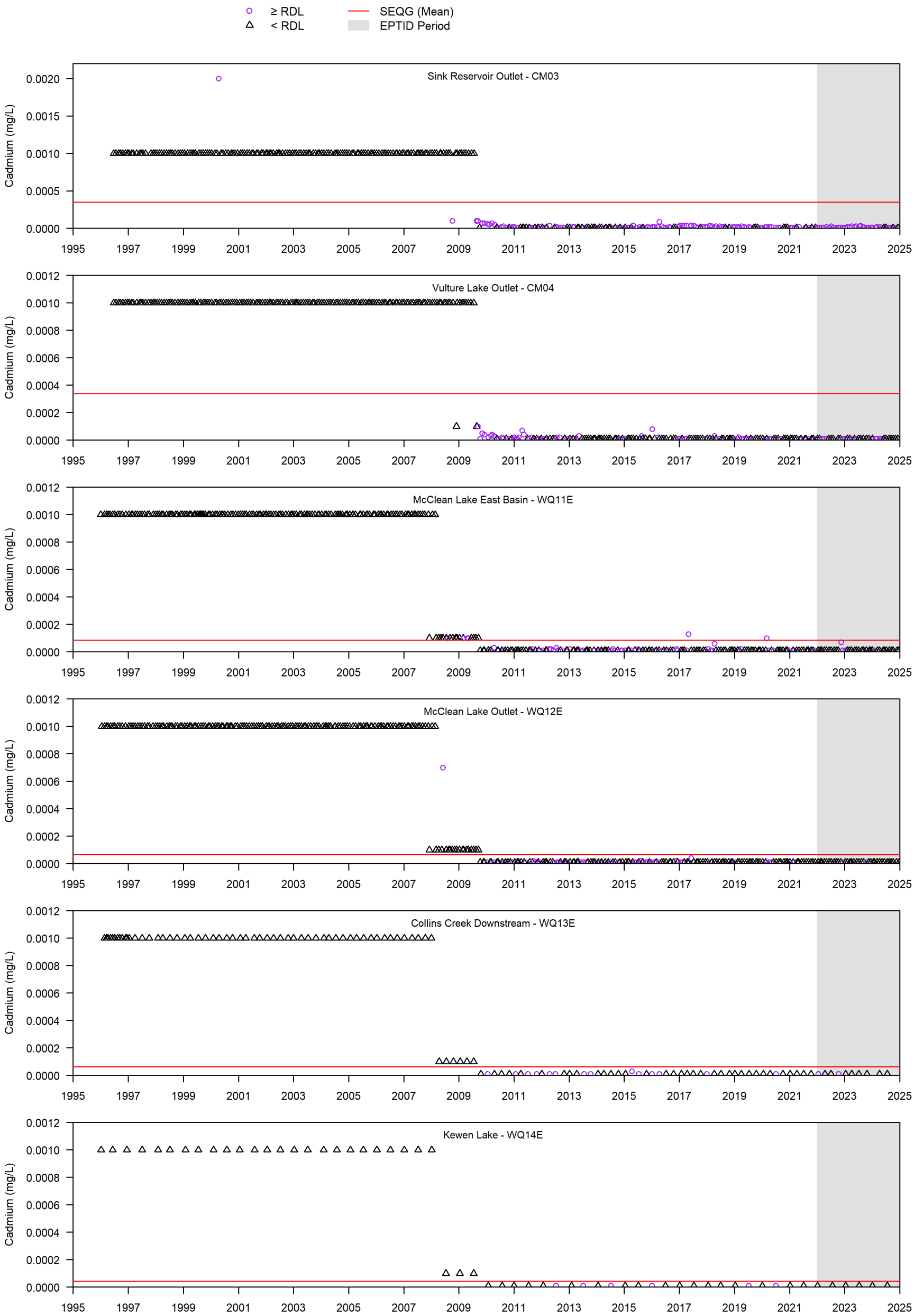


Figure 4.3-3 (29 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

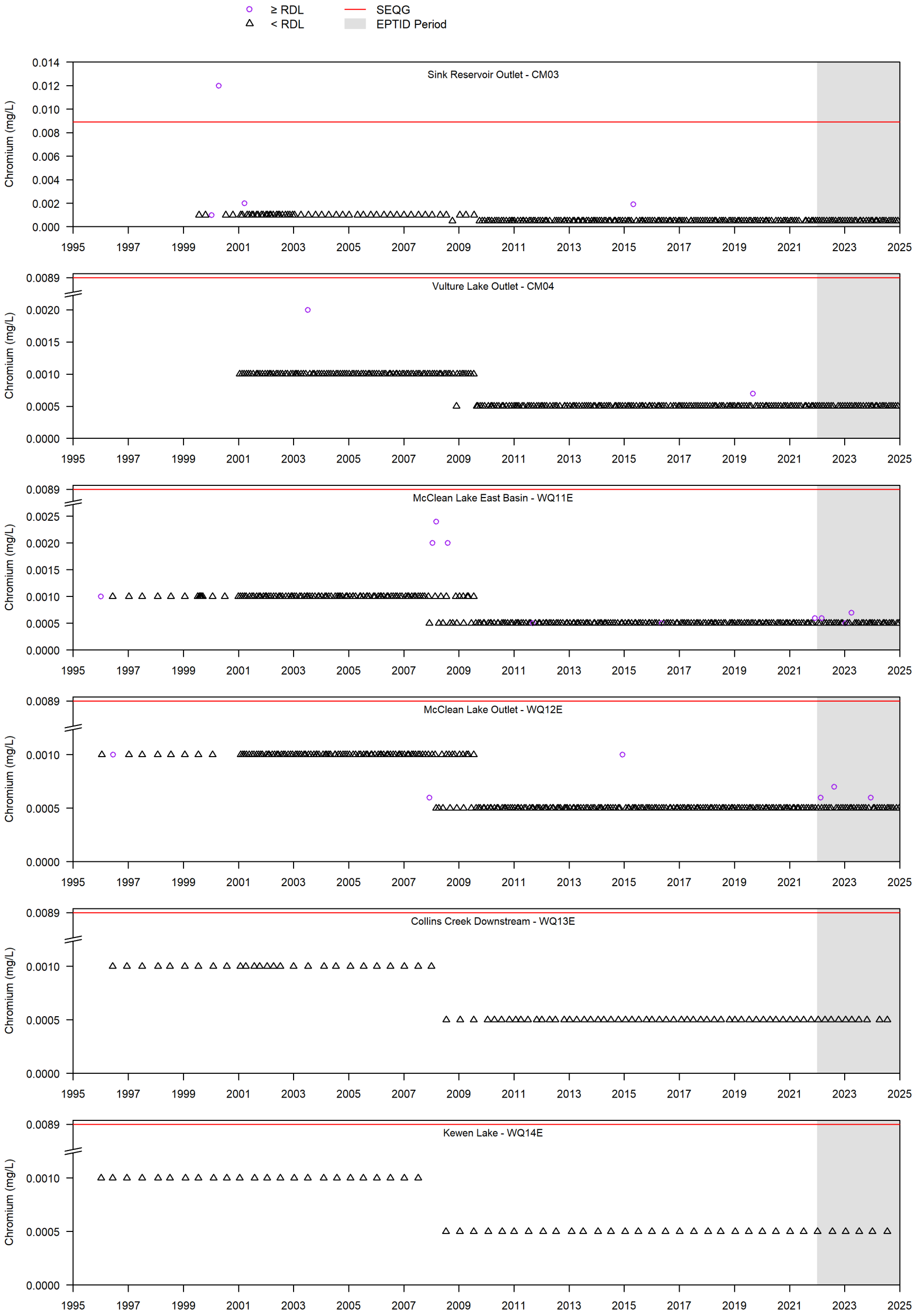


Figure 4.3-3 (30 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

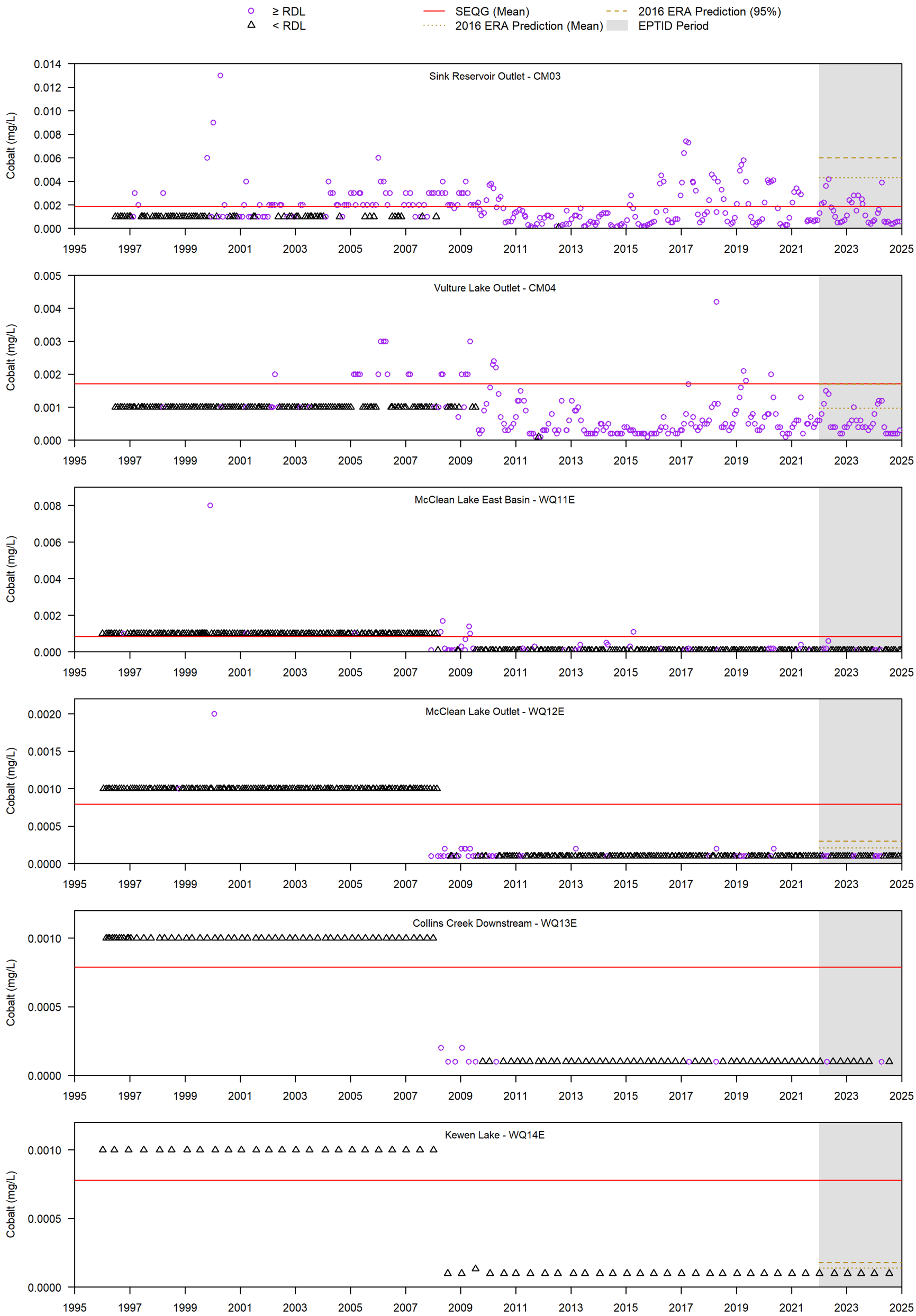


Figure 4.3-3 (31 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

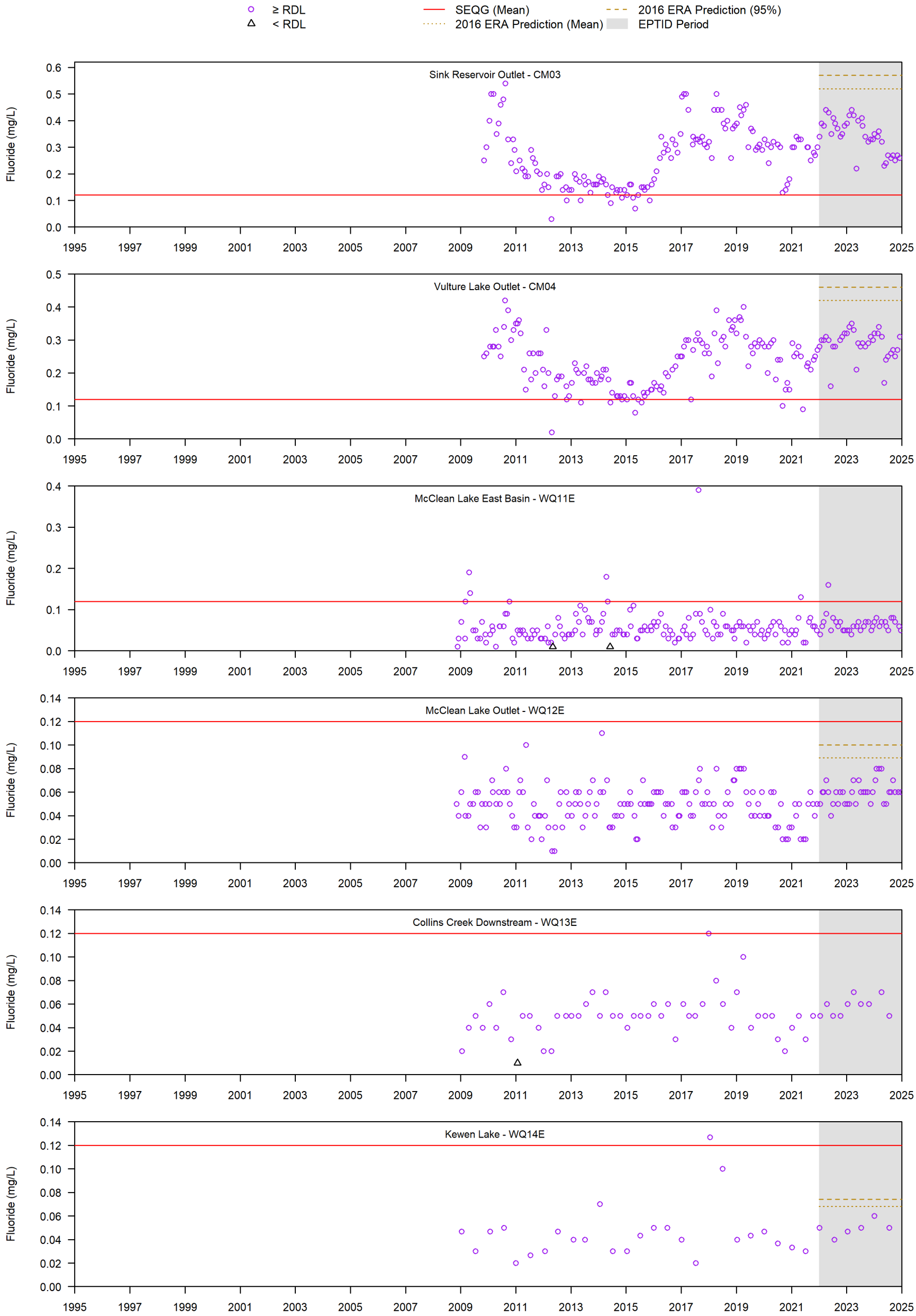


Figure 4.3-3 (32 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

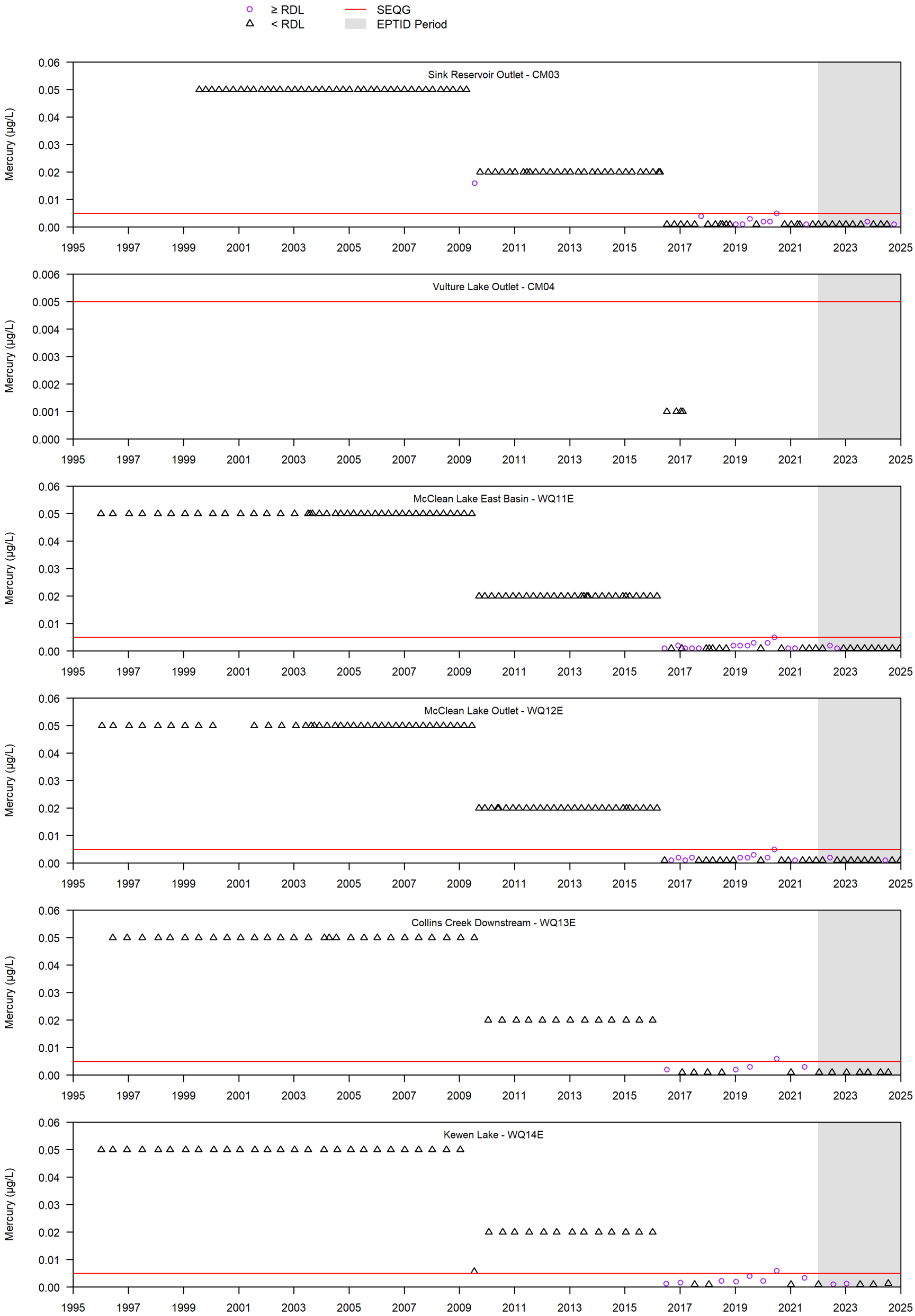


Figure 4.3-3 (33 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

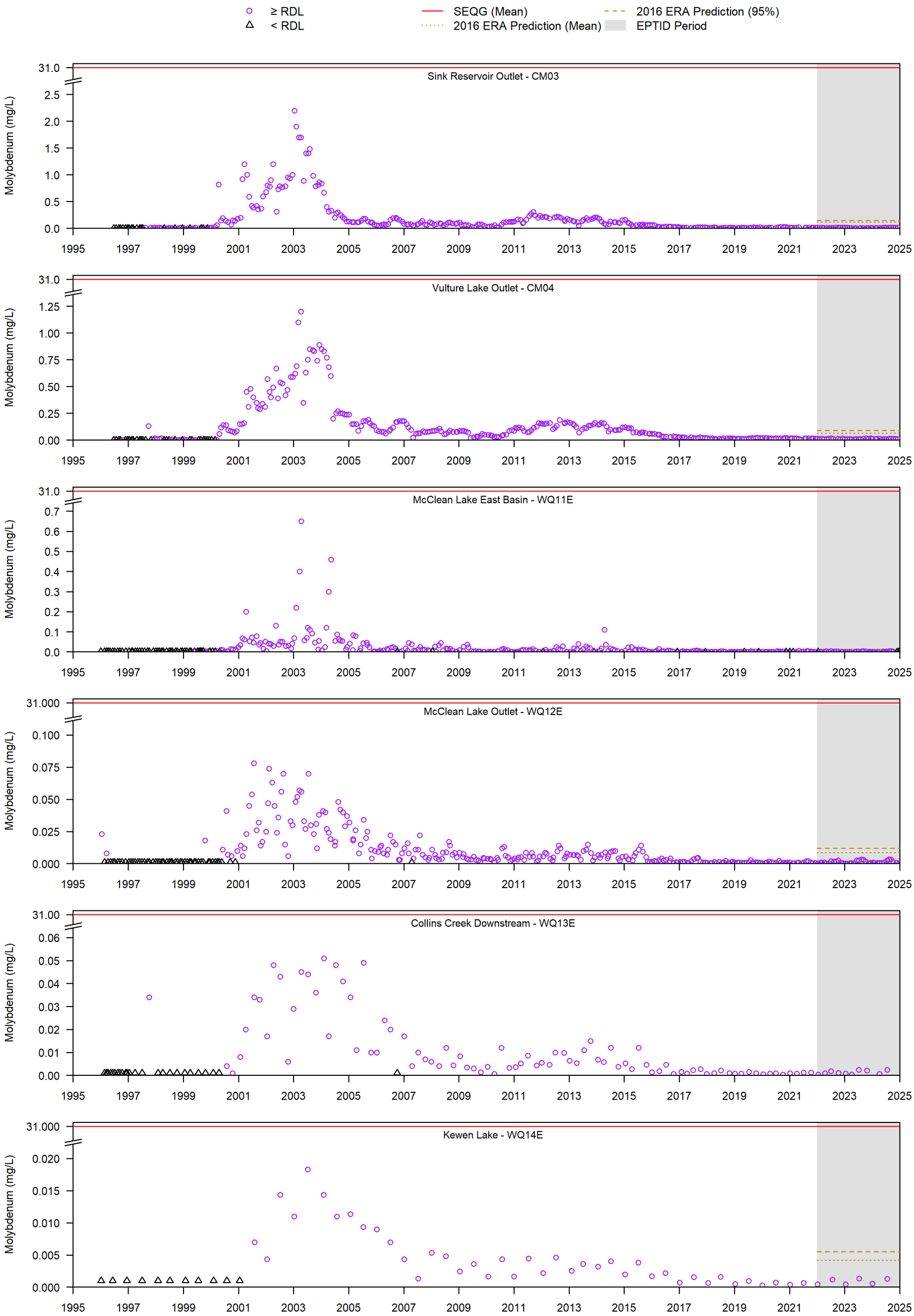


Figure 4.3-3 (34 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

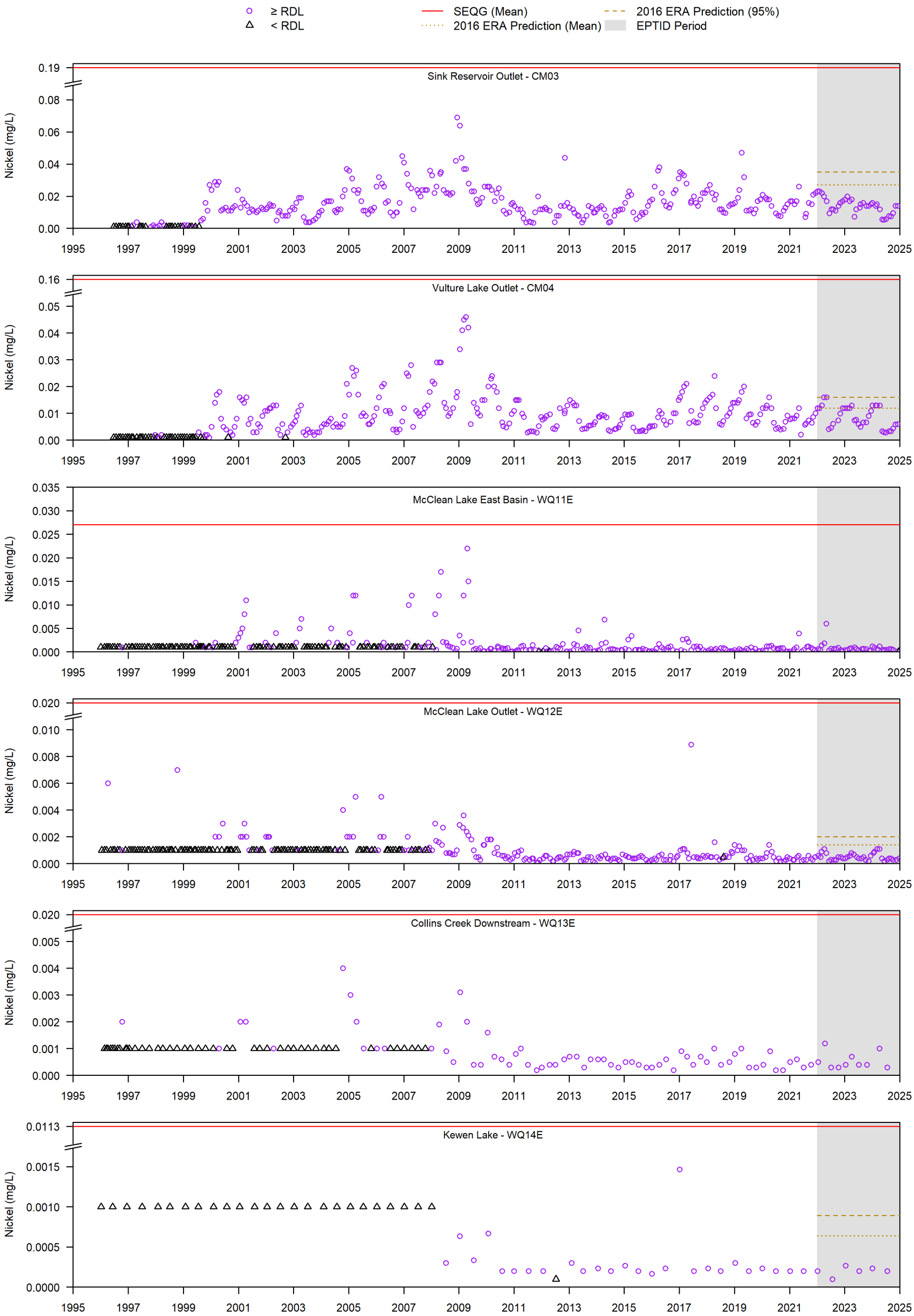


Figure 4.3-3 (35 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

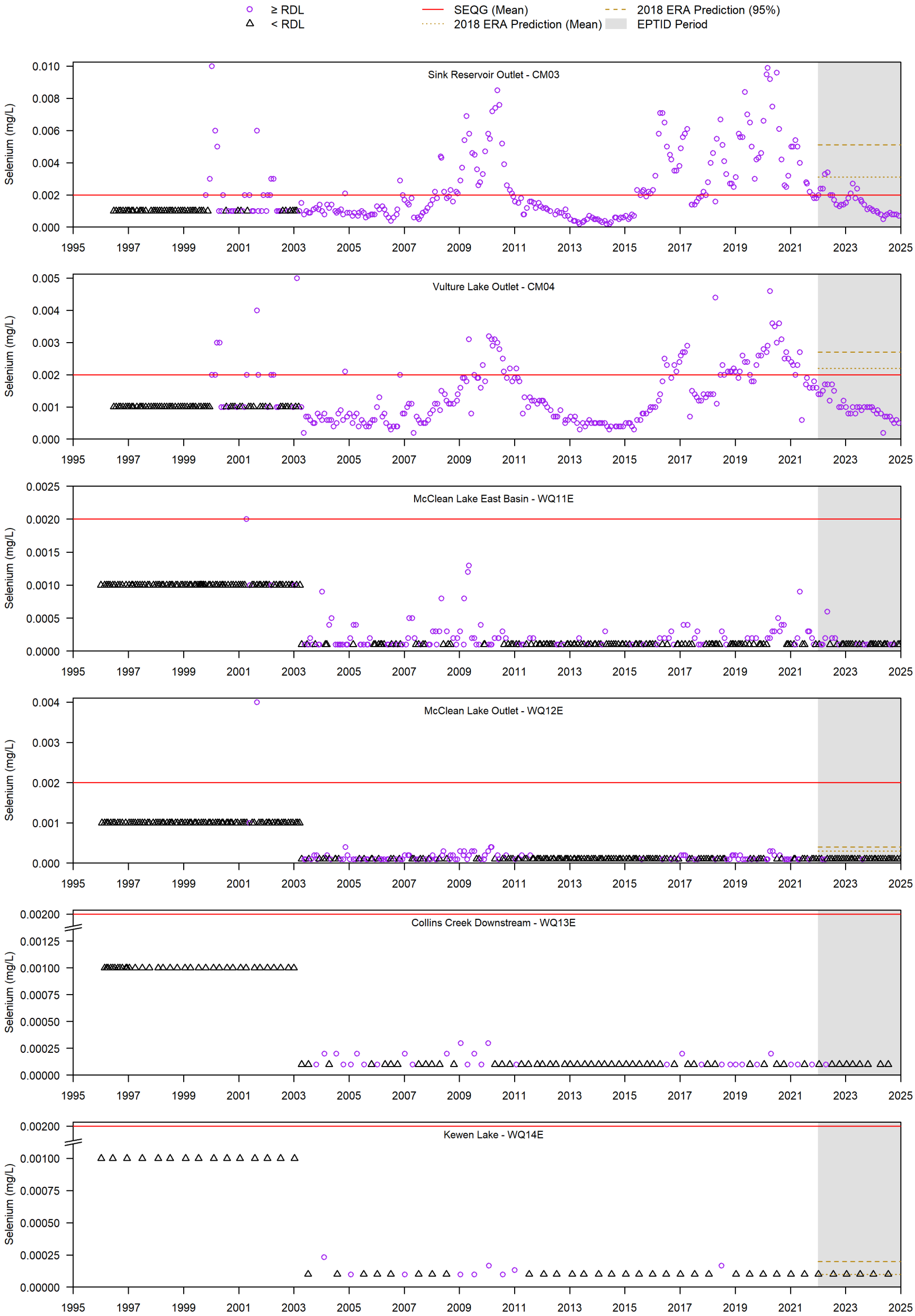


Figure 4.3-3 (36 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

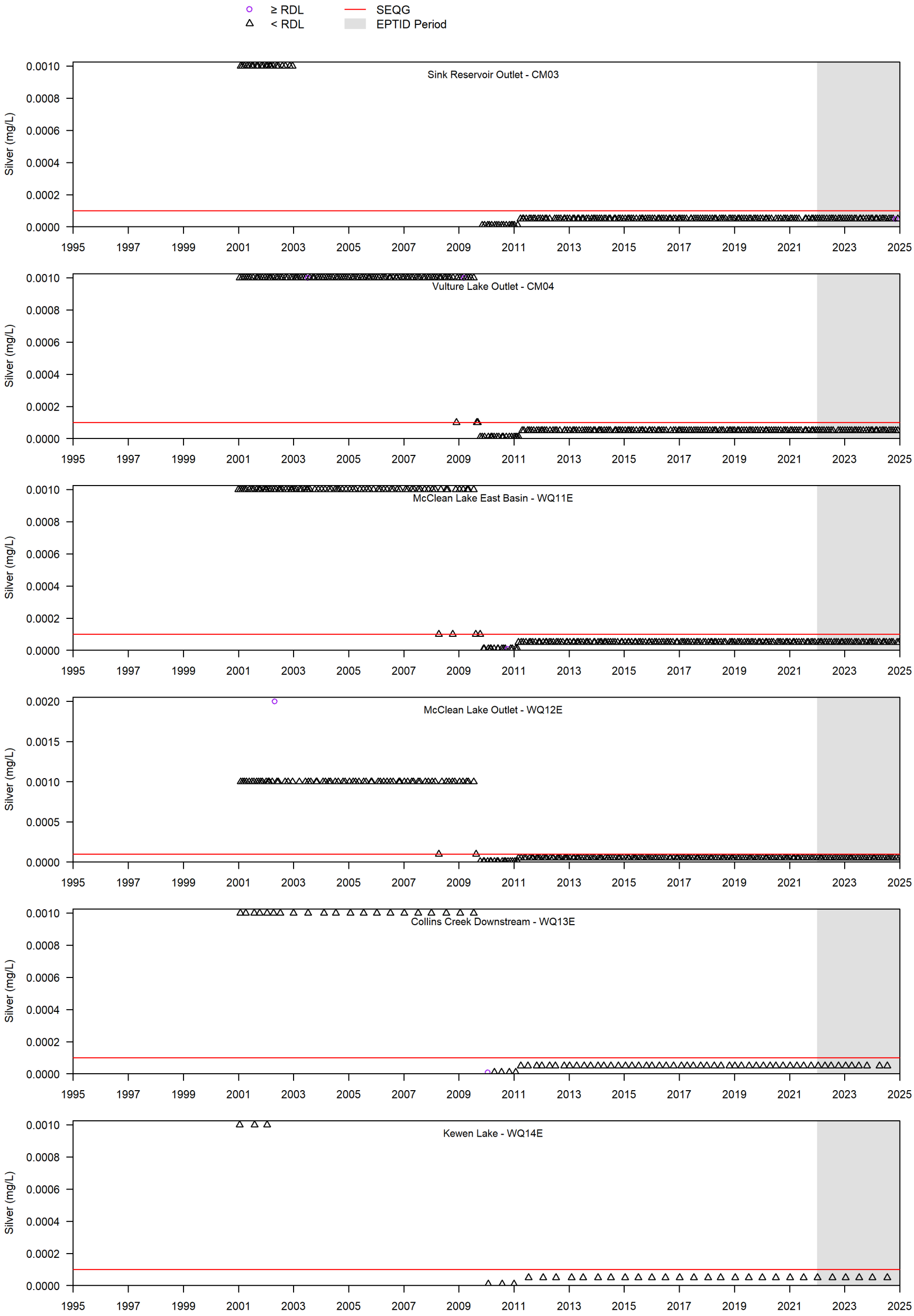


Figure 4.3-3 (37 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

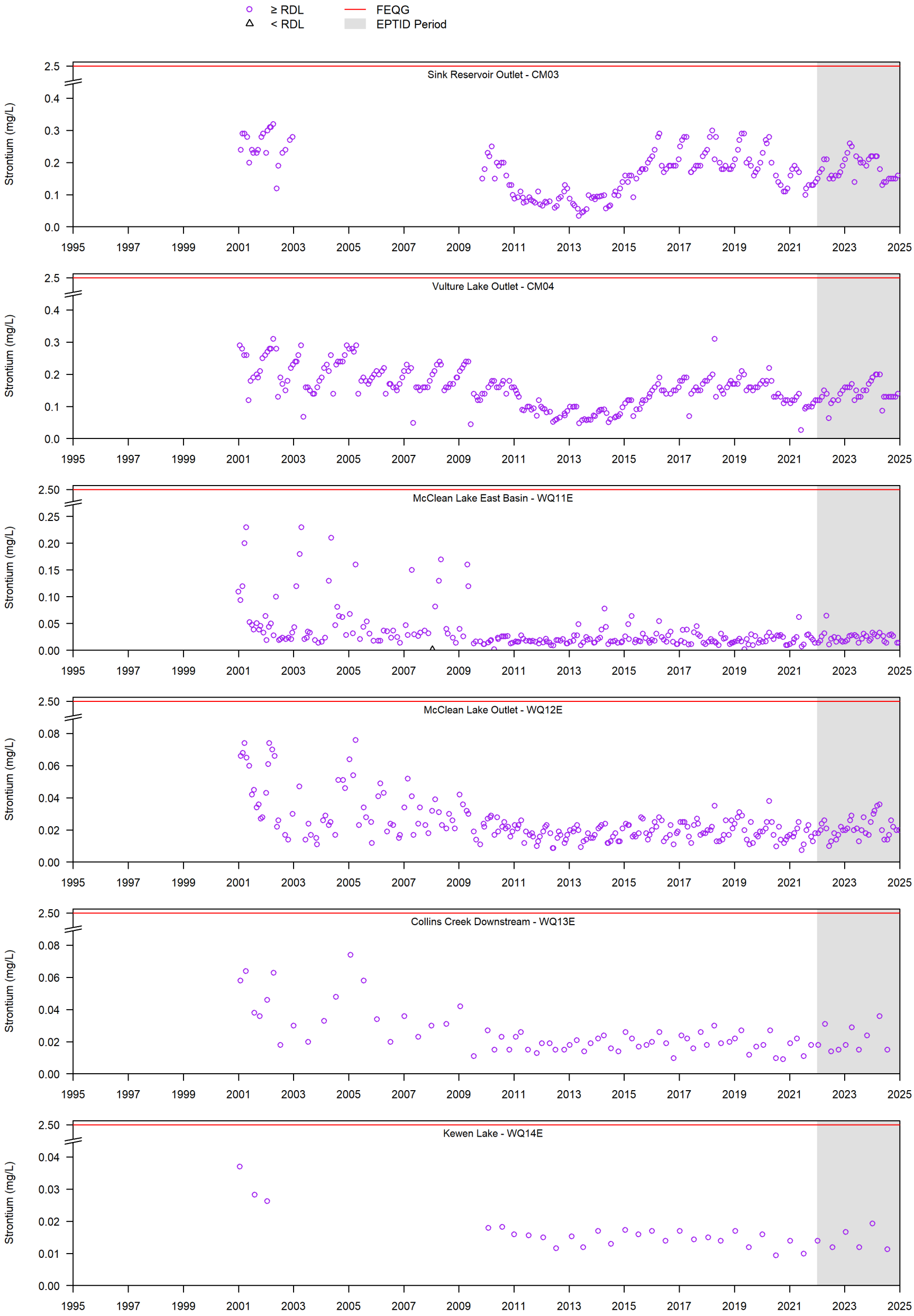


Figure 4.3-3 (38 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

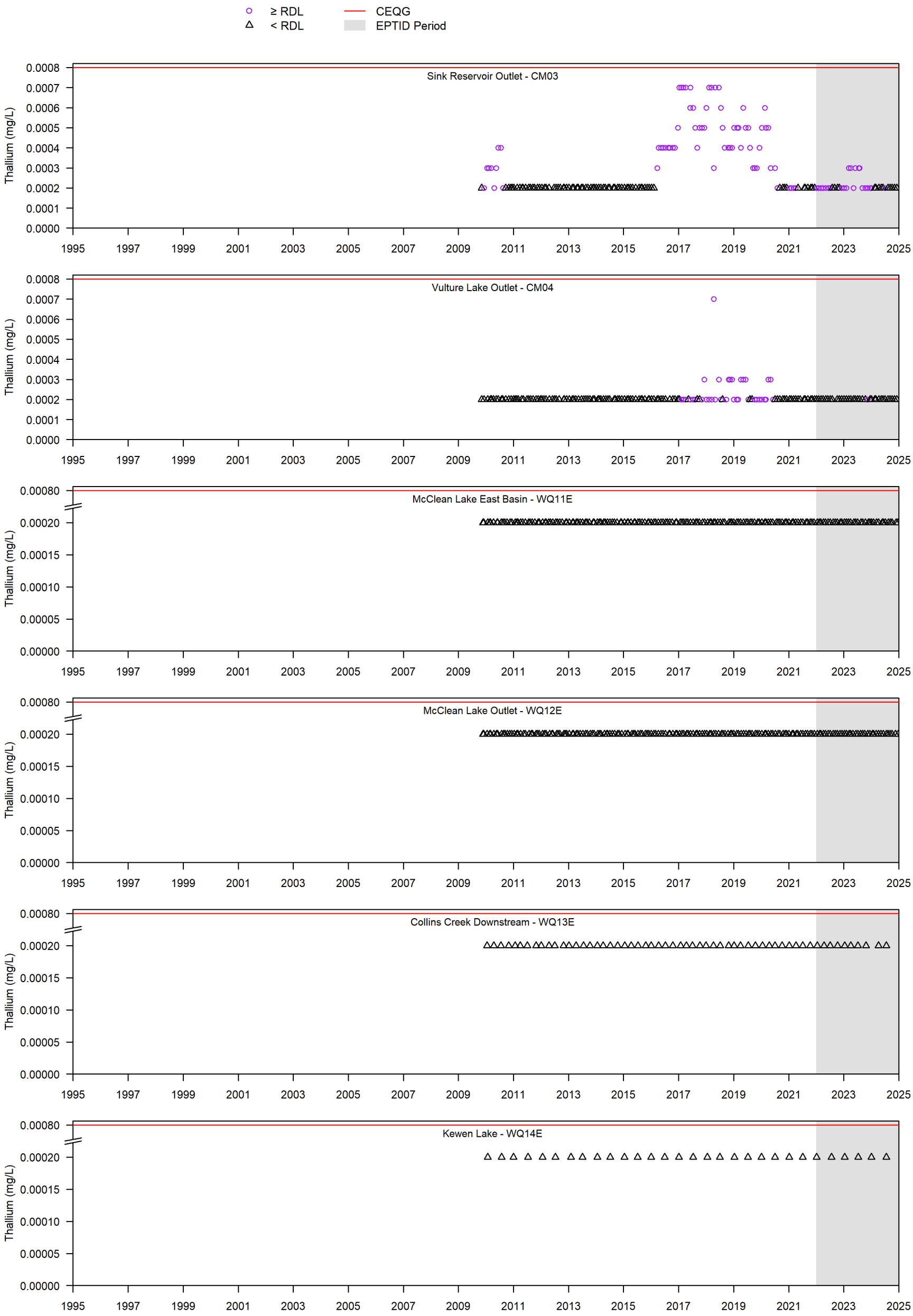


Figure 4.3-3 (39 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

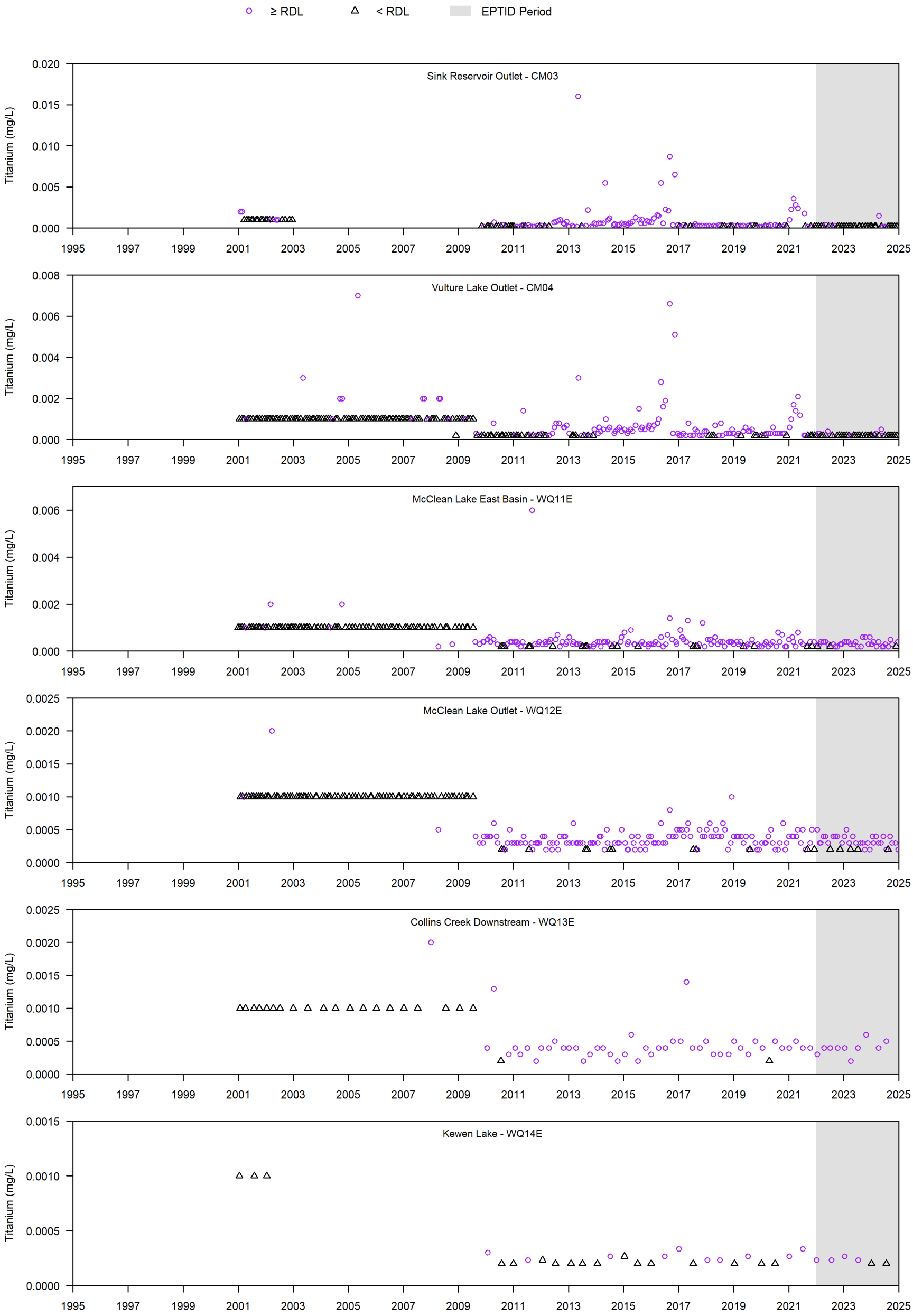


Figure 4.3-3 (40 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

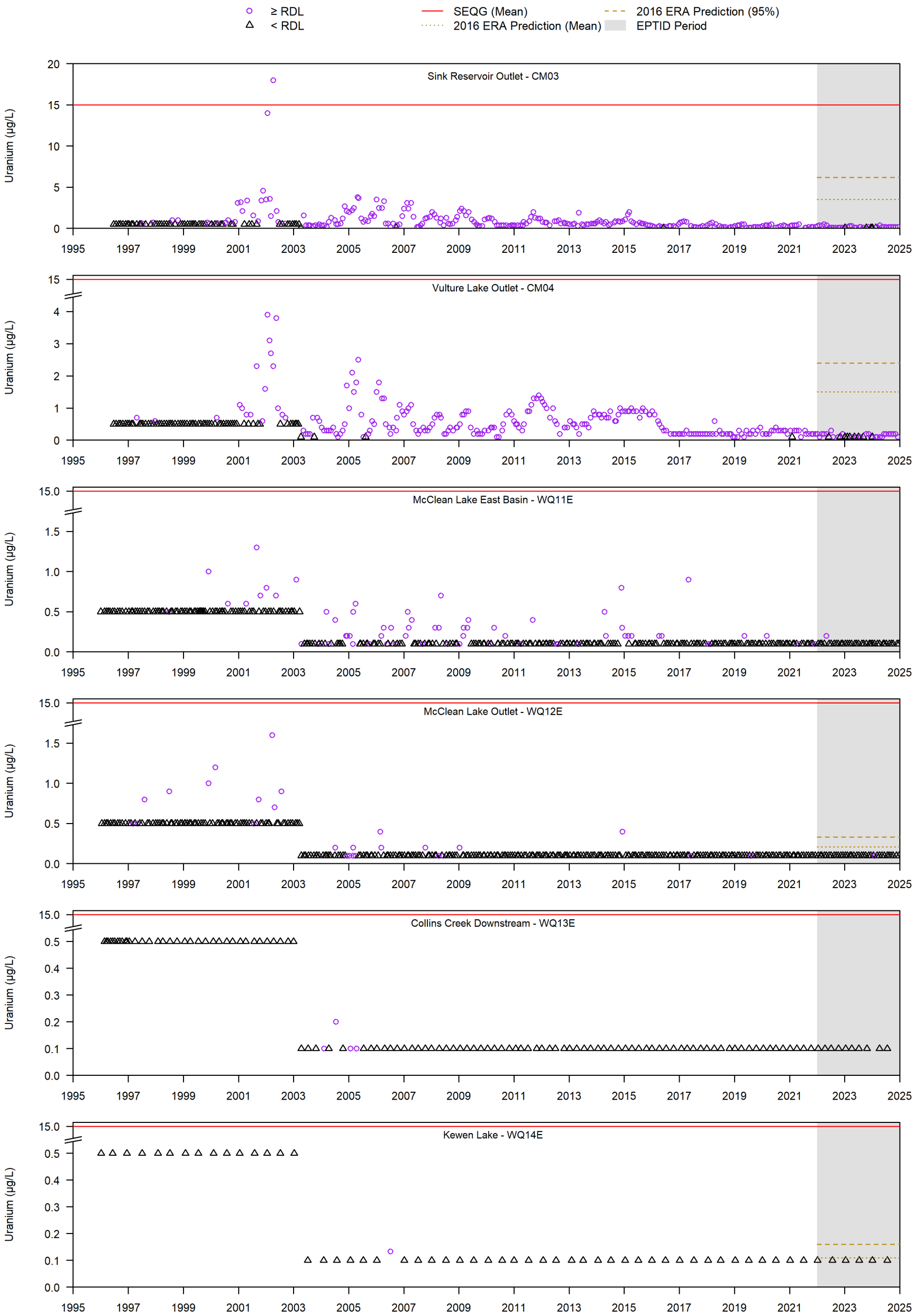


Figure 4.3-3 (41 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

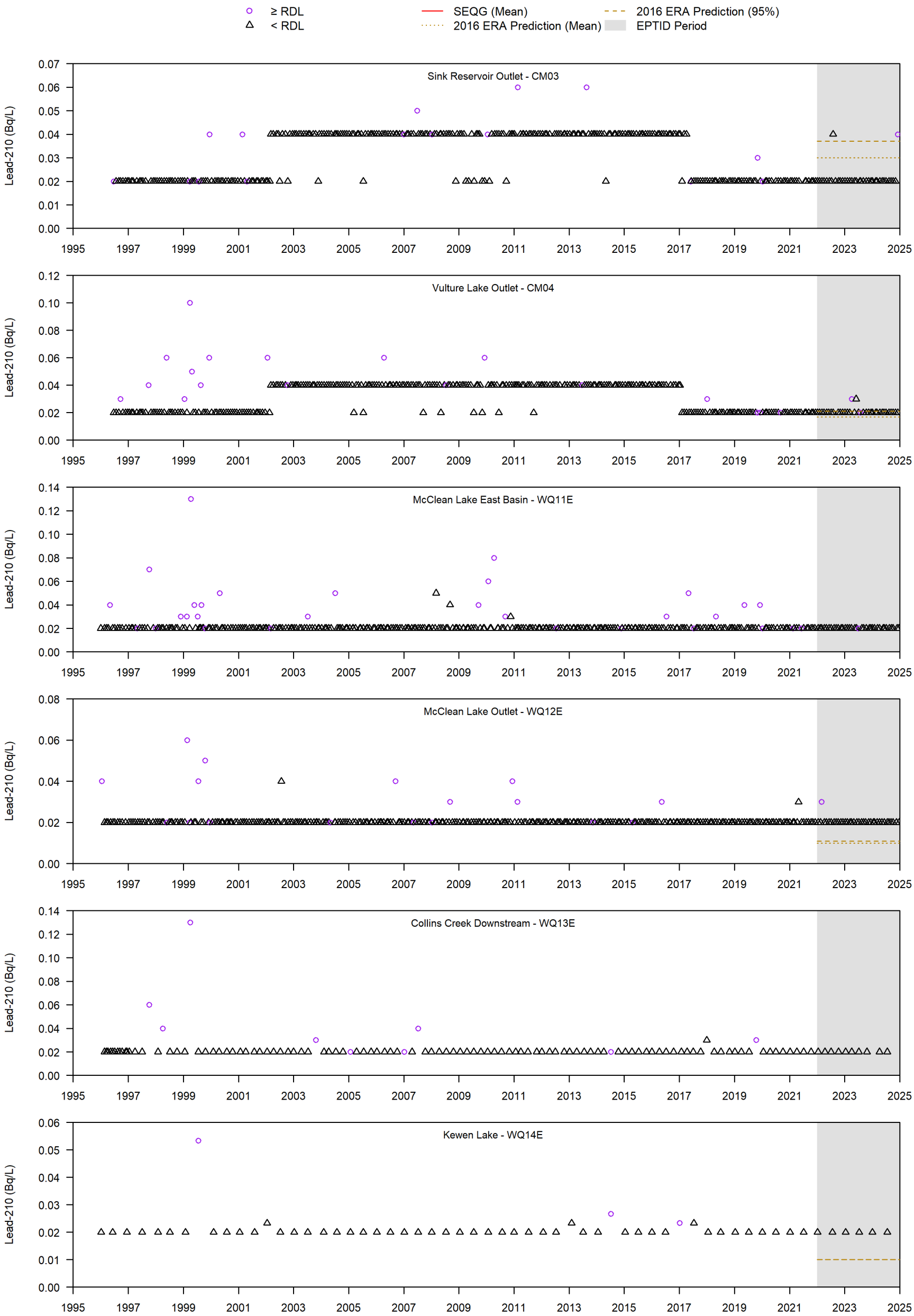


Figure 4.3-3 (42 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

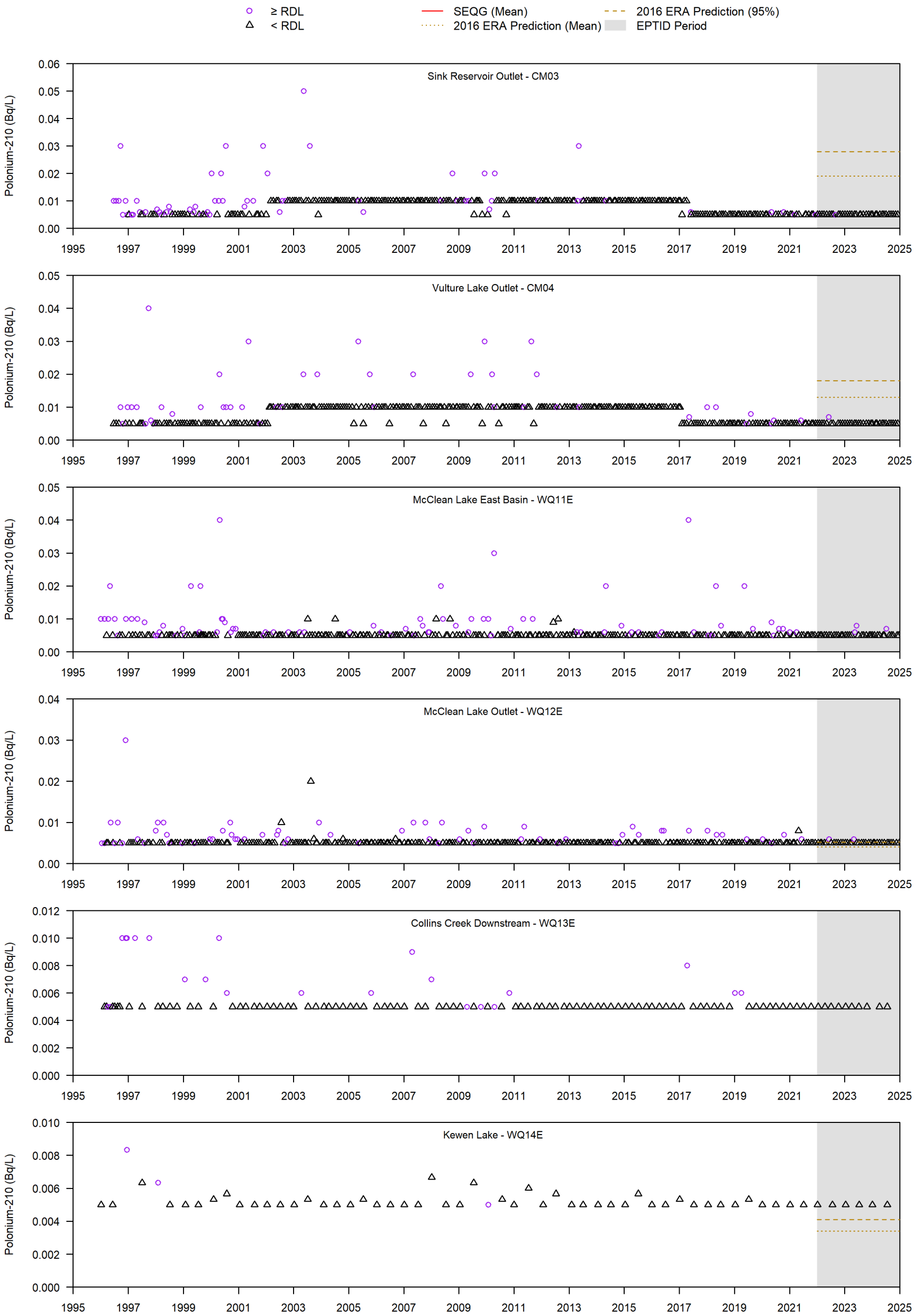


Figure 4.3-3 (43 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

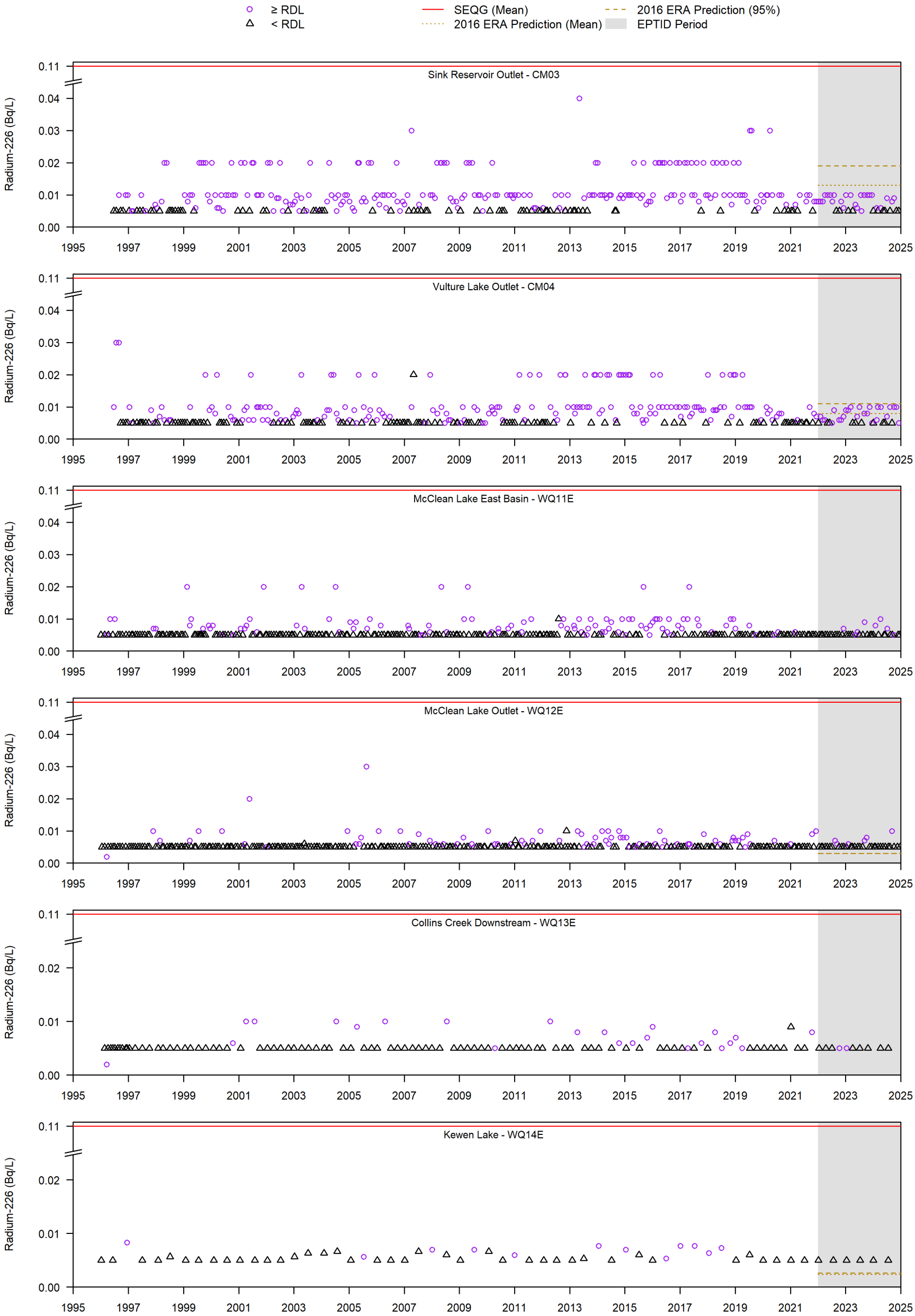


Figure 4.3-3 (44 of 44) COPC Levels in the Primary Exposure Area Surface Water with Associated Guidelines and Most Recent ERA Predictions.

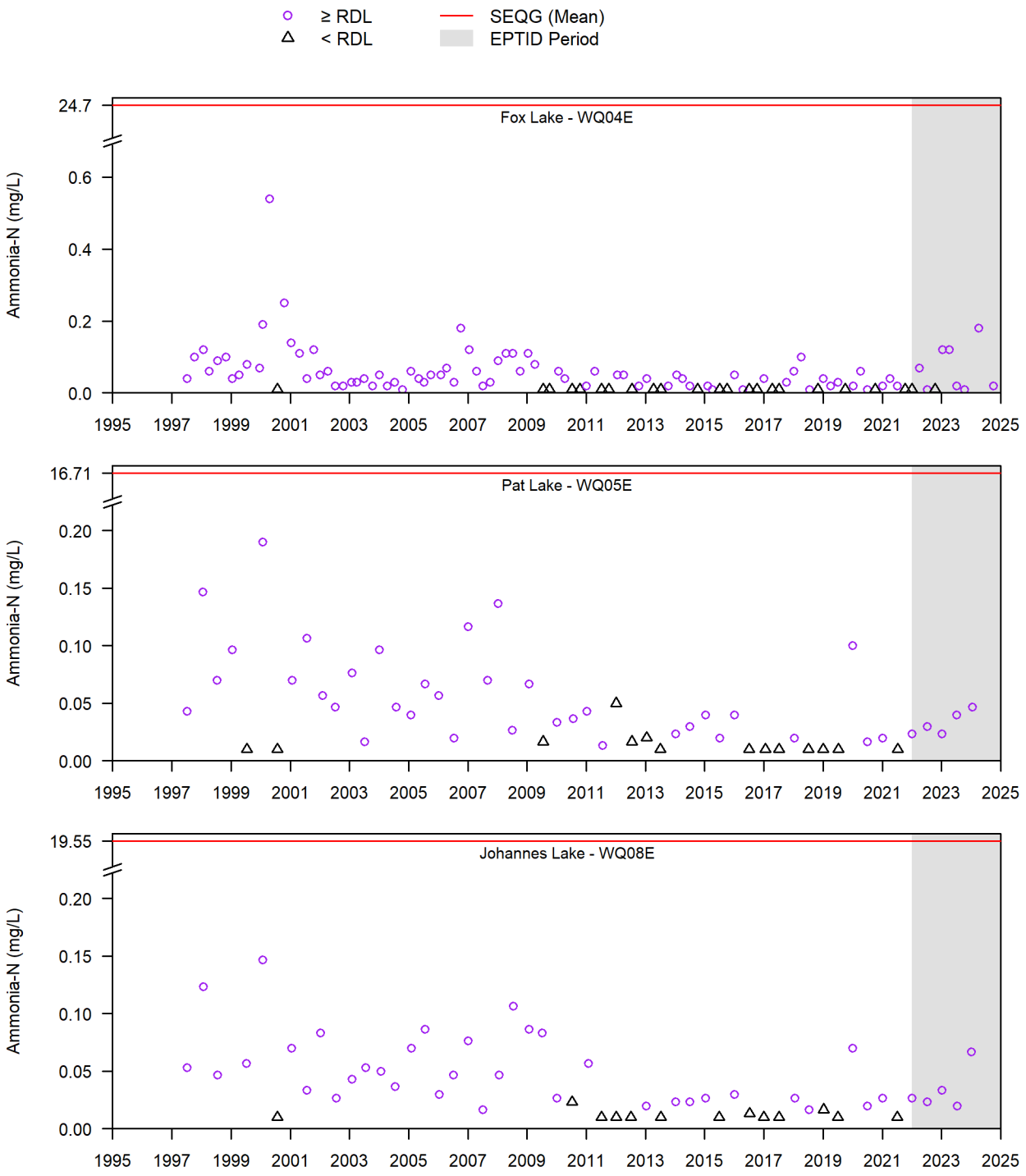


Figure 4.3-4 (1 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

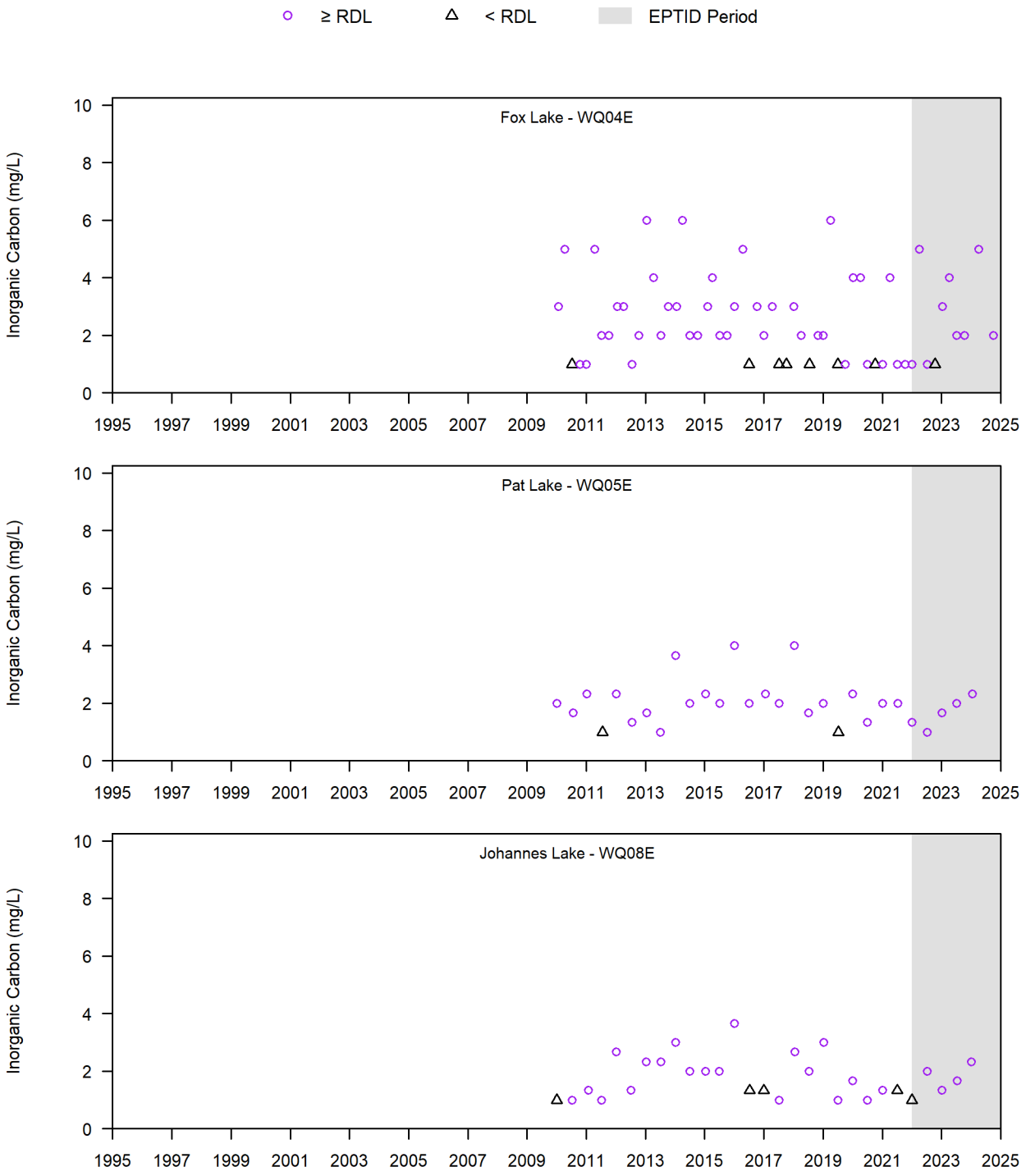


Figure 4.3-4 (2 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

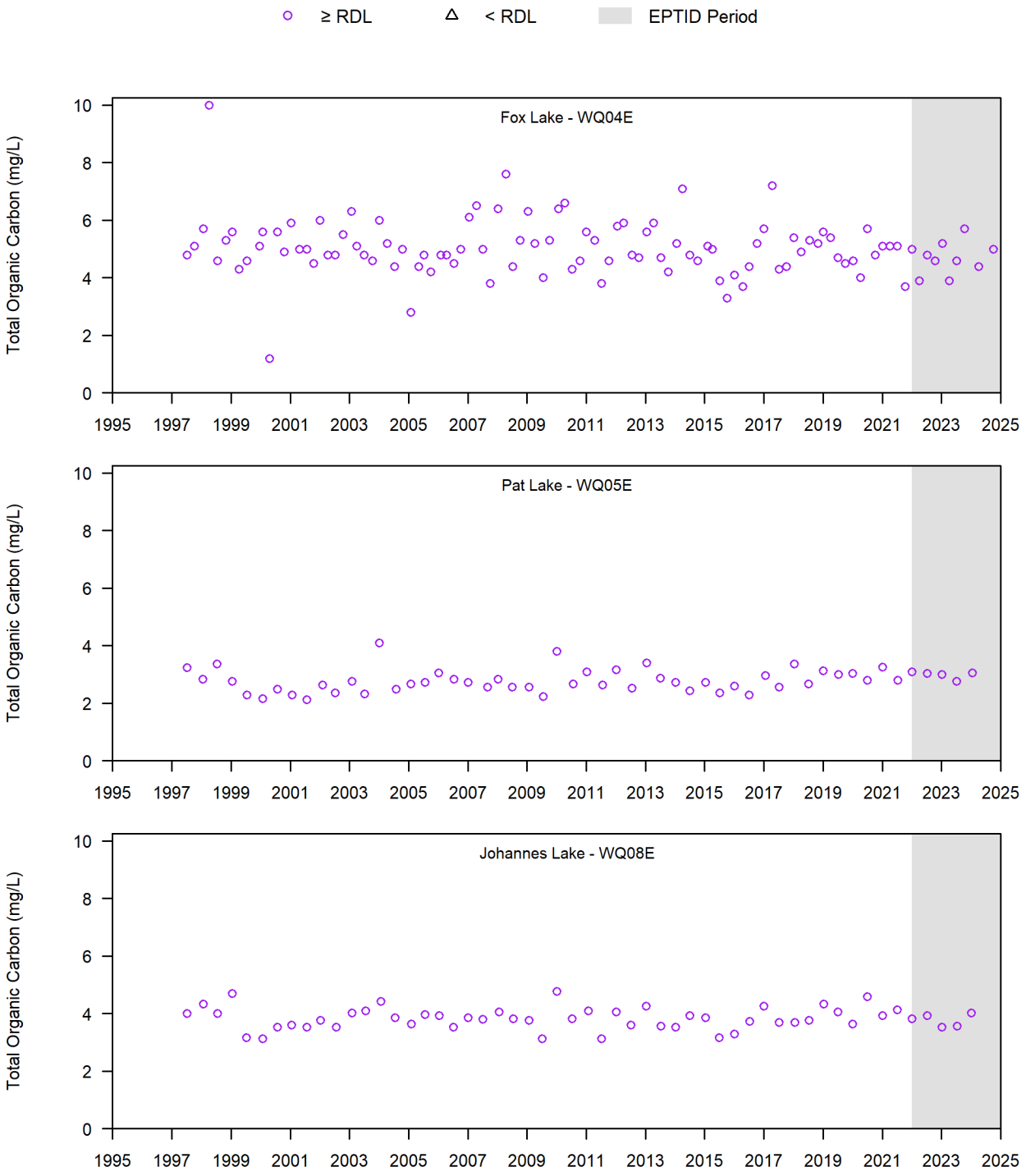


Figure 4.3-4 (3 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

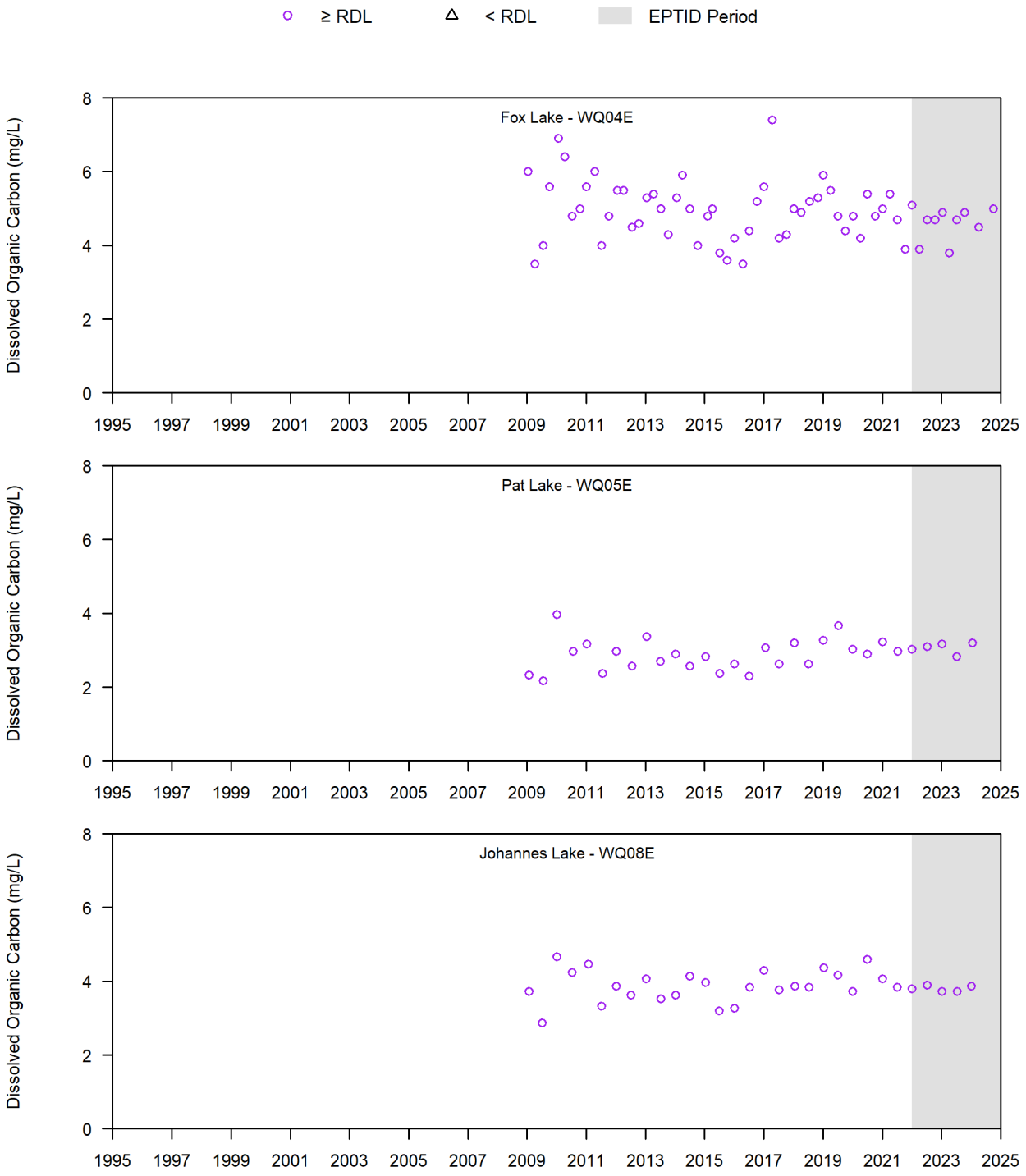


Figure 4.3-4 (4 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

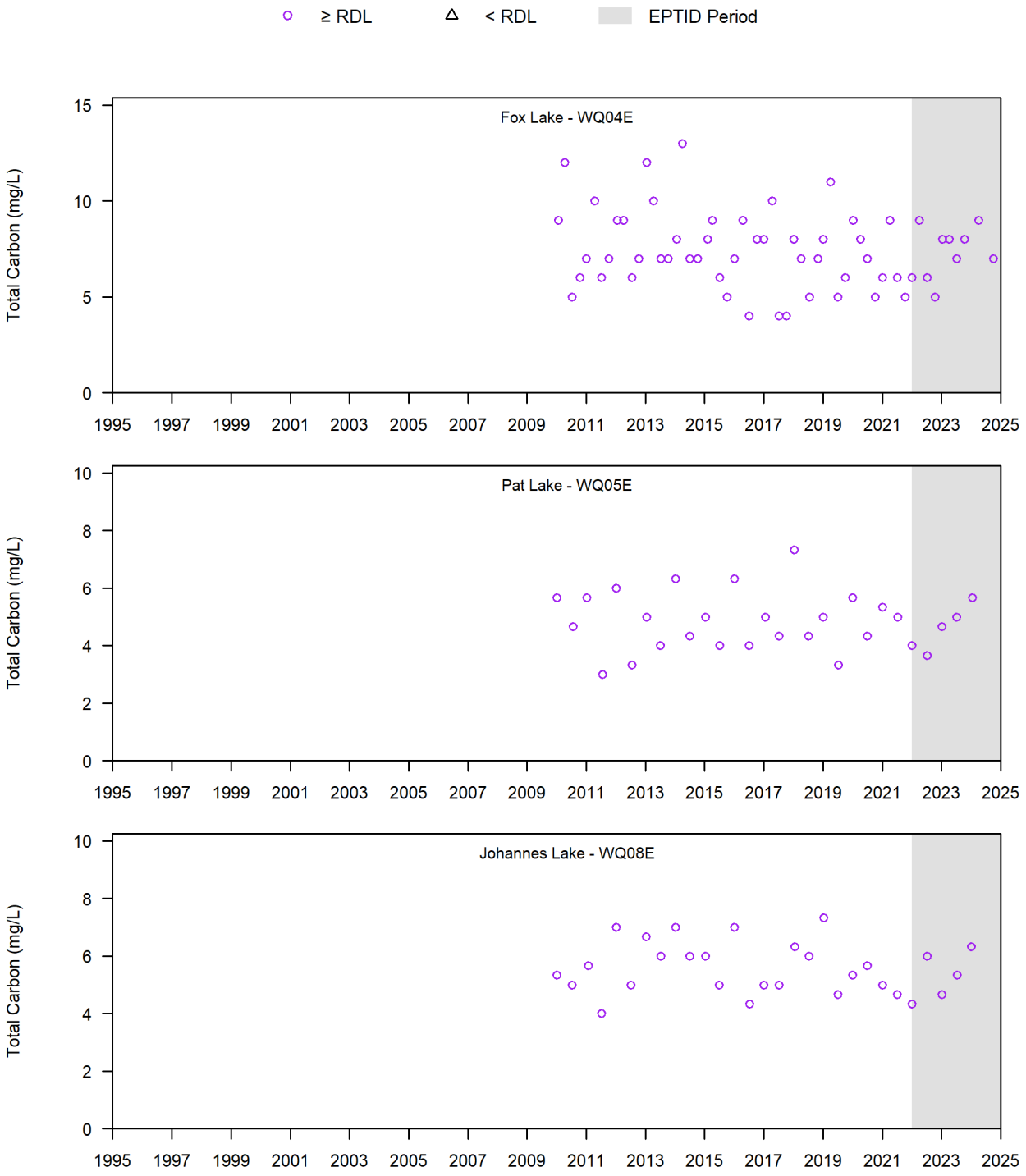


Figure 4.3-4 (5 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

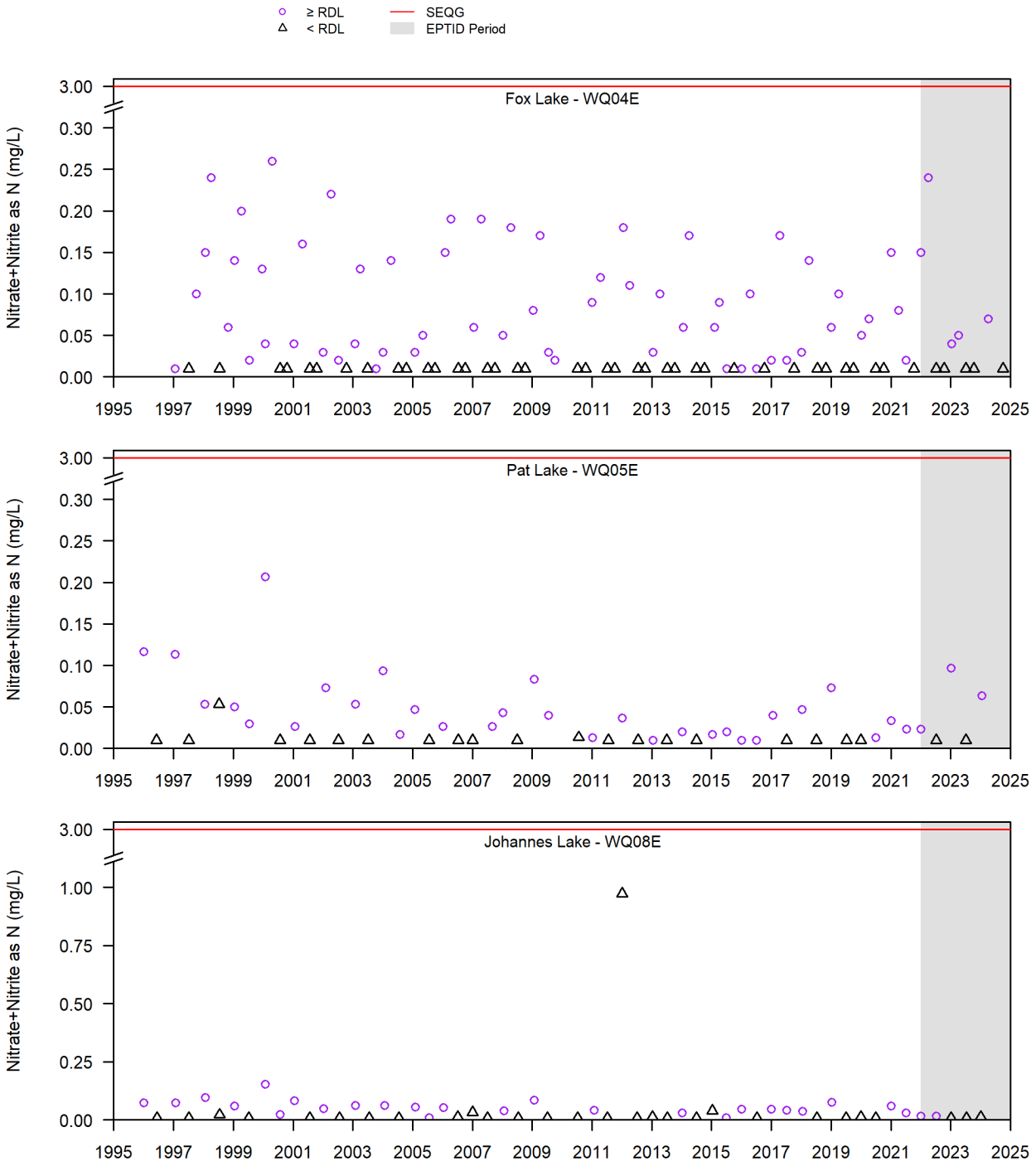


Figure 4.3-4 (6 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

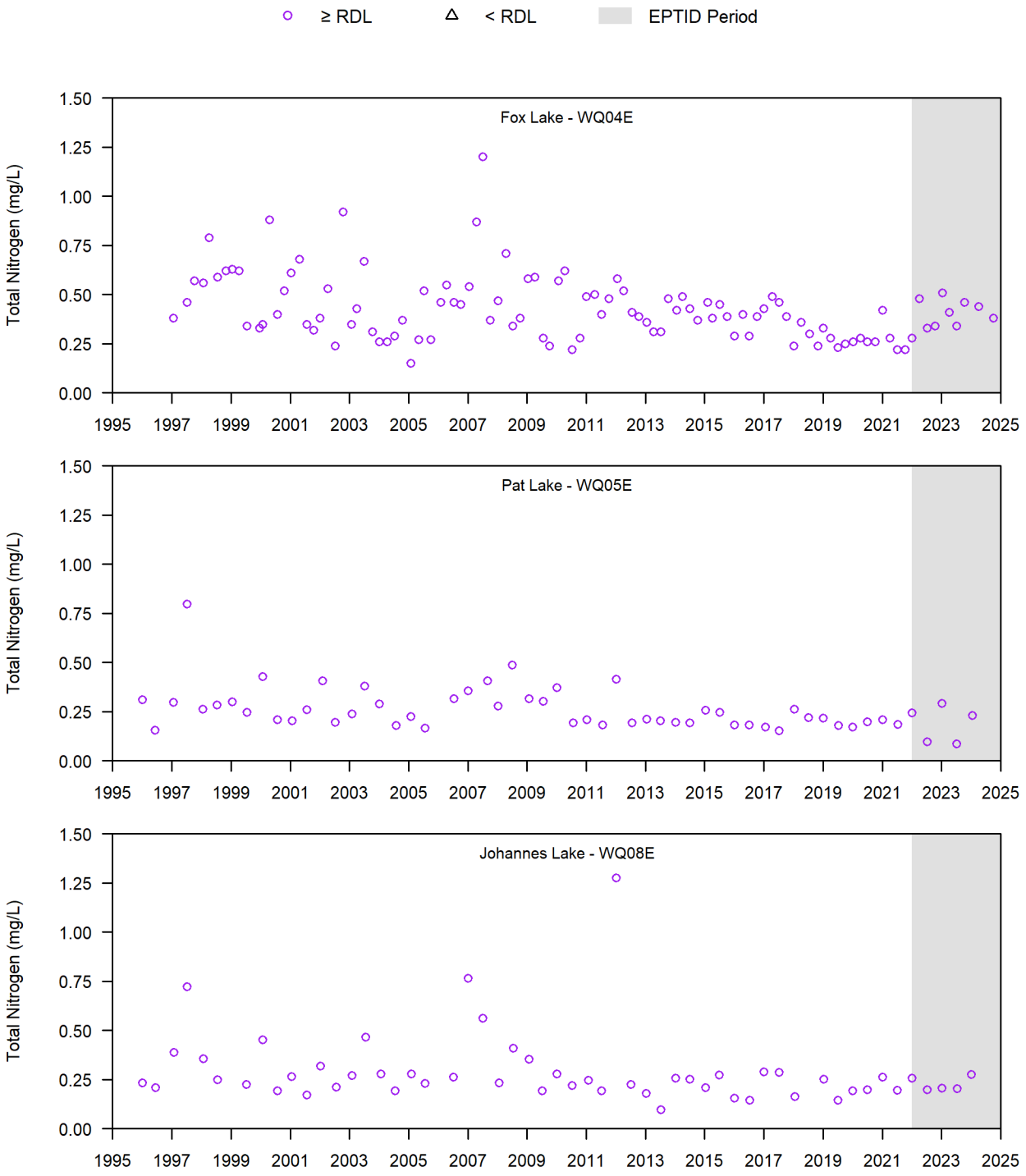


Figure 4.3-4 (7 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

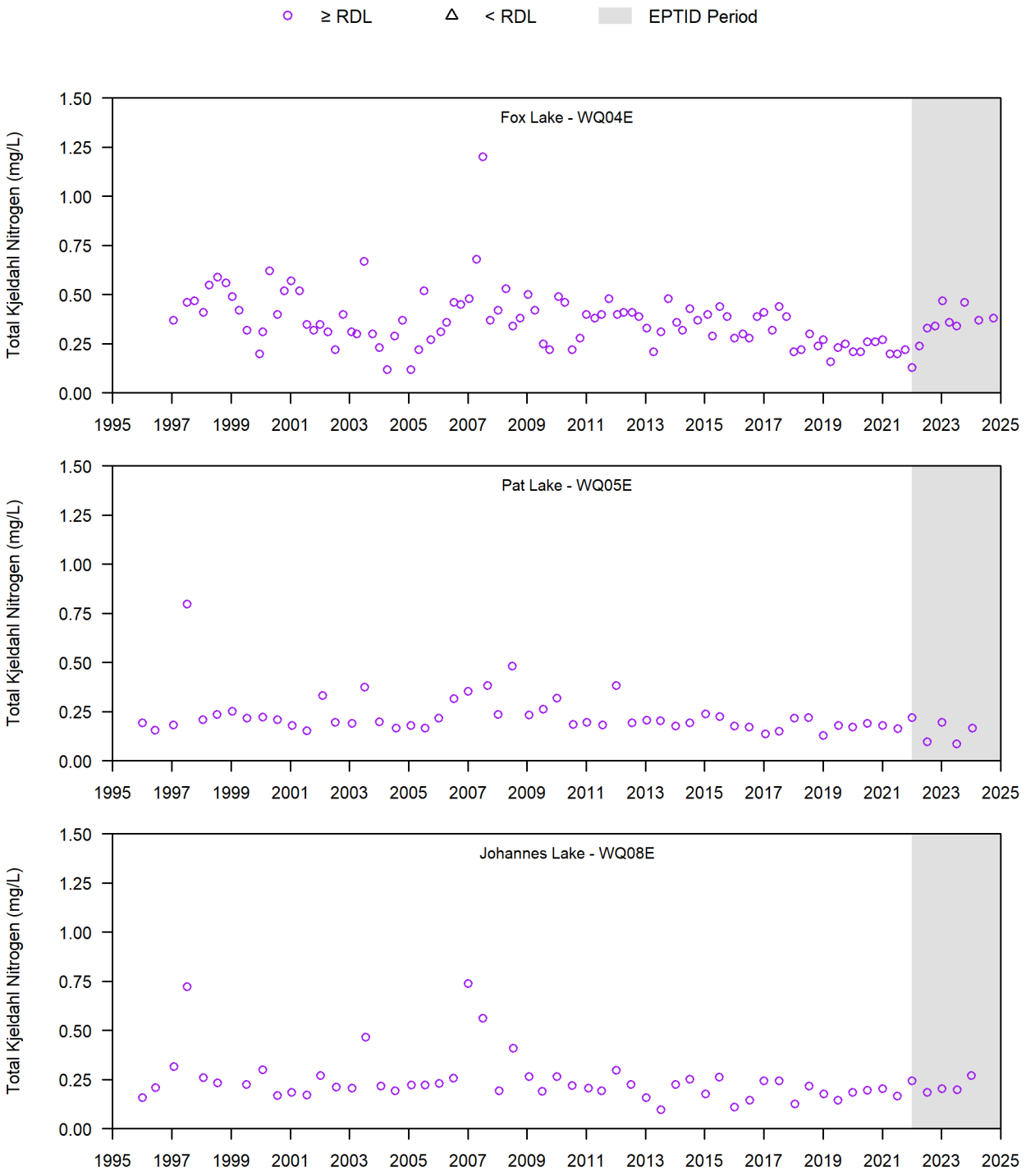


Figure 4.3-4 (8 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

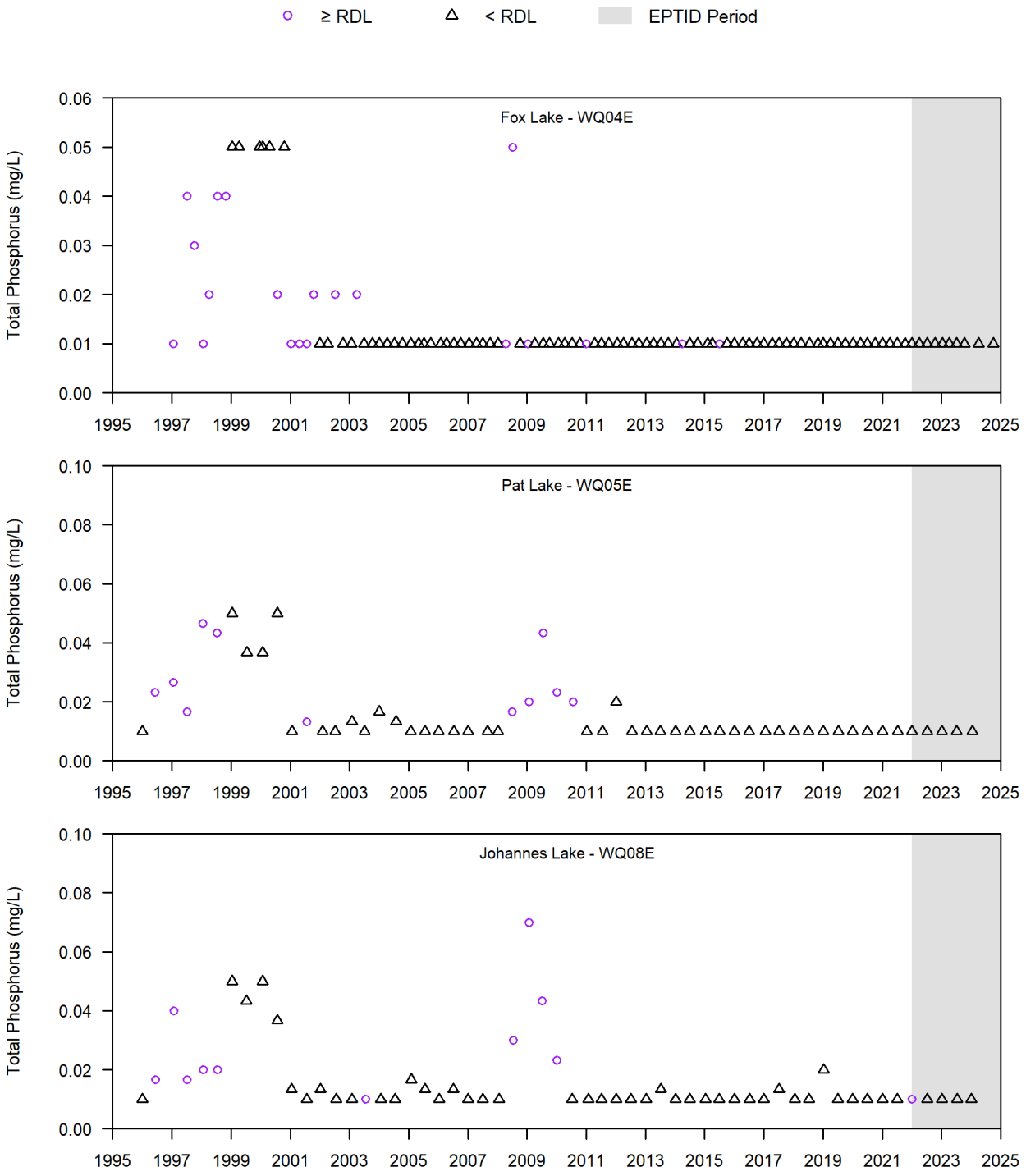


Figure 4.3-4 (9 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

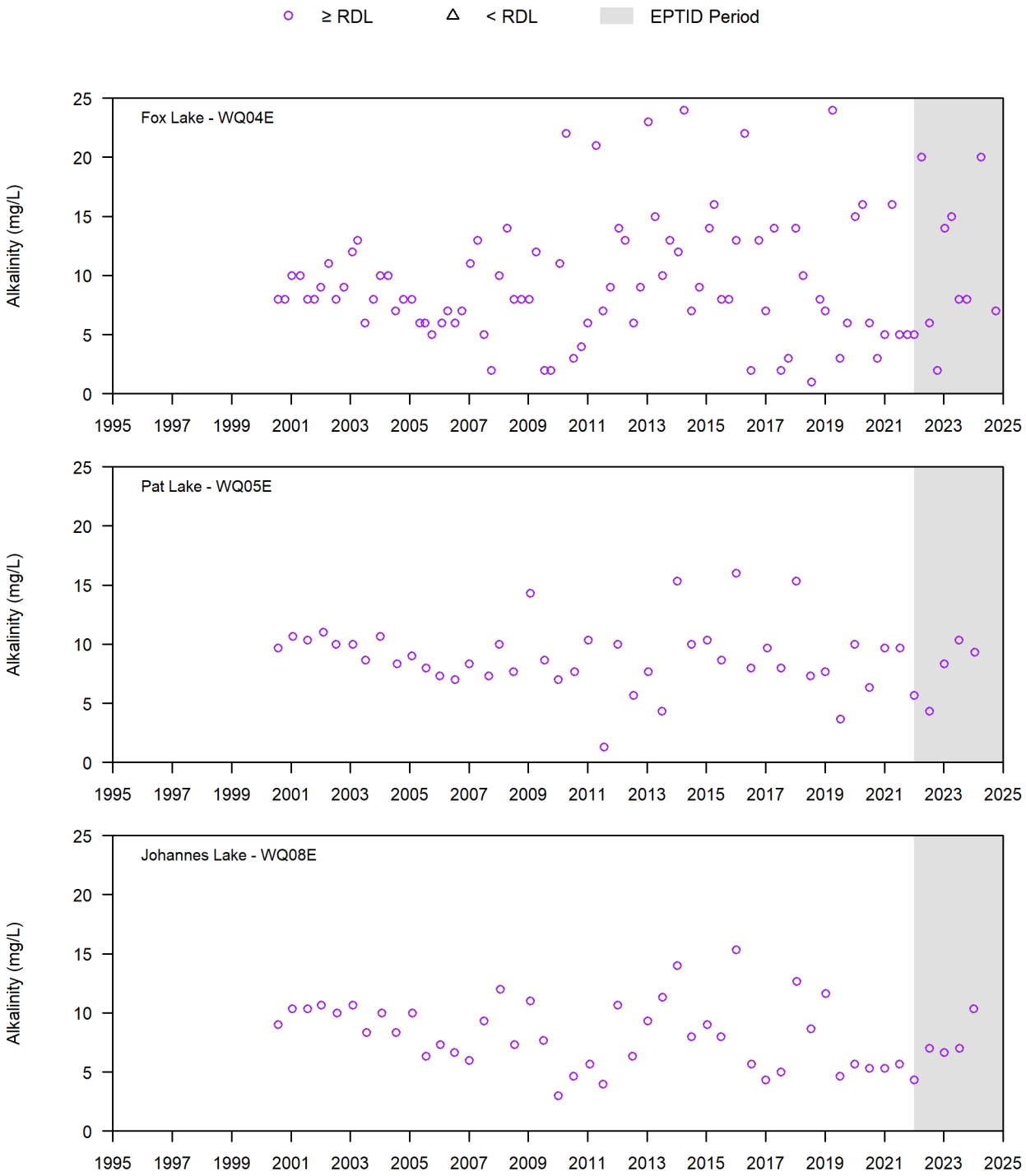


Figure 4.3-4 (10 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

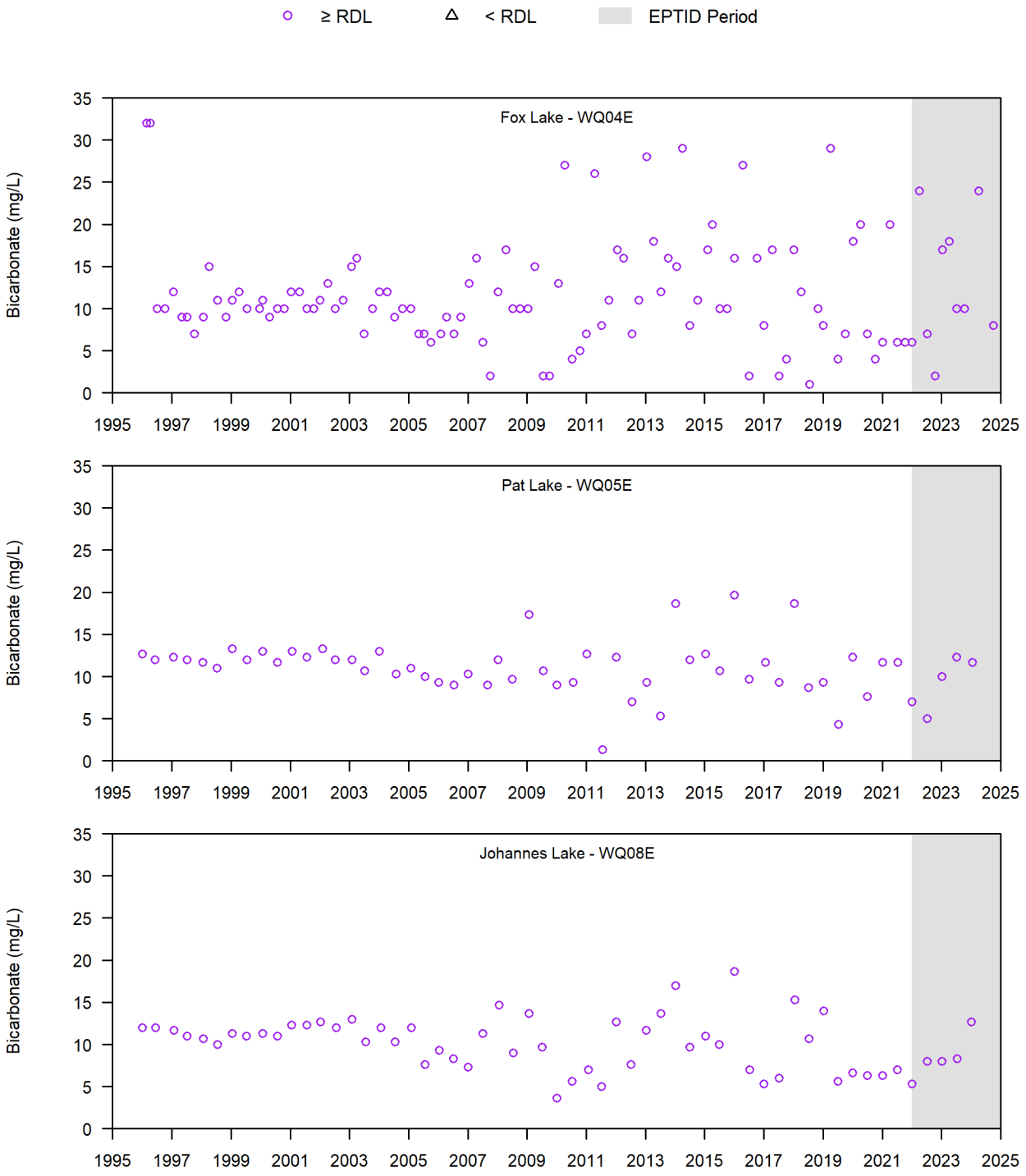


Figure 4.3-4 (11 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

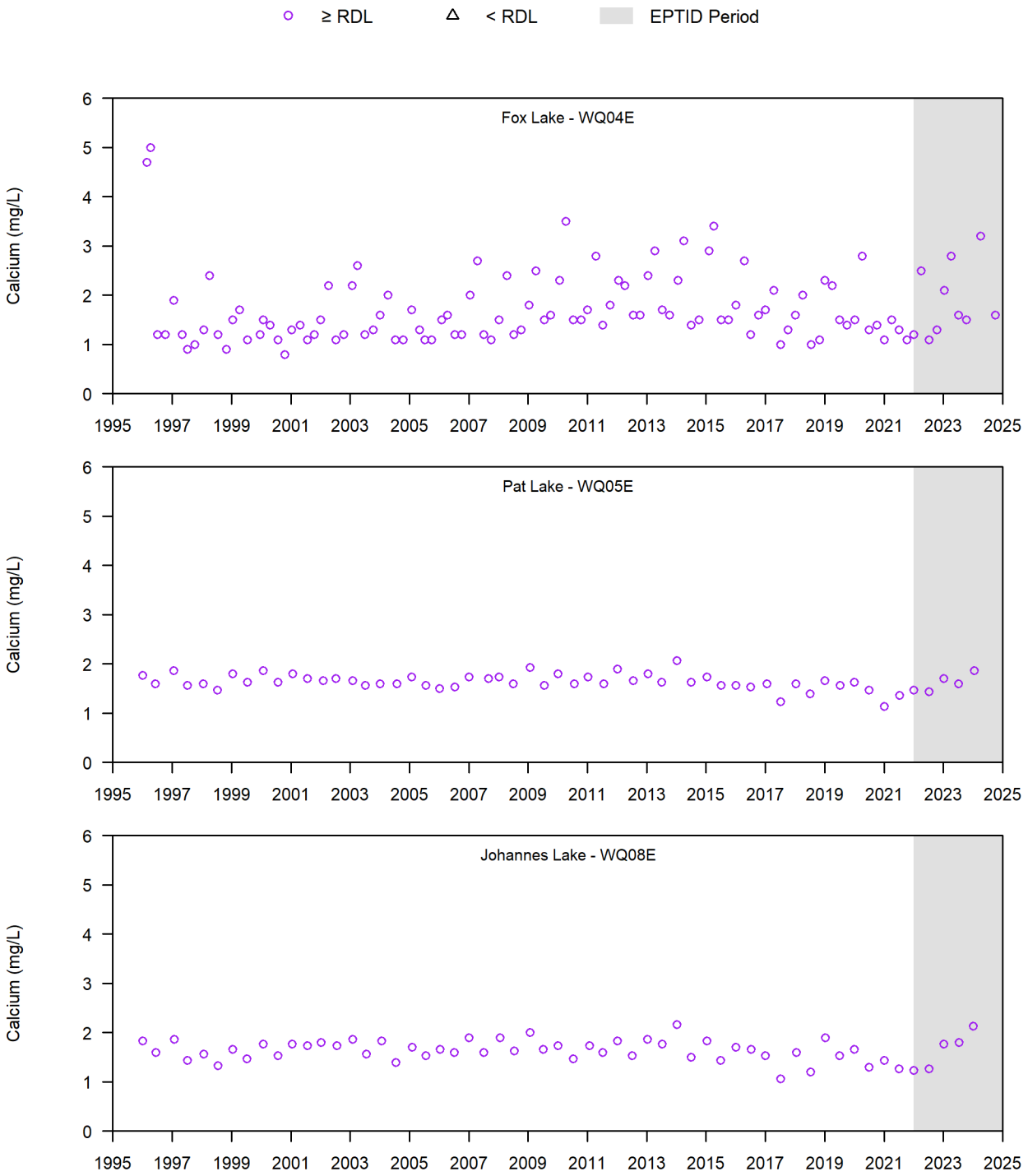


Figure 4.3-4 (12 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

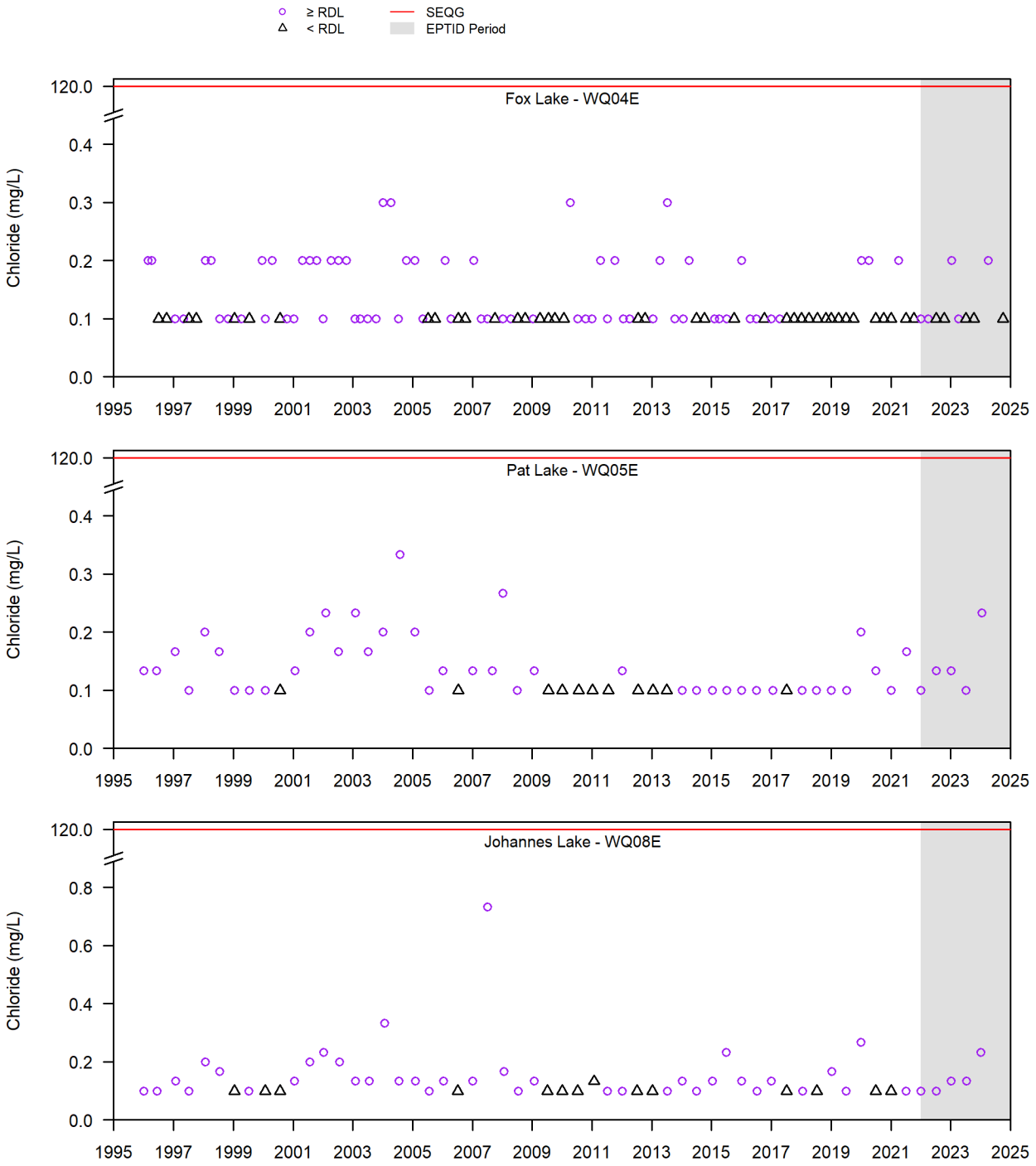


Figure 4.3-4 (13 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

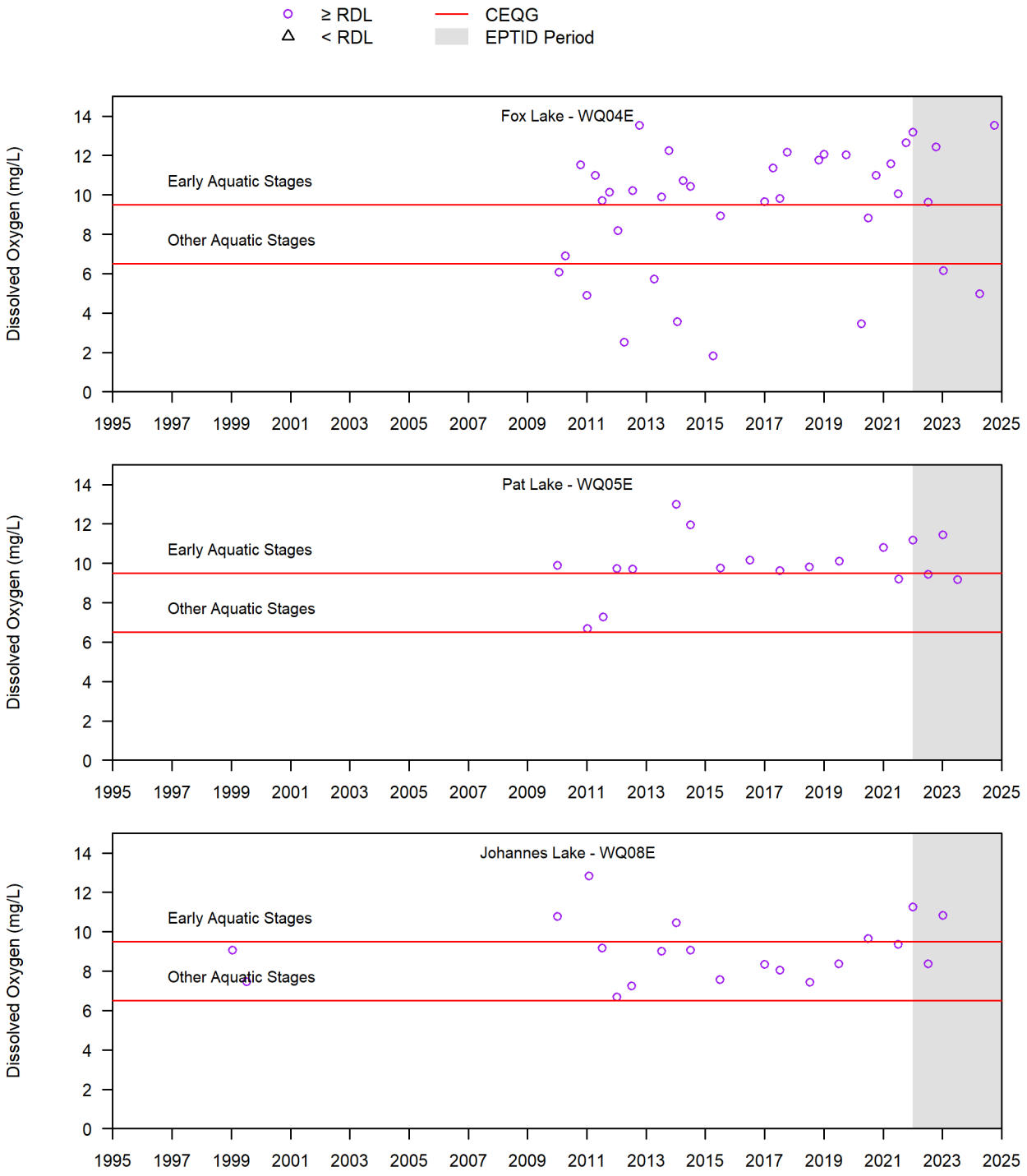


Figure 4.3-4 (14 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

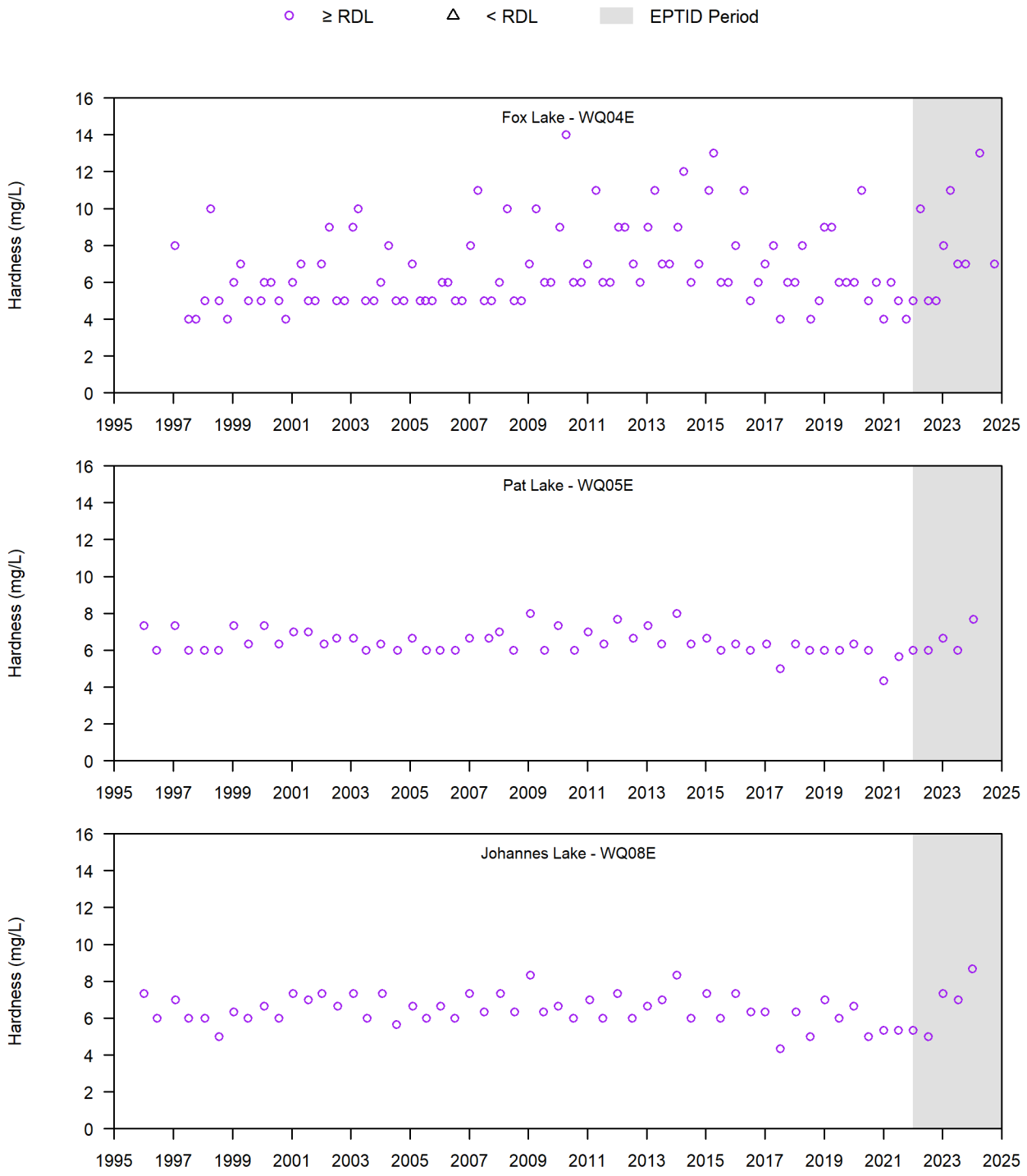


Figure 4.3-4 (15 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

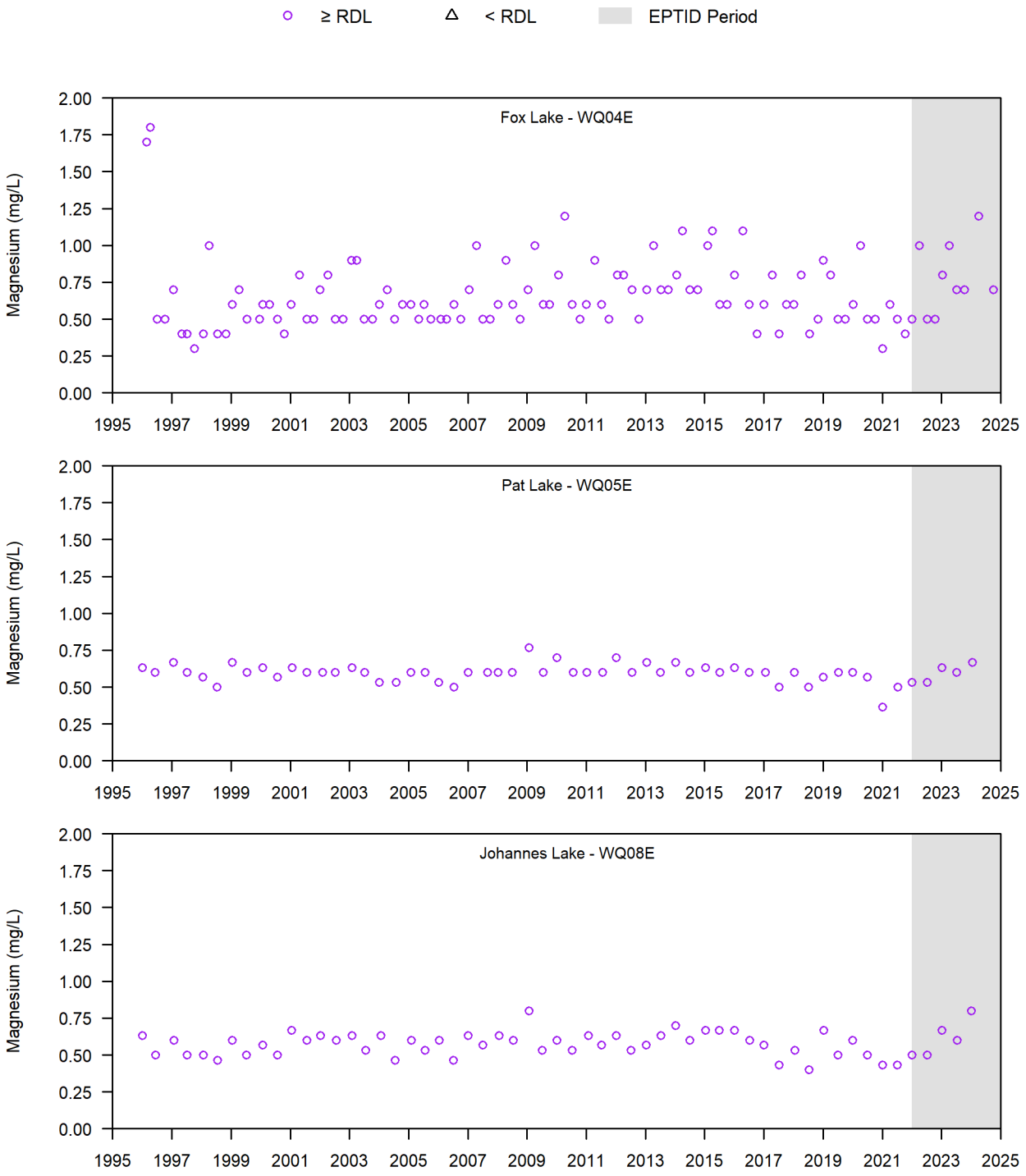


Figure 4.3-4 (16 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

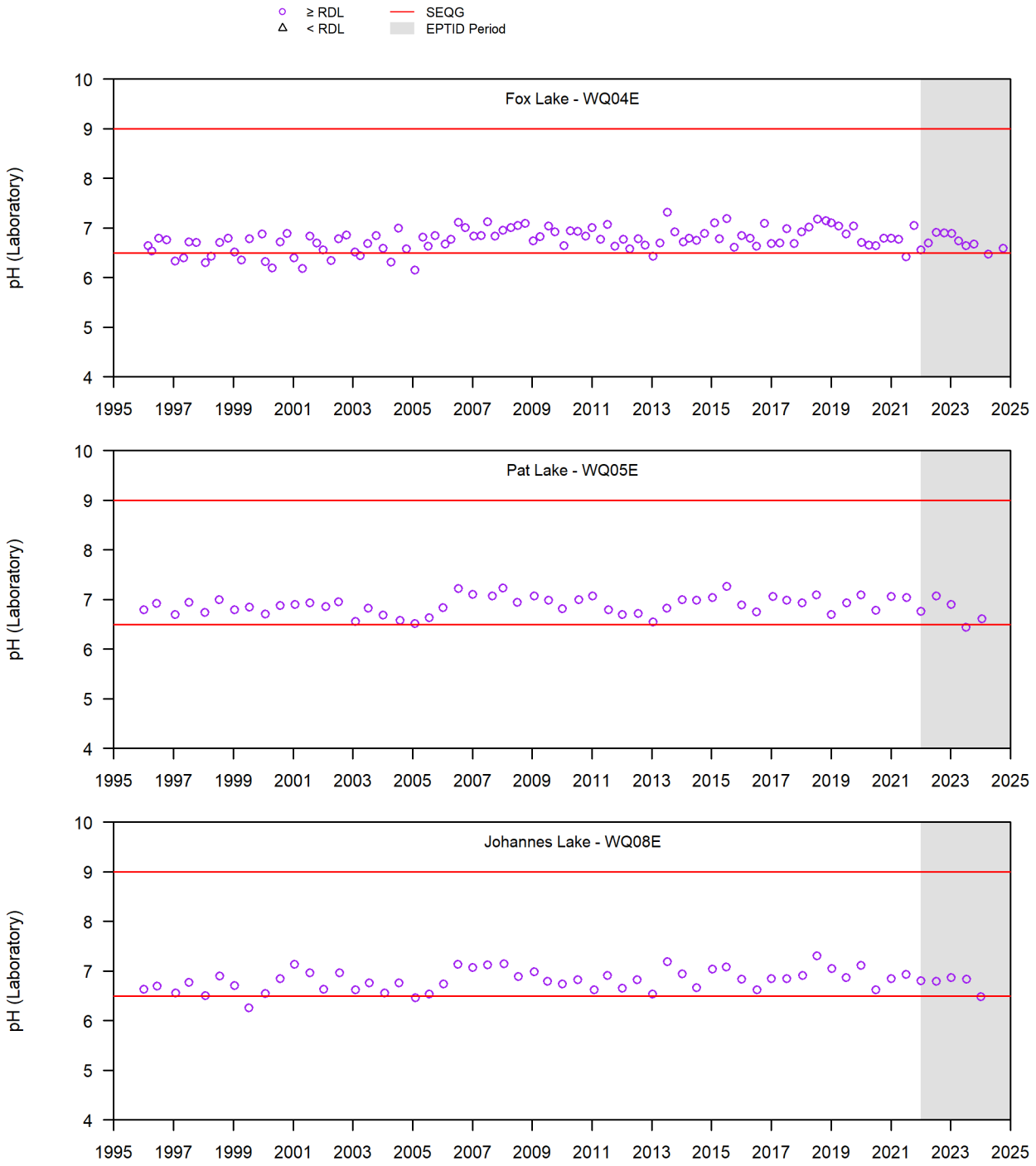


Figure 4.3-4 (17 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

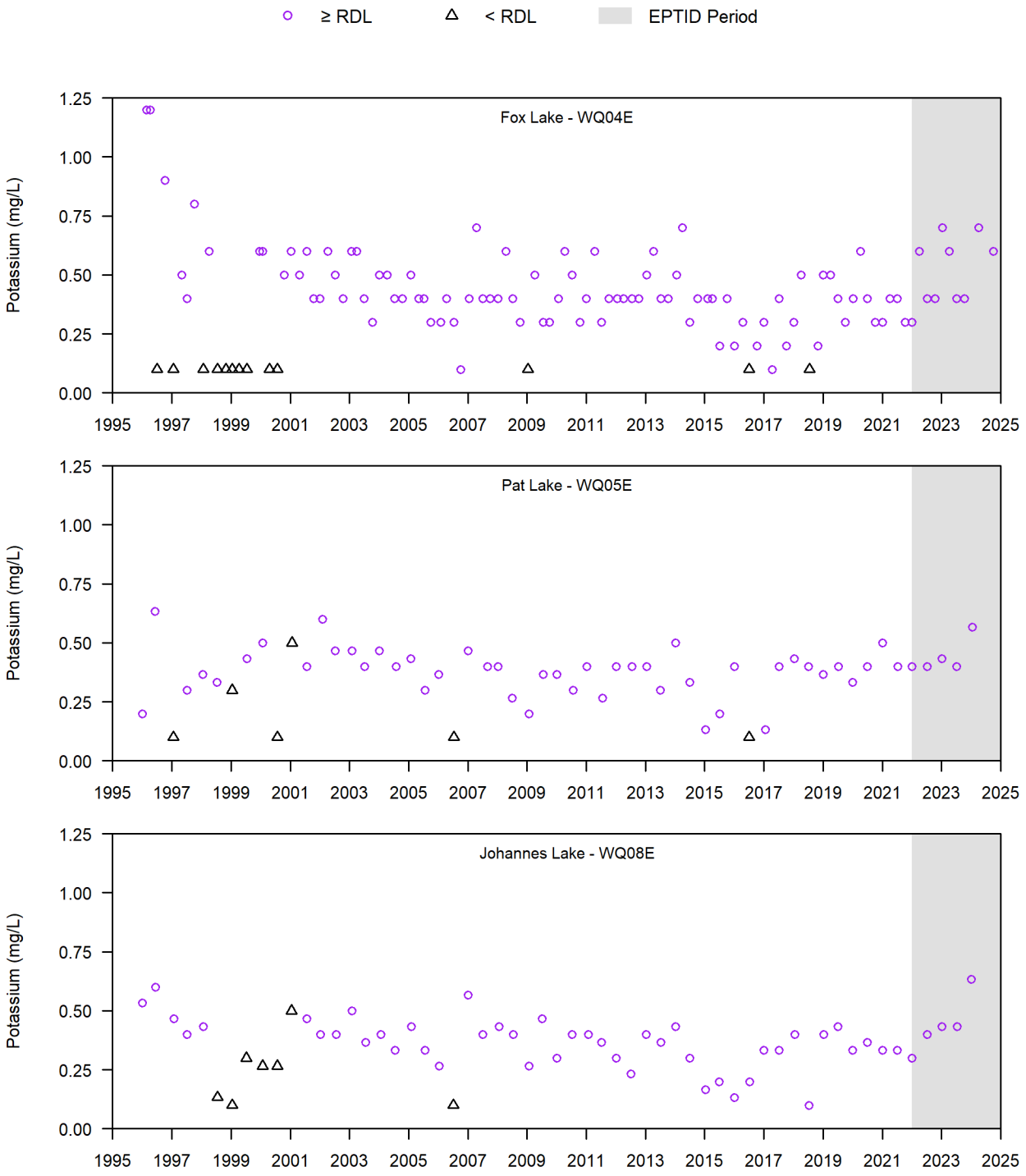


Figure 4.3-4 (18 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

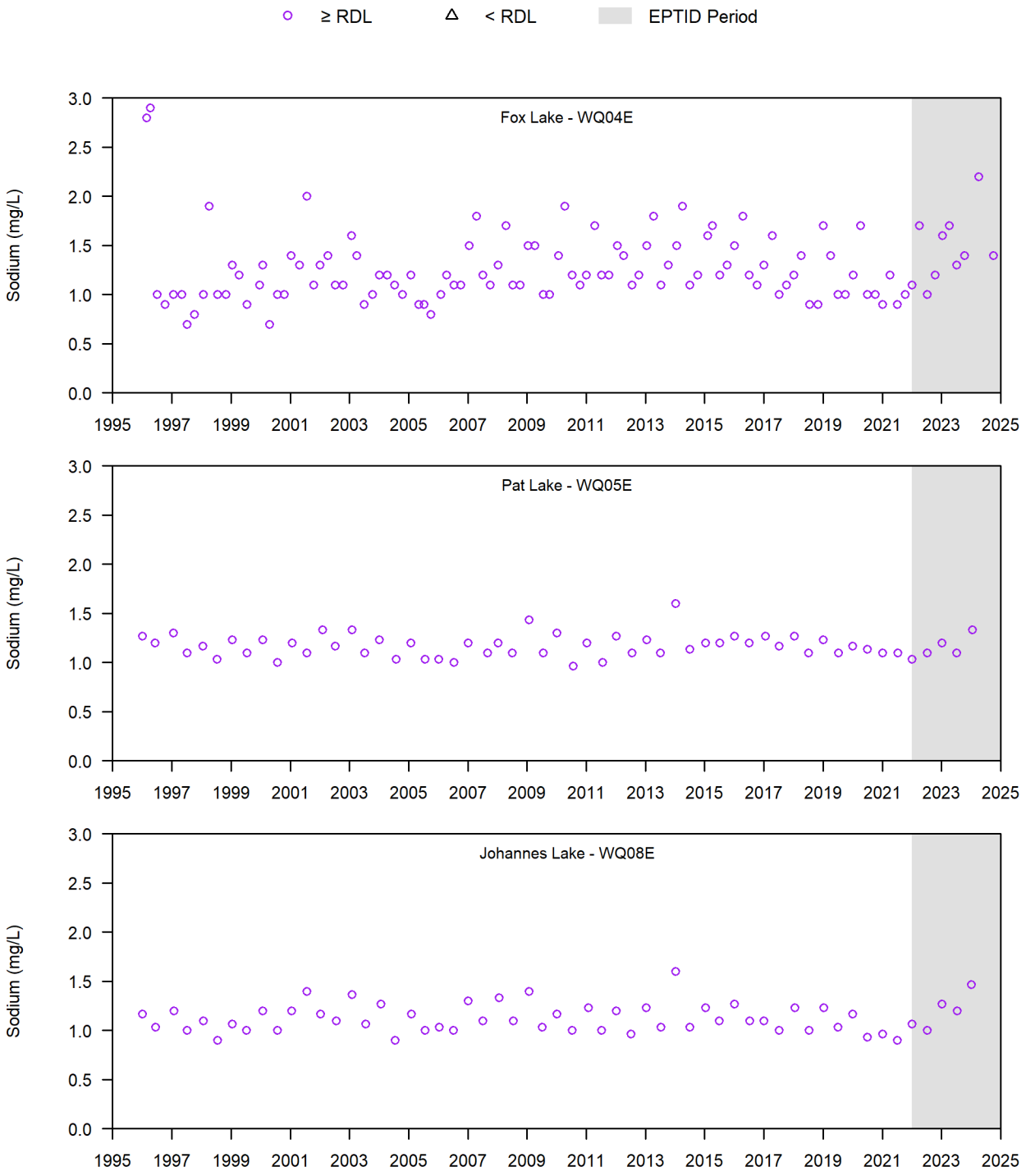


Figure 4.3-4 (19 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

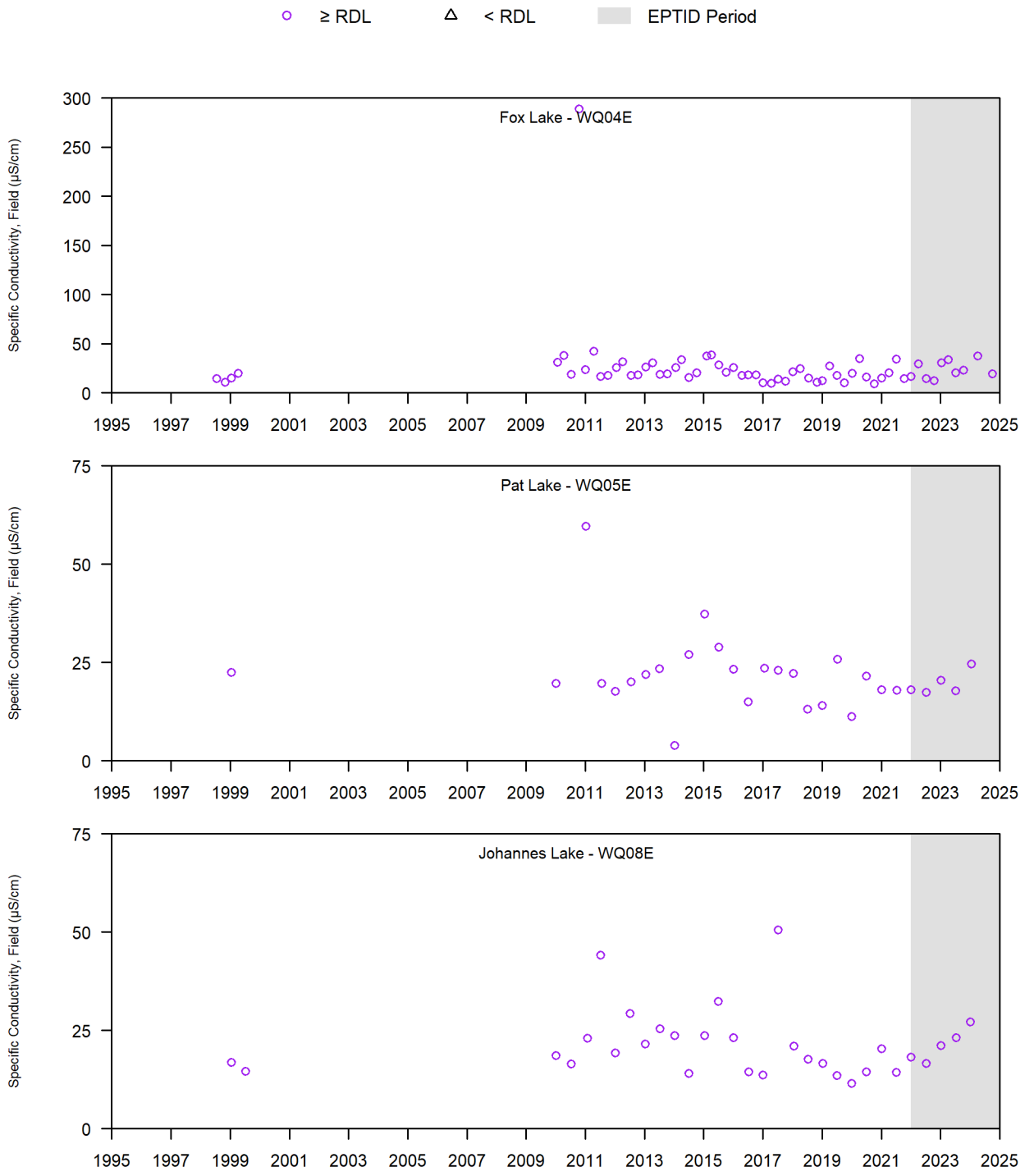


Figure 4.3-4 (20 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

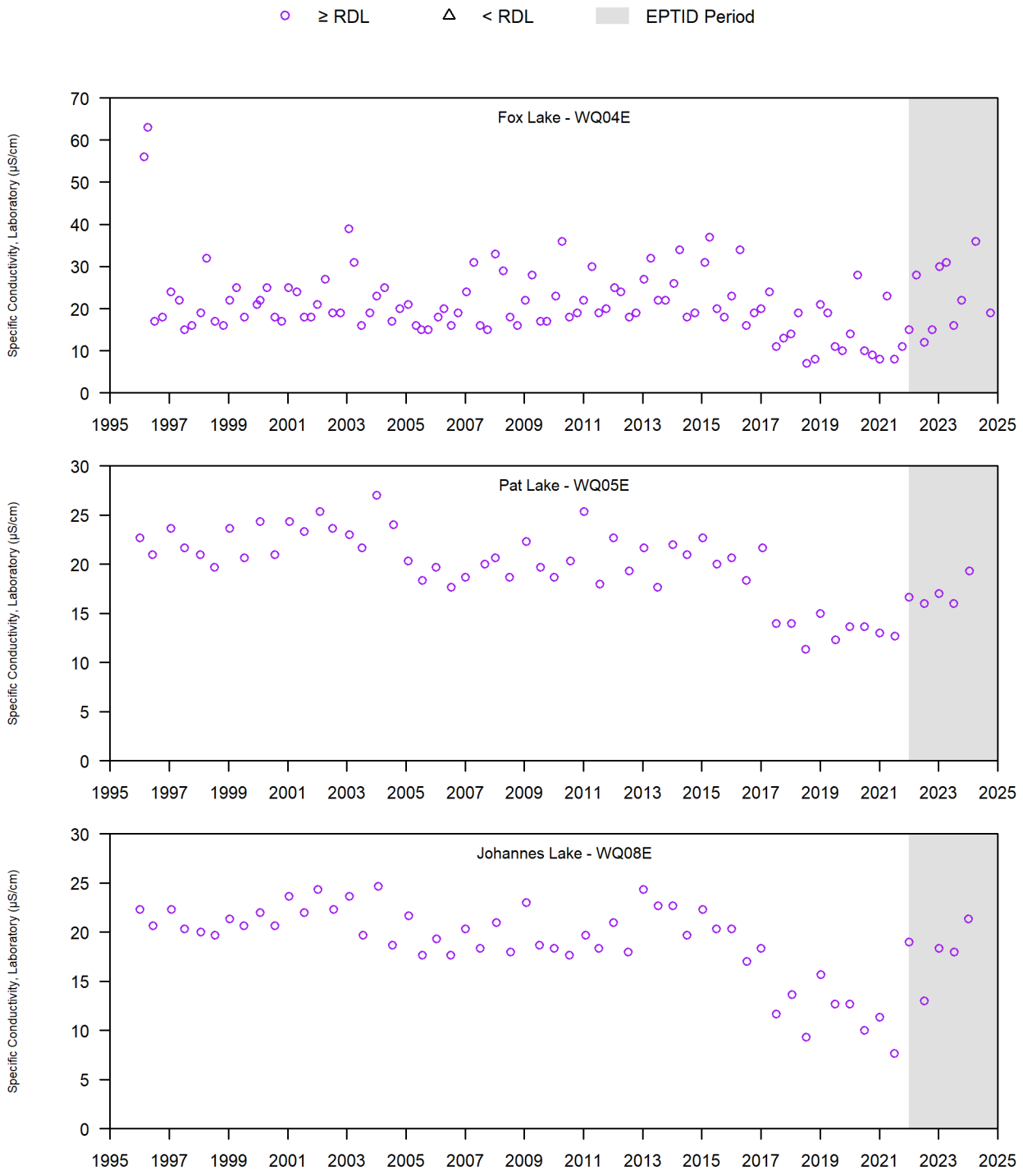


Figure 4.3-4 (21 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

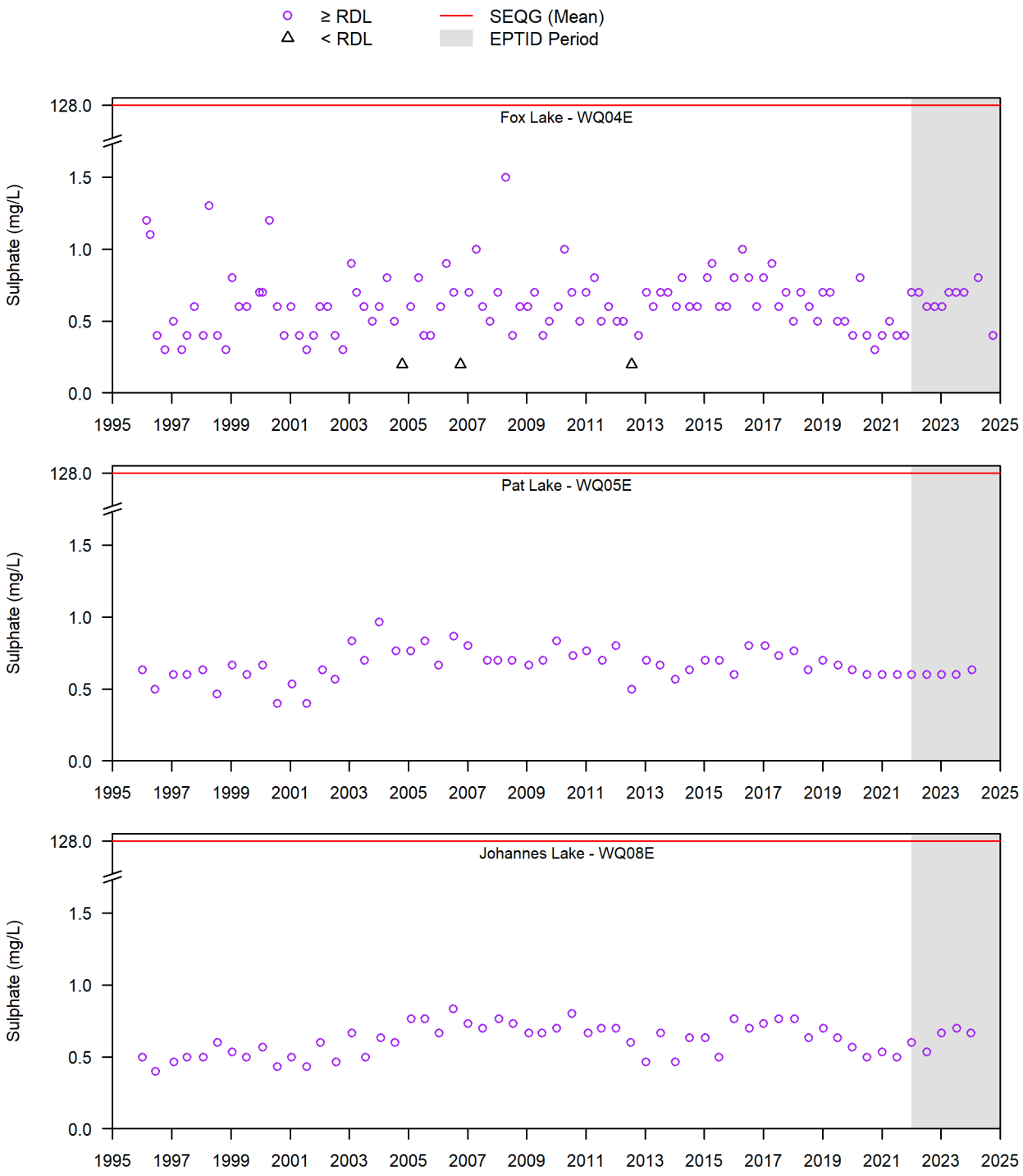


Figure 4.3-4 (22 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

.

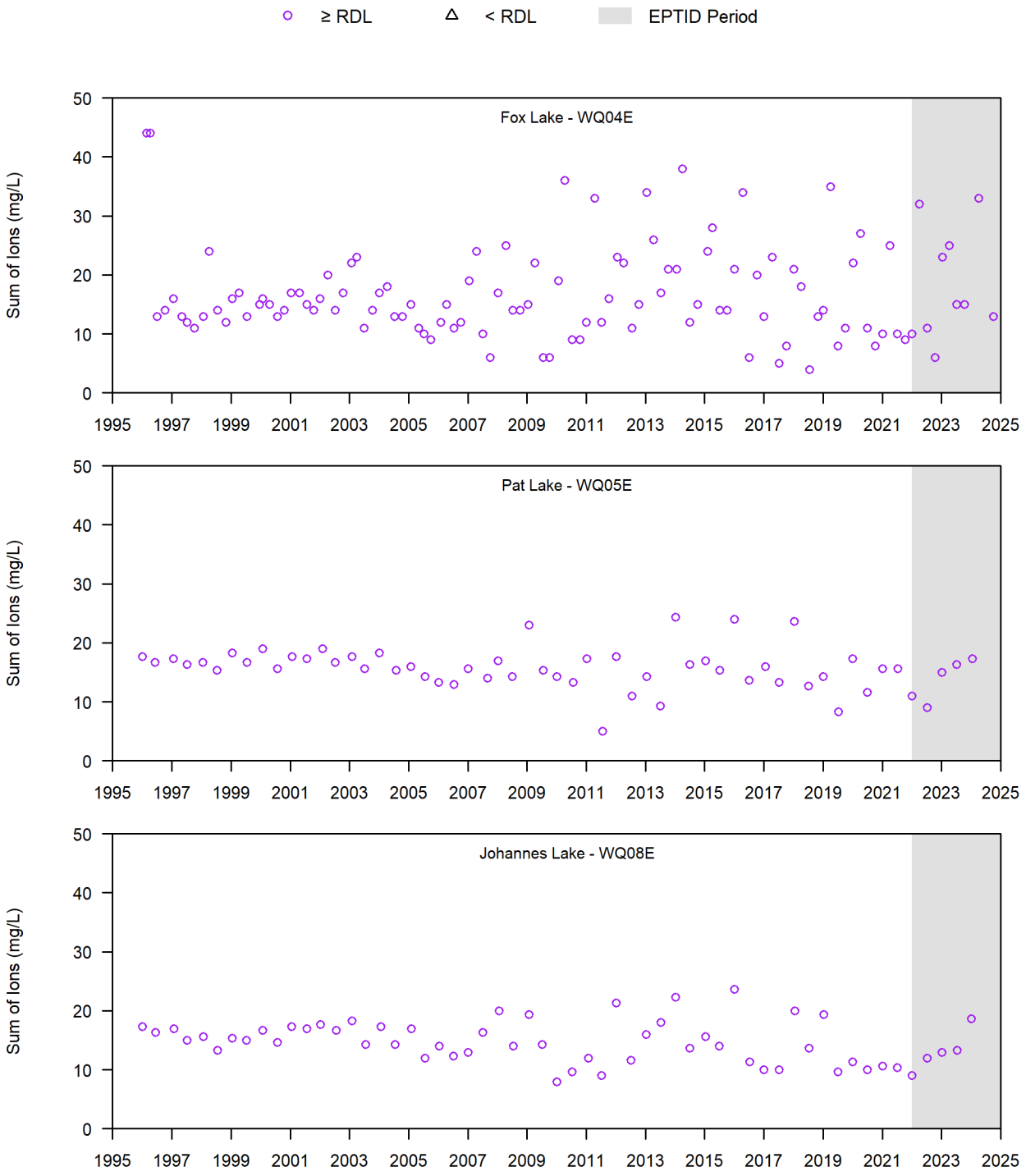


Figure 4.3-4 (23 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

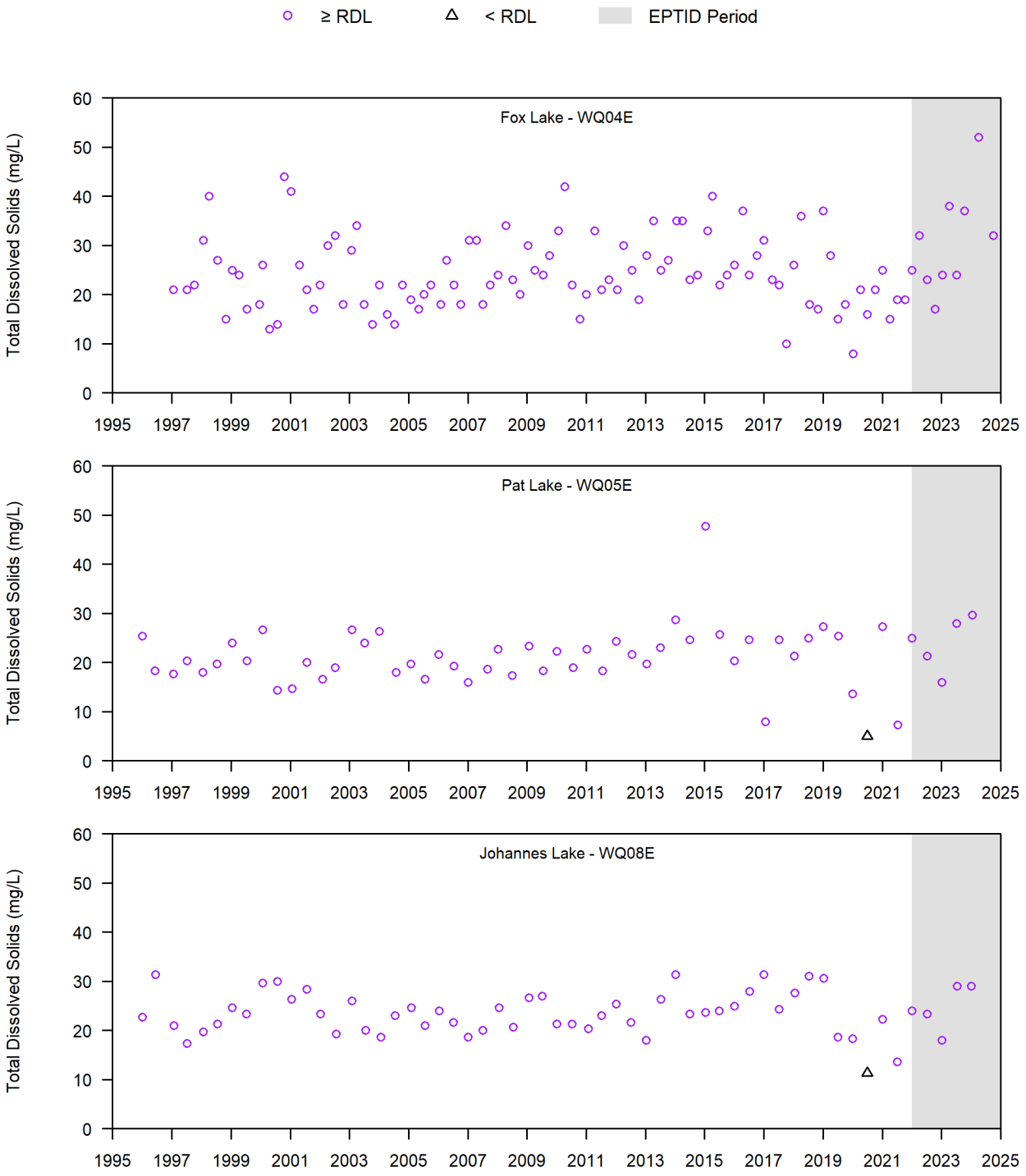


Figure 4.3-4 (24 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

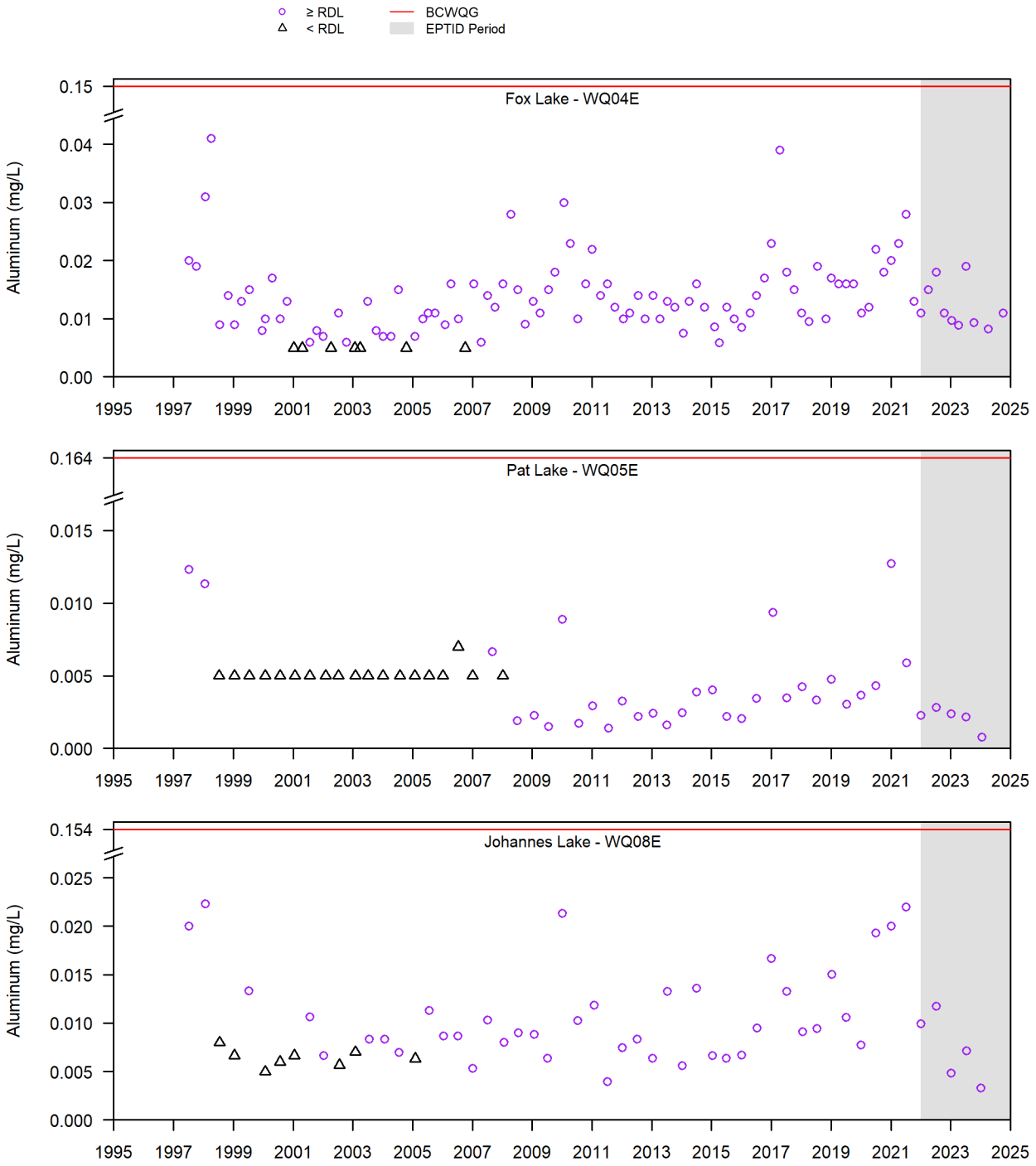


Figure 4.3-4 (25 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

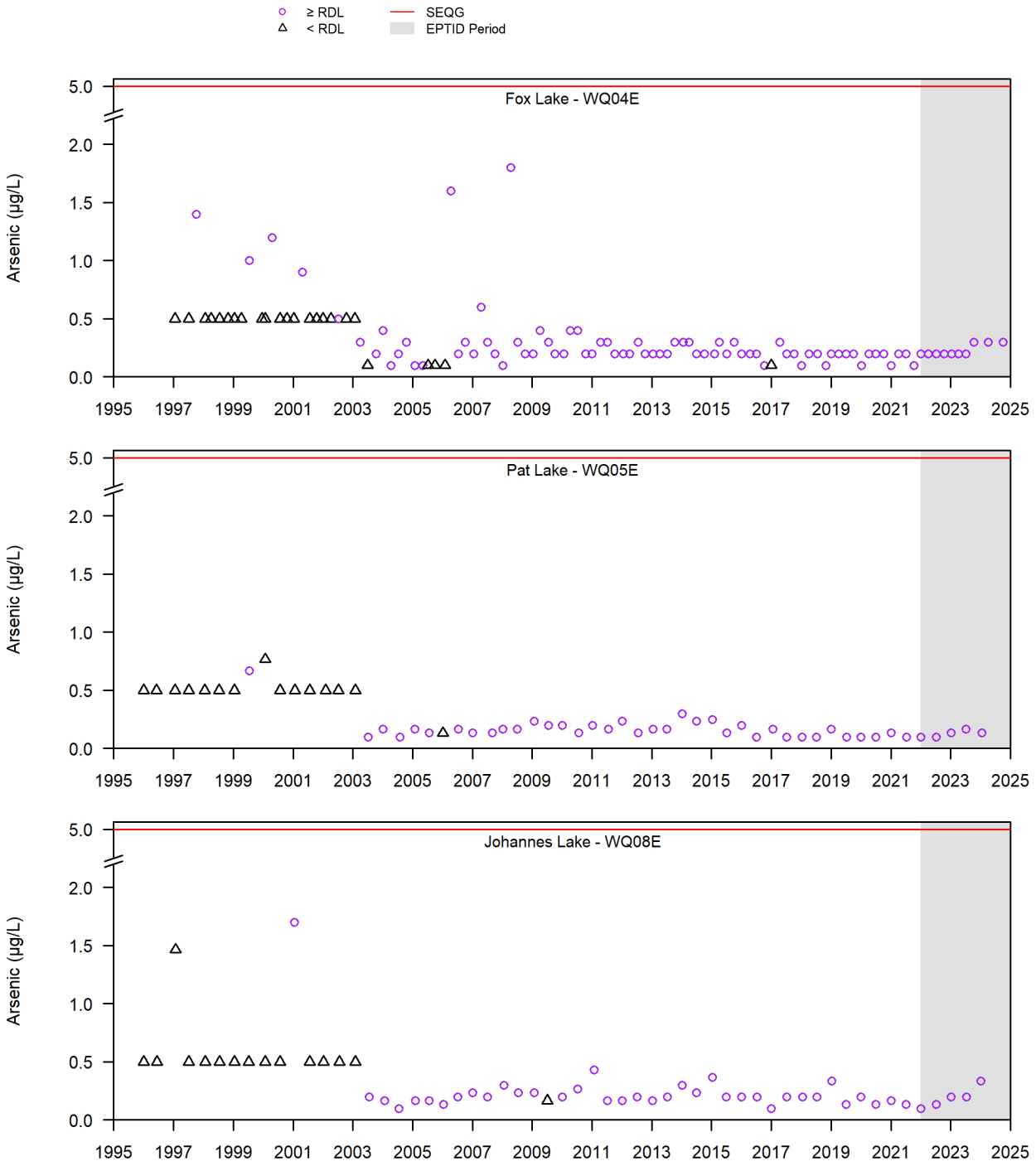


Figure 4.3-4 (26 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

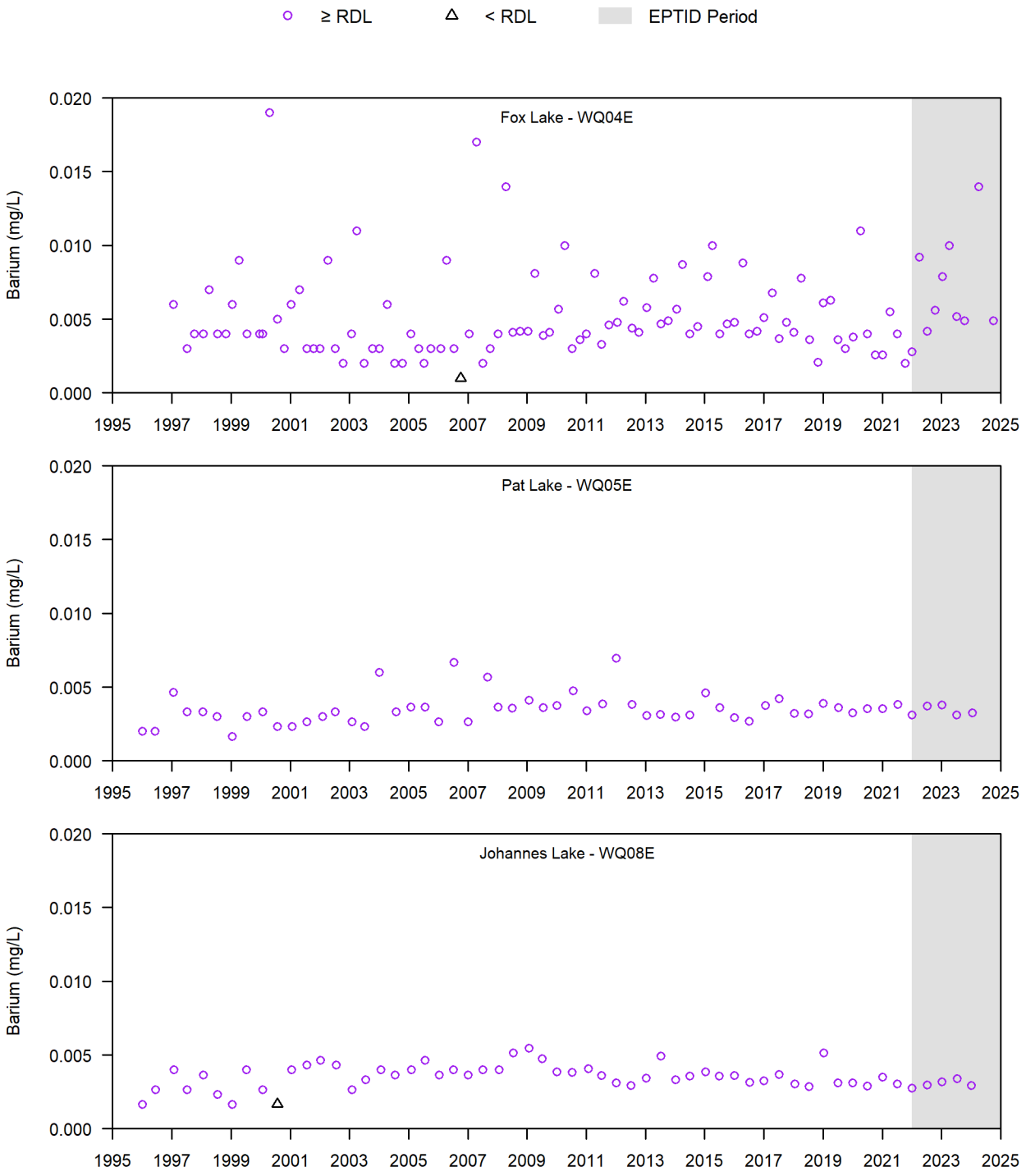


Figure 4.3-4 (27 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

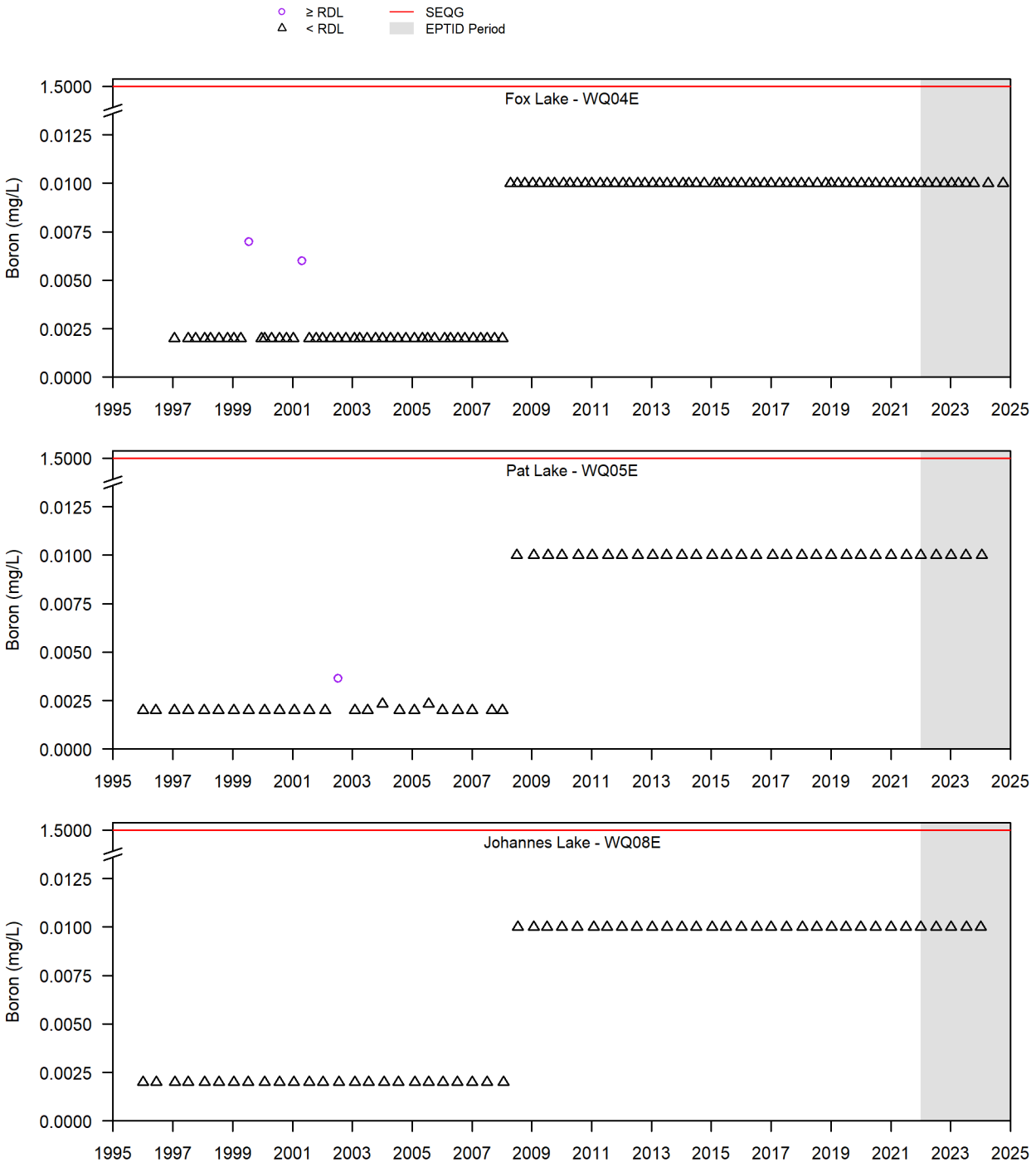


Figure 4.3-4 (28 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

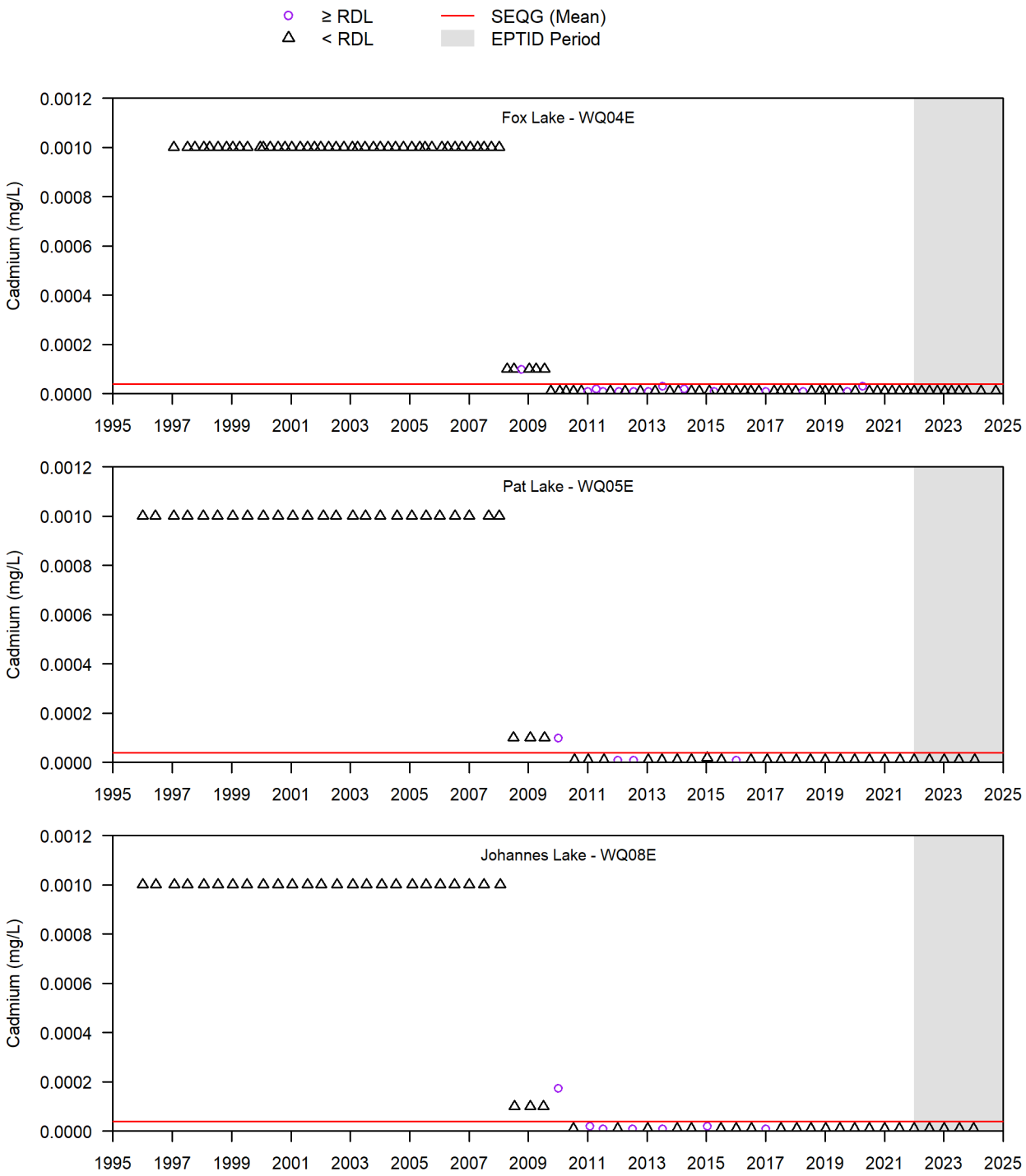


Figure 4.3-4 (29 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

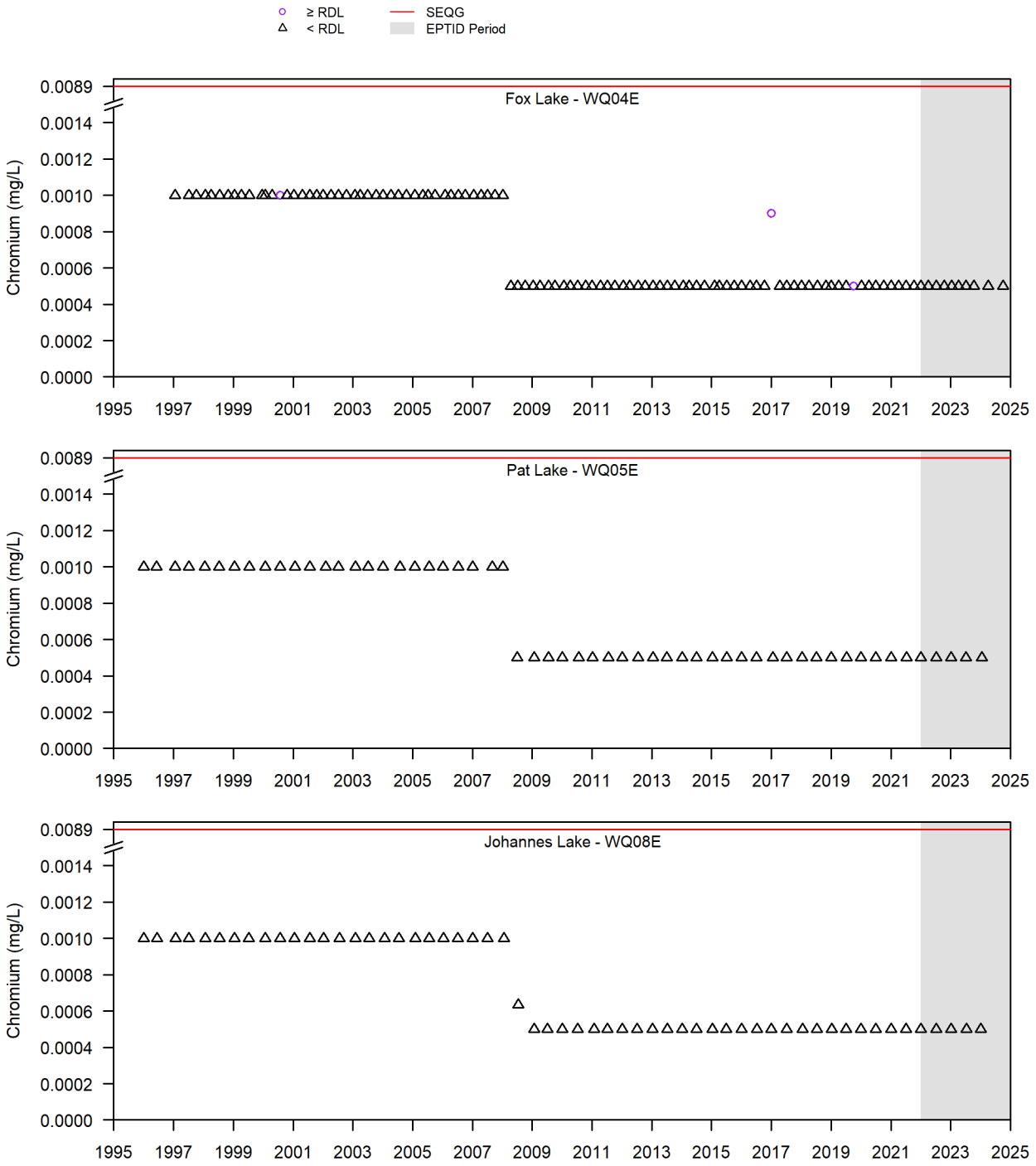


Figure 4.3-4 (30 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

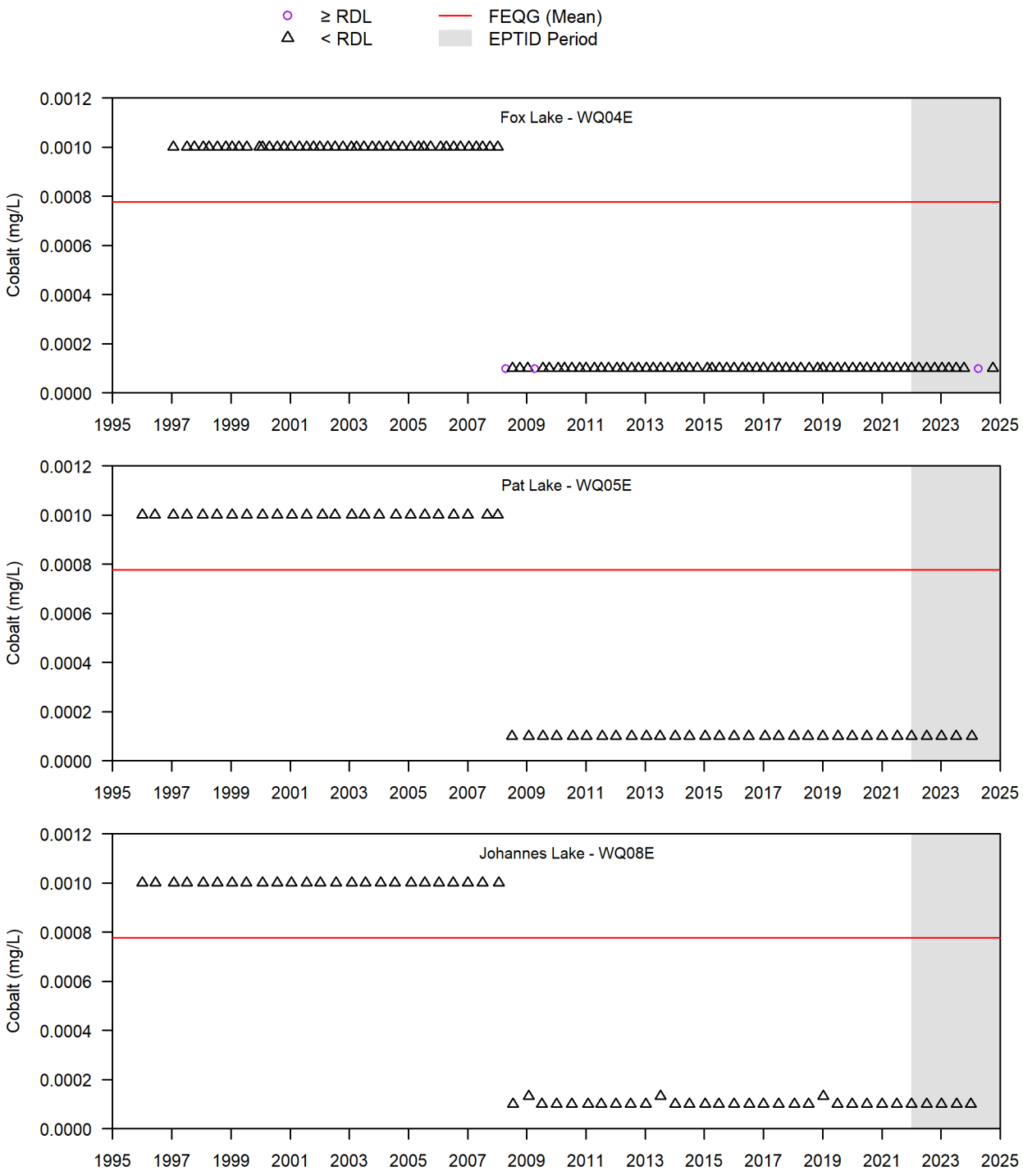


Figure 4.3-4 (31 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

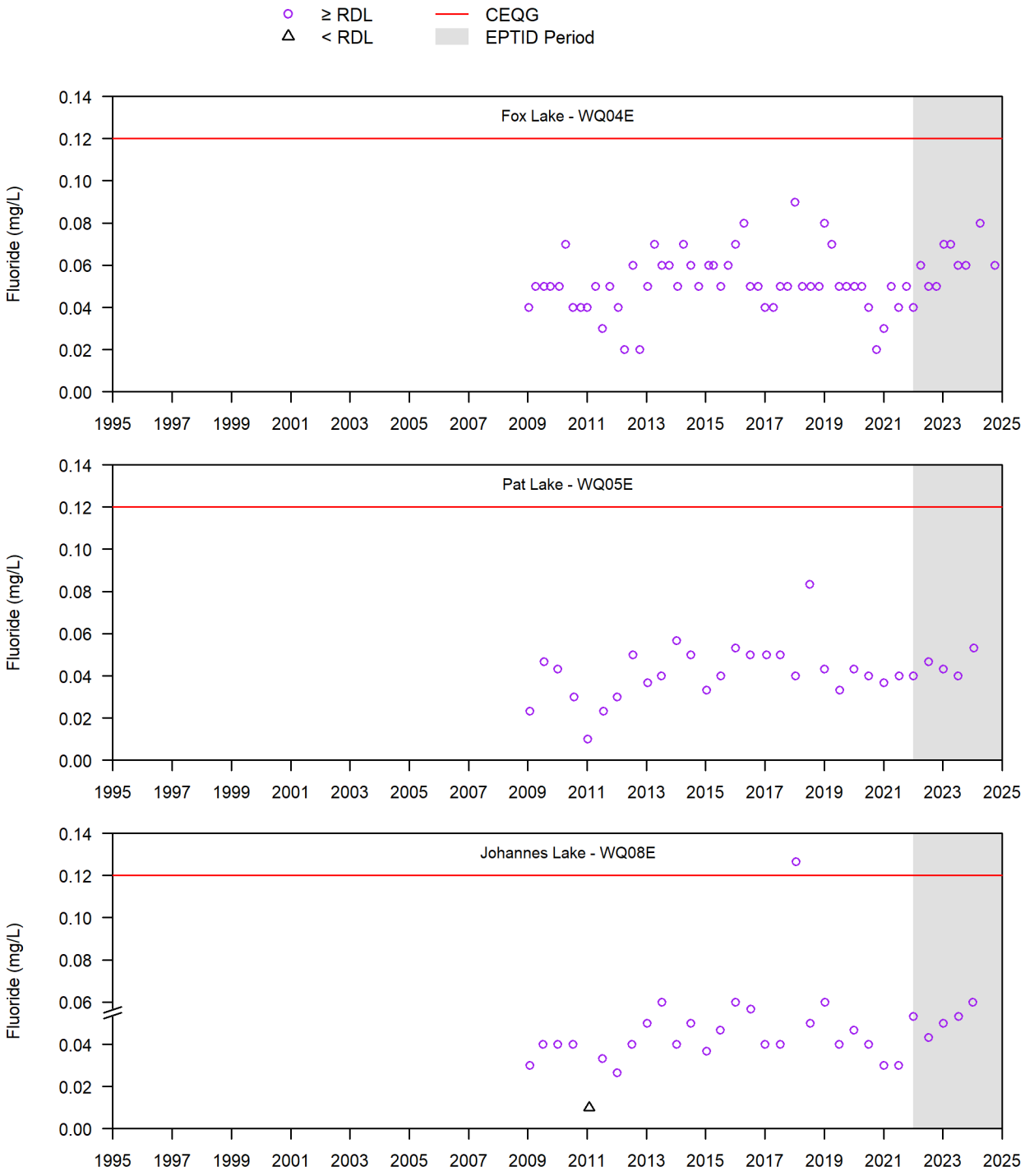


Figure 4.3-4 (32 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

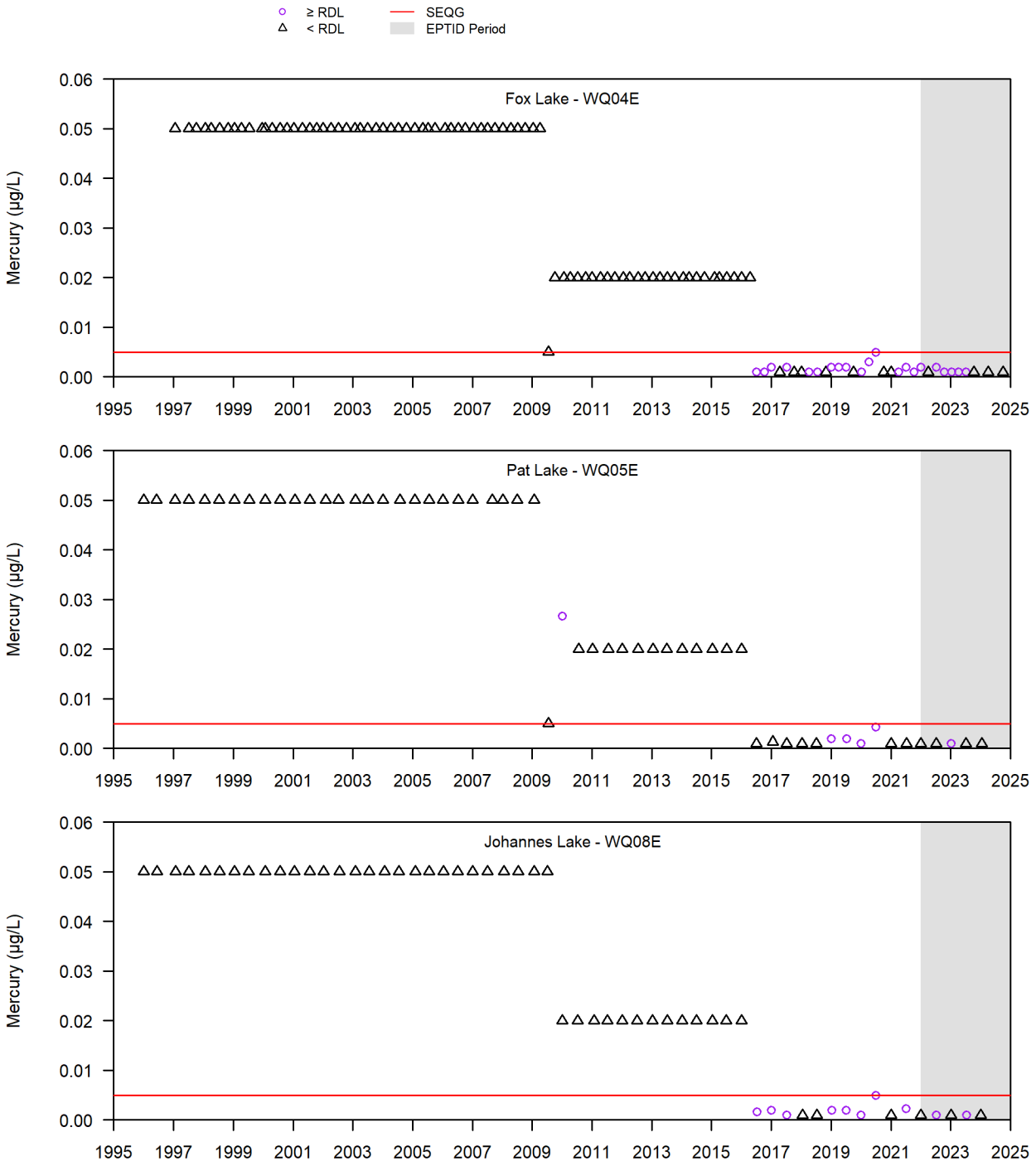


Figure 4.3-4 (33 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

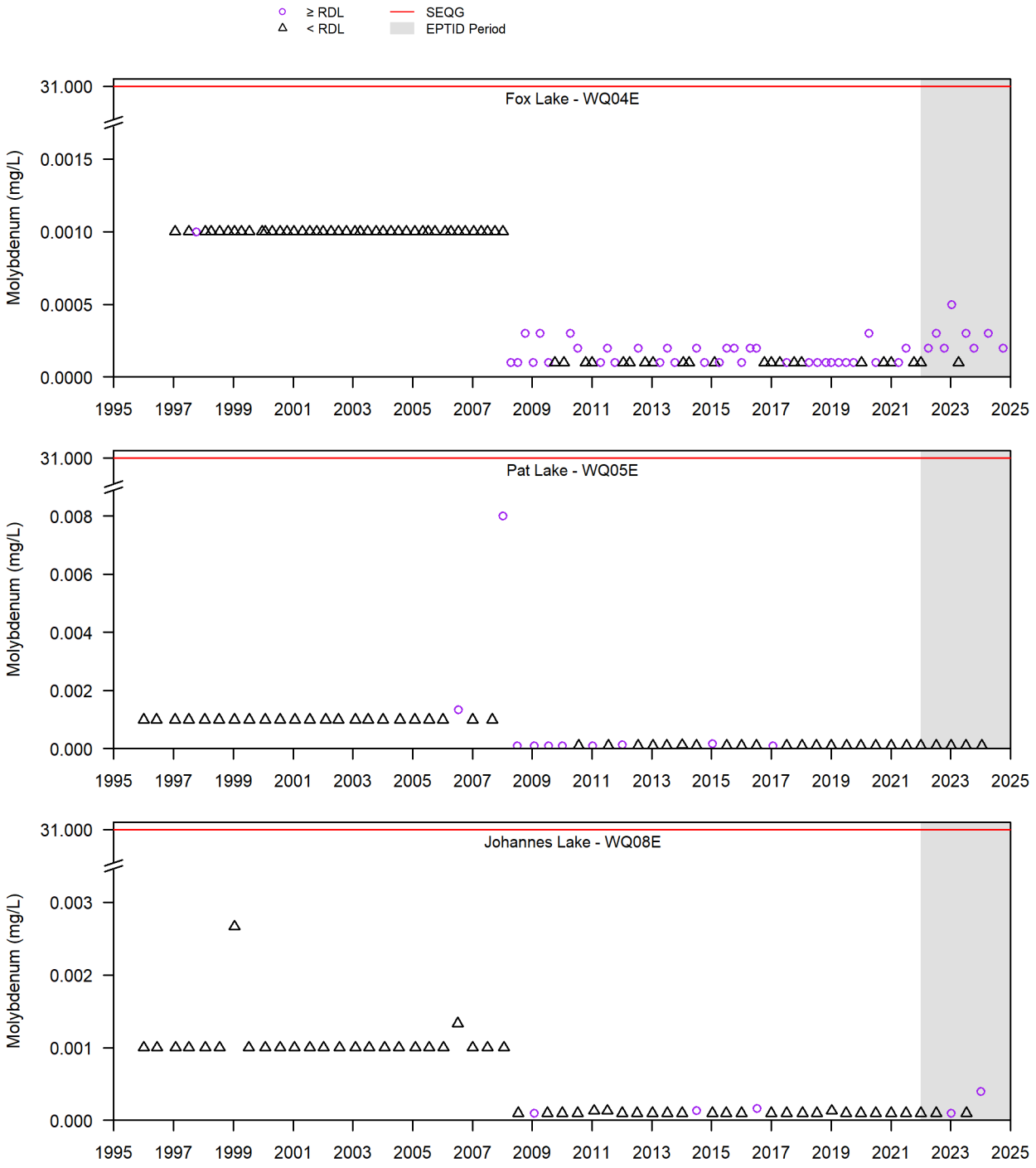


Figure 4.3-4 (34 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

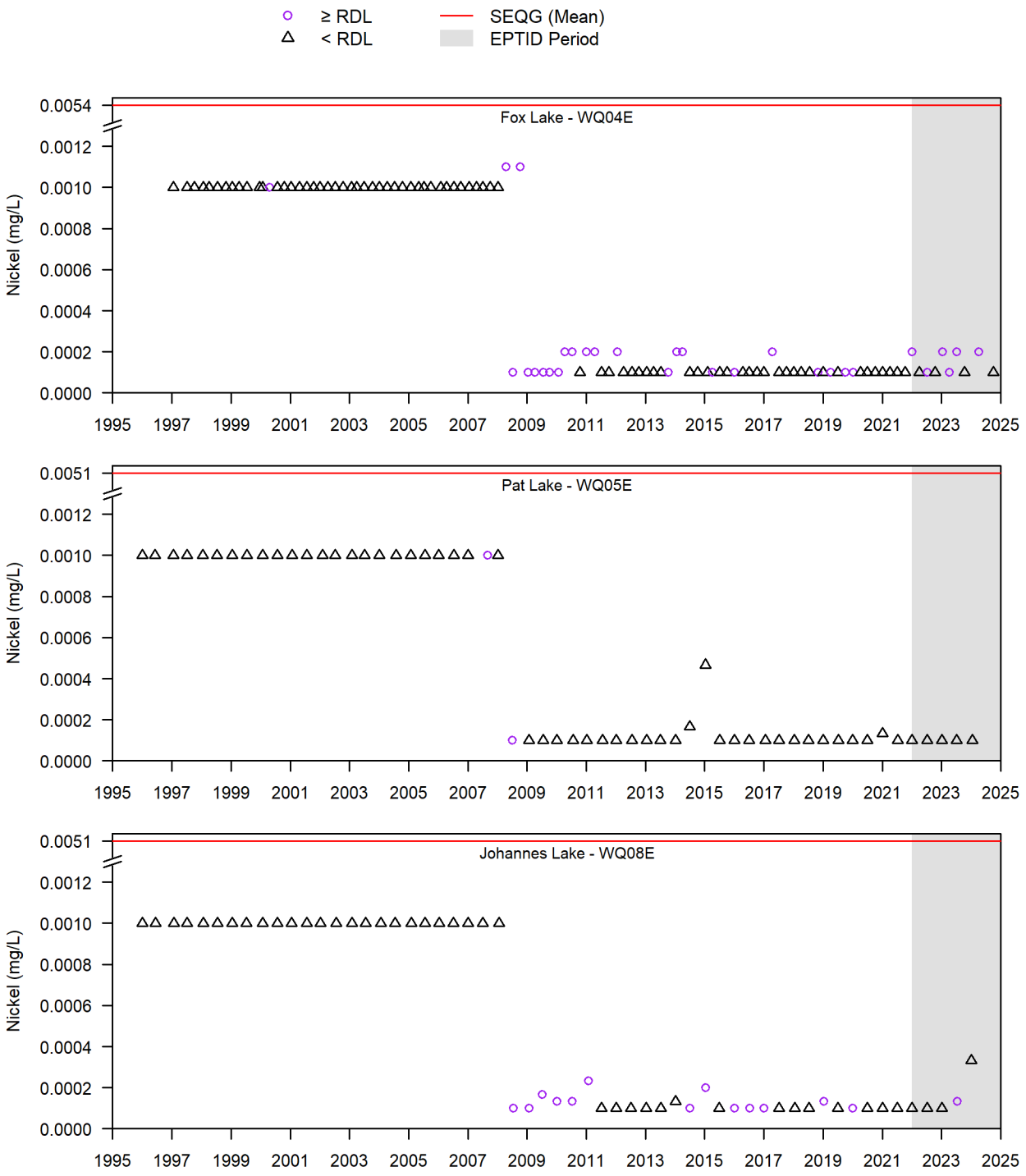


Figure 4.3-4 (35 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

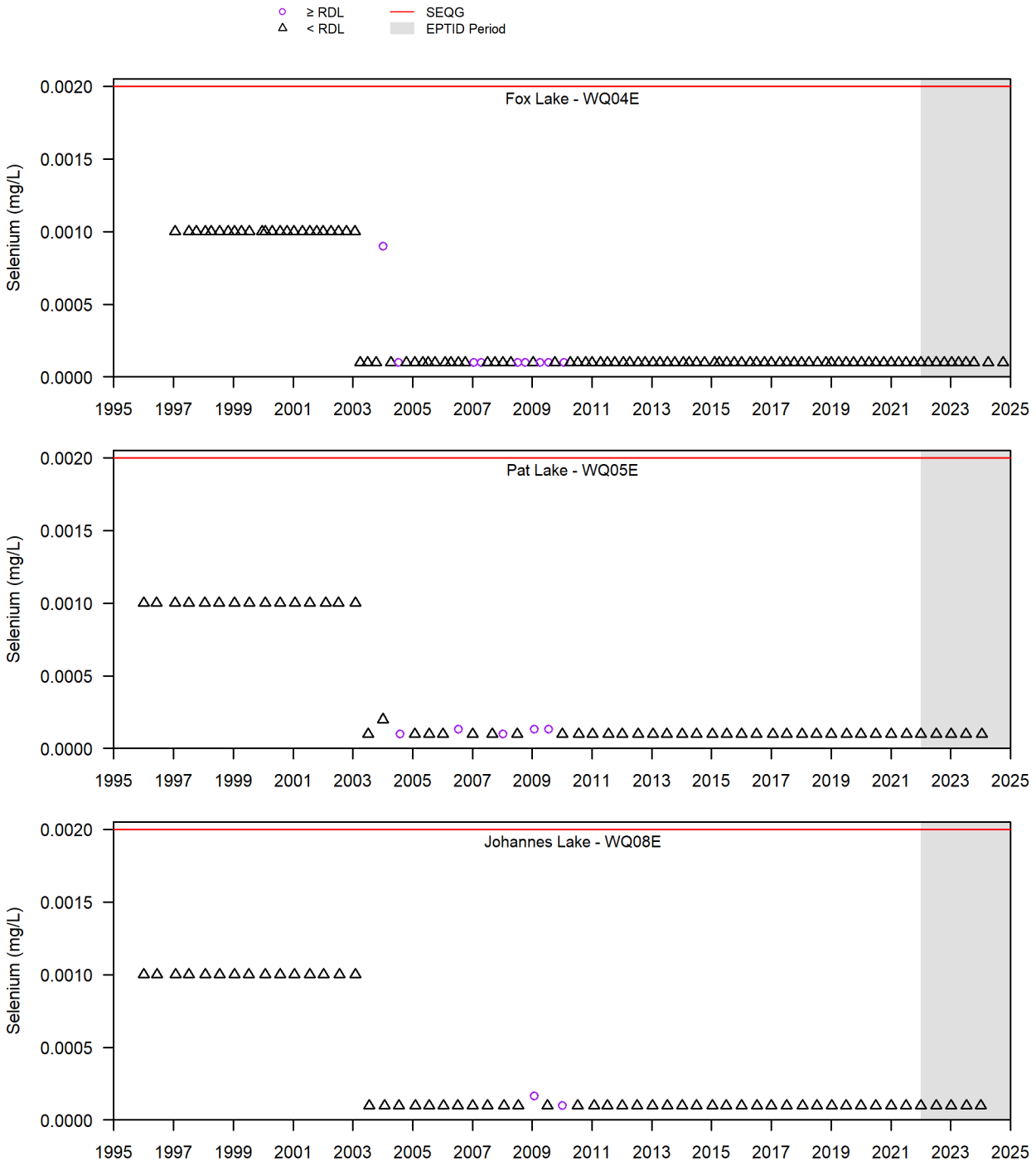


Figure 4.3-4 (36 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

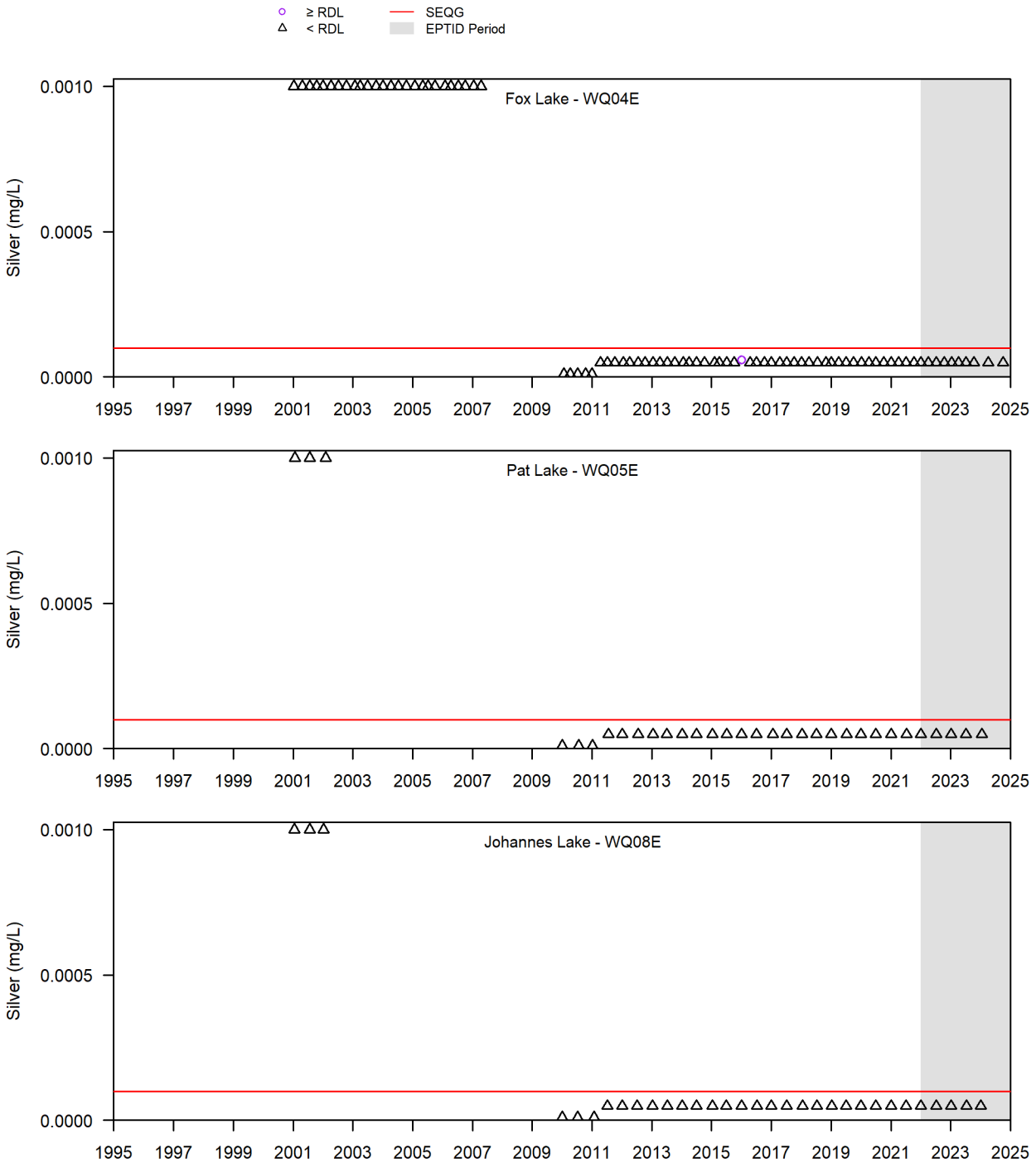


Figure 4.3-4 (37 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

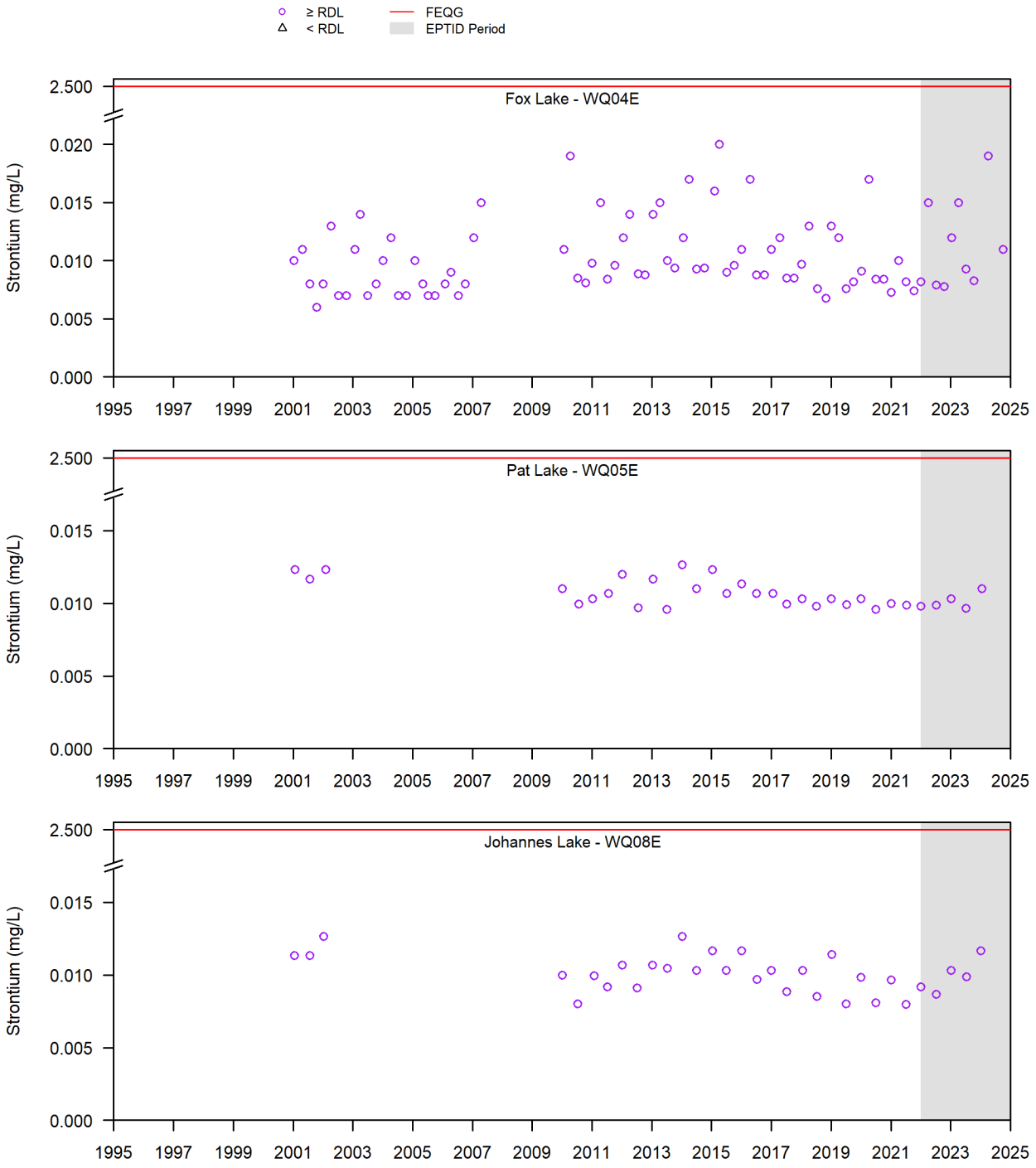


Figure 4.3-4 (38 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

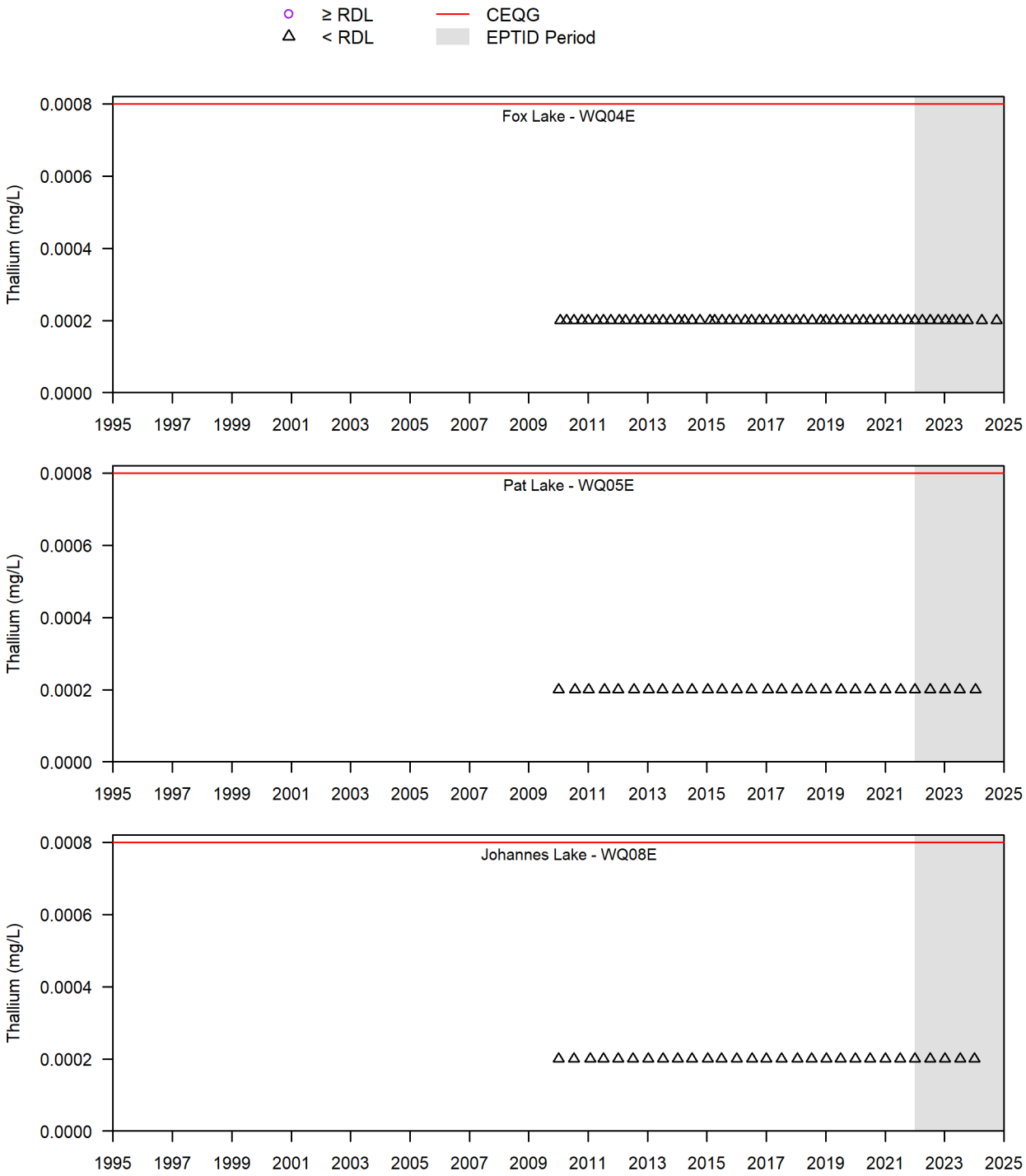


Figure 4.3-4 (39 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

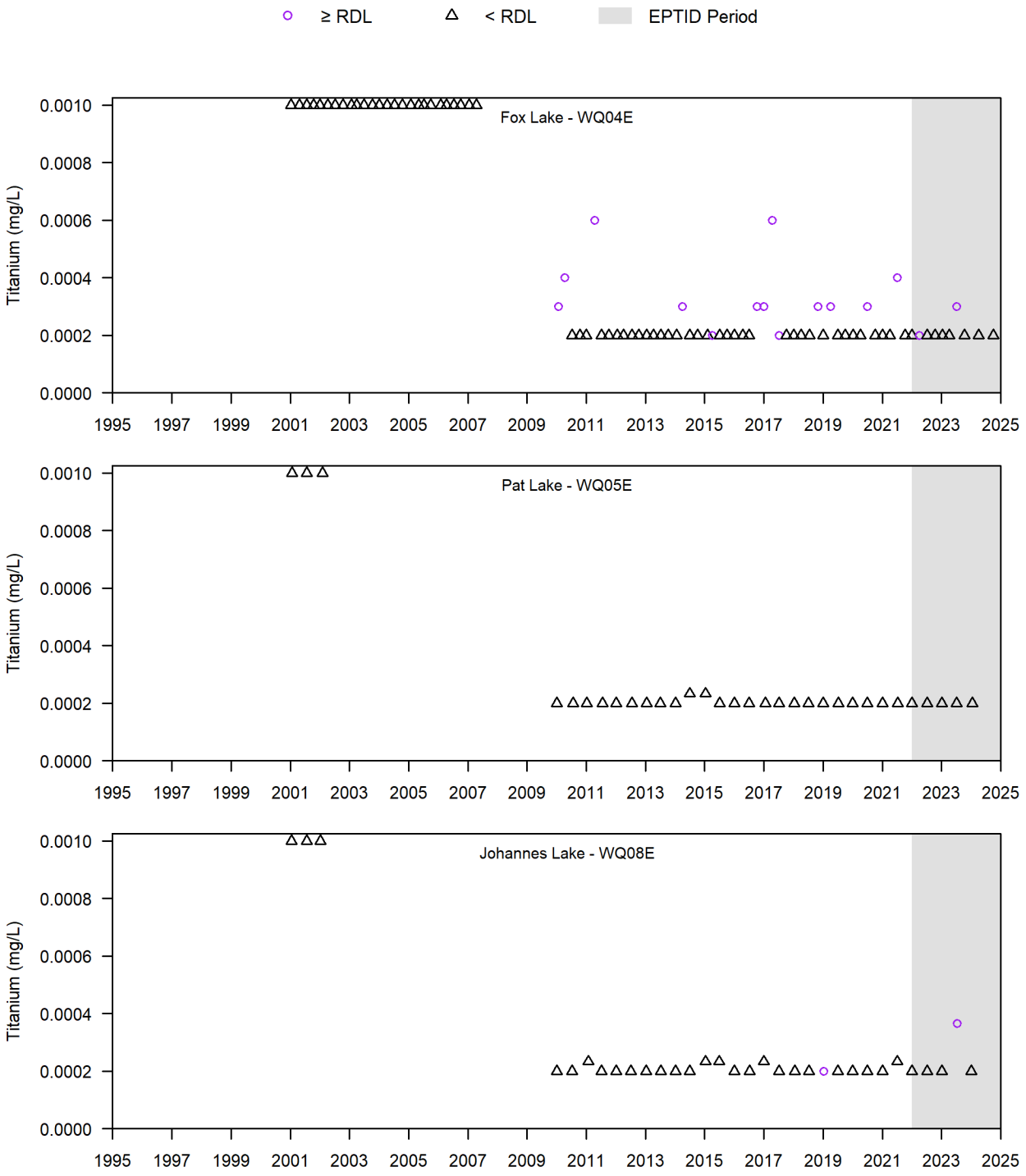


Figure 4.3-4 (40 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

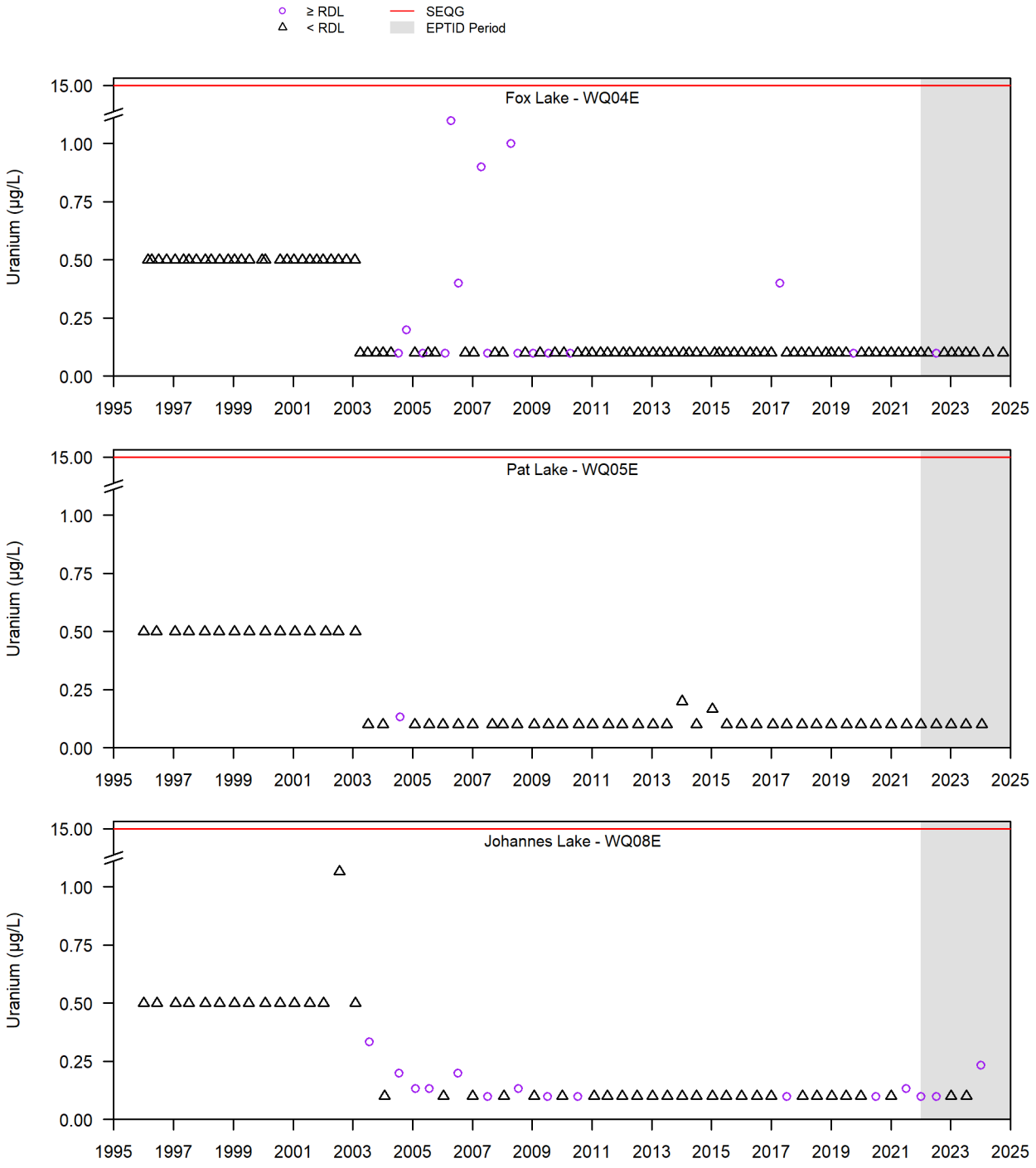


Figure 4.3-4 (41 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

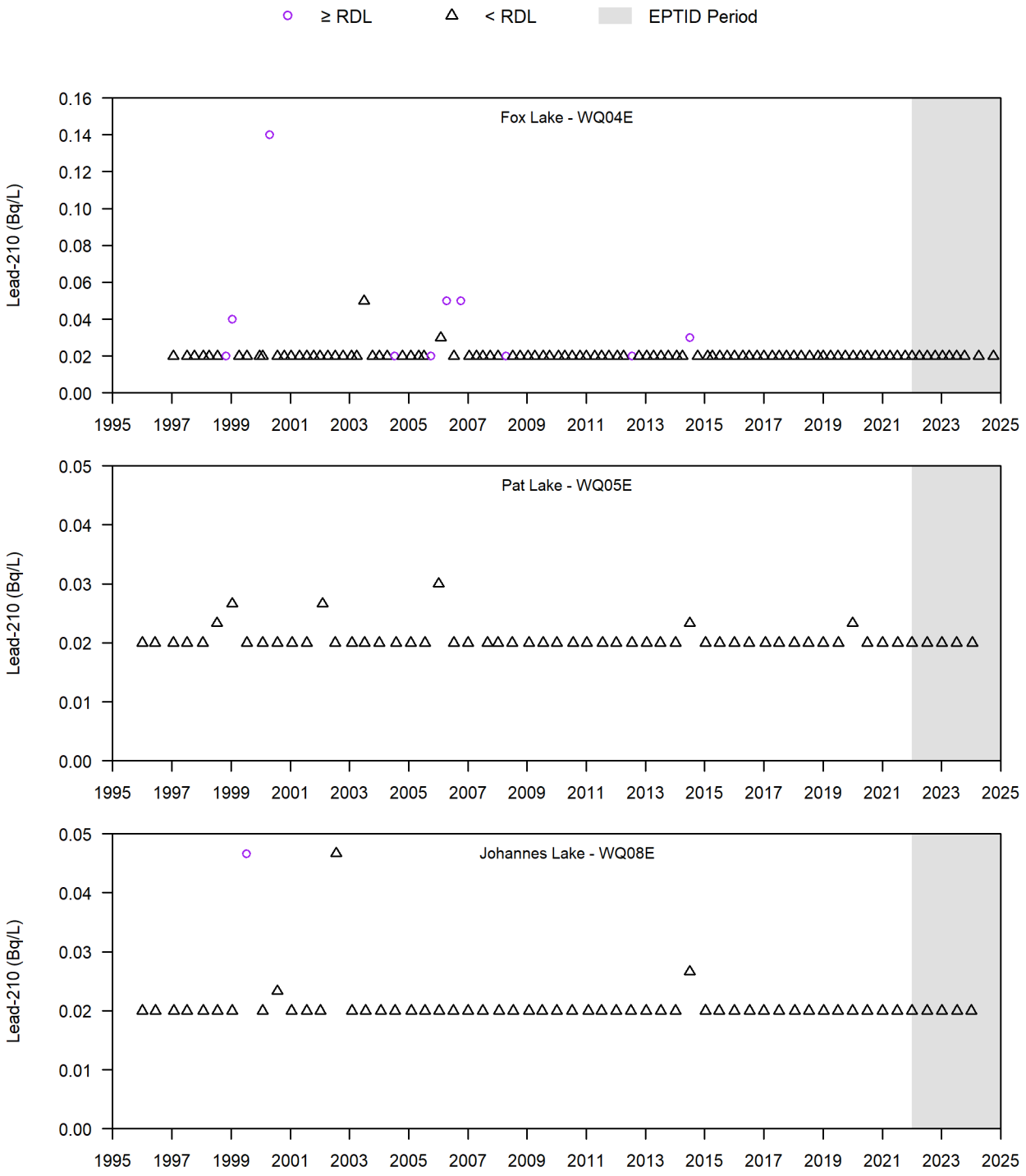


Figure 4.3-4 (42 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

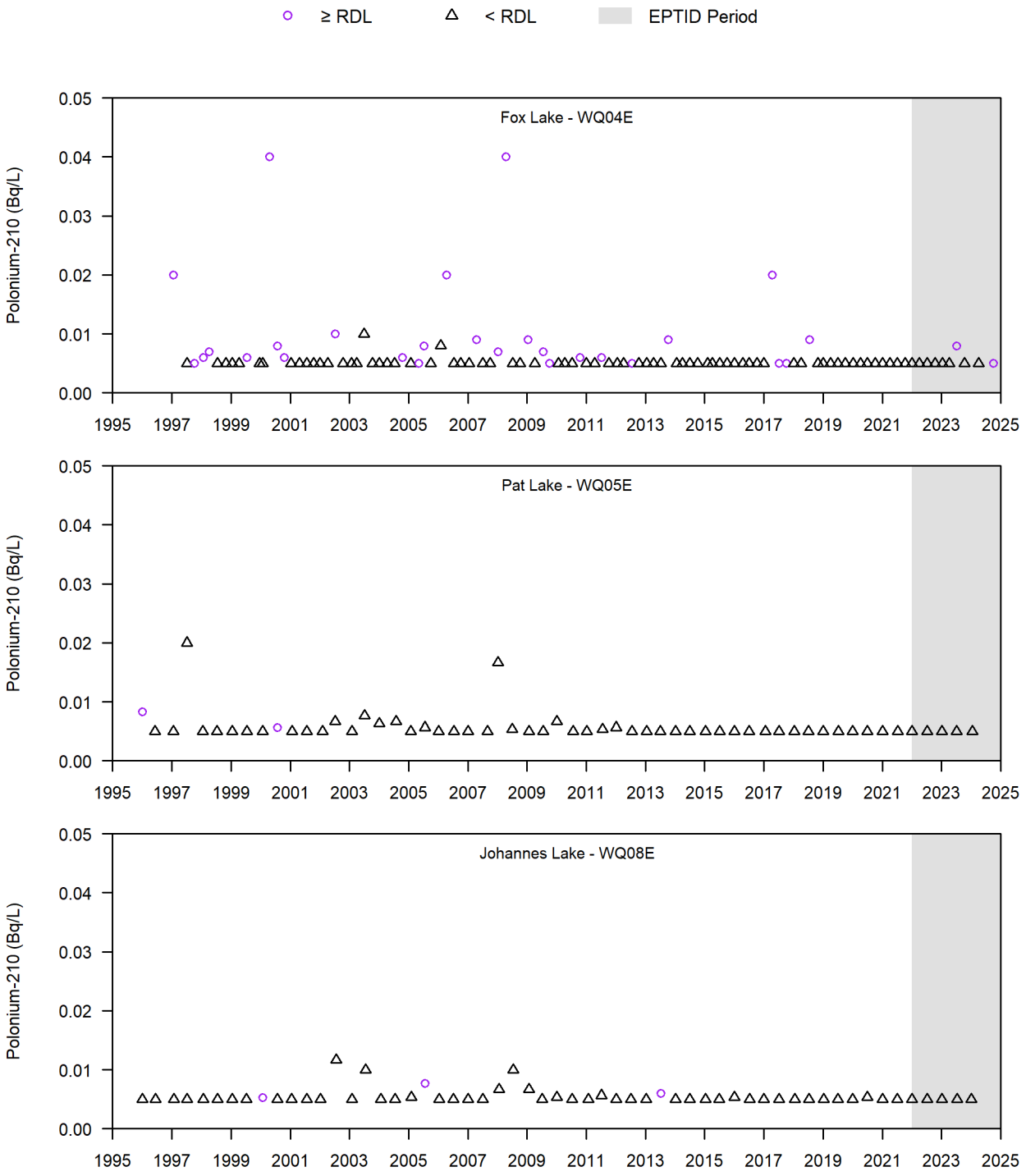


Figure 4.3-4 (43 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

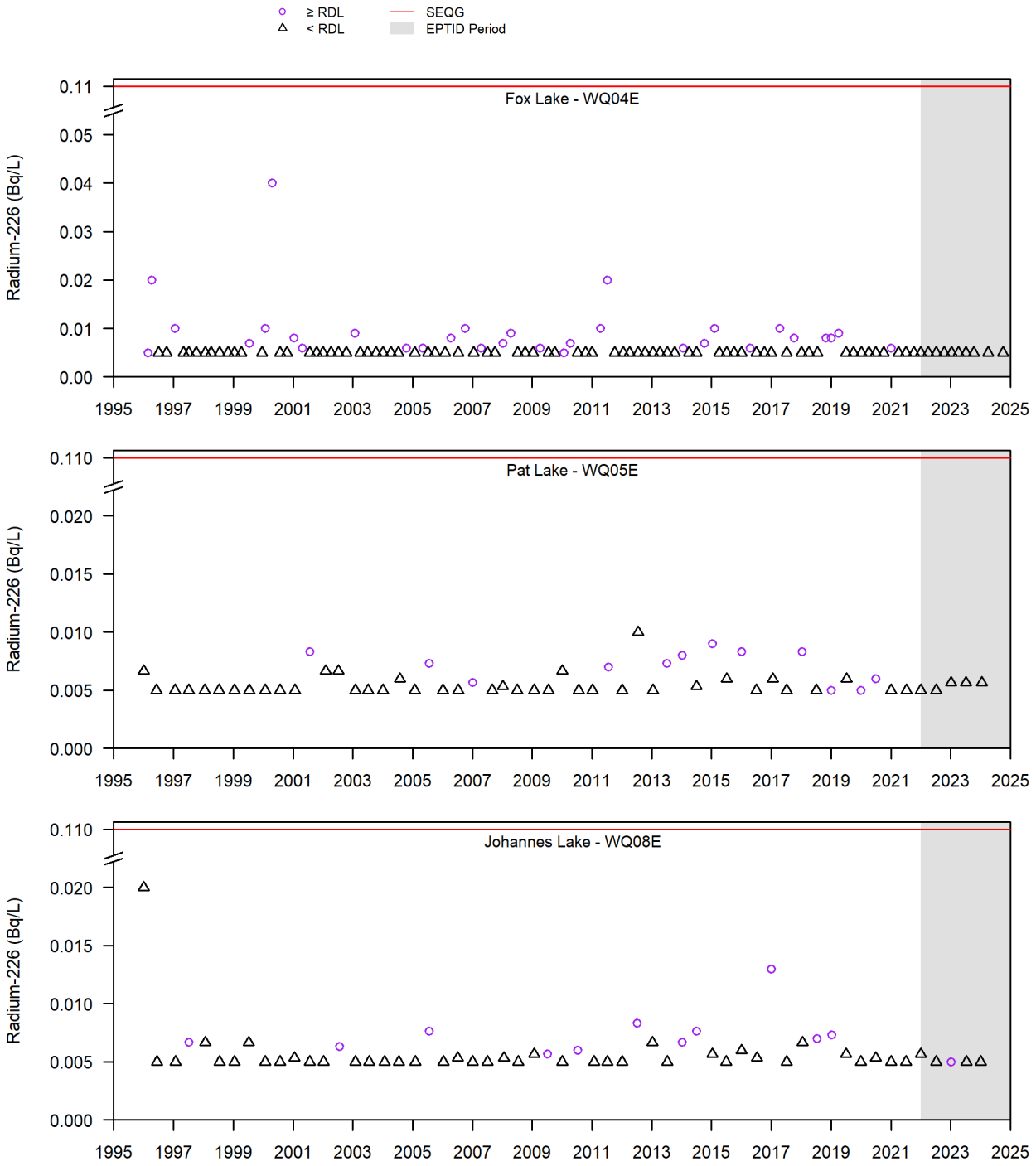


Figure 4.3-4 (44 of 44) COPC Levels in the JEB Secondary Exposure Area Surface Water with Associated Guidelines.

.

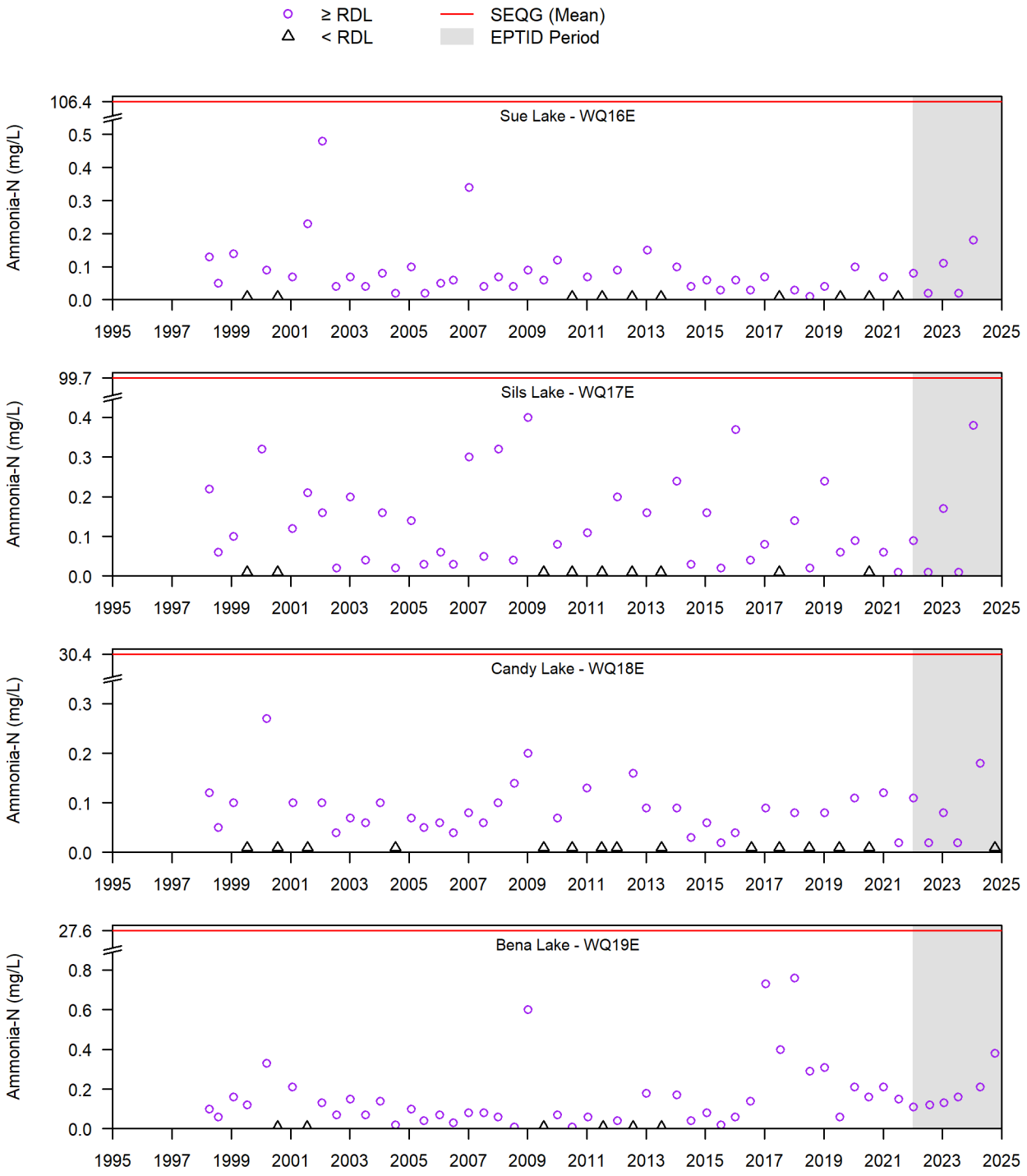


Figure 4.3-5 (1 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

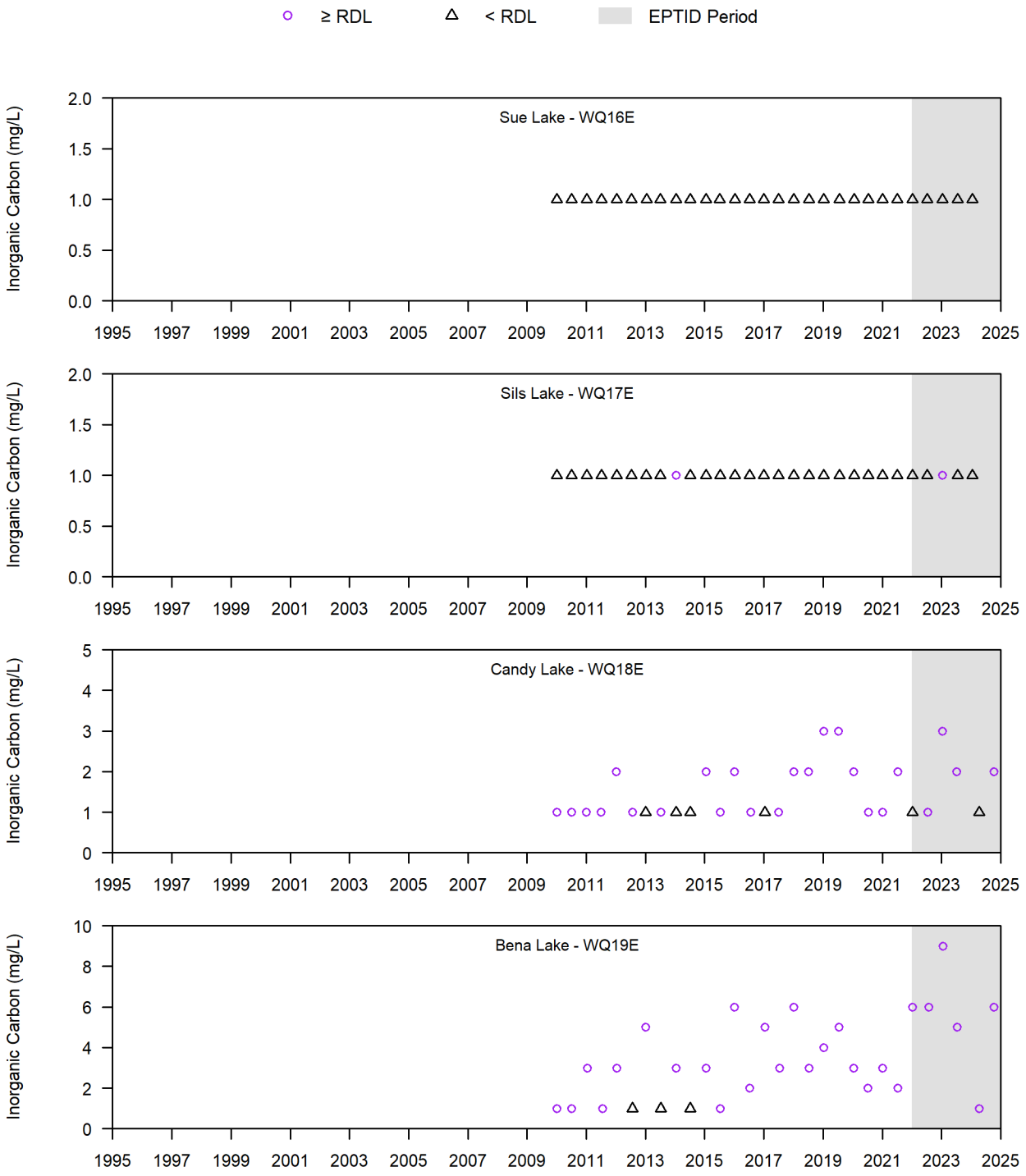


Figure 4.3-5 (2 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

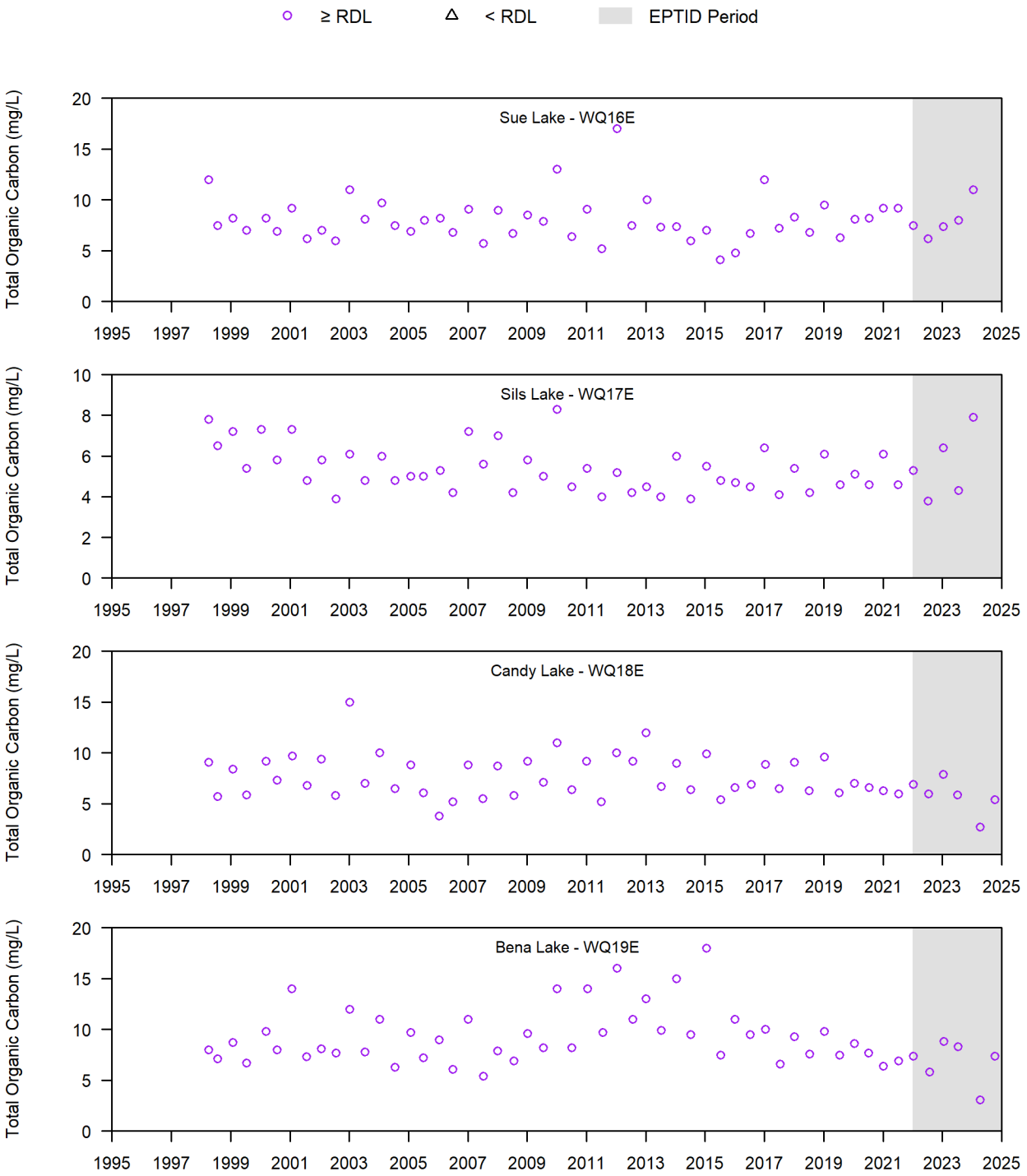


Figure 4.3-5 (3 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

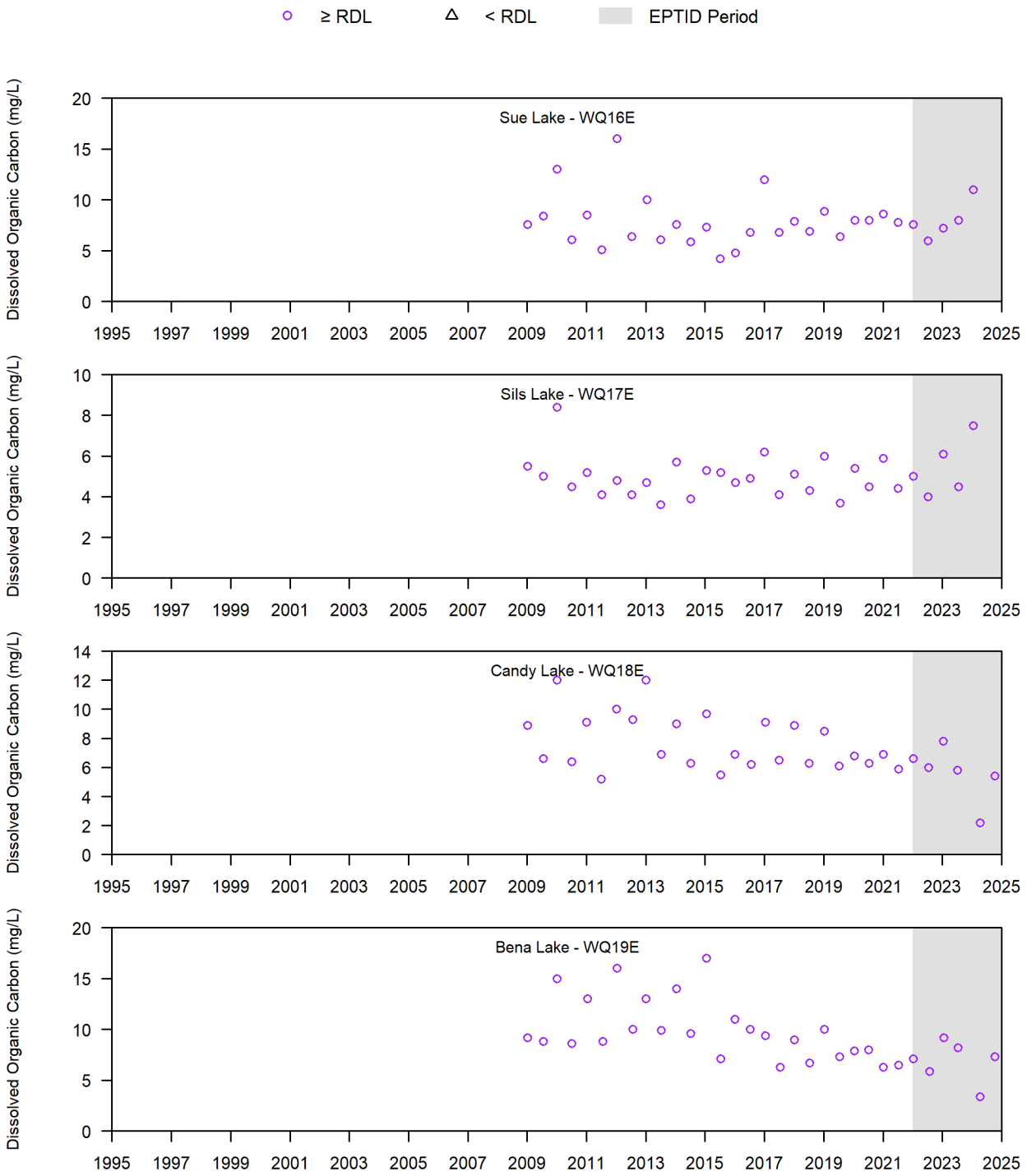


Figure 4.3-5 (4 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

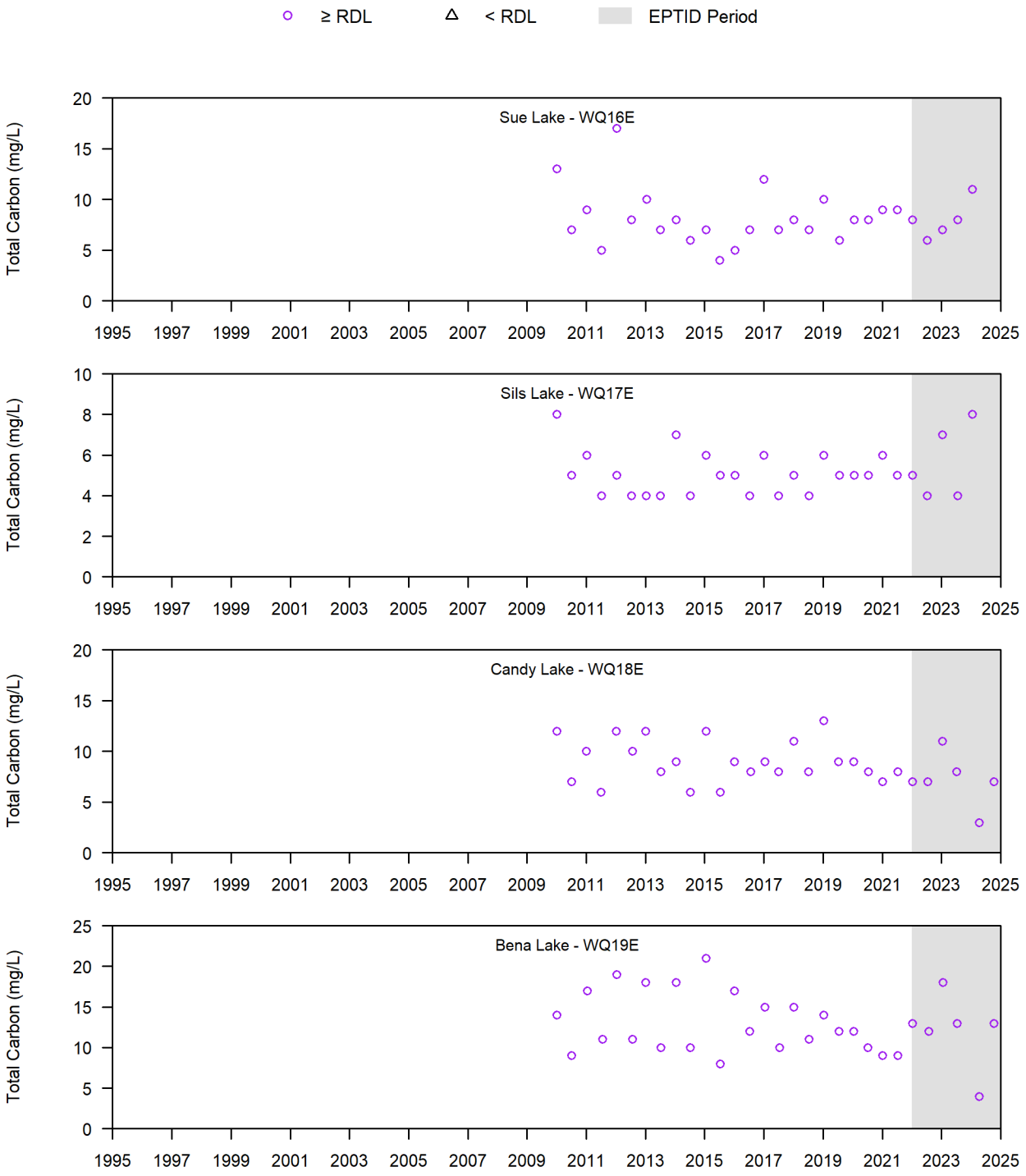


Figure 4.3-5 (5 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

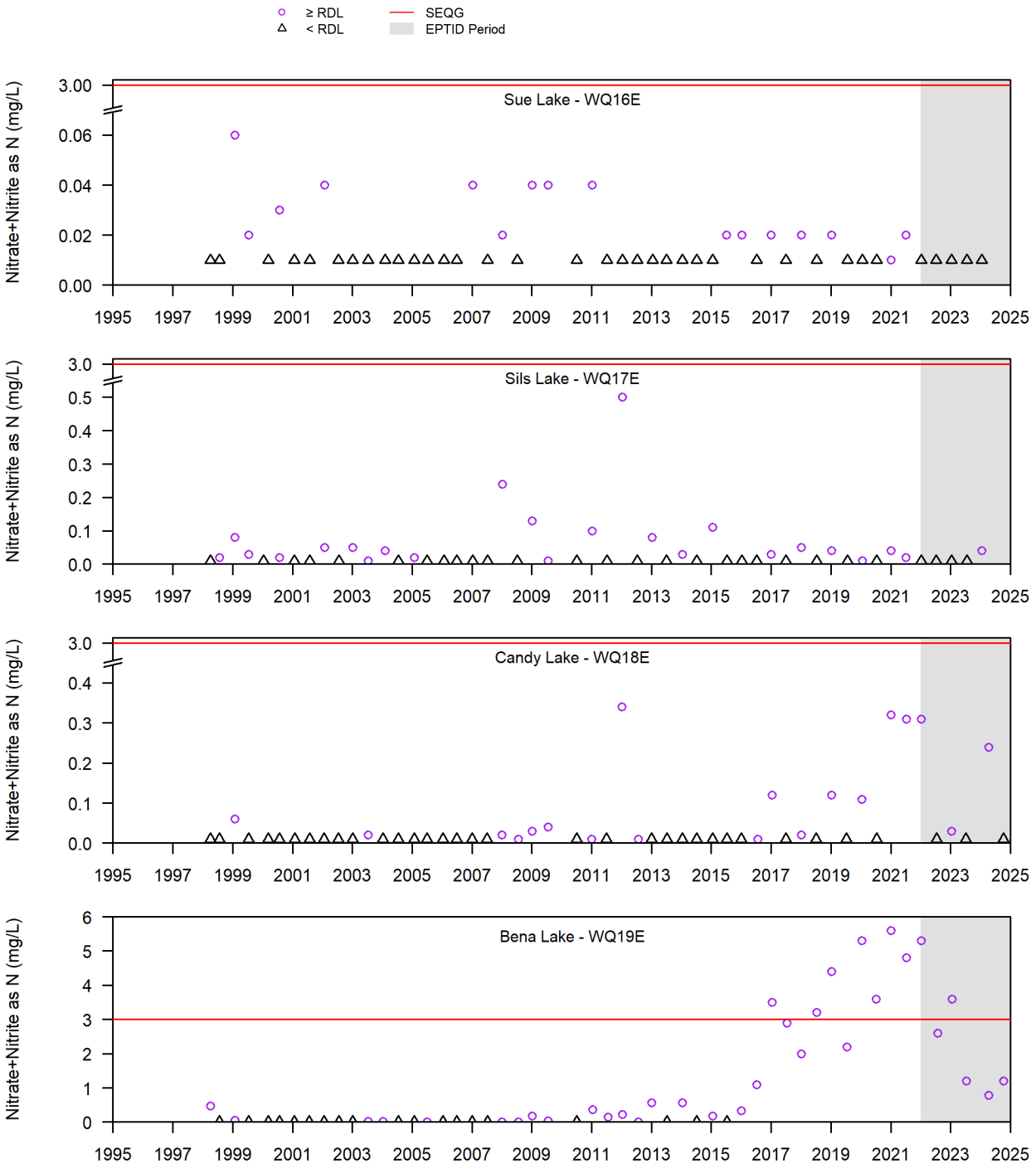


Figure 4.3-5 (6 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

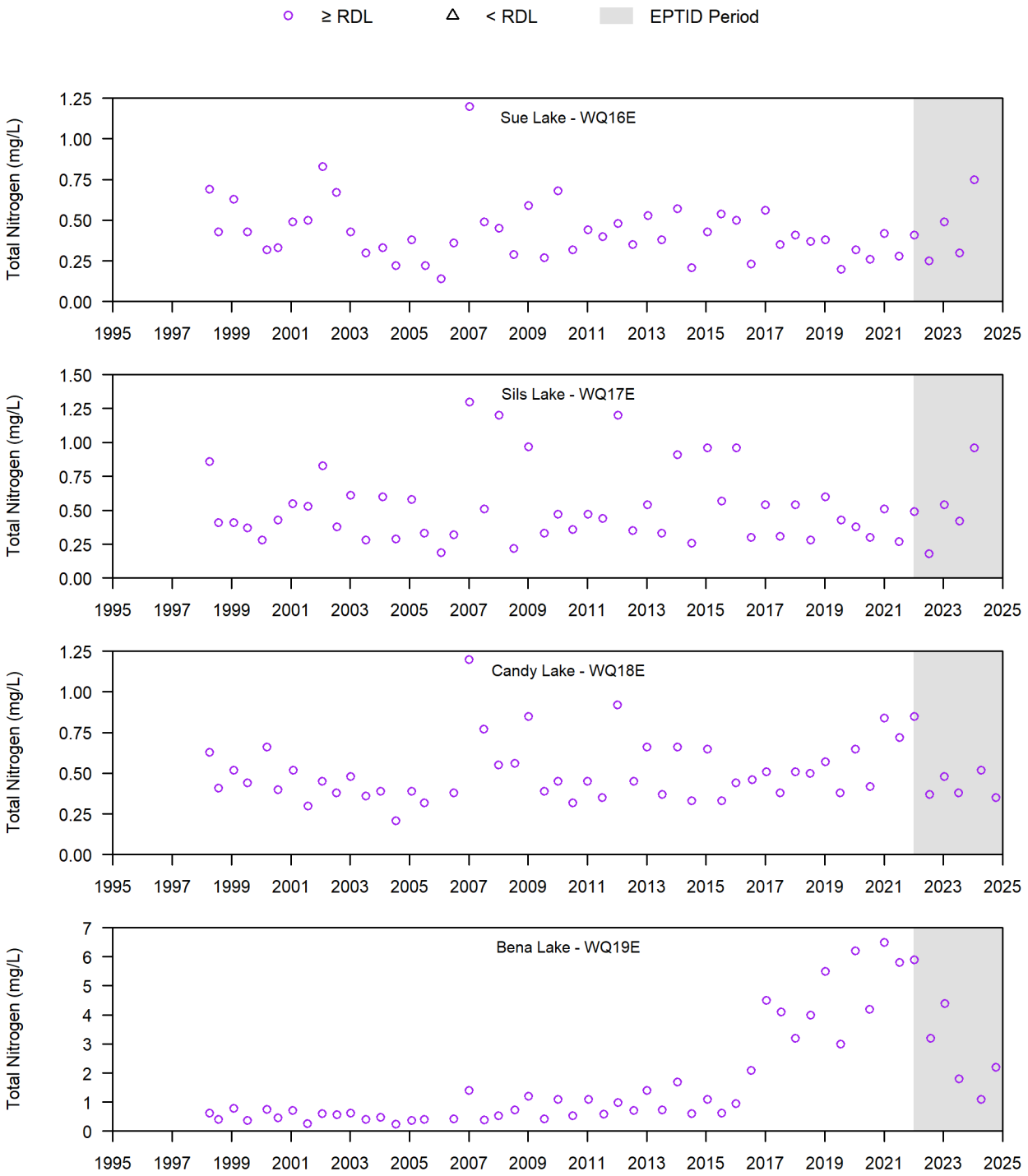


Figure 4.3-5 (7 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

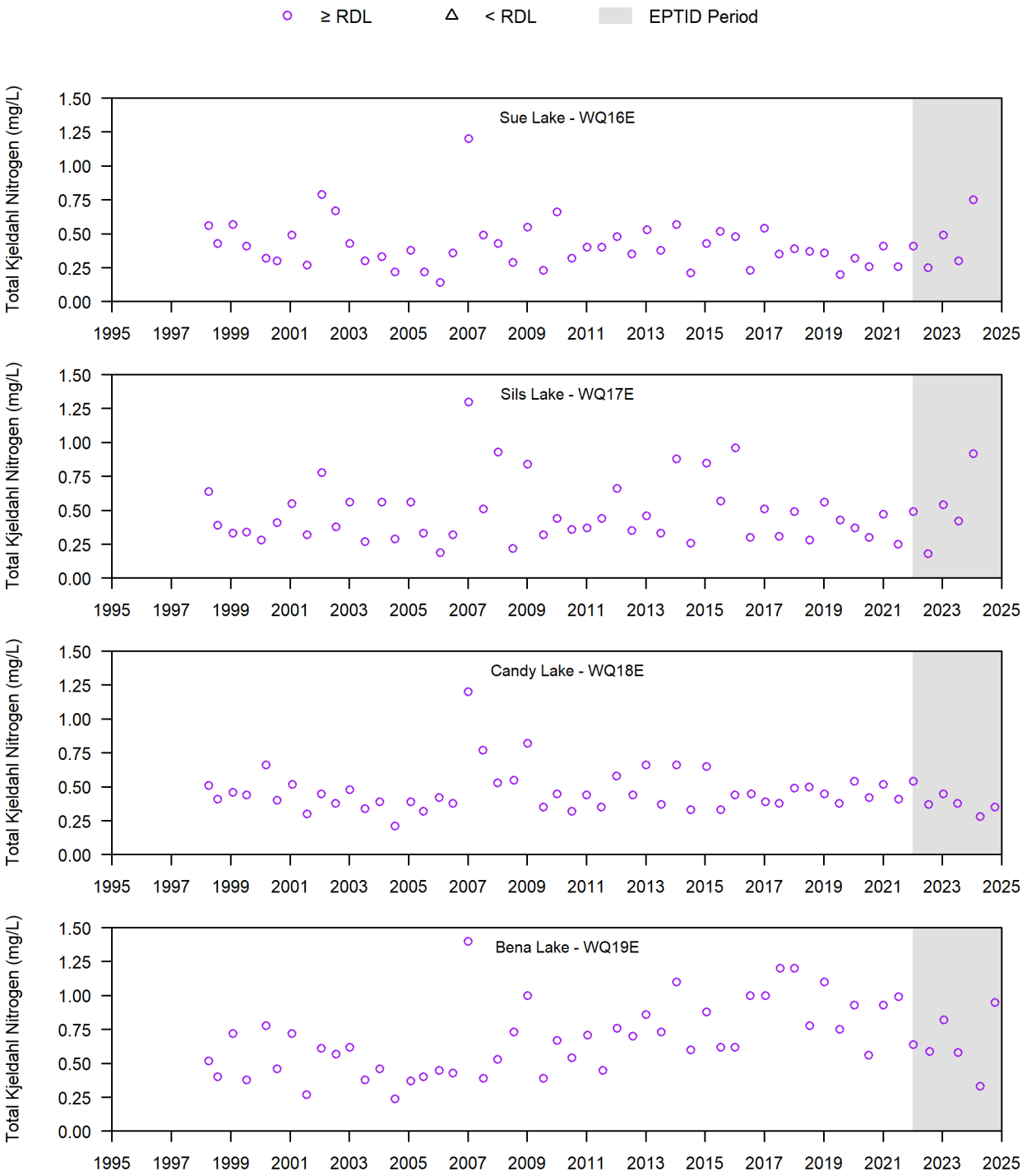


Figure 4.3-5 (8 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

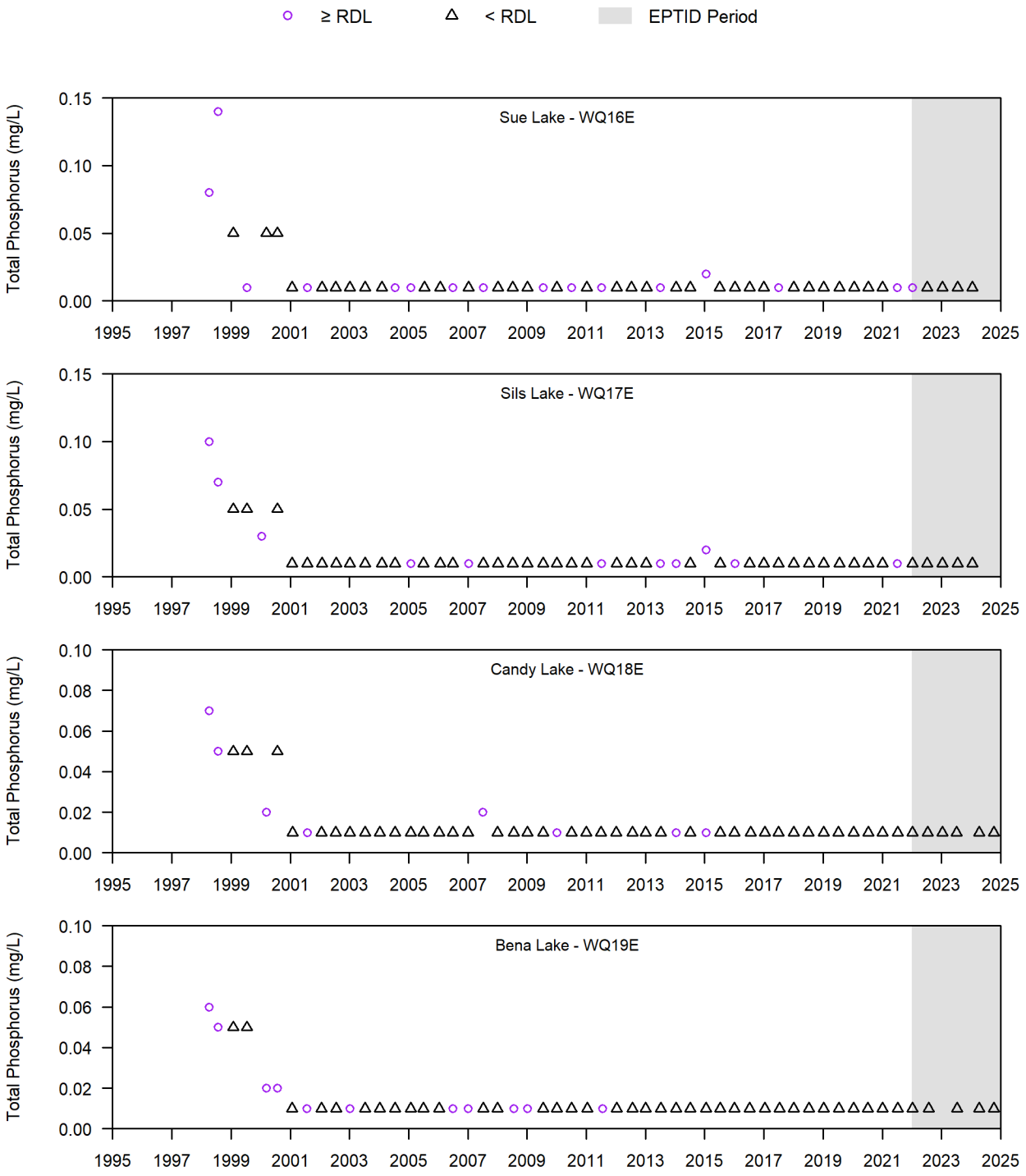


Figure 4.3-5 (9 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

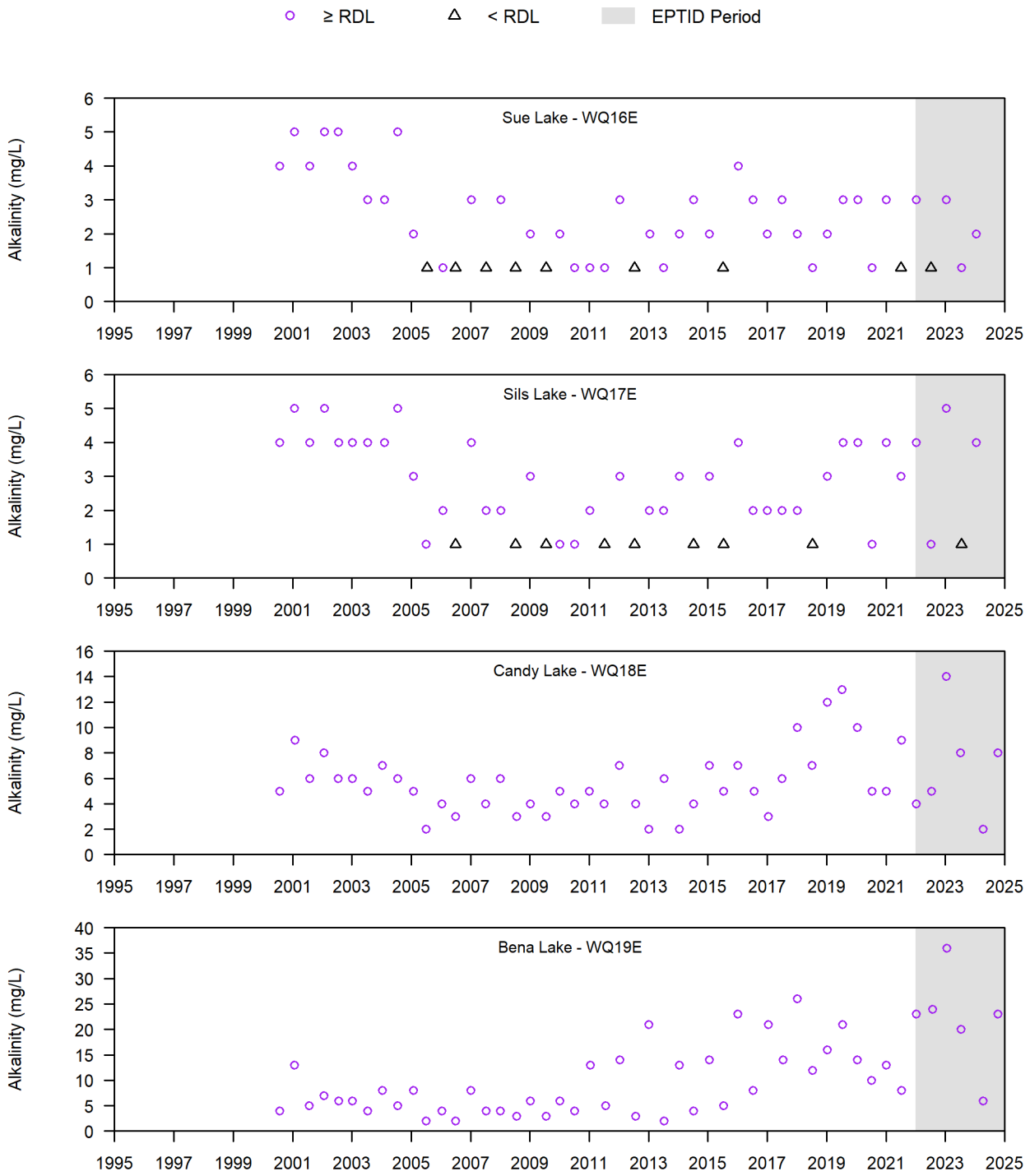


Figure 4.3-5 (10 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

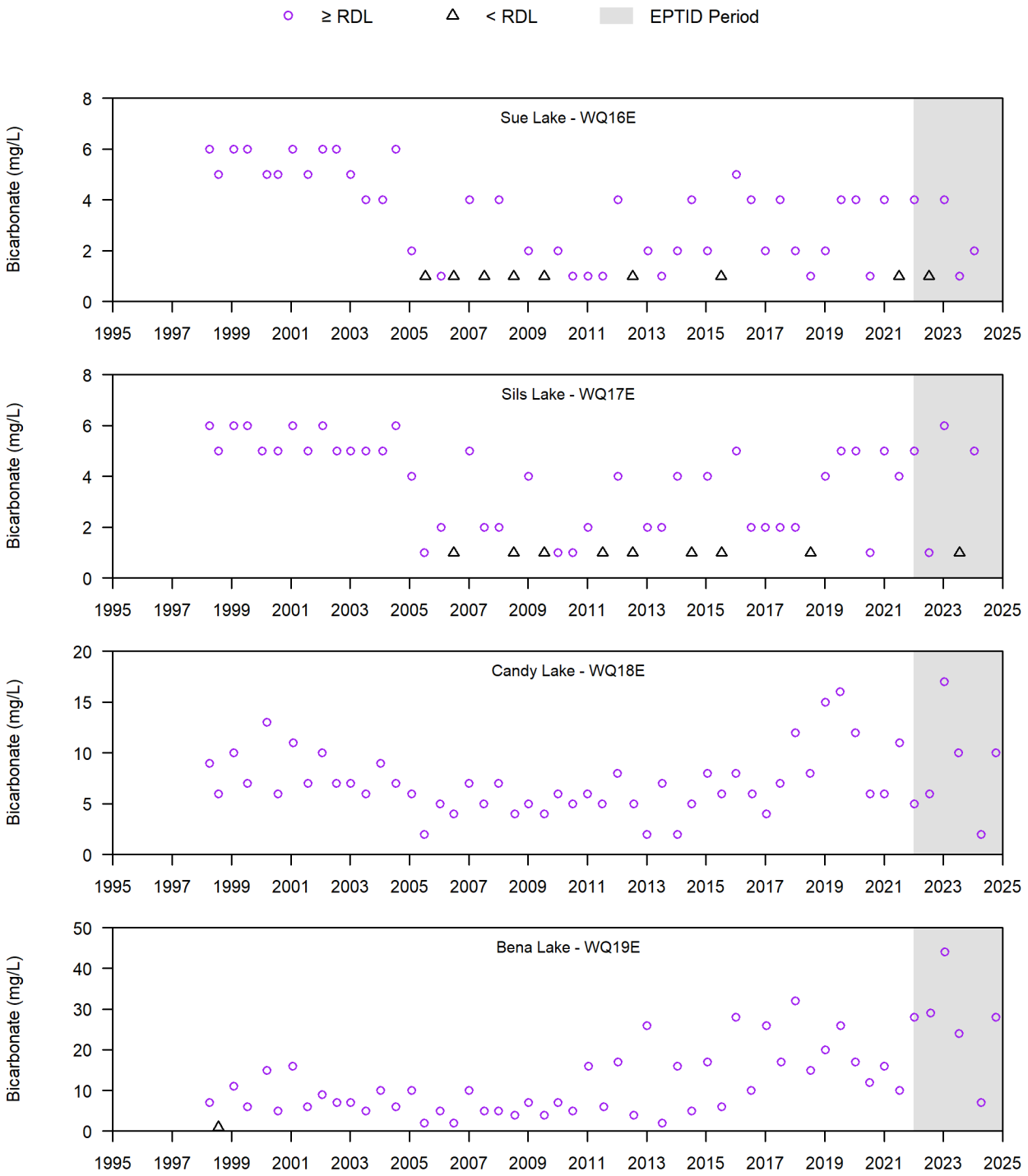


Figure 4.3-5 (11 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

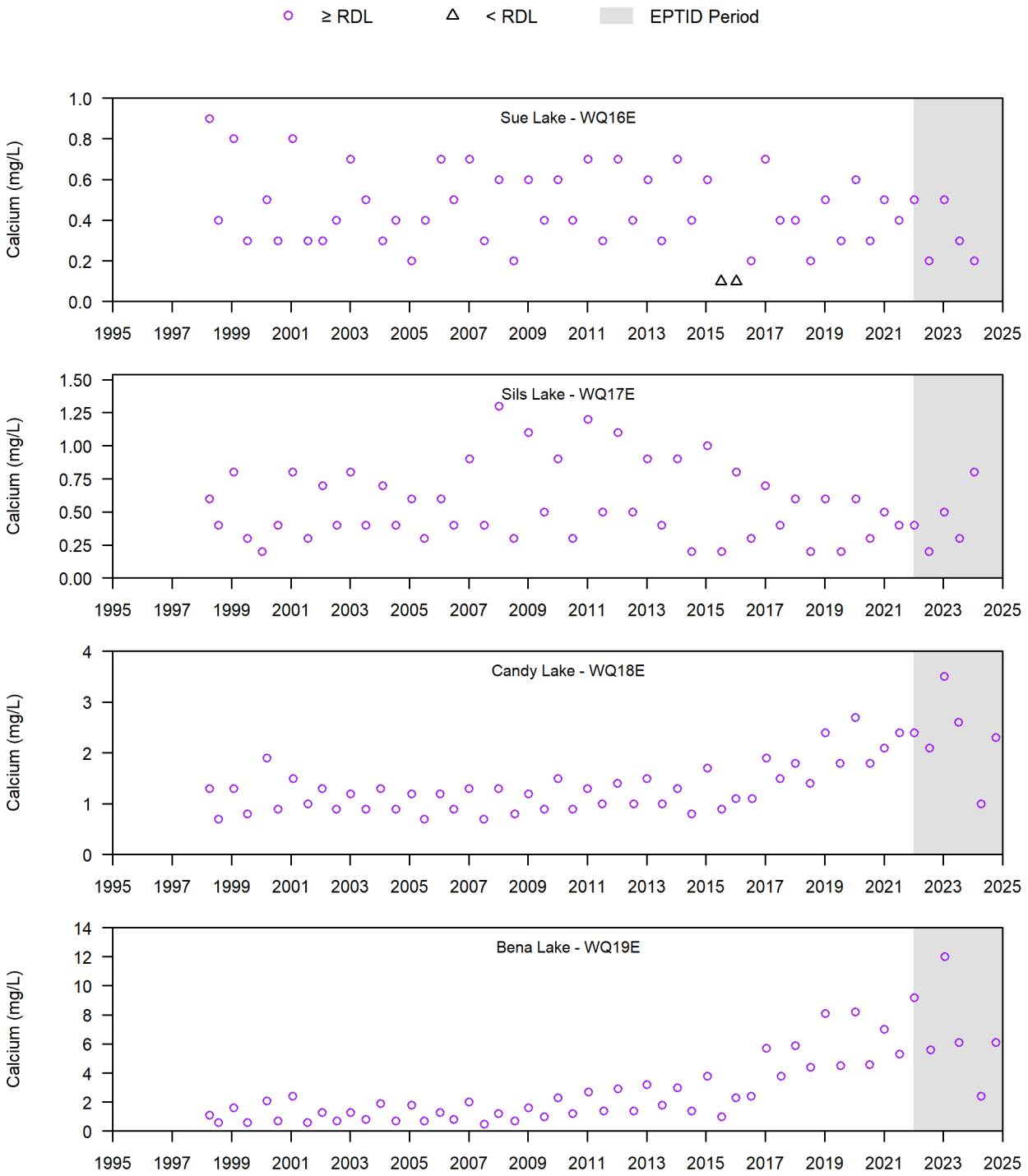


Figure 4.3-5 (12 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

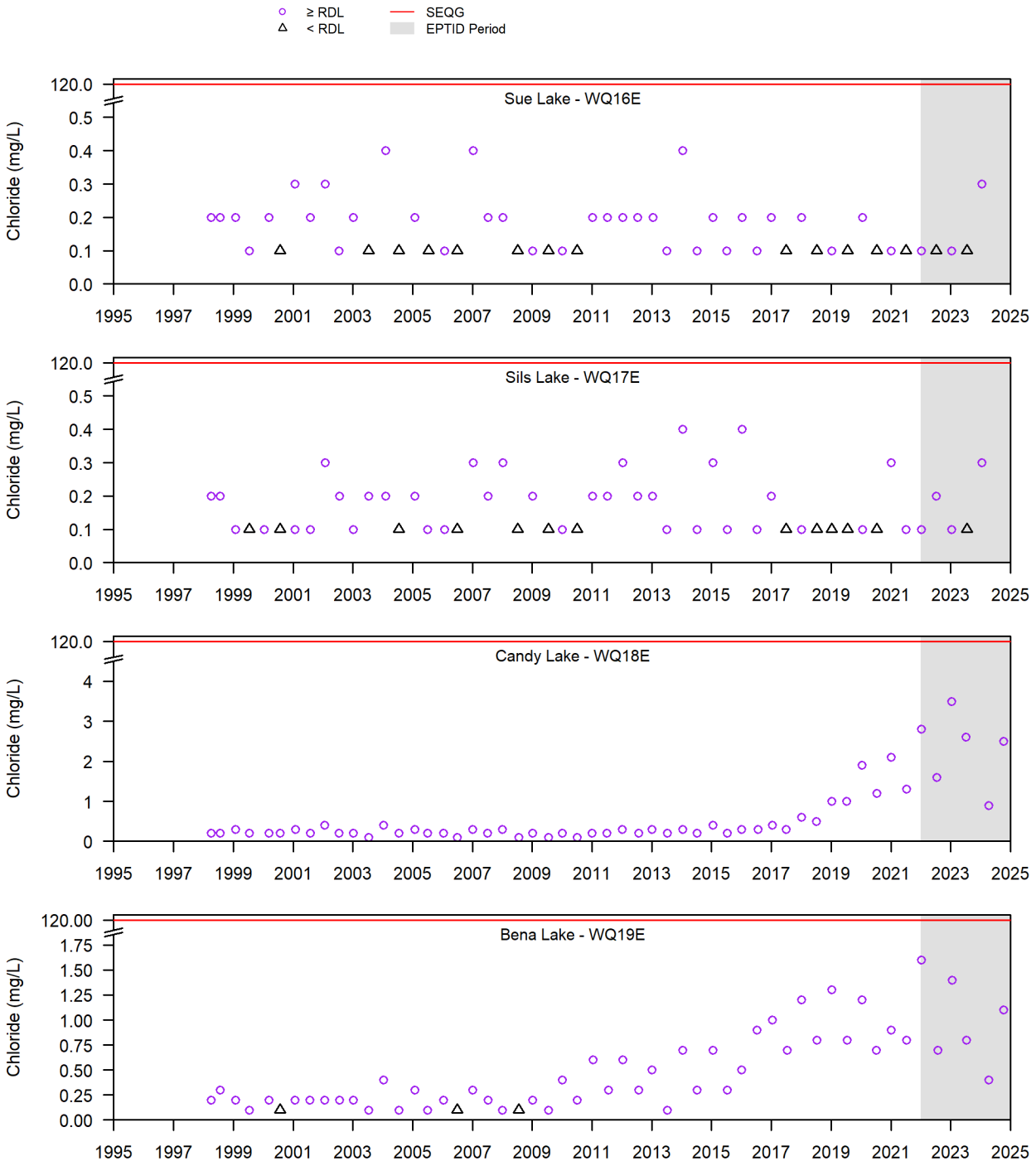


Figure 4.3-5 (13 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

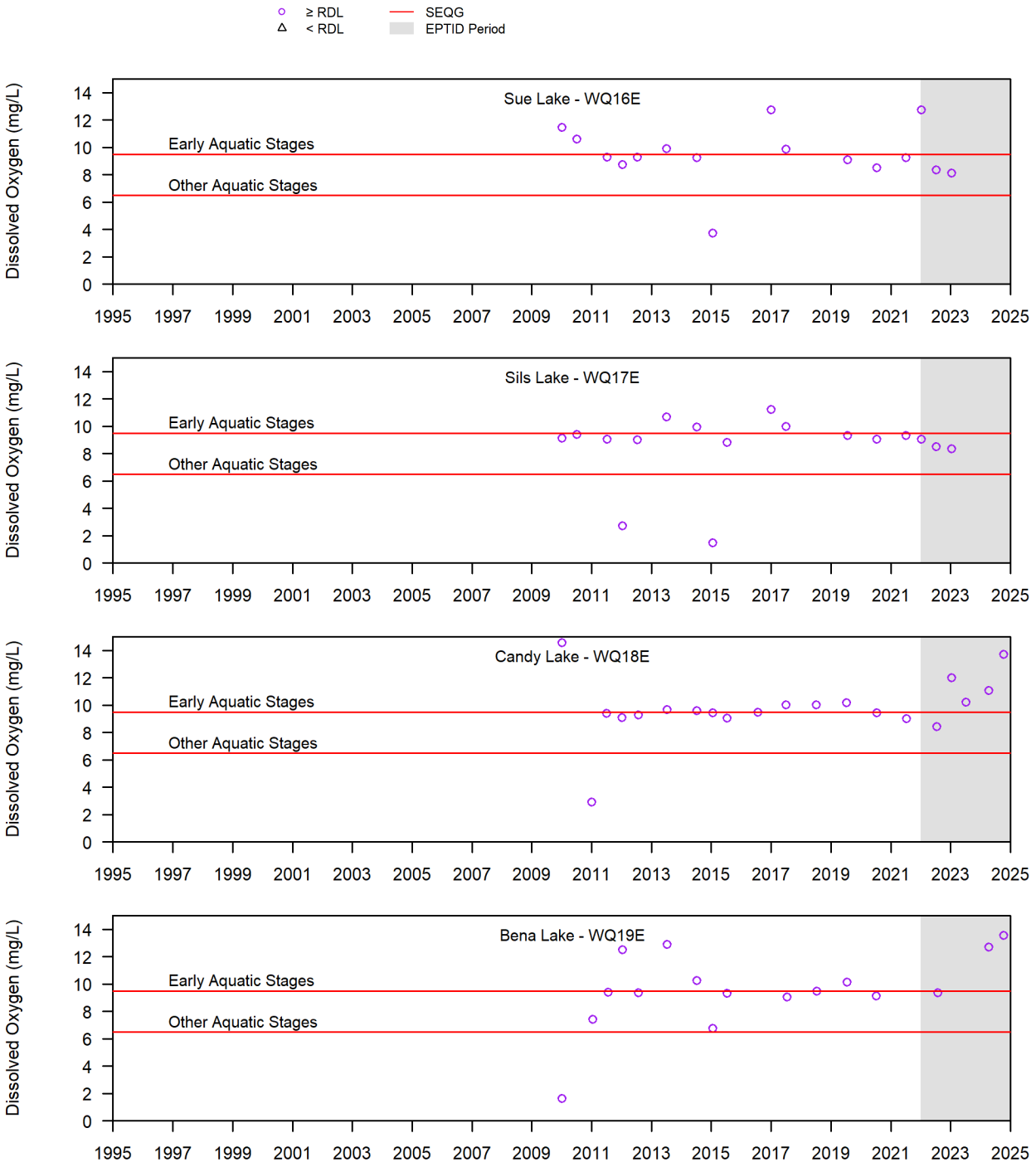


Figure 4.3-5 (14 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

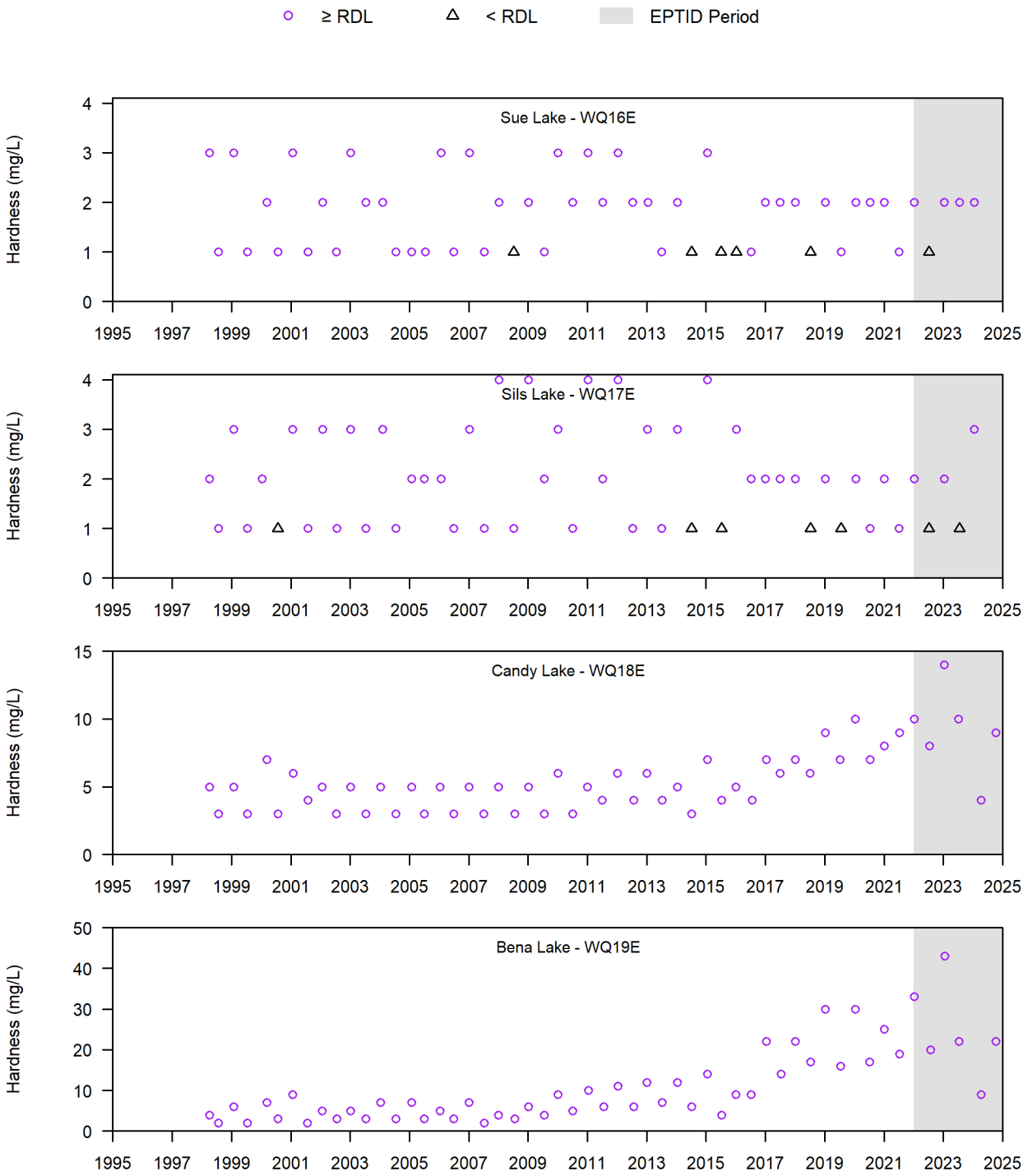


Figure 4.3-5 (15 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

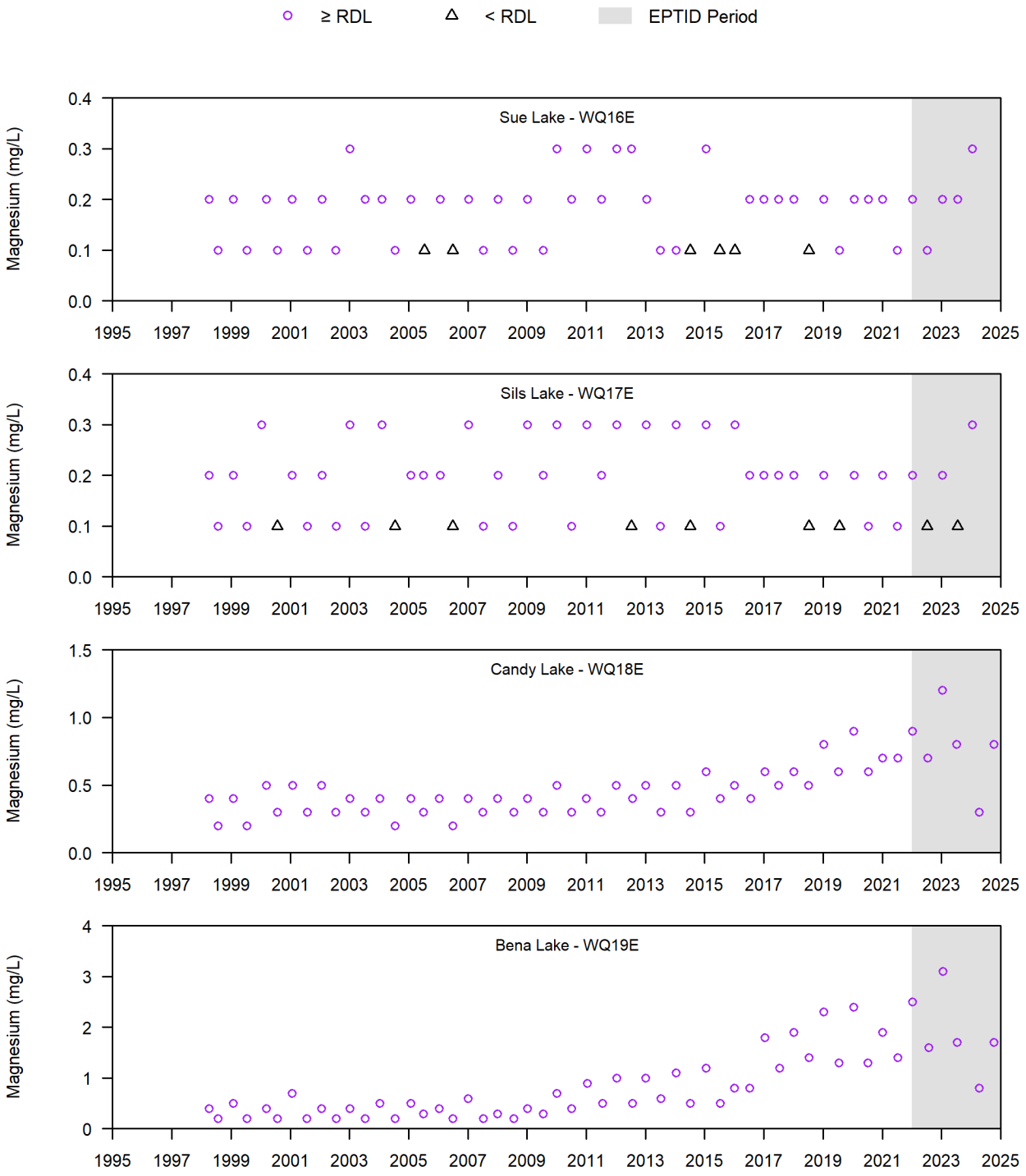


Figure 4.3-5 (16 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

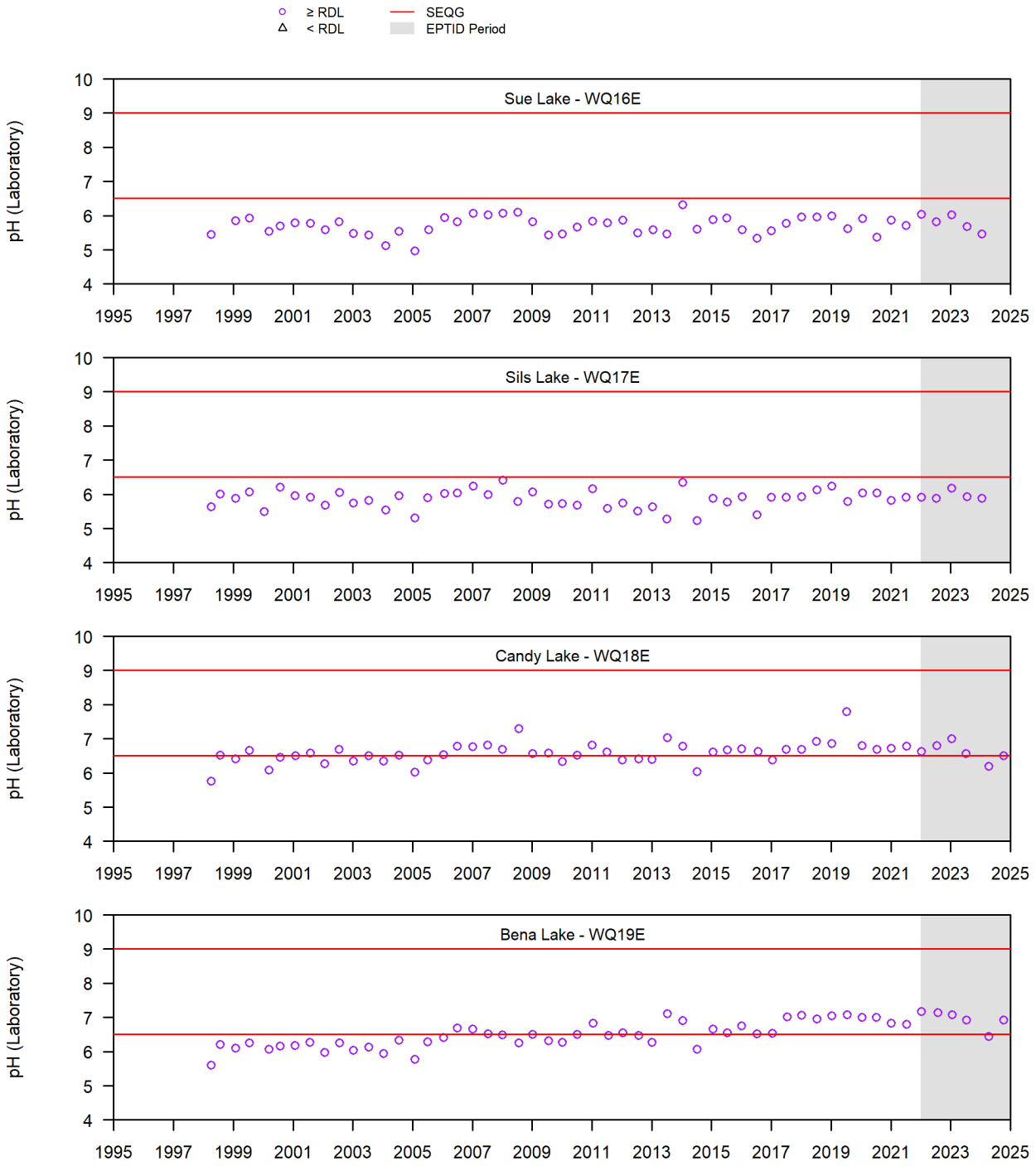


Figure 4.3-5 (17 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

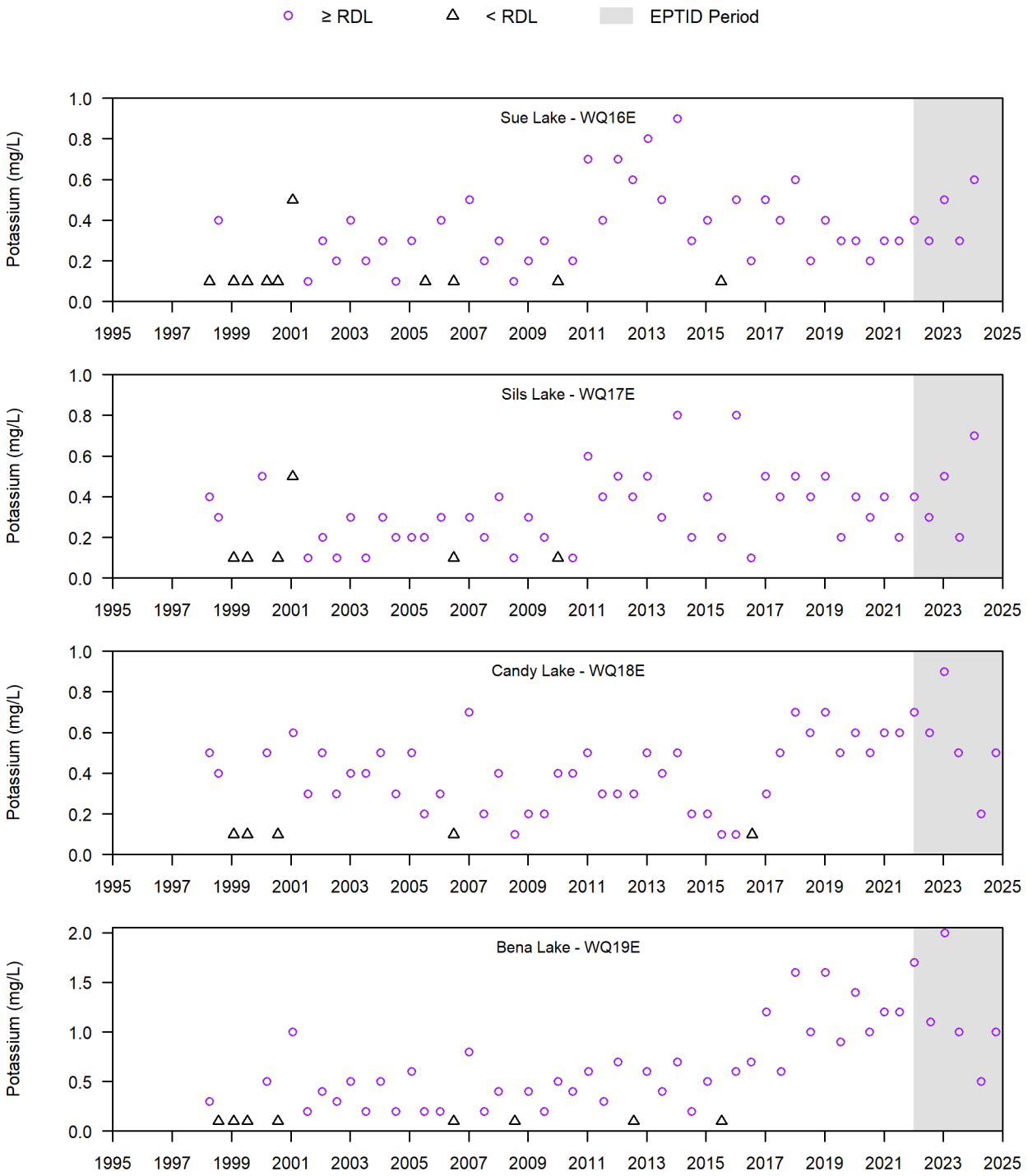


Figure 4.3-5 (18 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

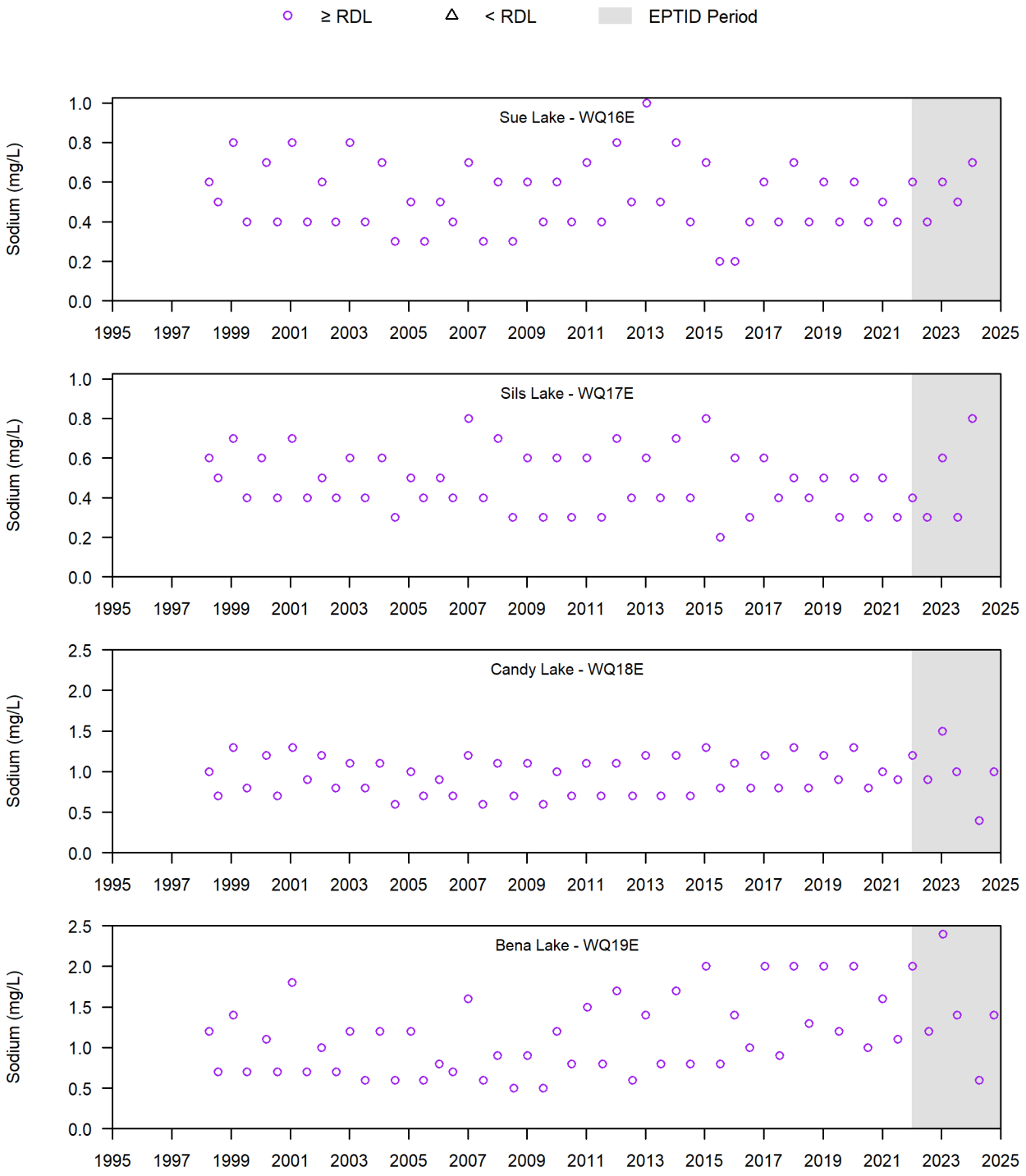


Figure 4.3-5 (19 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

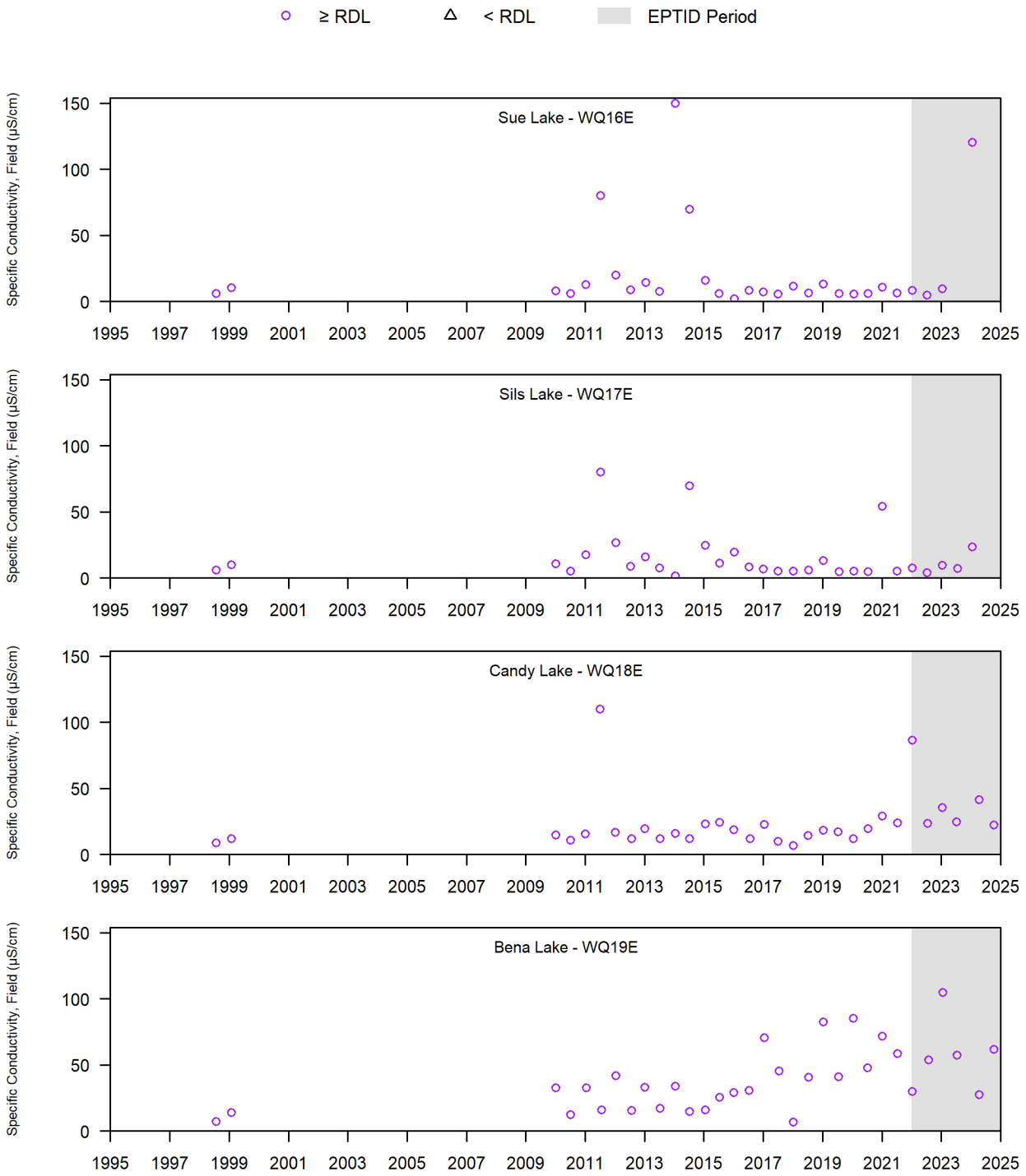


Figure 4.3-5 (20 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

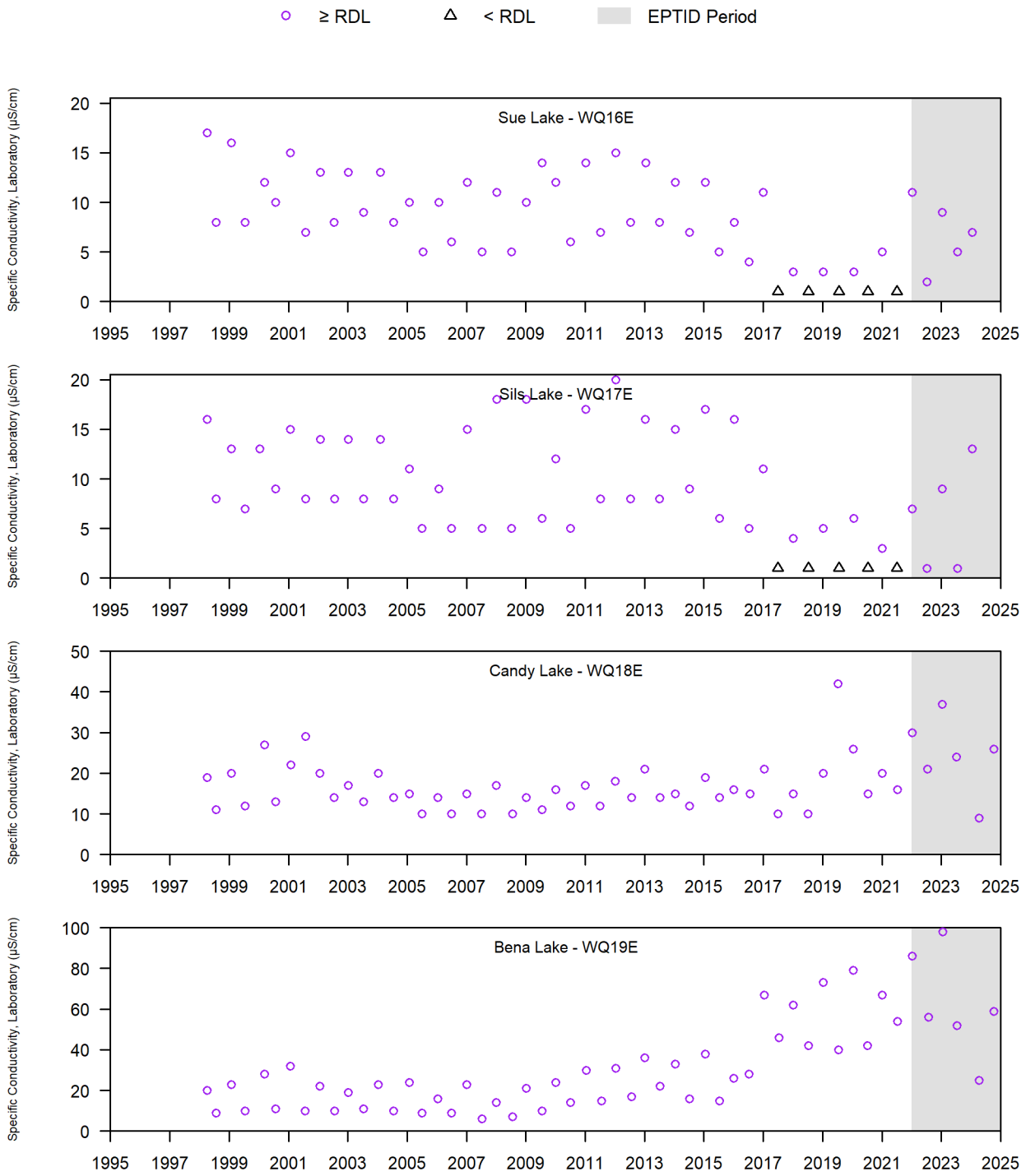


Figure 4.3-5 (21 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

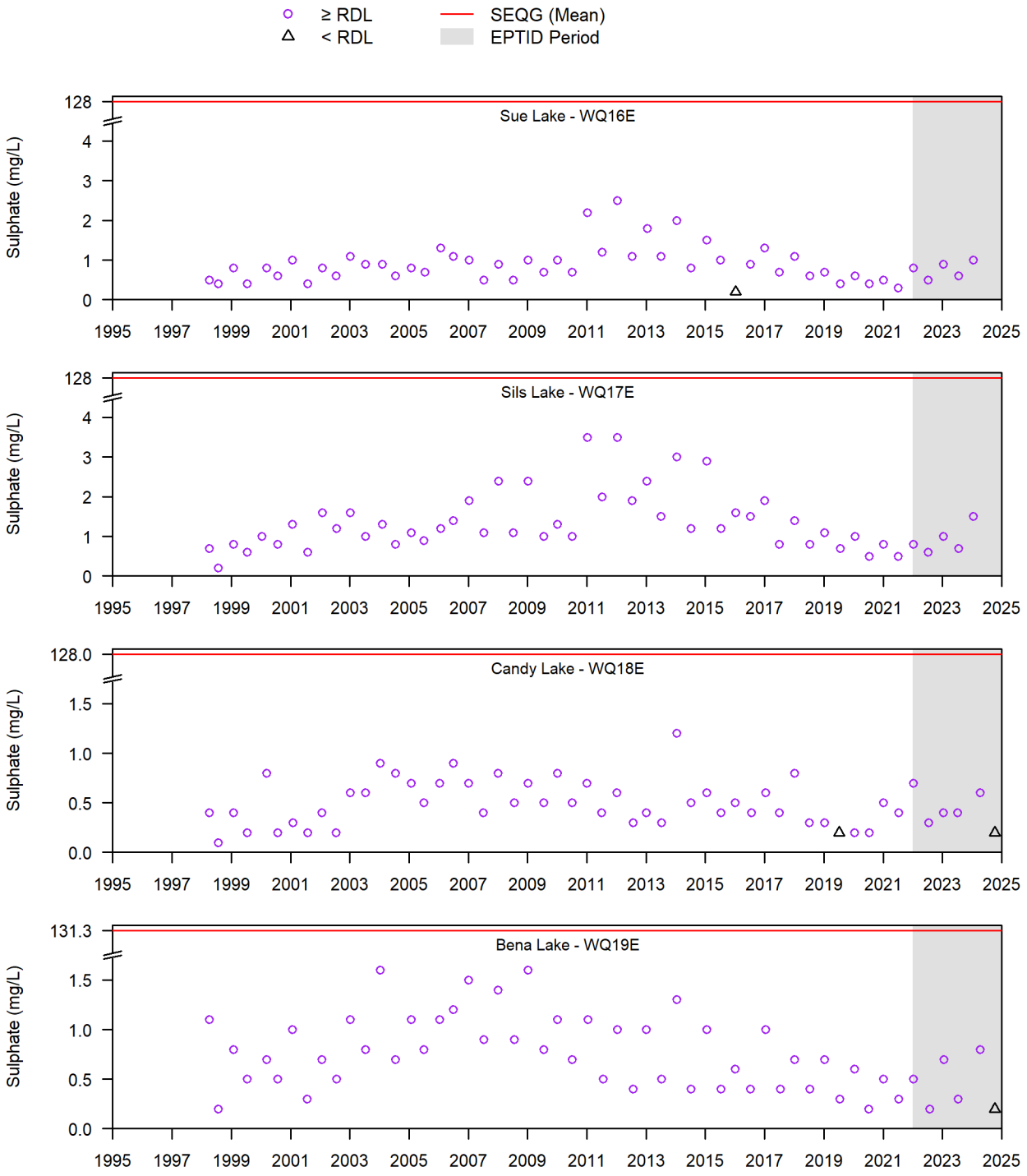


Figure 4.3-5 (22 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

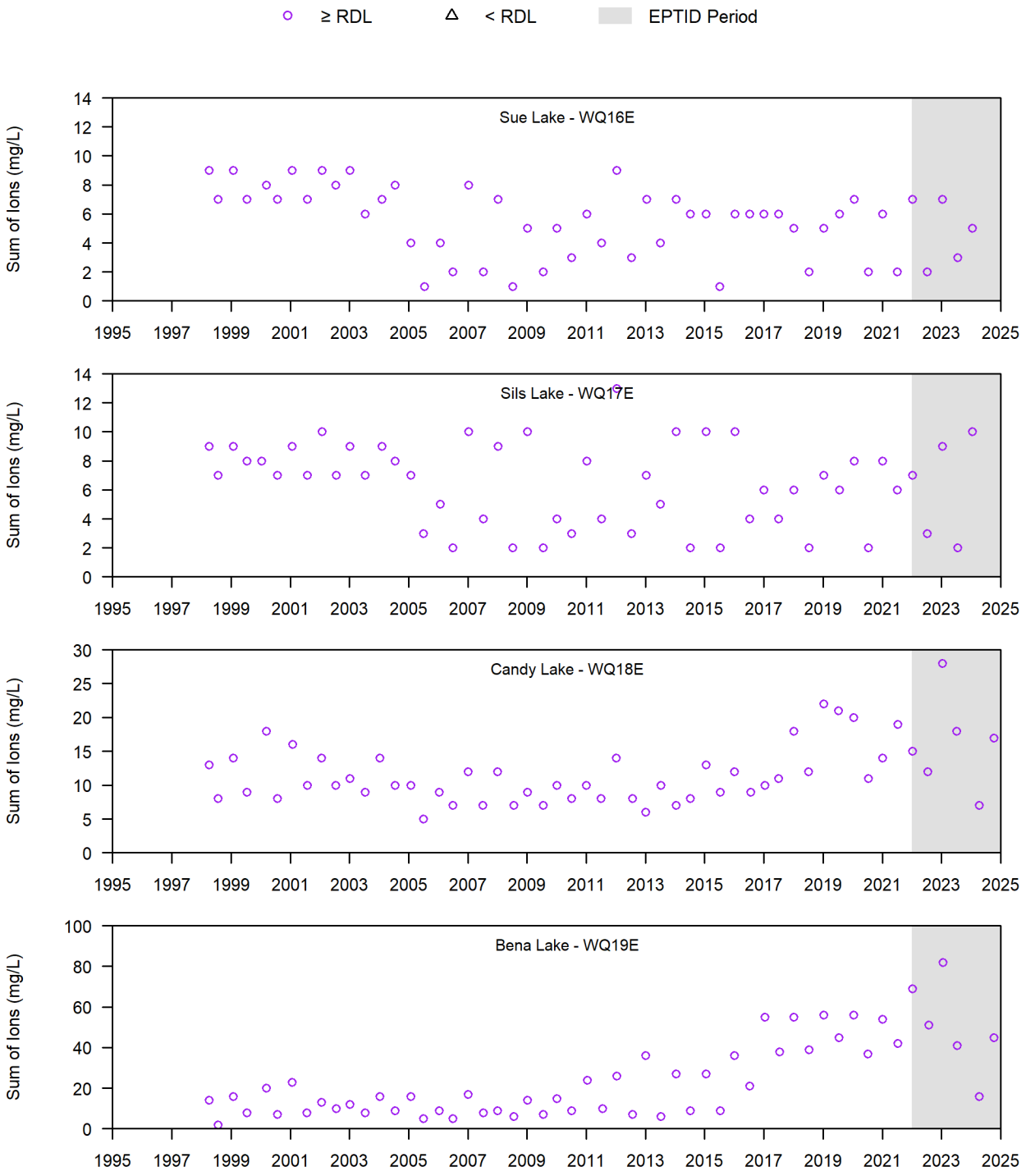


Figure 4.3-5 (23 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

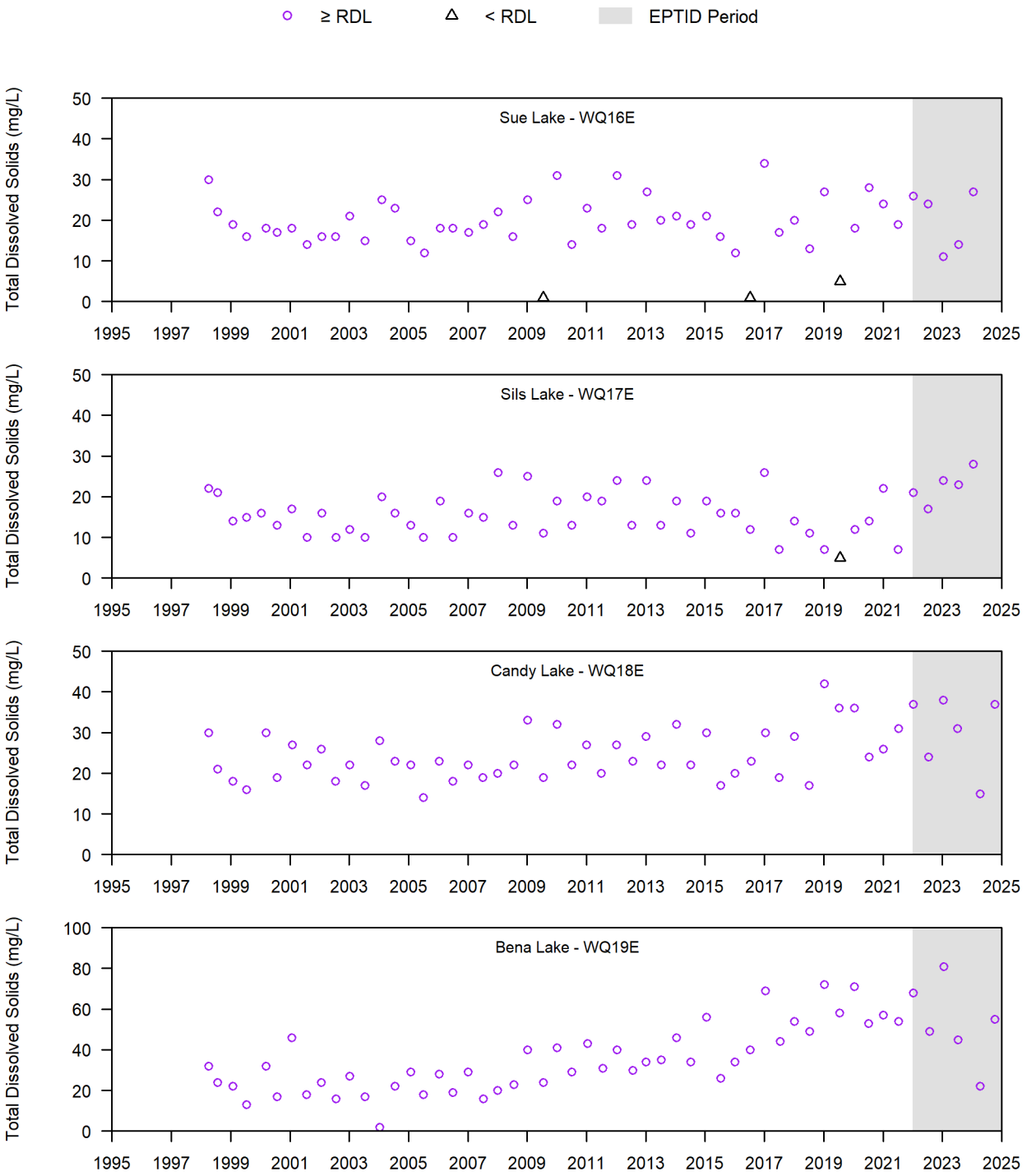


Figure 4.3-5 (24 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

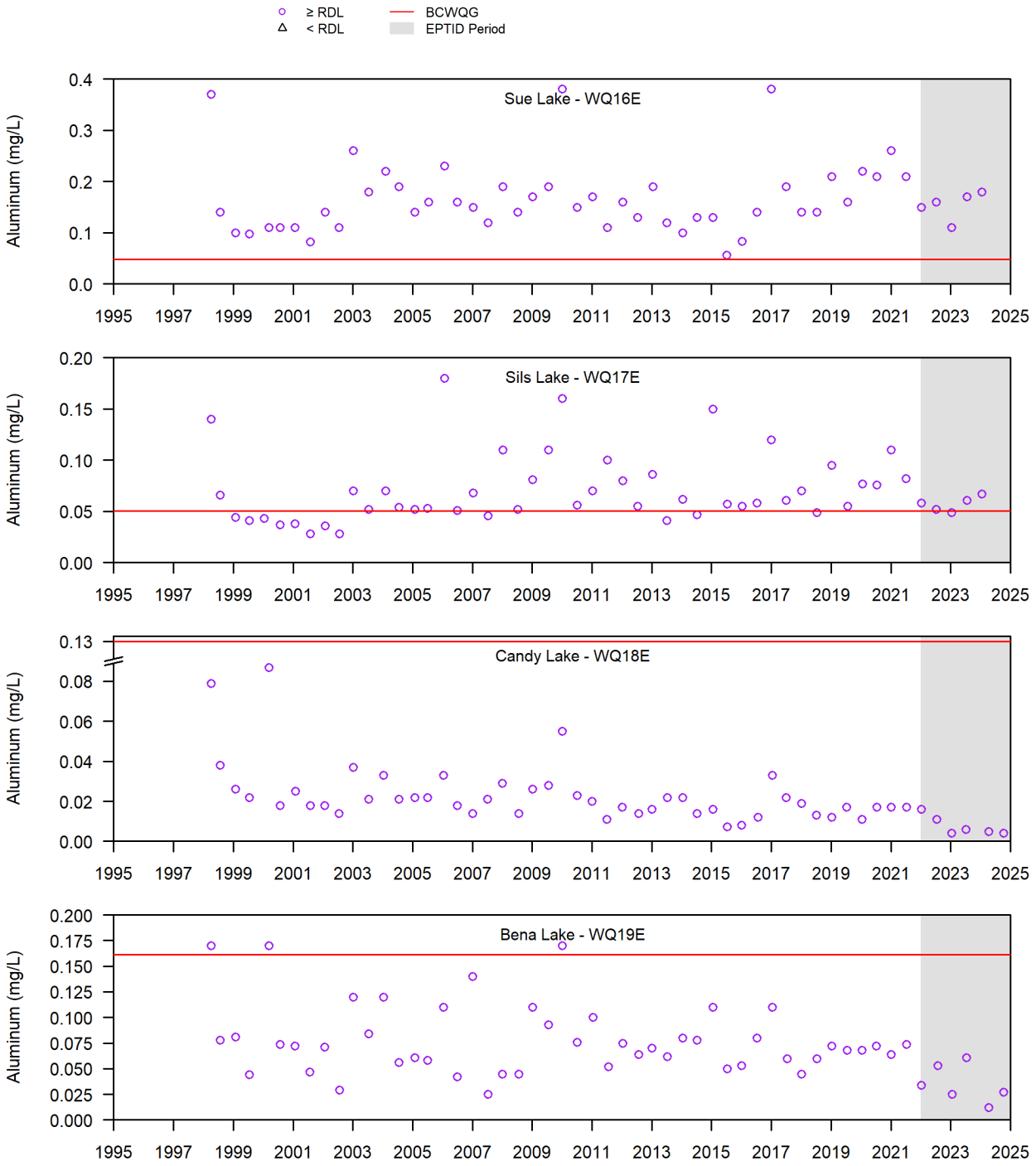


Figure 4.3-5 (25 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

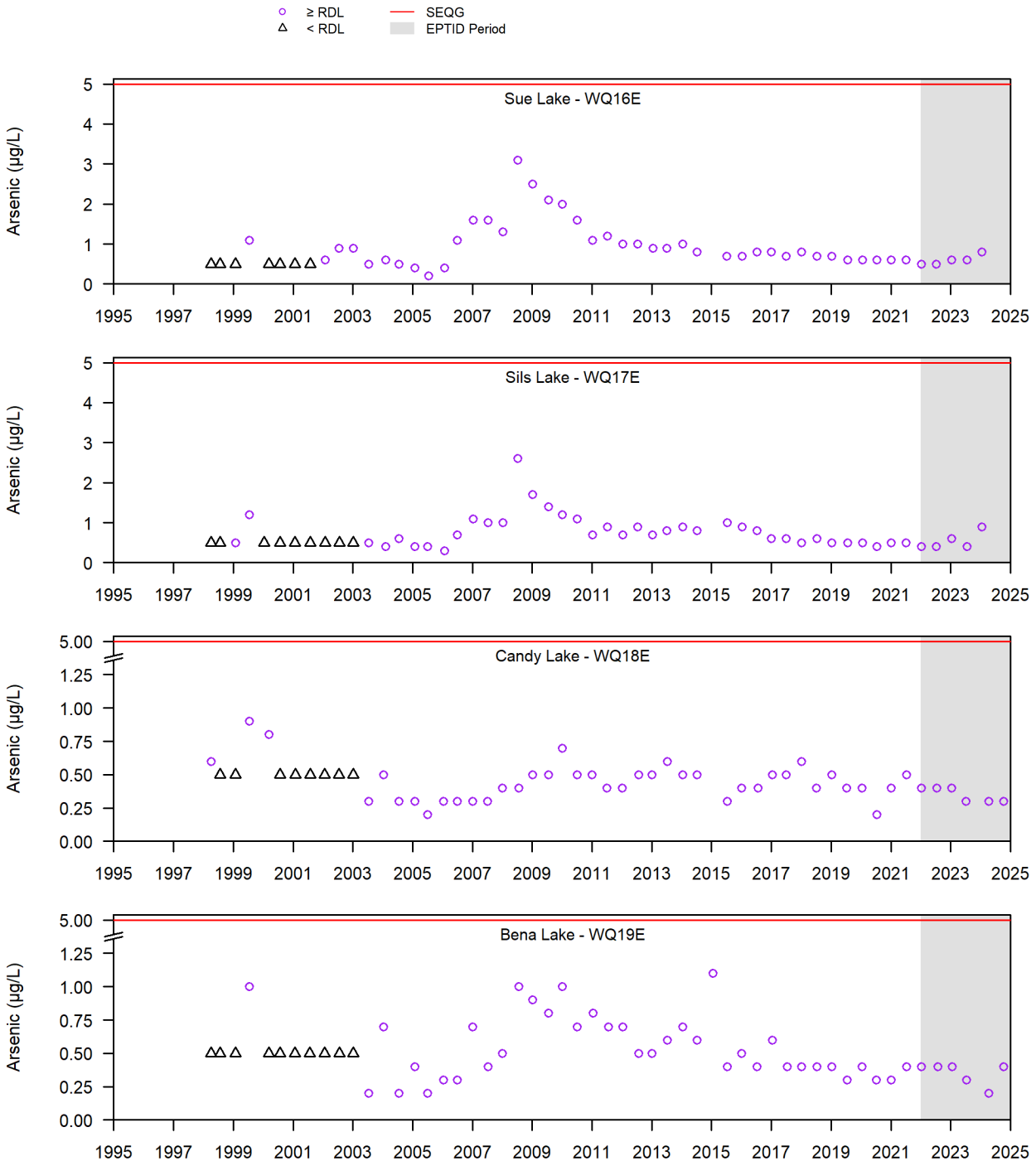


Figure 4.3-5 (26 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

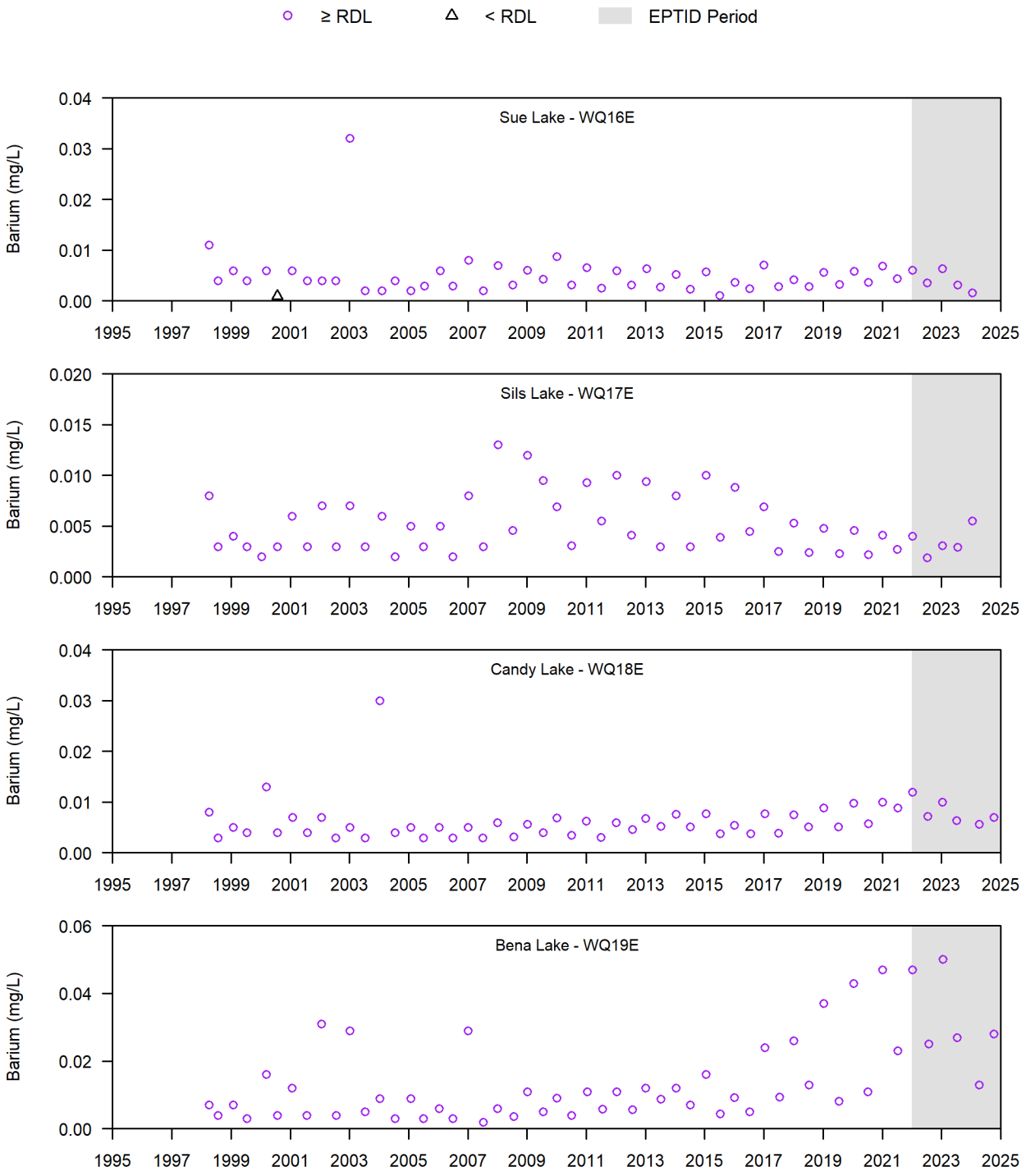


Figure 4.3-5 (27 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

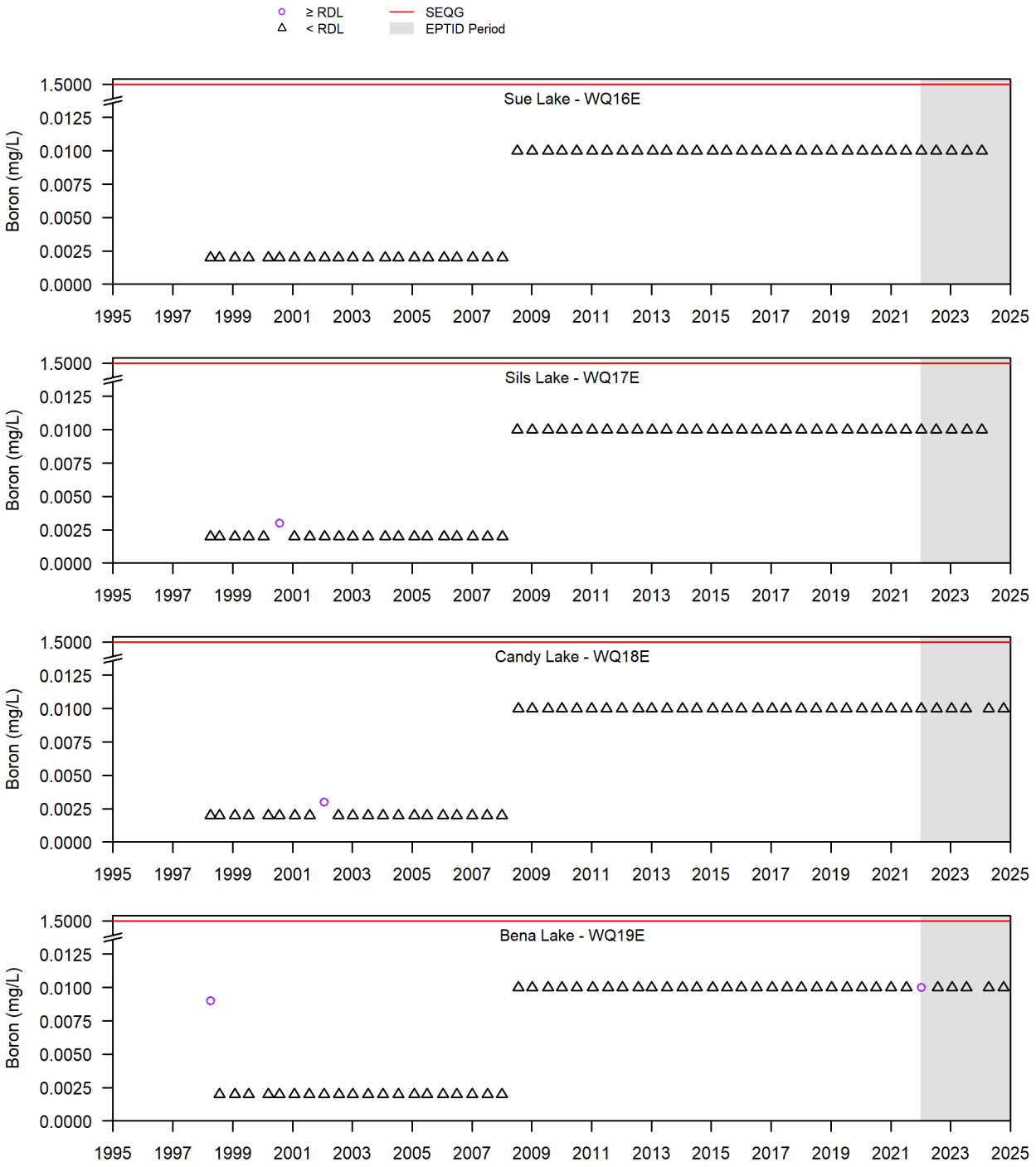


Figure 4.3-5 (28 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

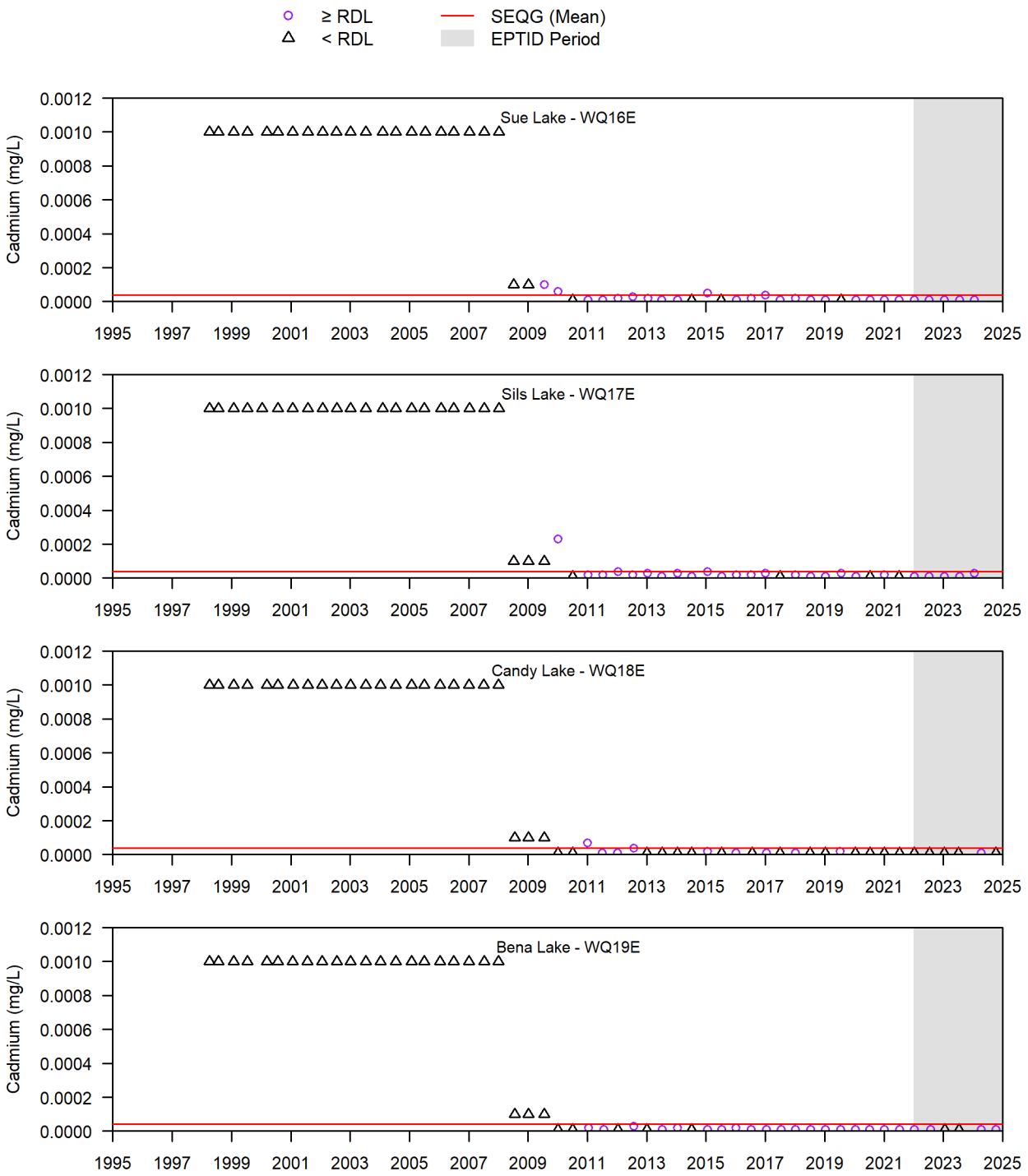


Figure 4.3-5 (29 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

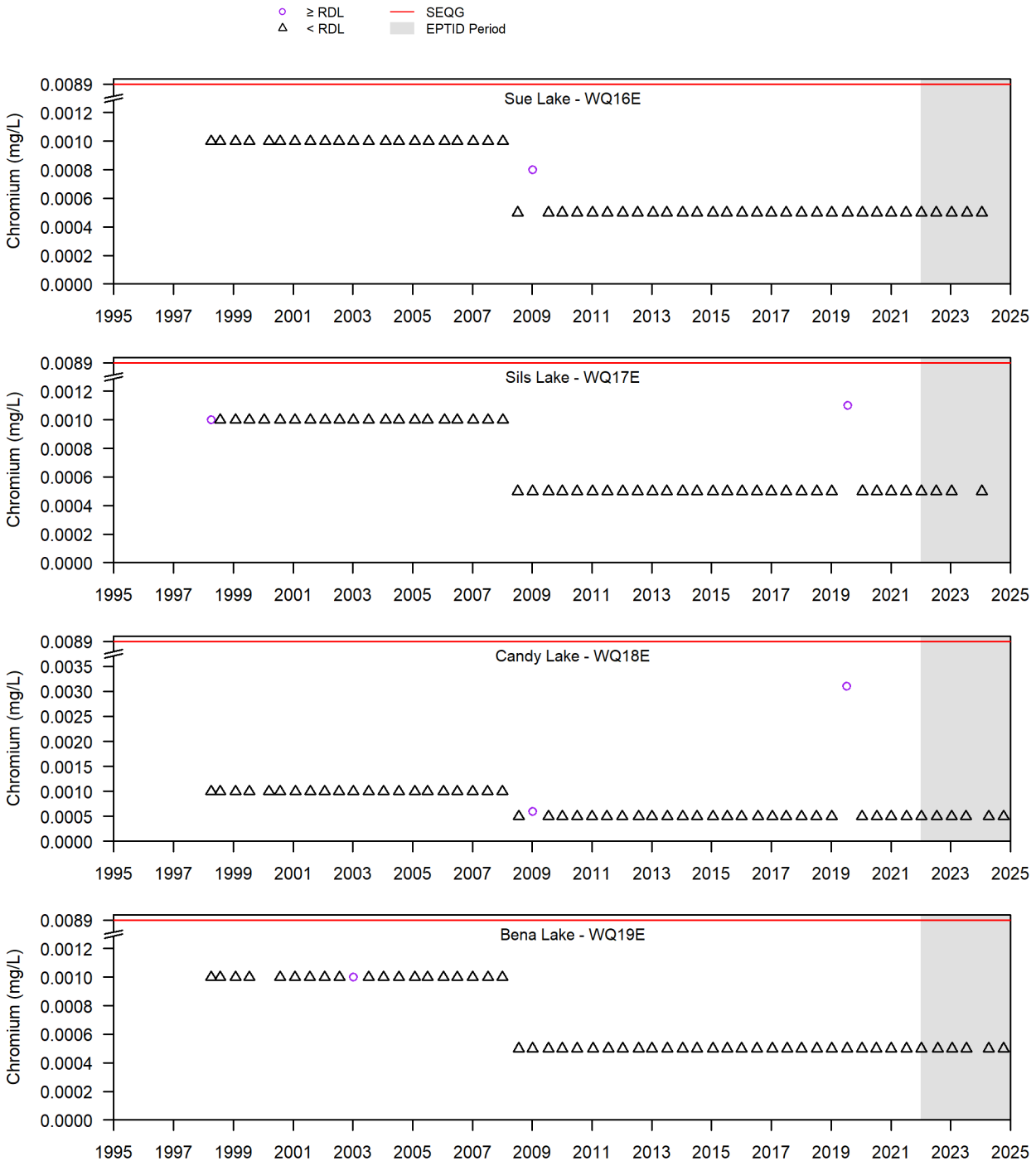


Figure 4.3-5 (30 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

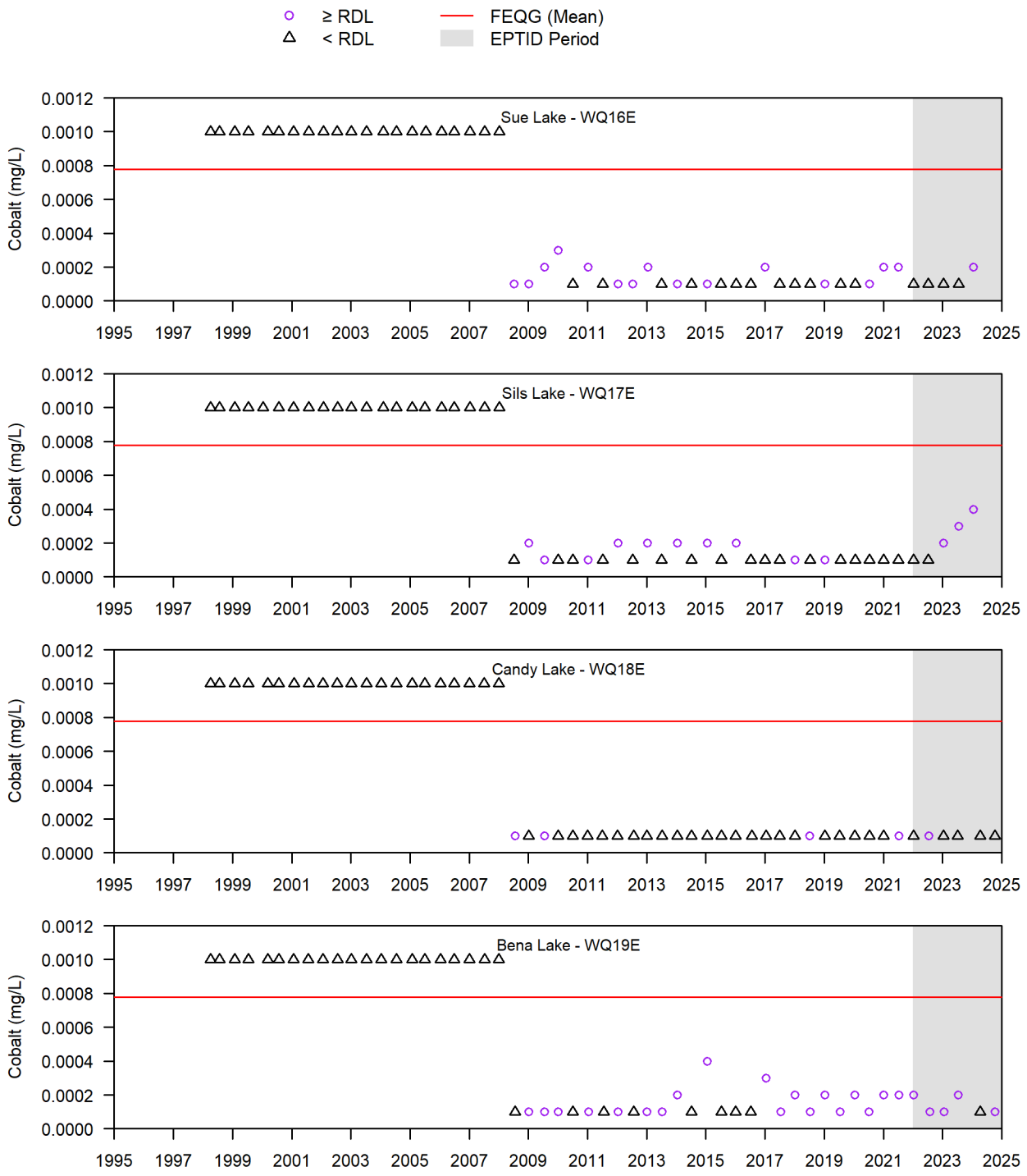


Figure 4.3-5 (31 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

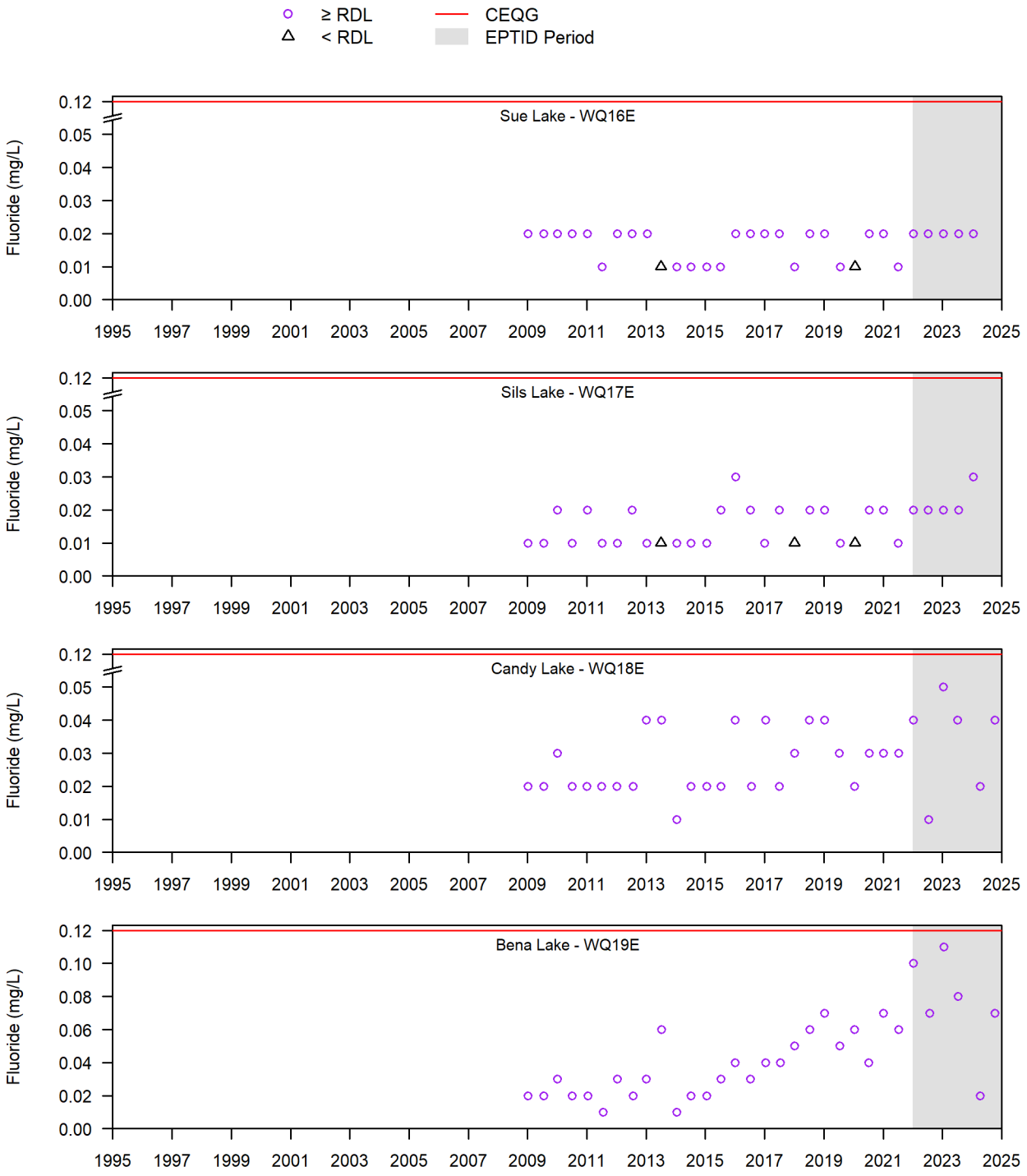


Figure 4.3-5 (32 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

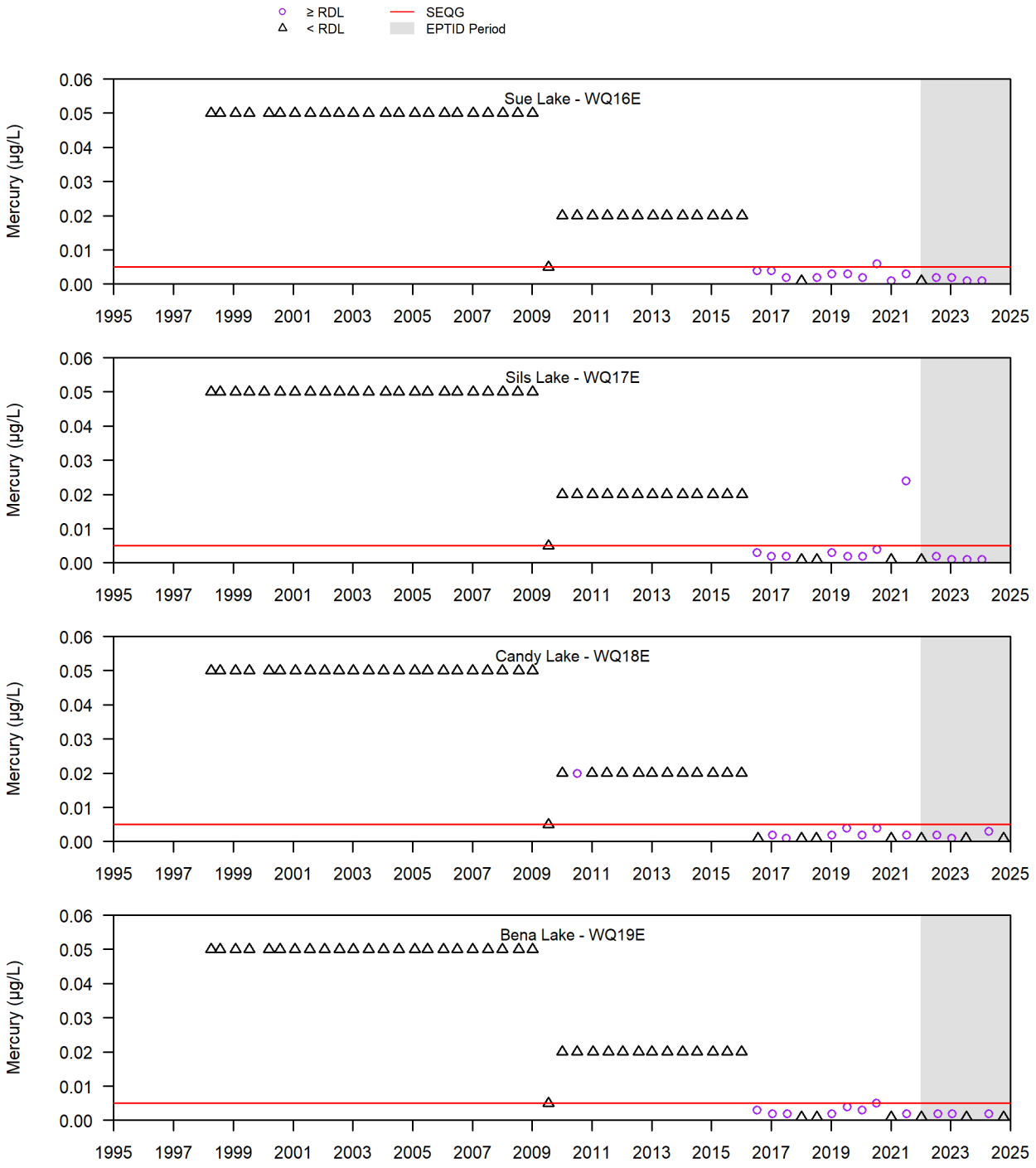


Figure 4.3-5 (33 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

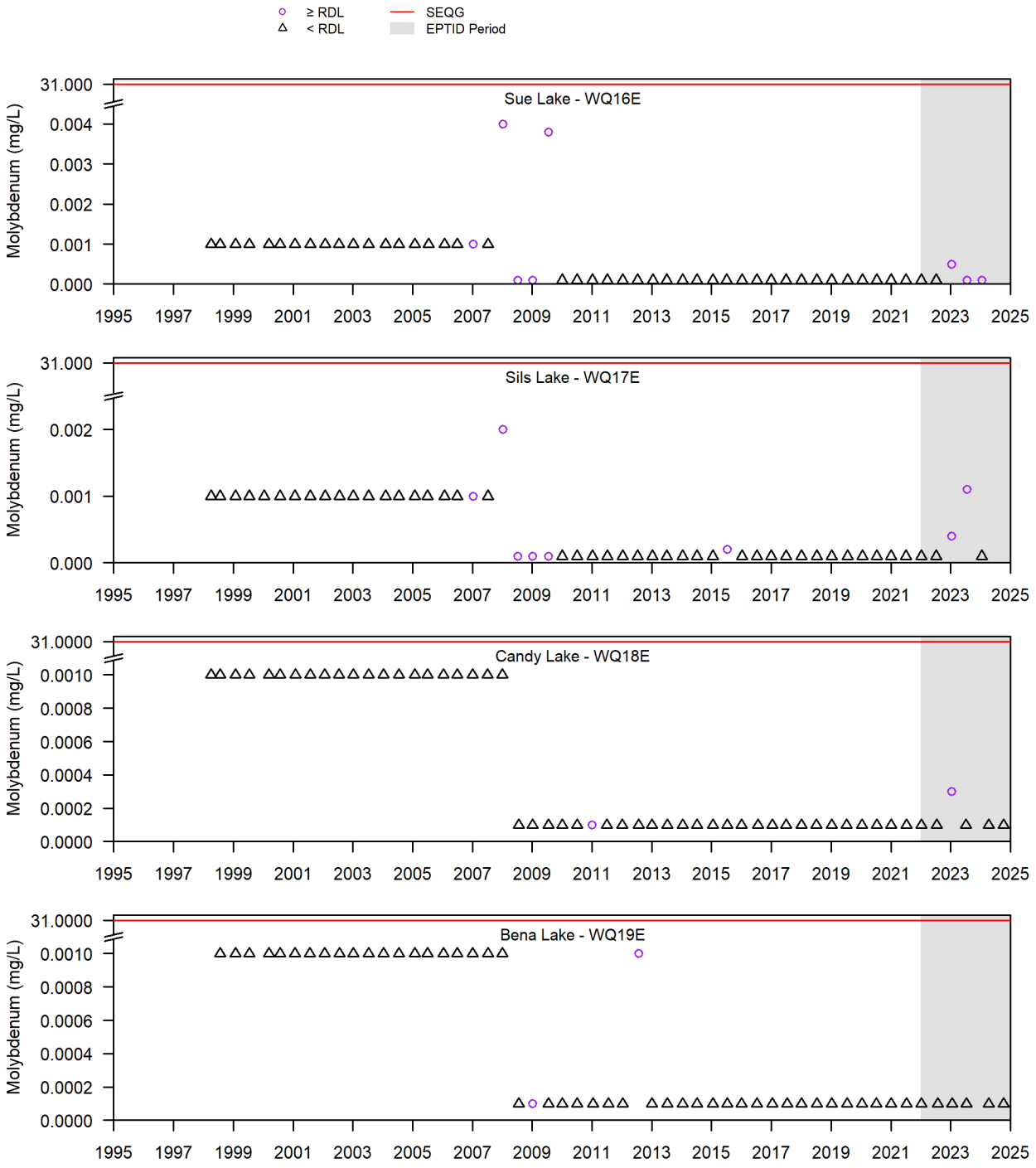


Figure 4.3-5 (34 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

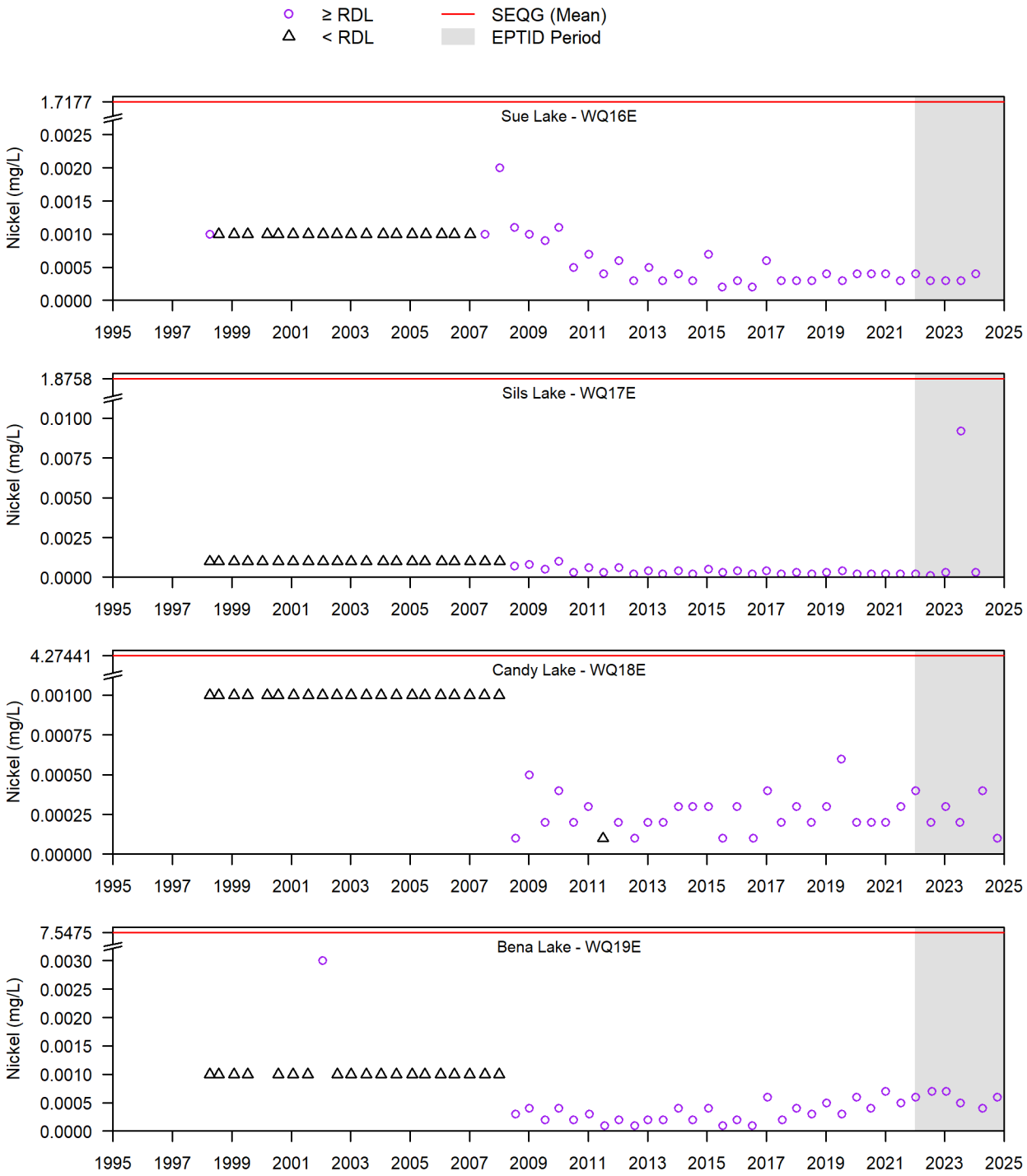


Figure 4.3-5 (35 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

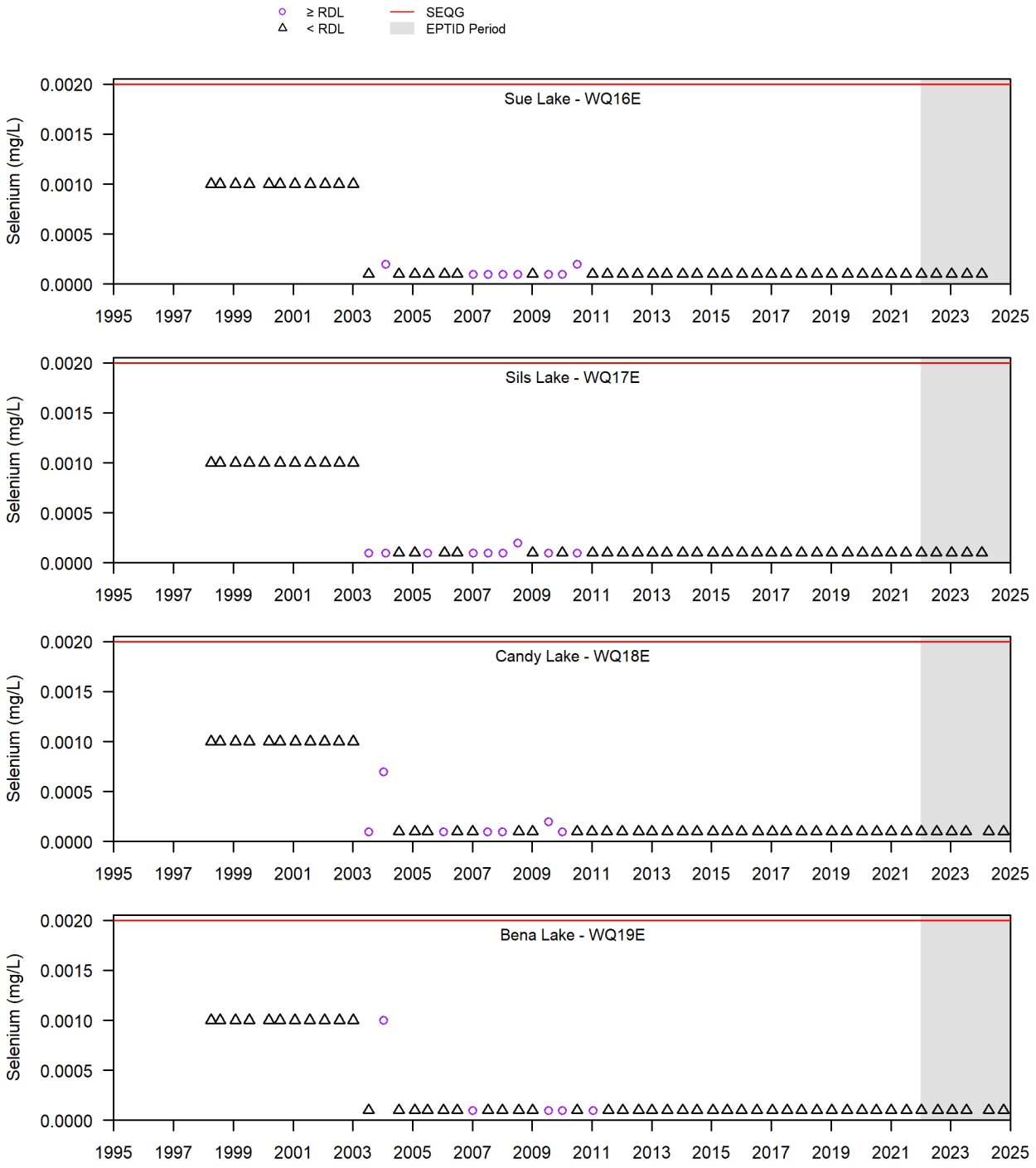


Figure 4.3-5 (36 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

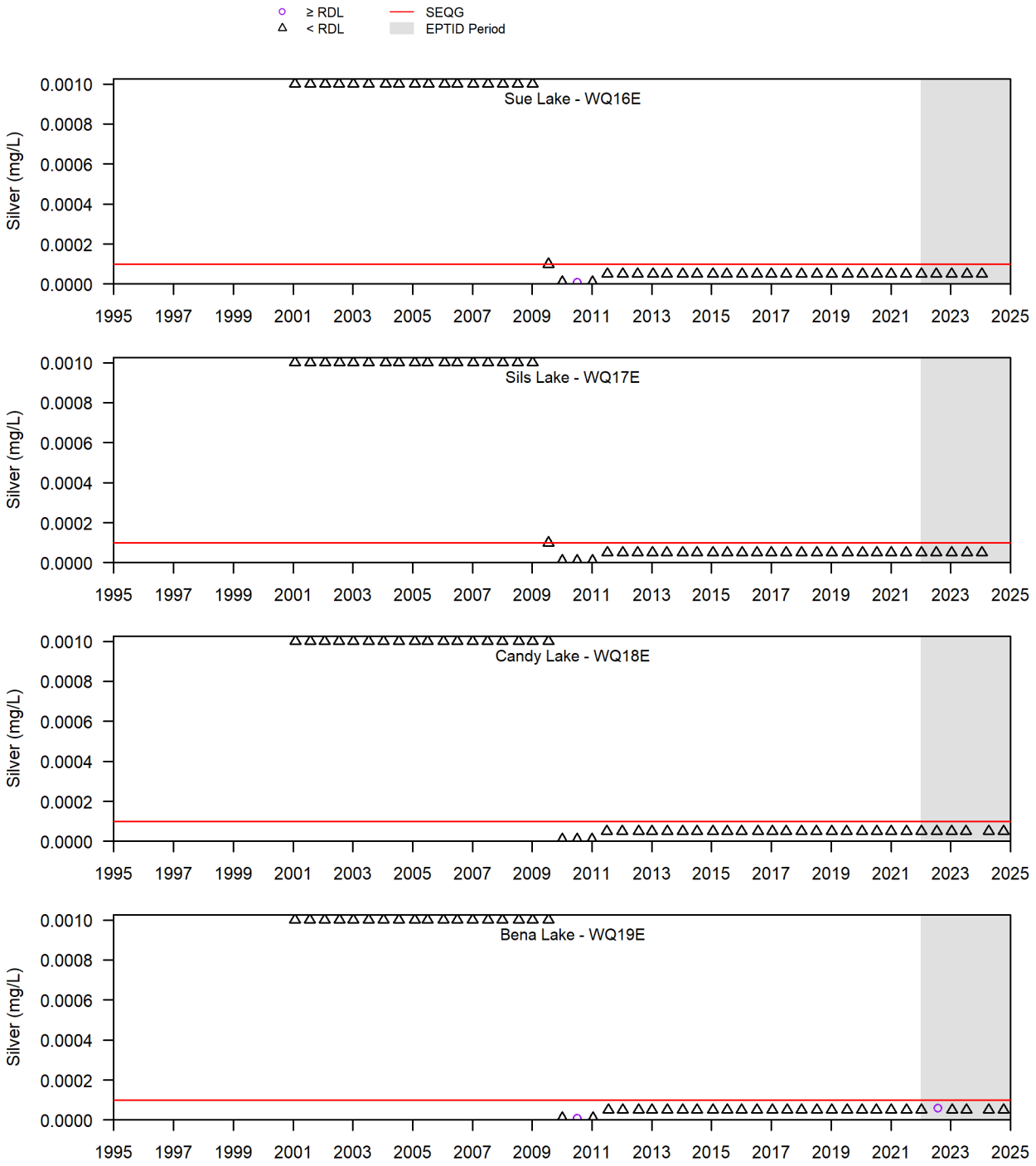


Figure 4.3-5 (37 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

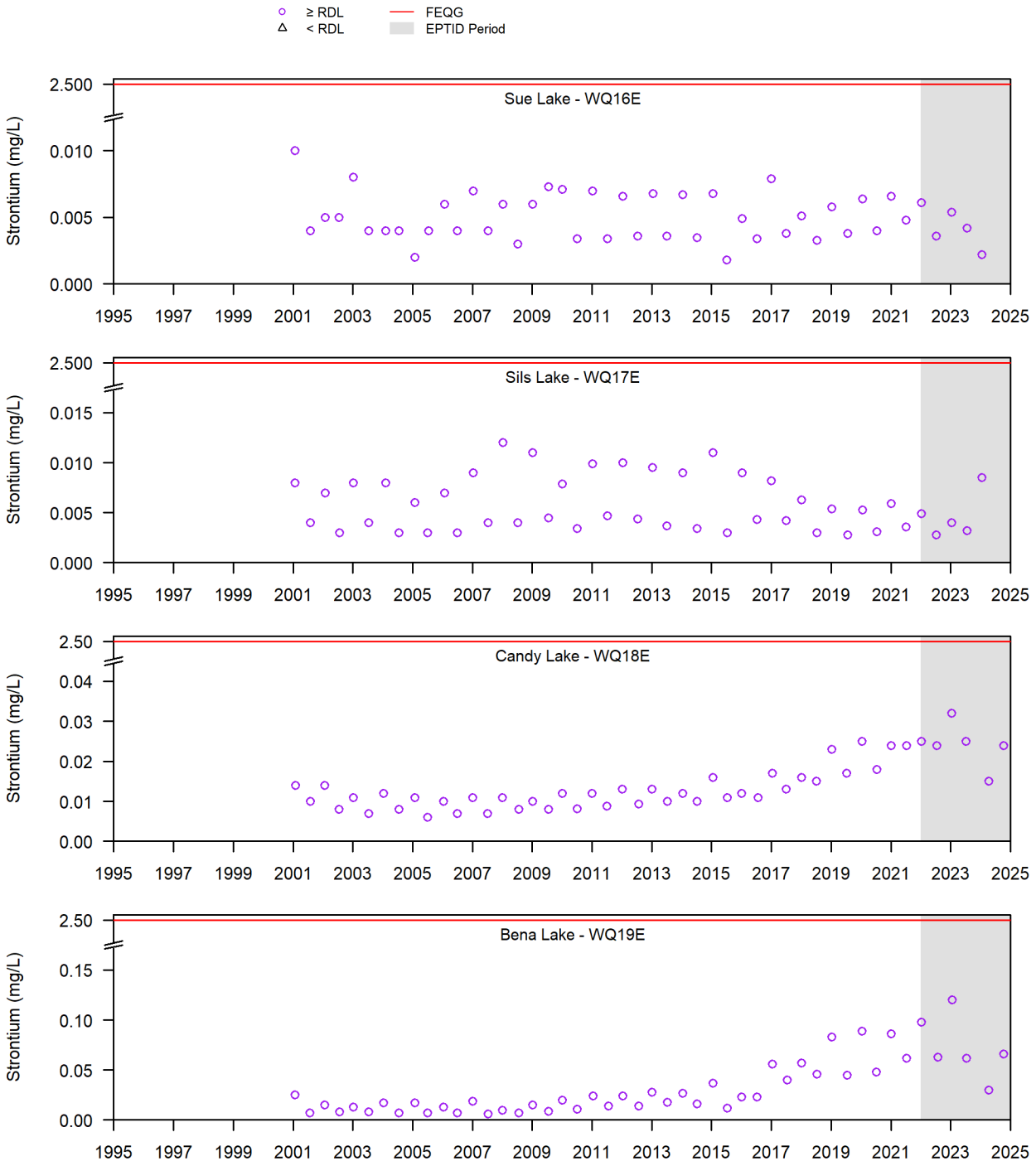


Figure 4.3-5 (38 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

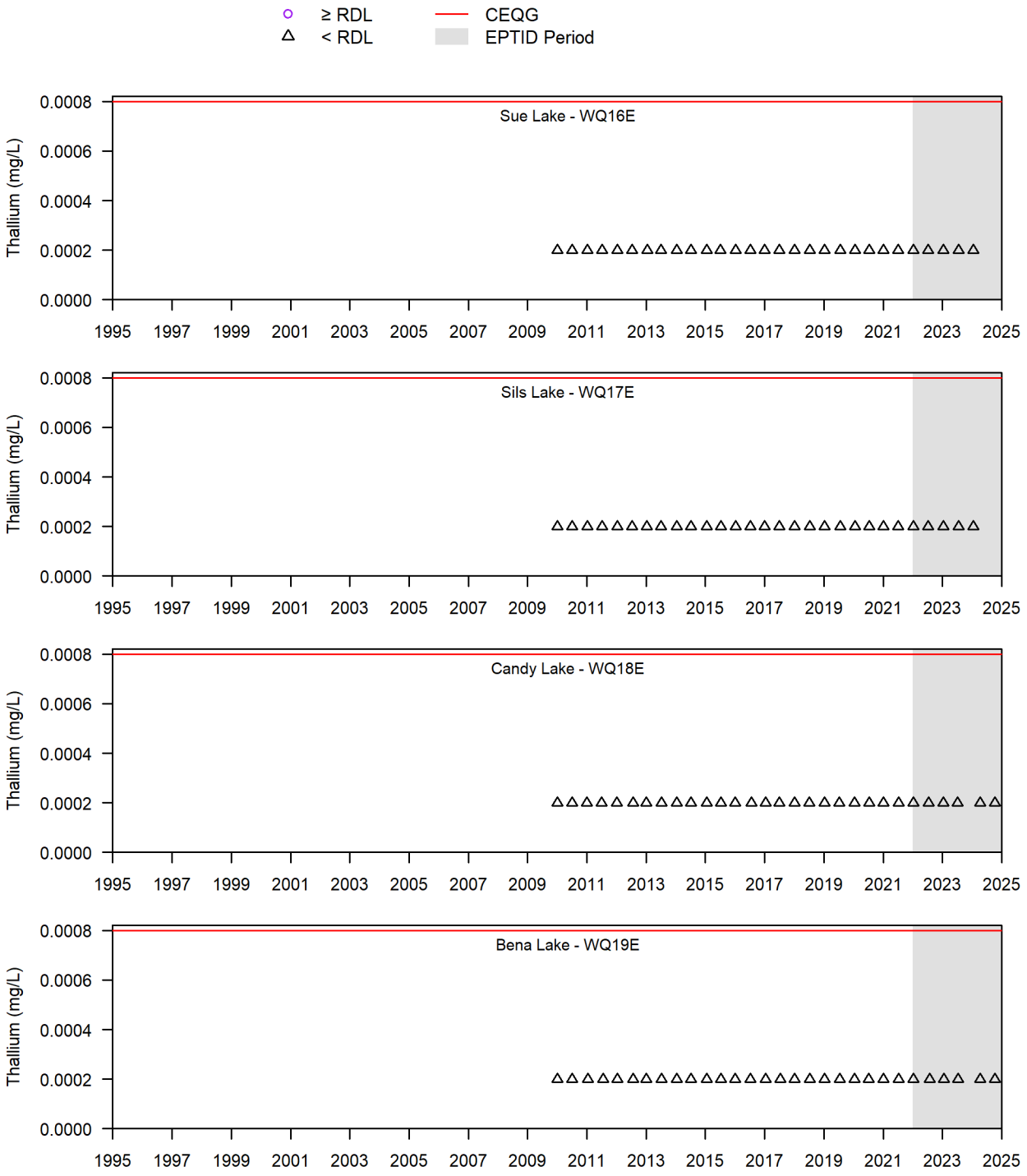


Figure 4.3-5 (39 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

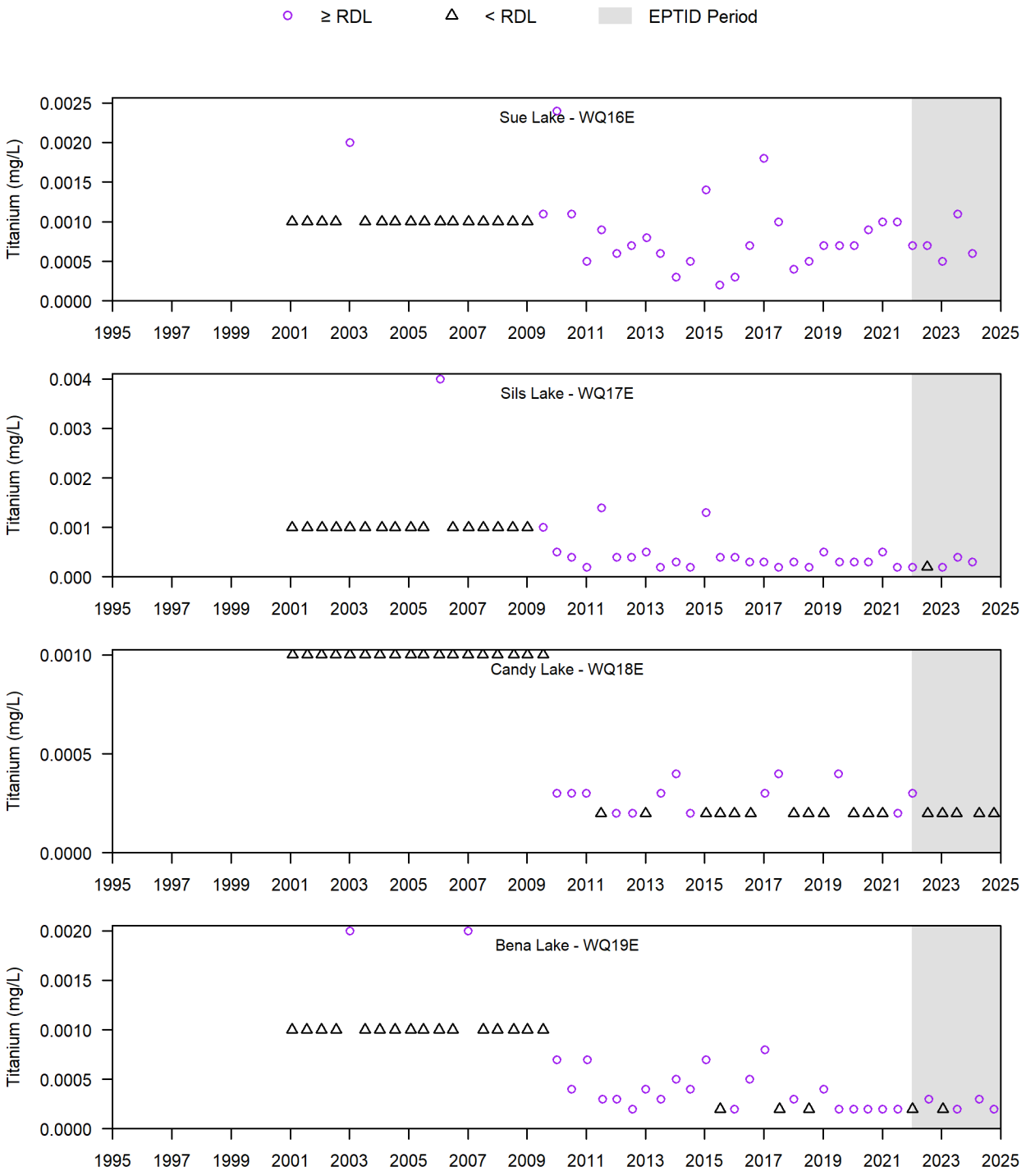


Figure 4.3-5 (40 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

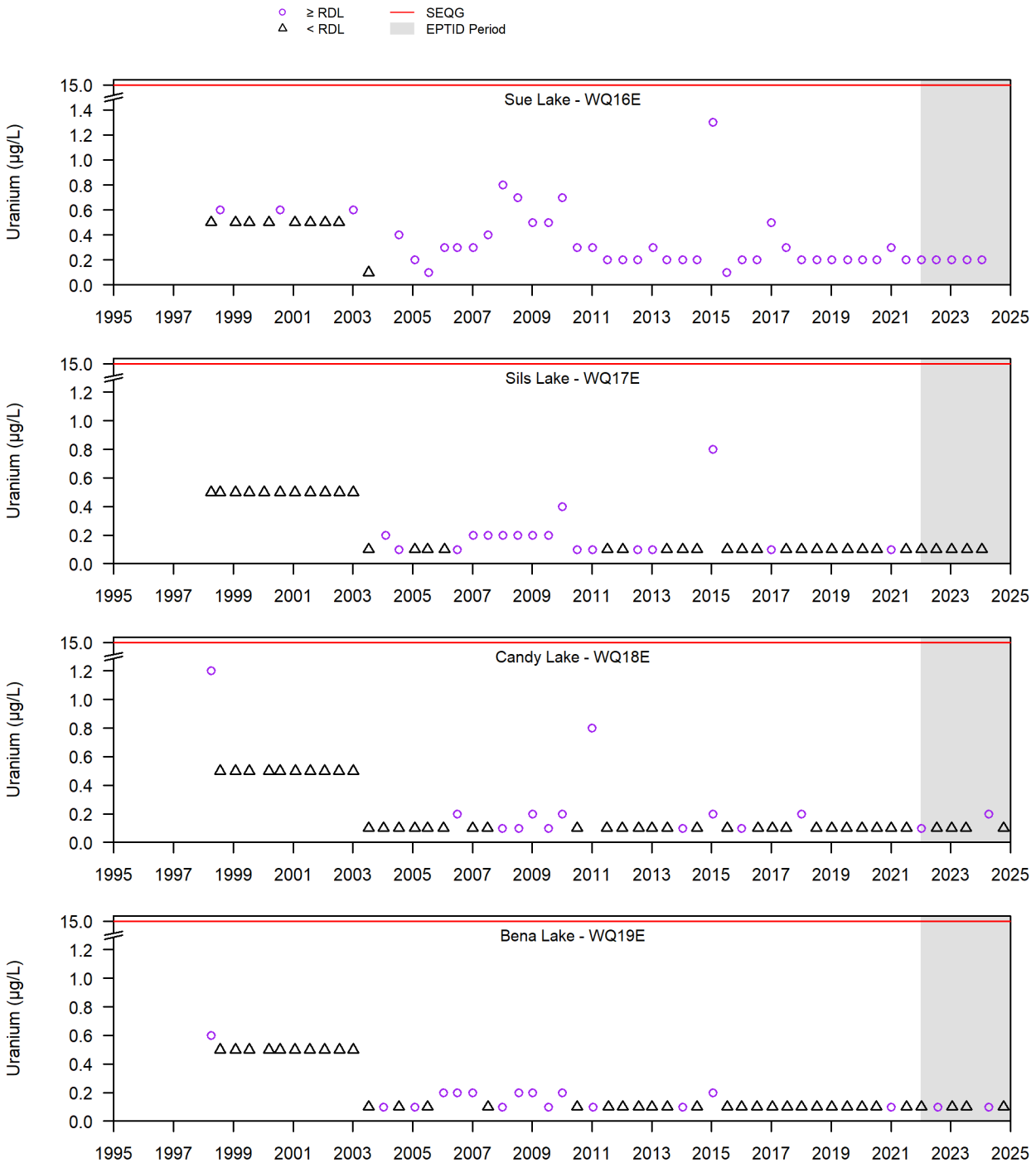


Figure 4.3-5 (41 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

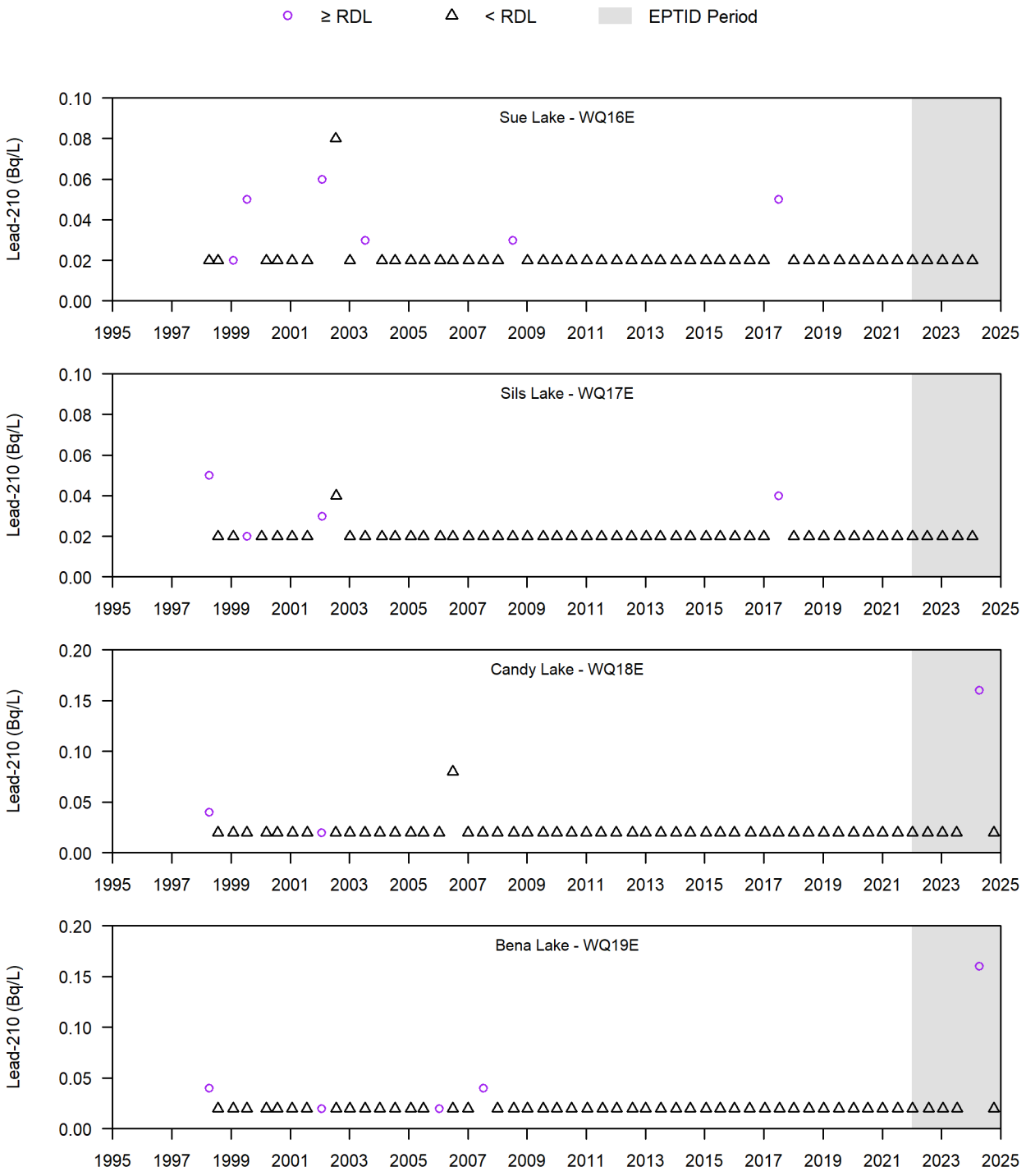


Figure 4.3-5 (42 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

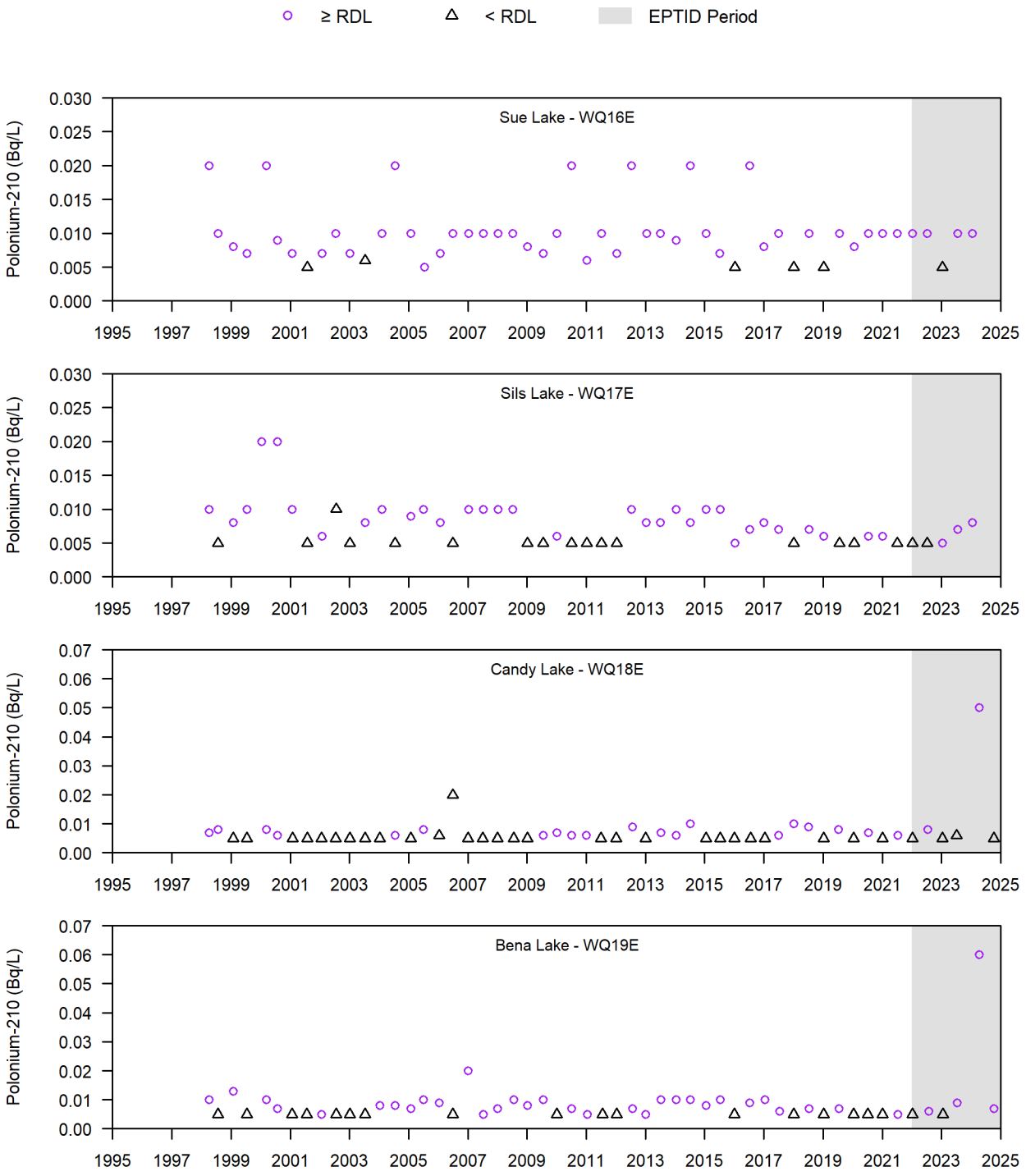


Figure 4.3-5 (43 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

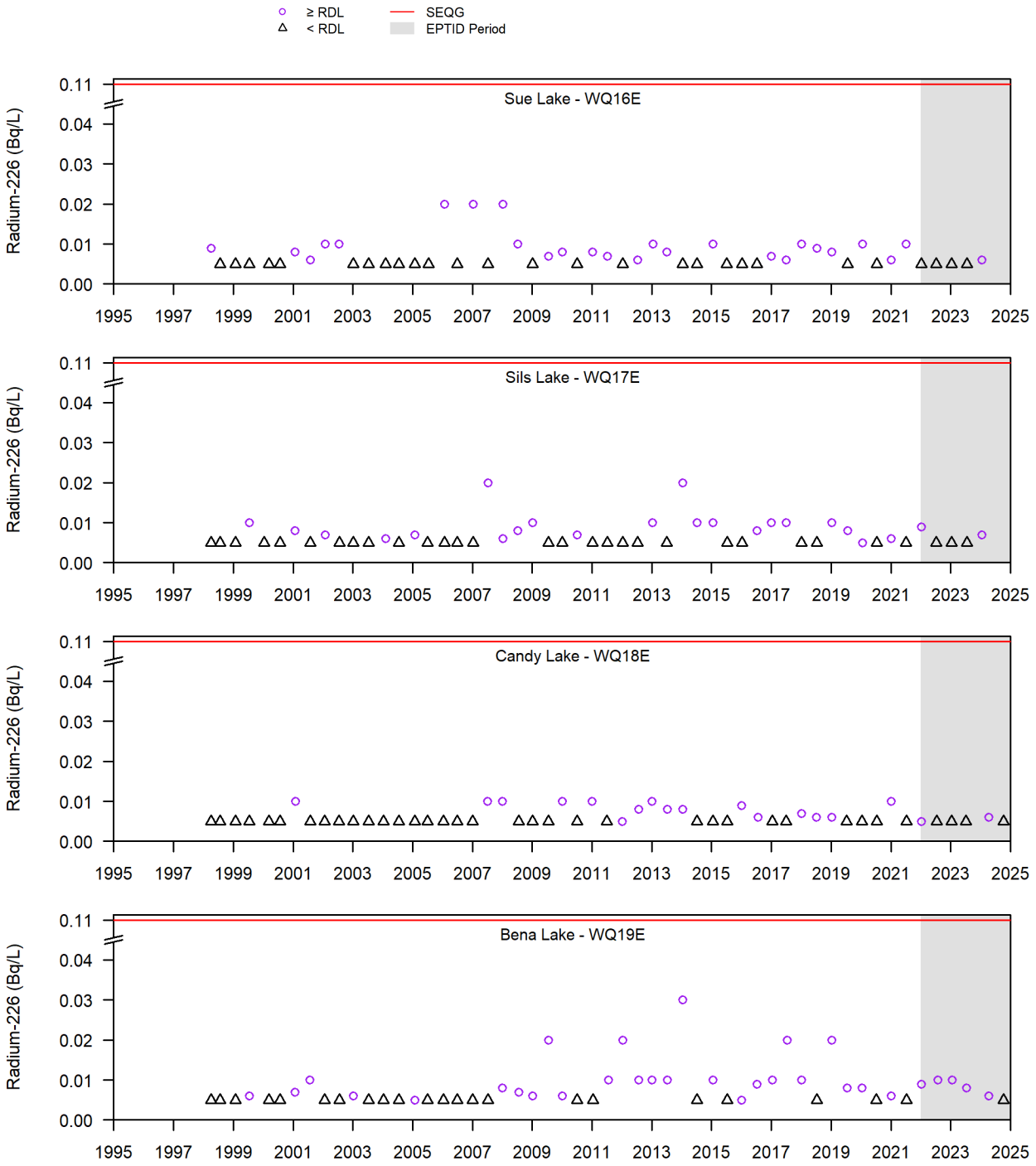


Figure 4.3-5 (44 of 44) COPC Levels in the Sue Secondary Exposure Area Surface Water with Associated Guidelines.

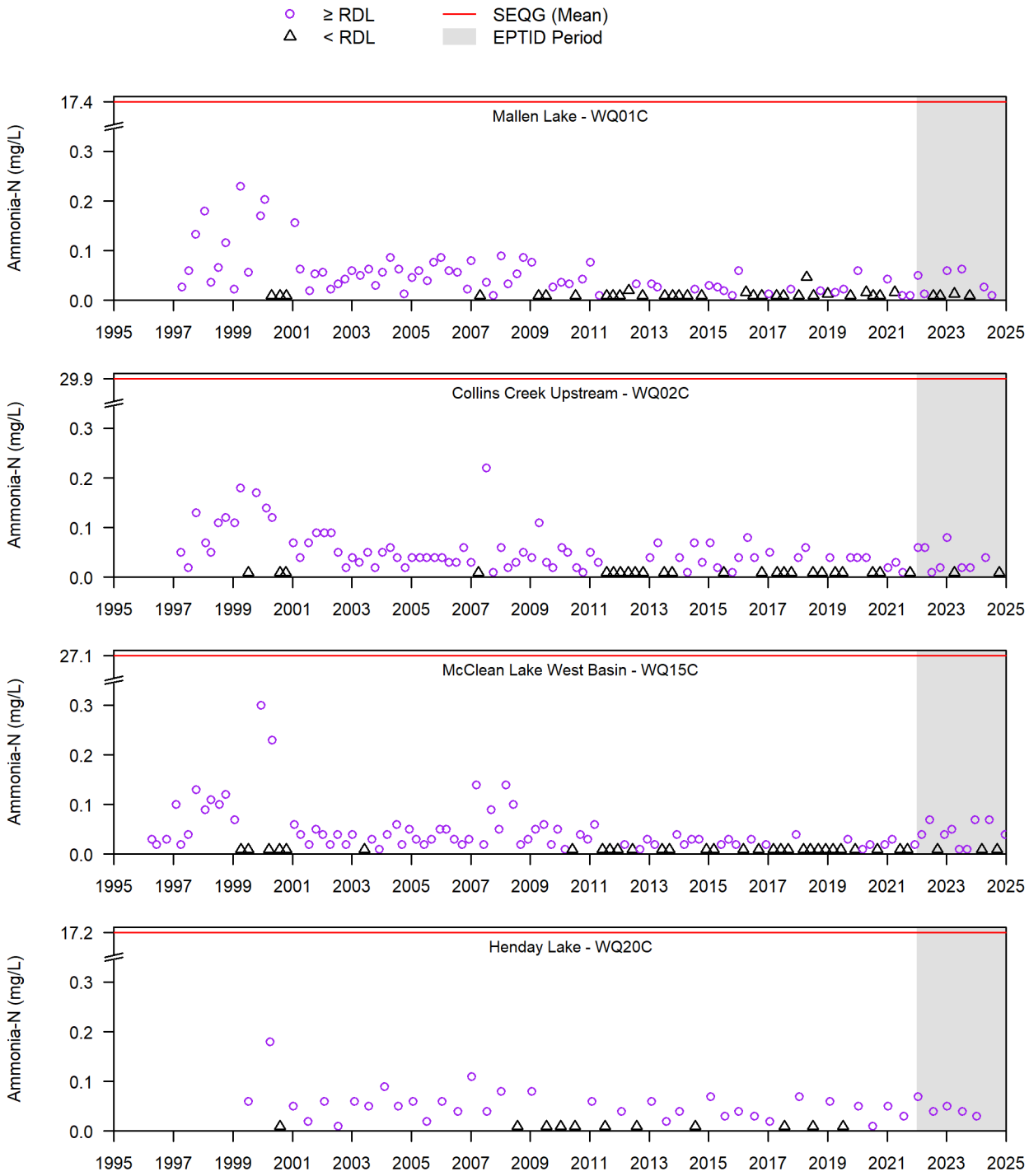


Figure 4.3-6 (1 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

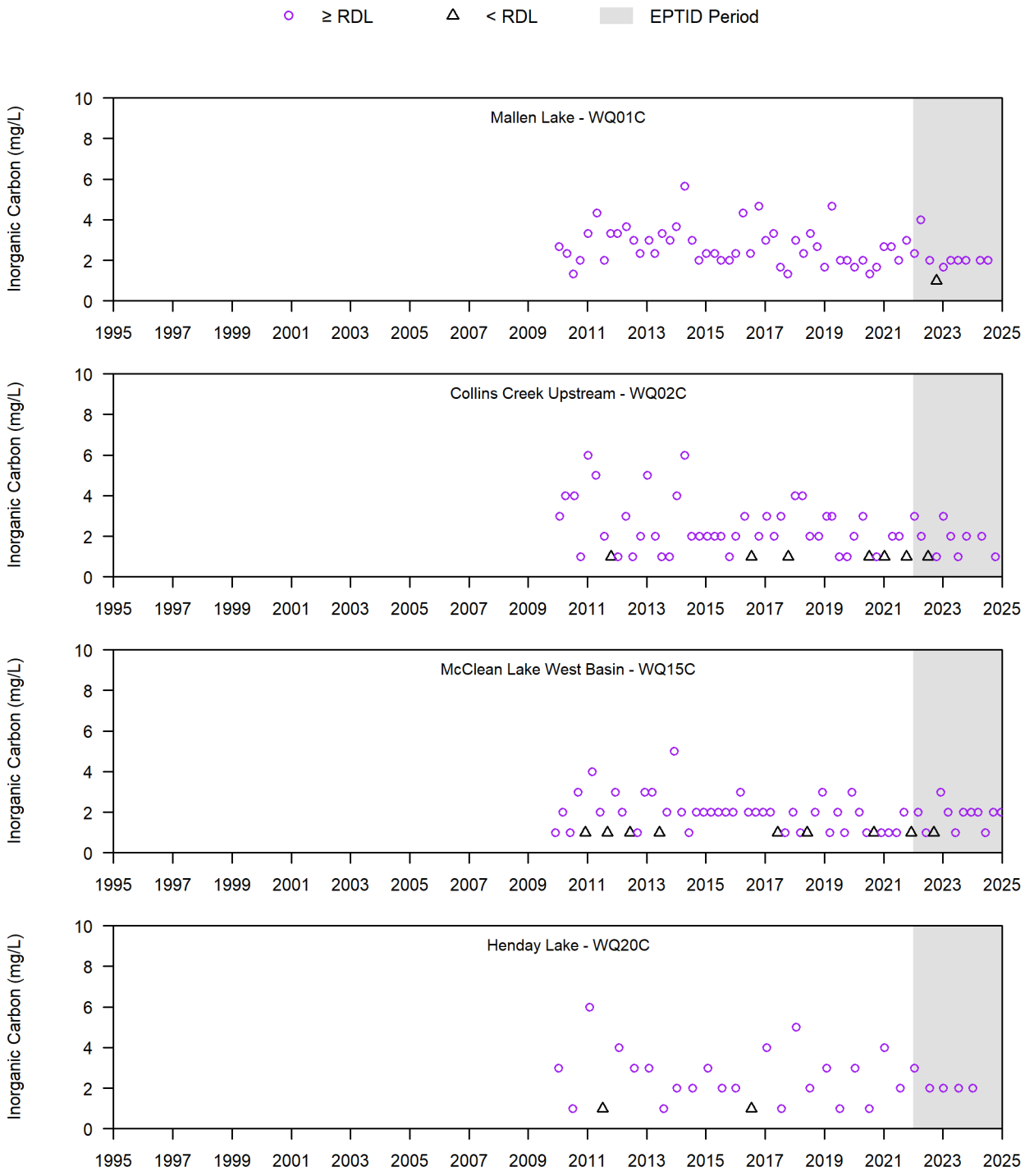


Figure 4.3-6 (2 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

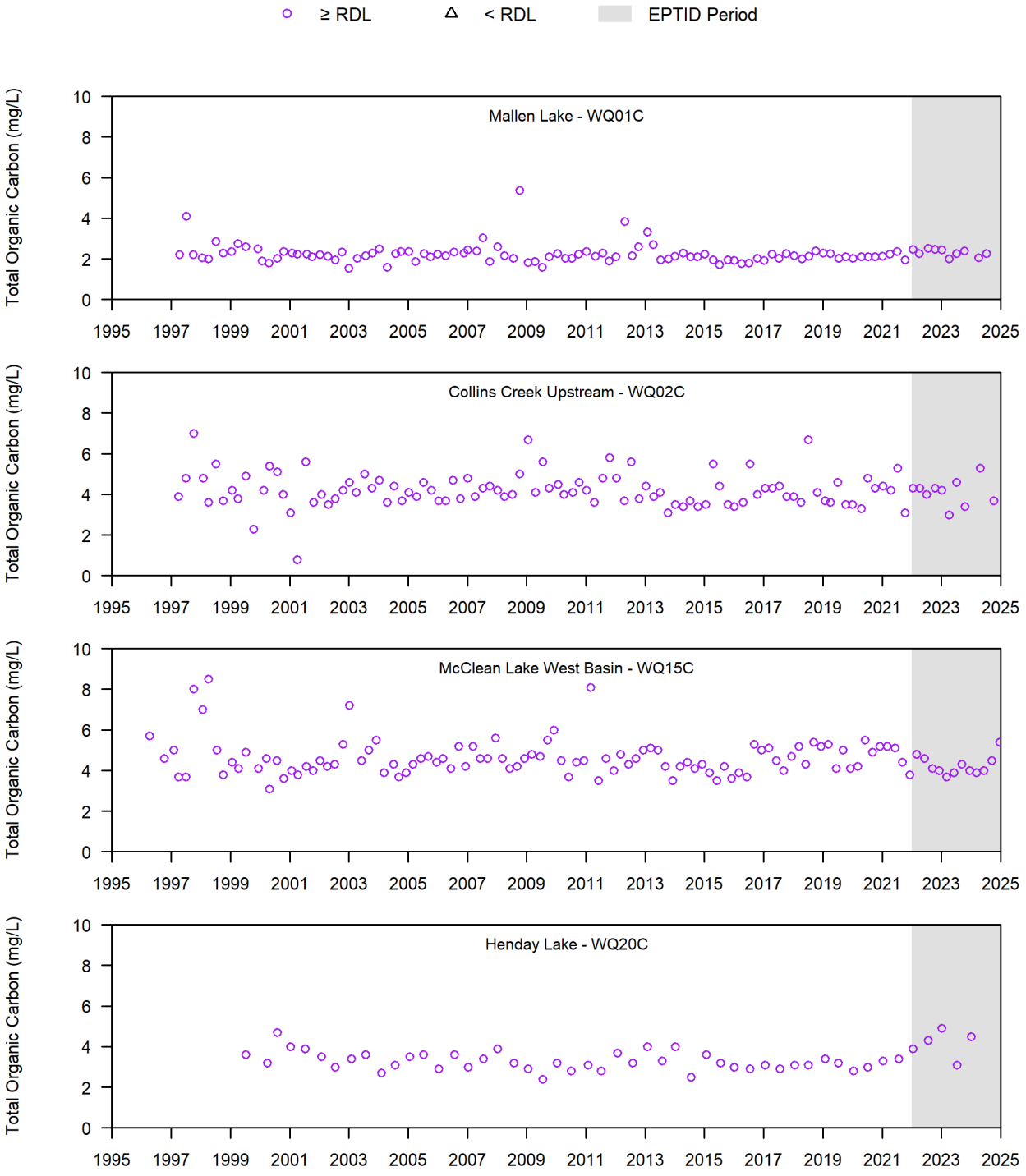


Figure 4.3-6 (3 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

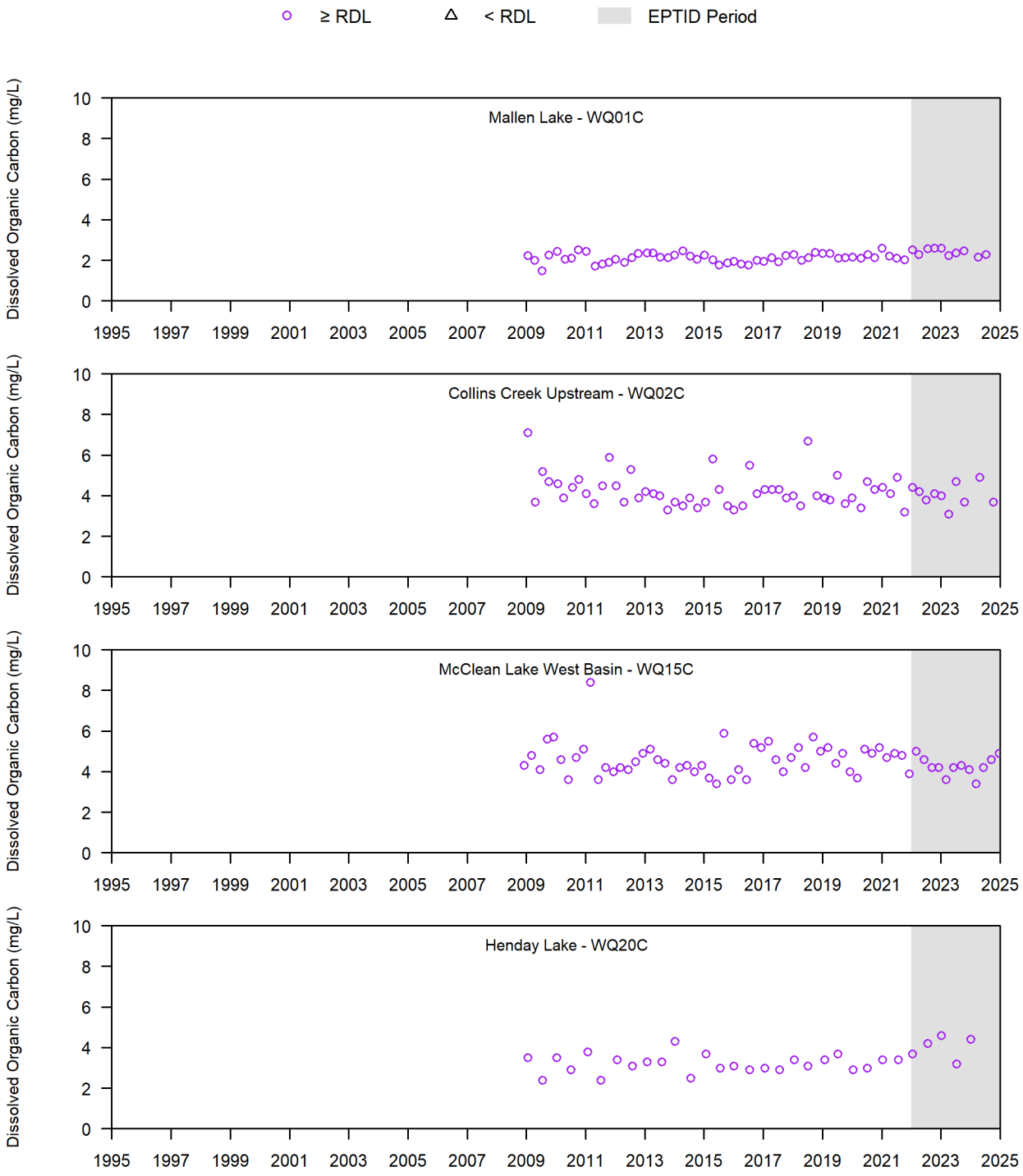


Figure 4.3-6 (4 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

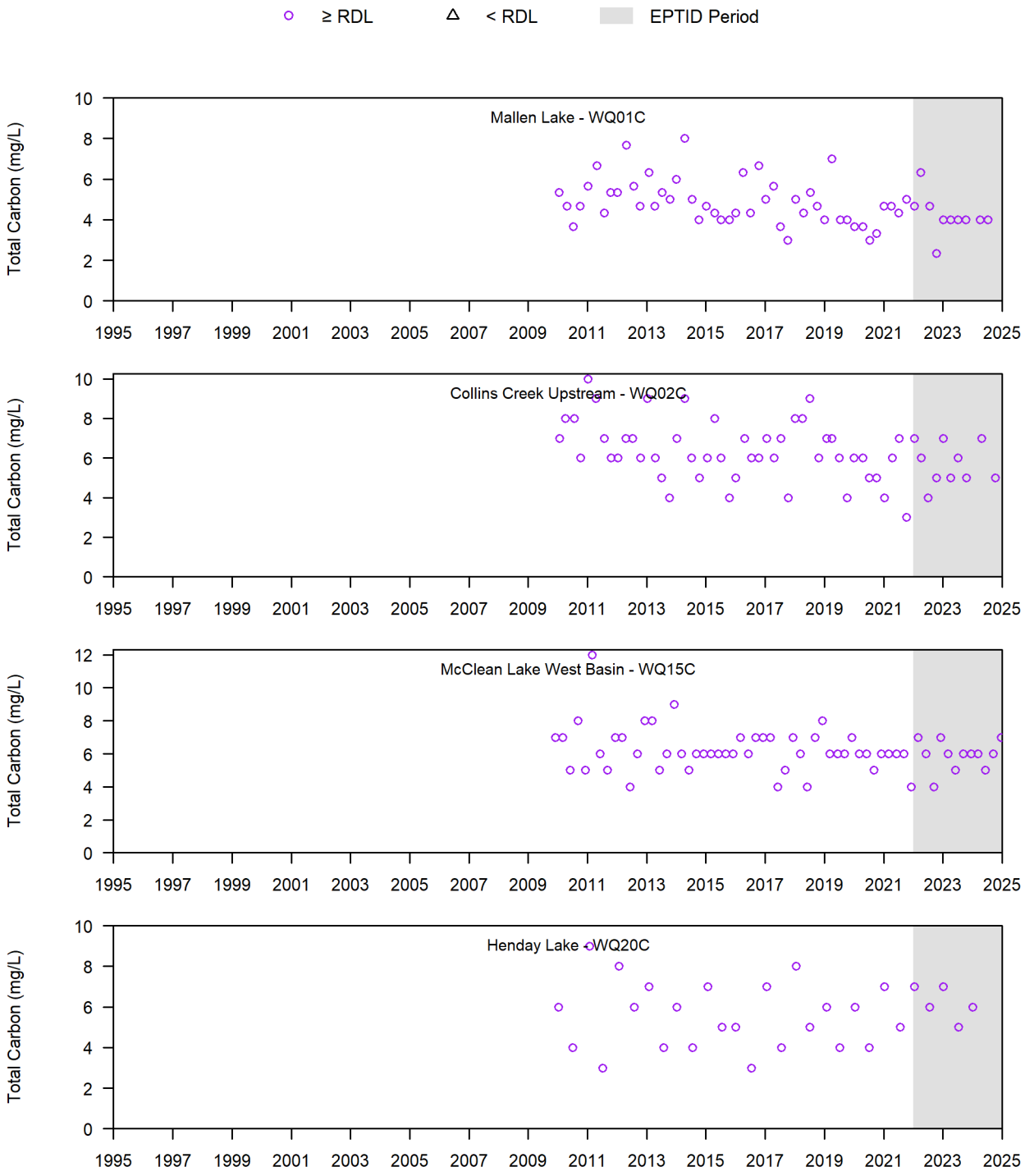


Figure 4.3-6 (5 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

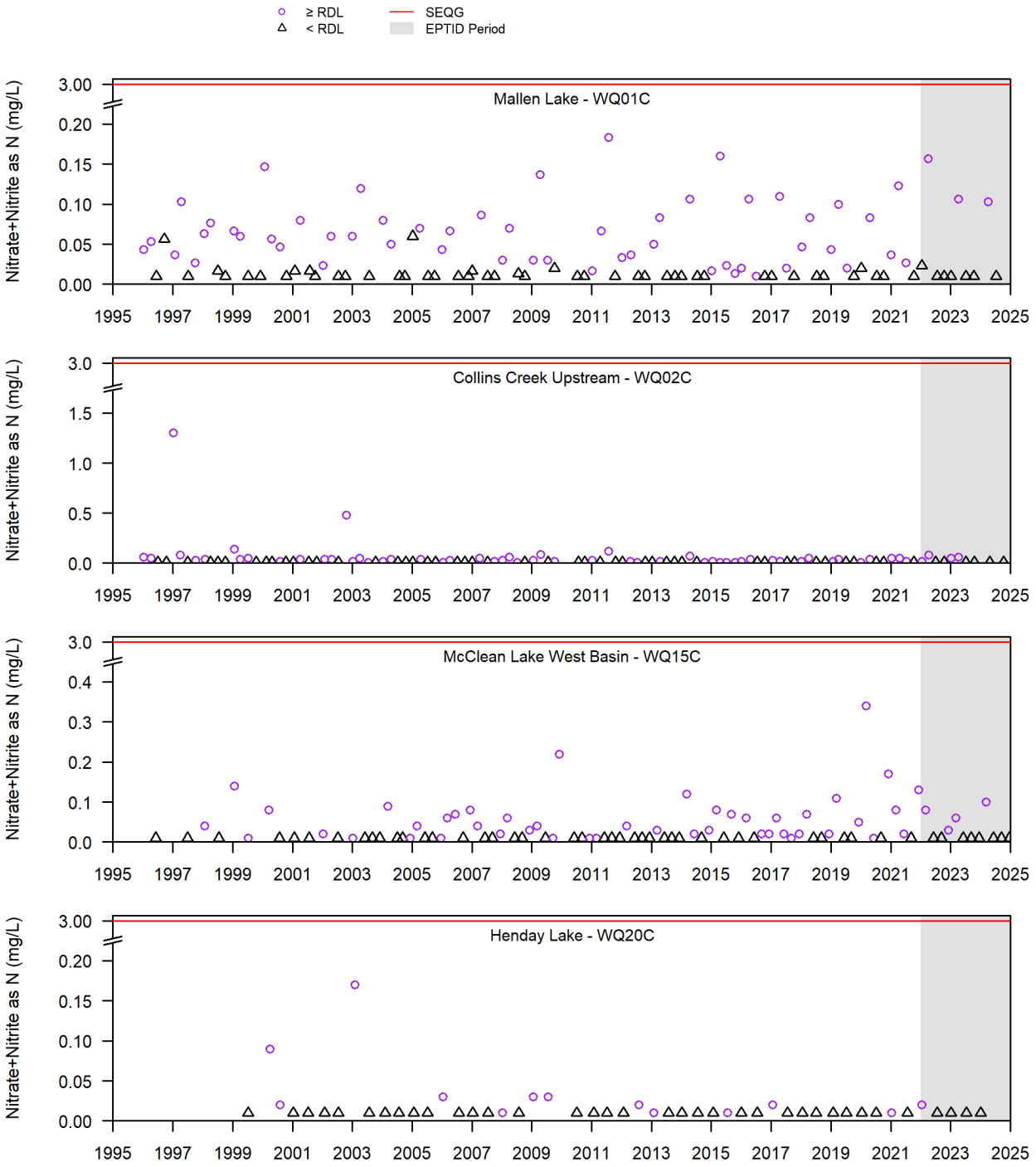


Figure 4.3-6 (6 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

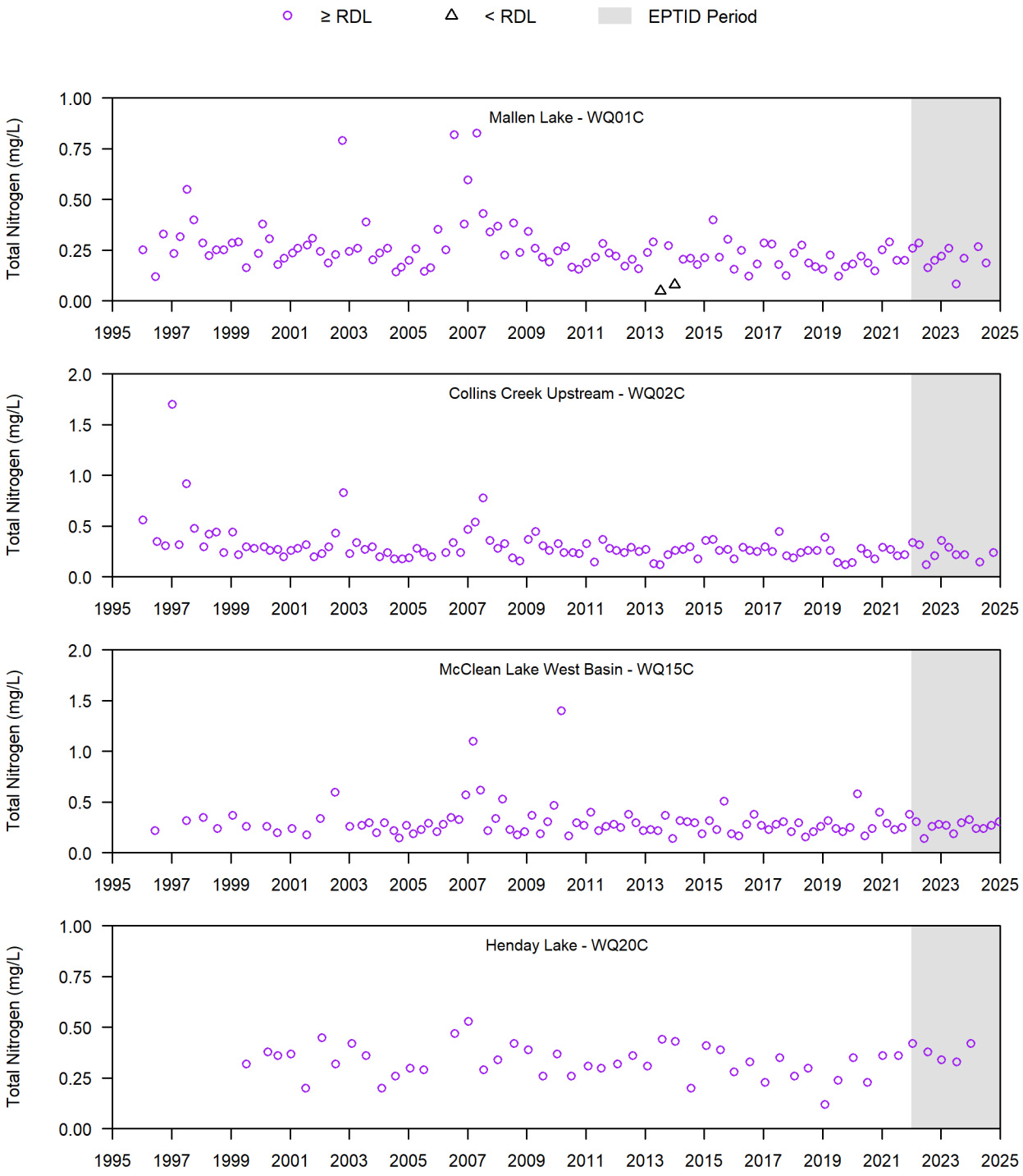


Figure 4.3-6 (7 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

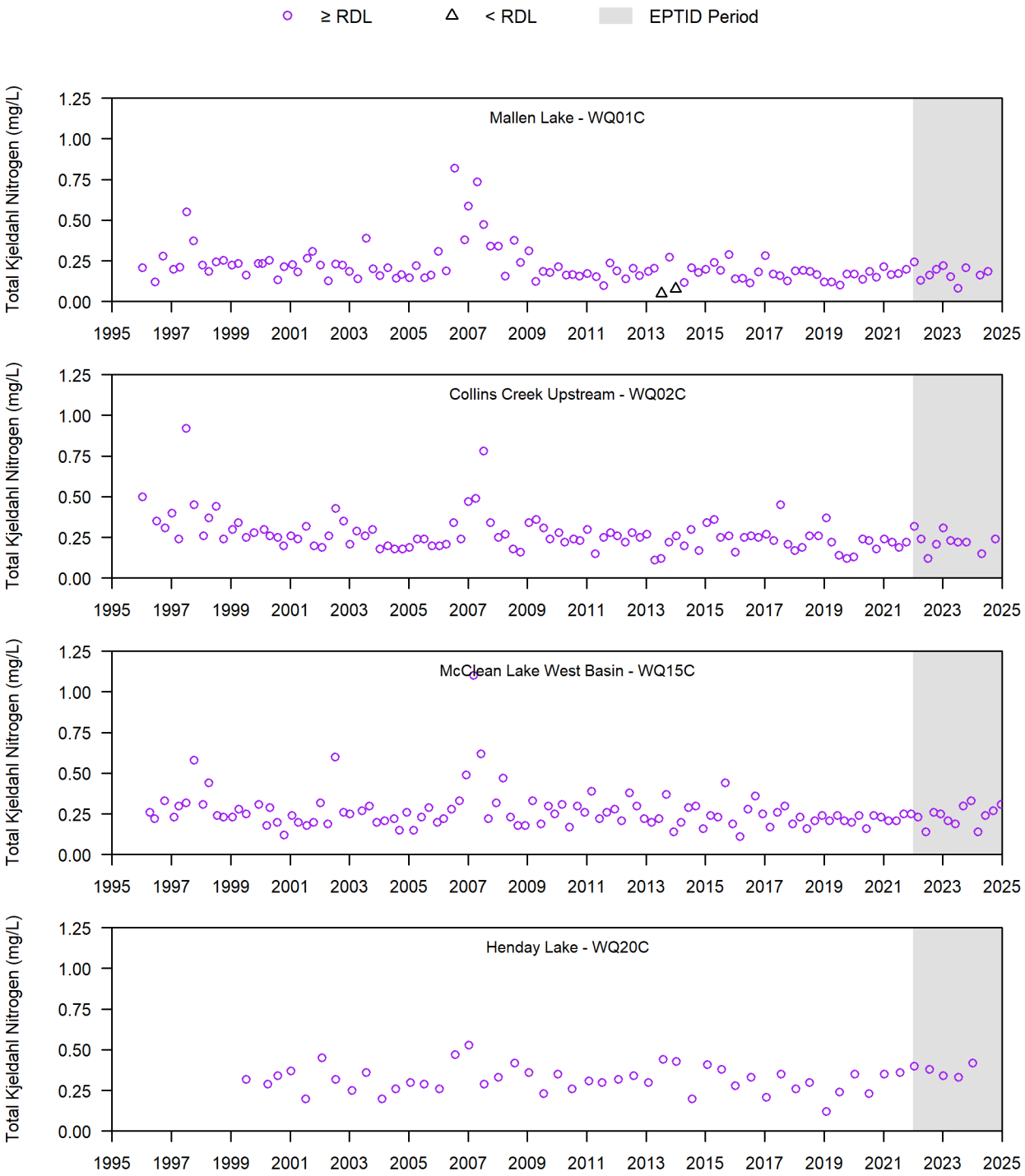


Figure 4.3-6 (8 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

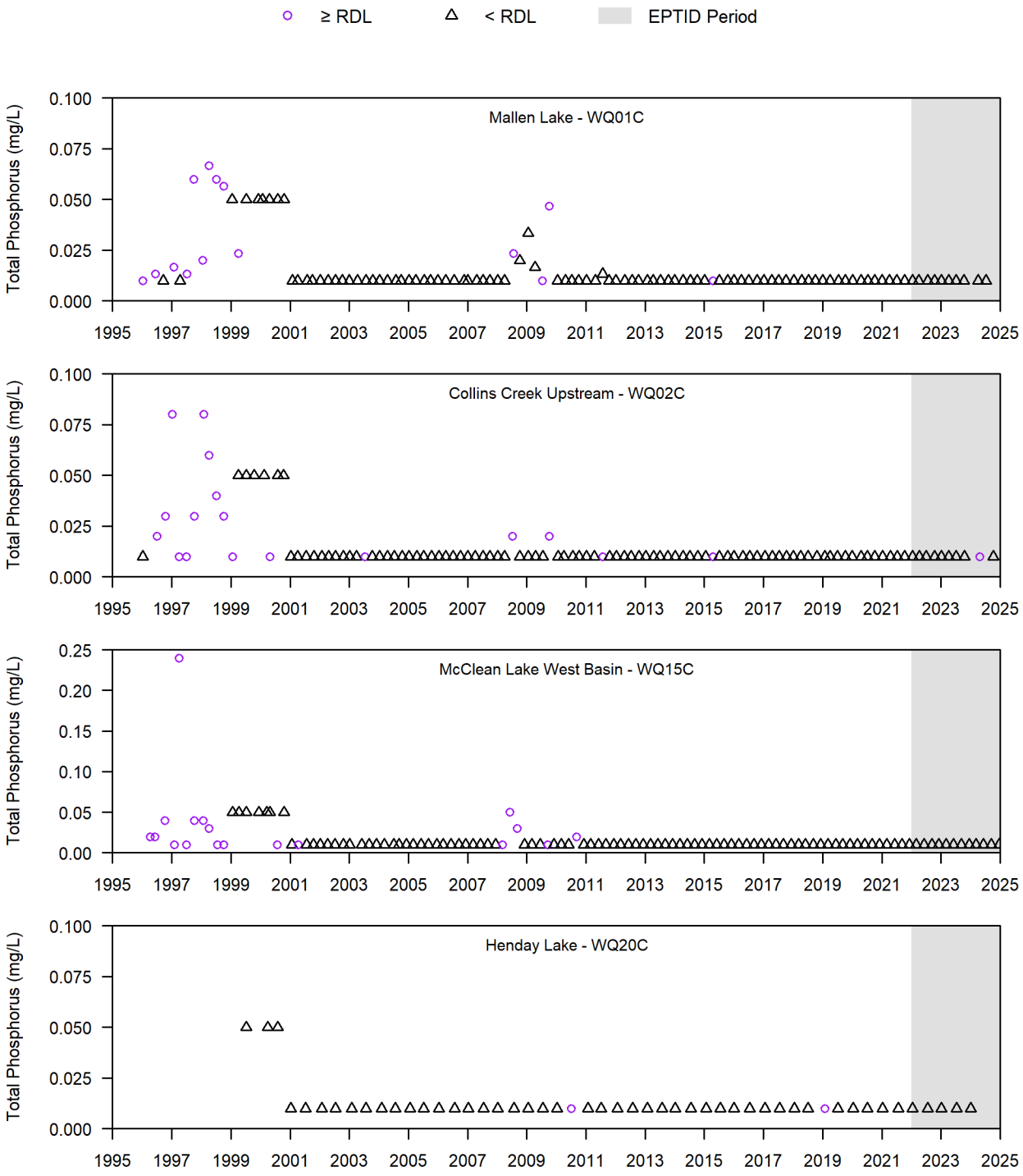


Figure 4.3-6 (9 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

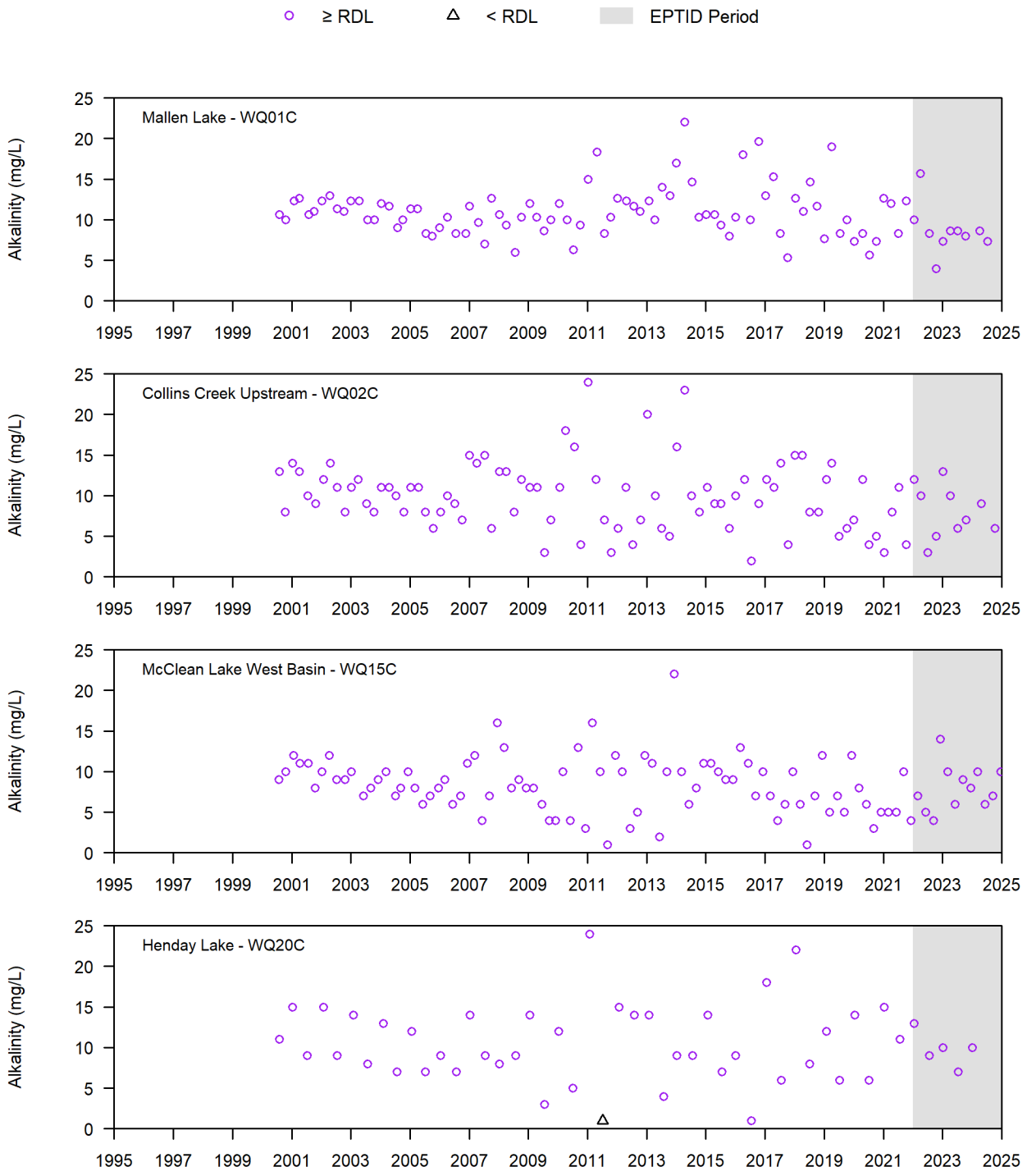


Figure 4.3-6 (10 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

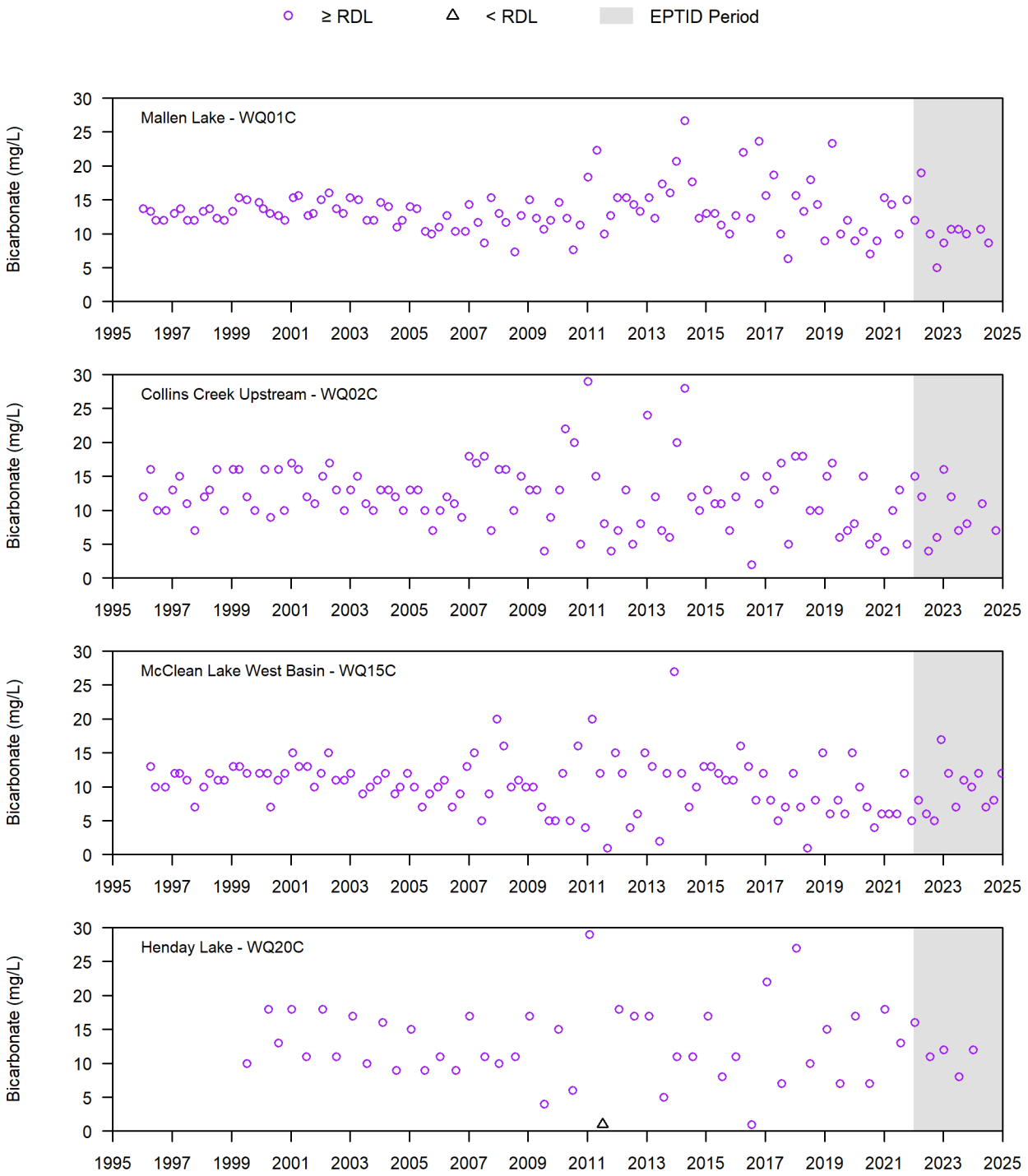


Figure 4.3-6 (11 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

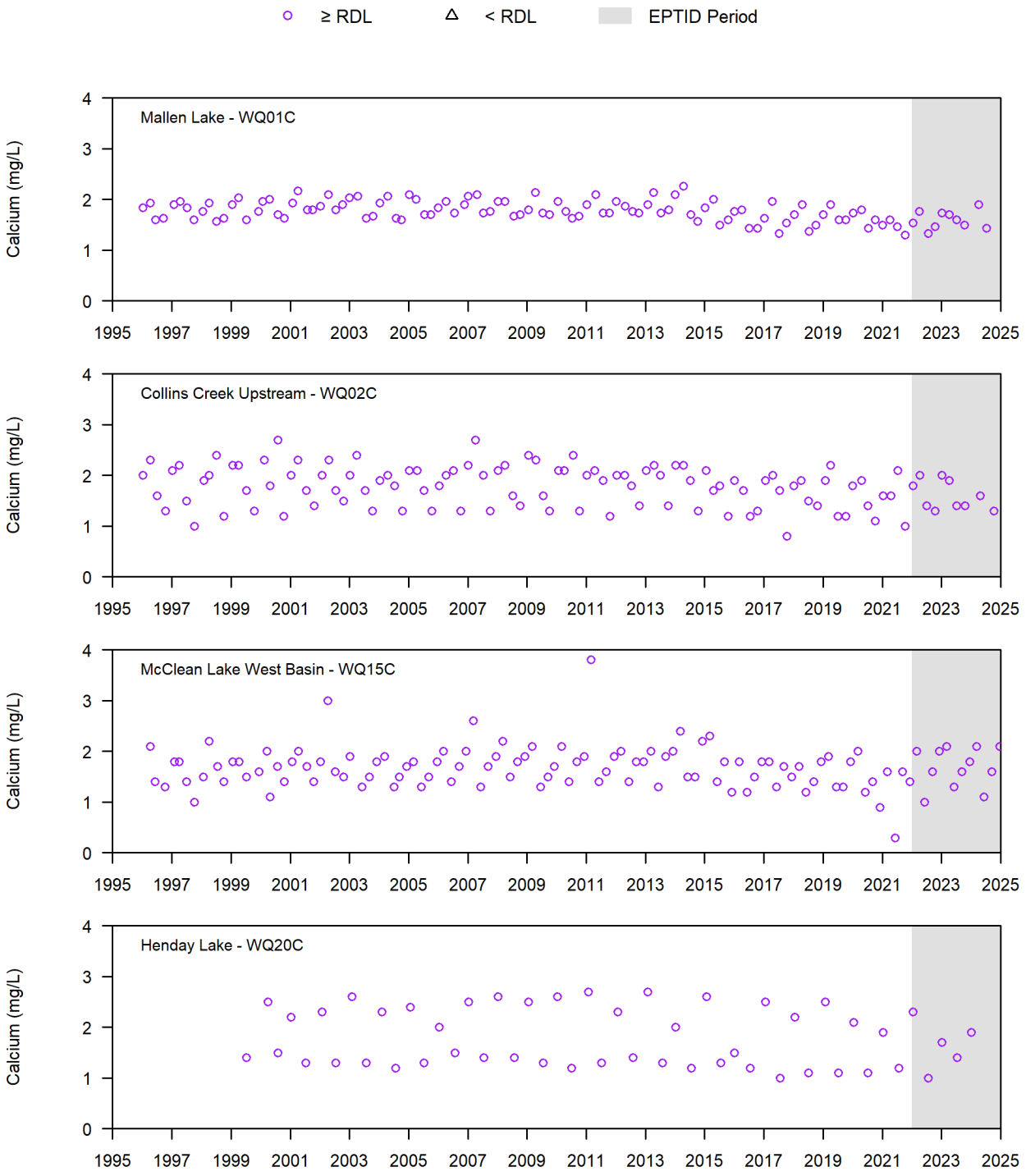


Figure 4.3-6 (12 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

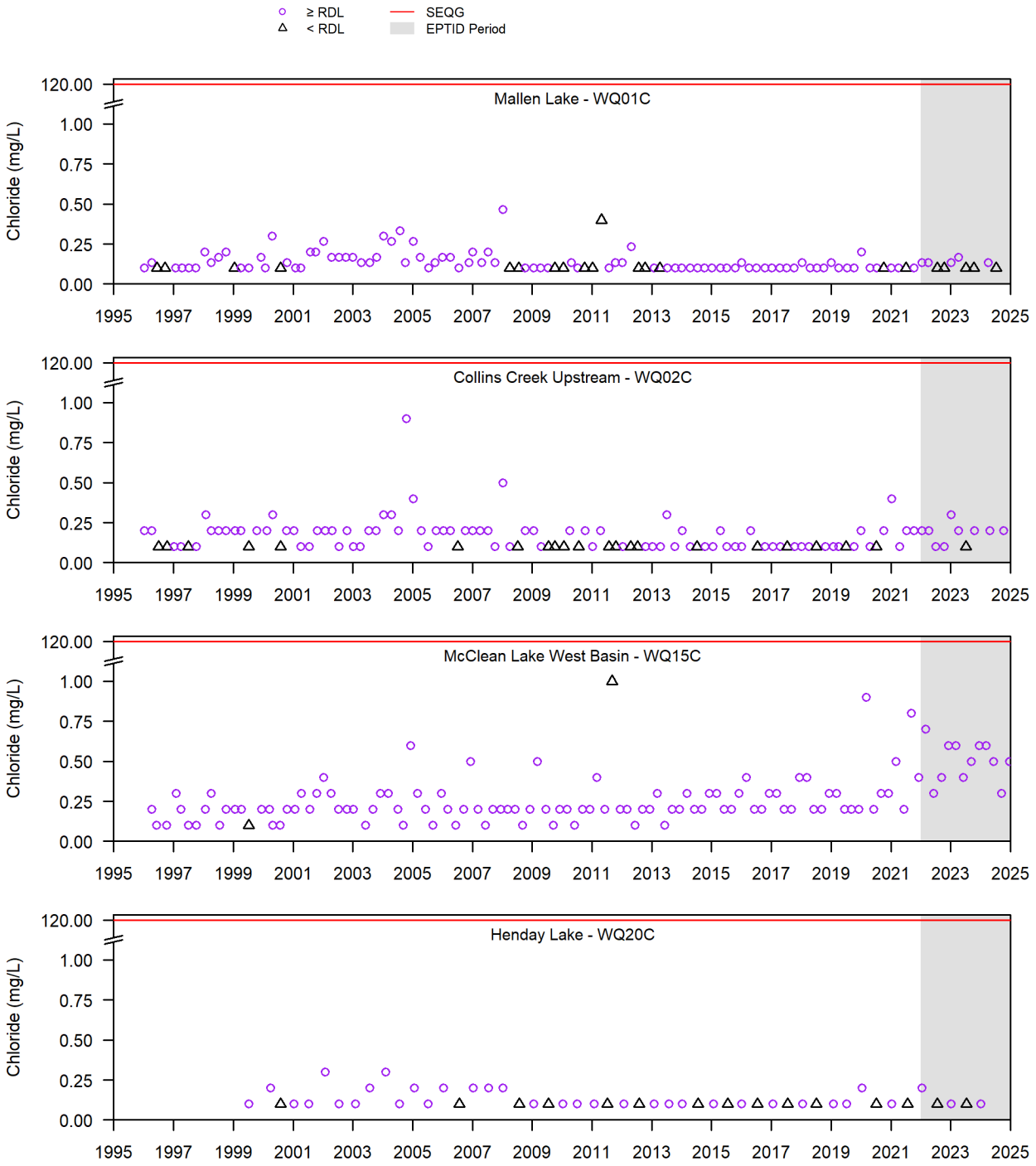


Figure 4.3-6 (13 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

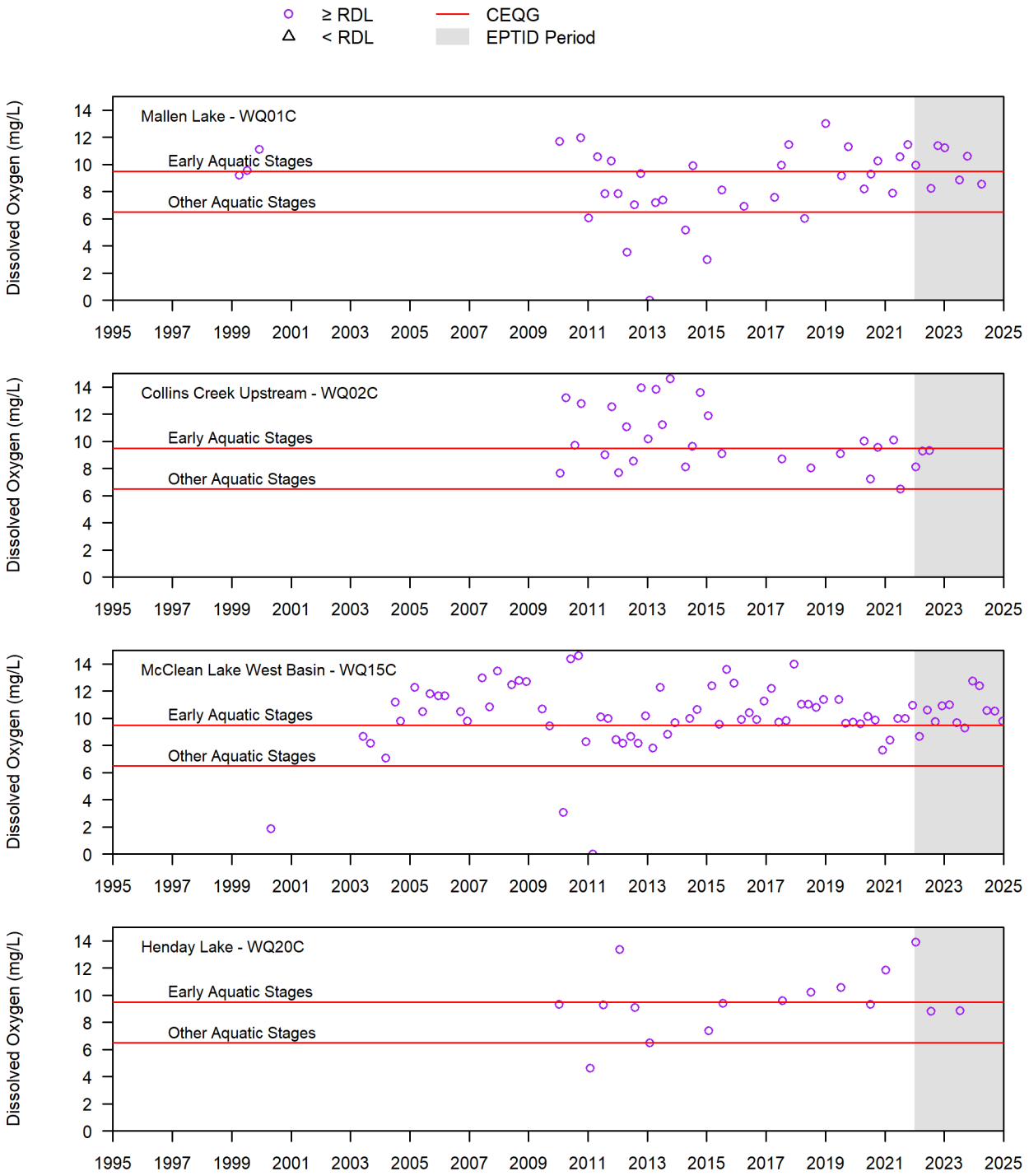


Figure 4.3-6 (14 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

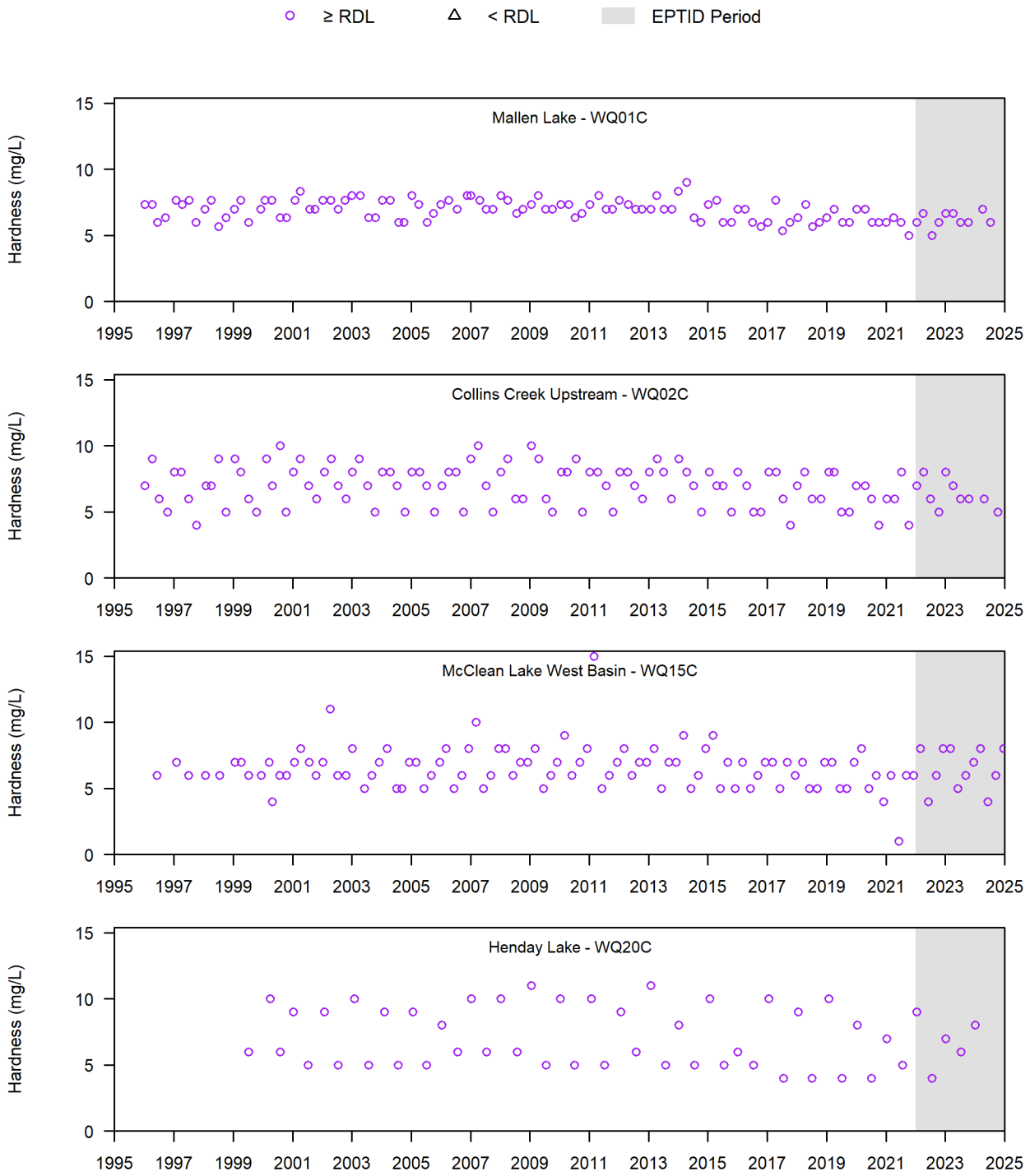


Figure 4.3-6 (15 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

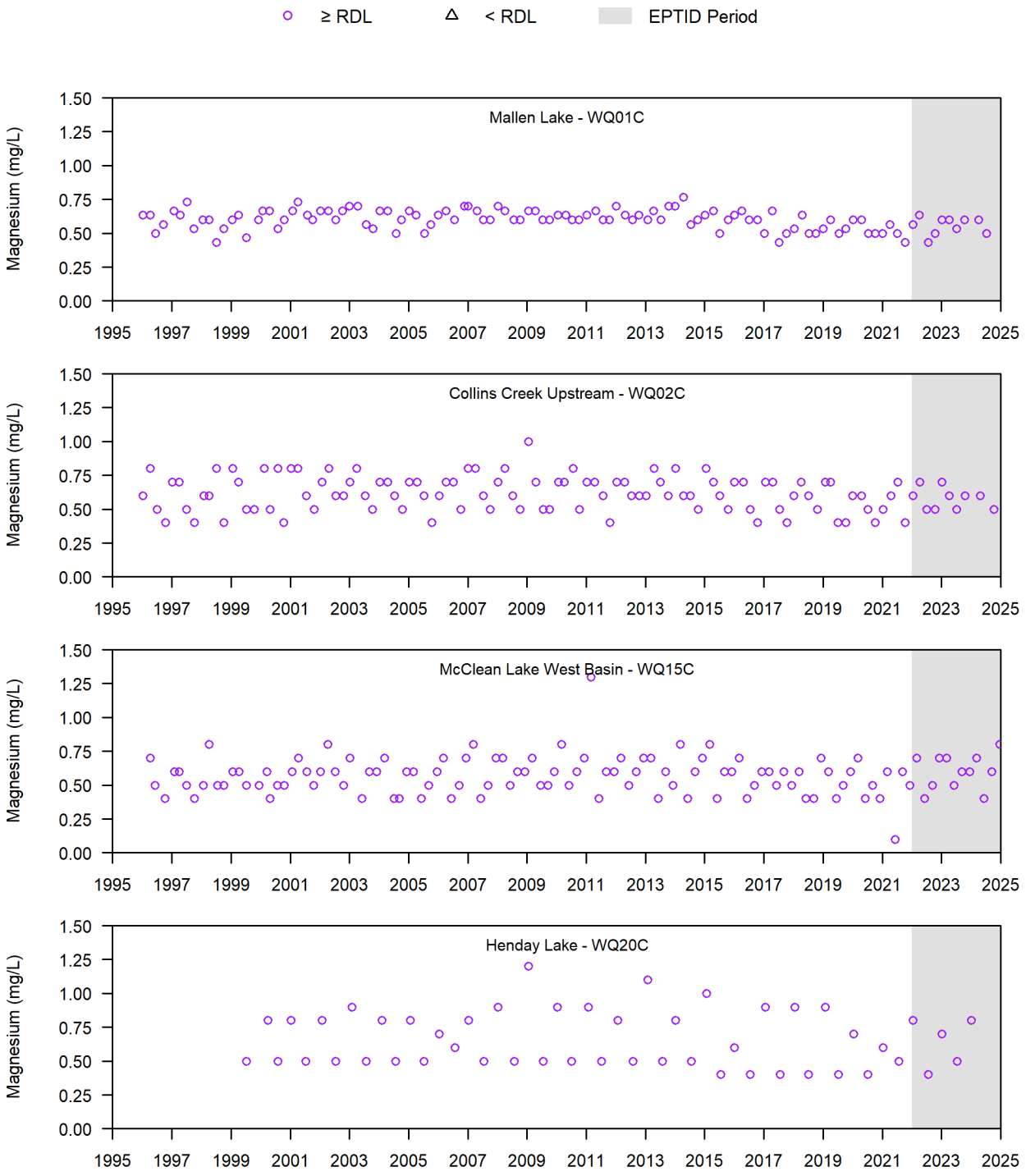


Figure 4.3-6 (16 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

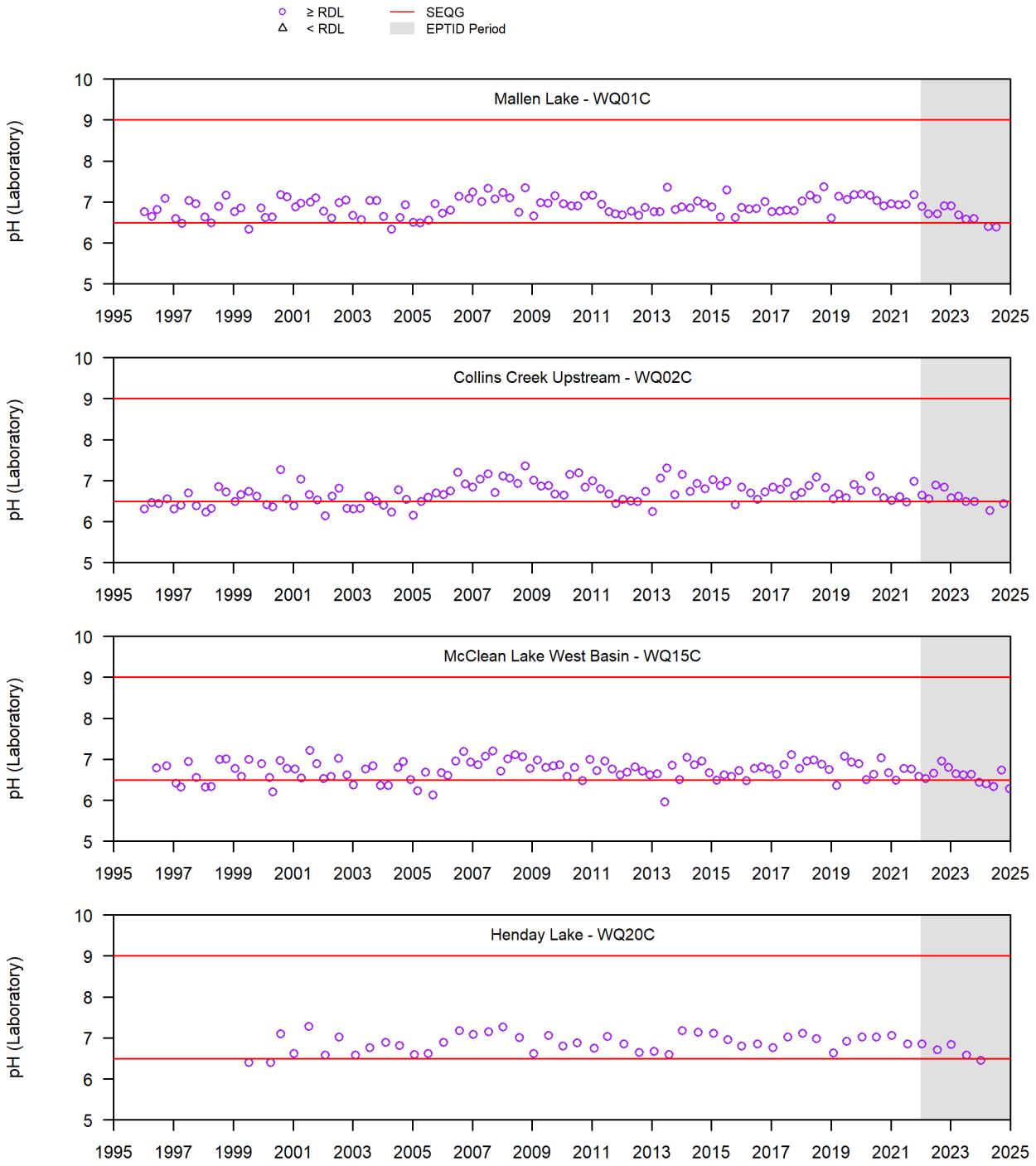


Figure 4.3-6 (17 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

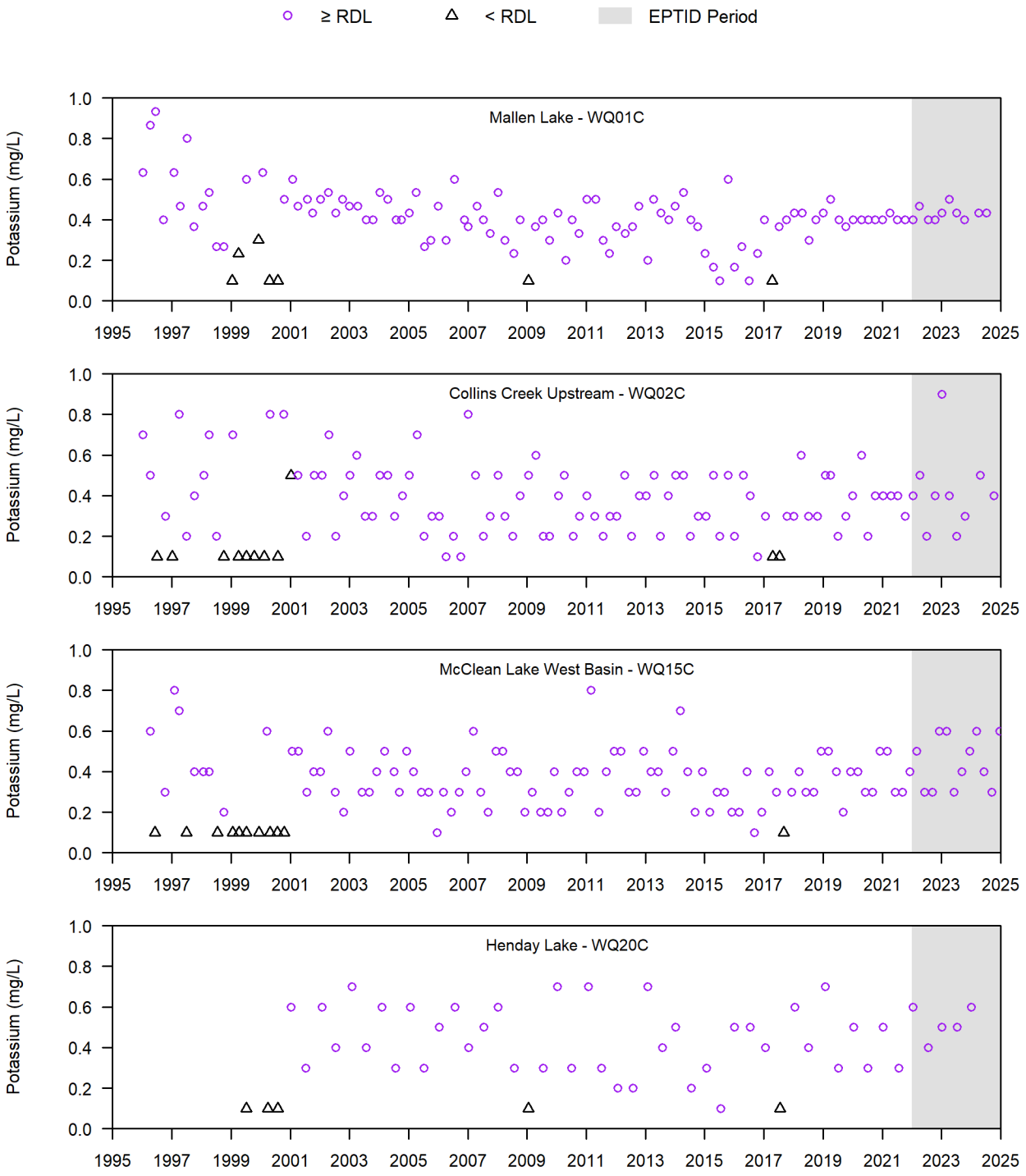


Figure 4.3-6 (18 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

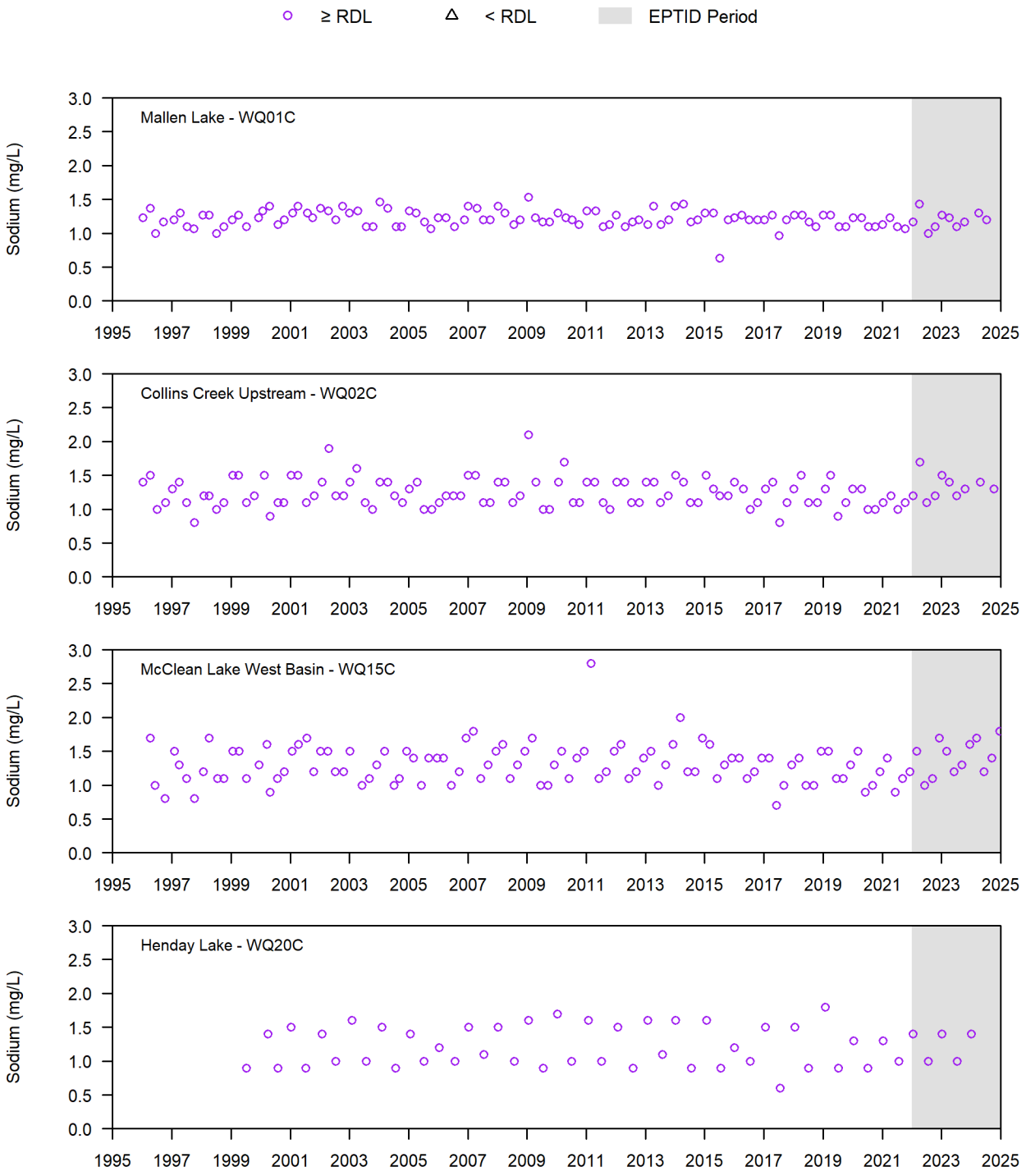


Figure 4.3-6 (19 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

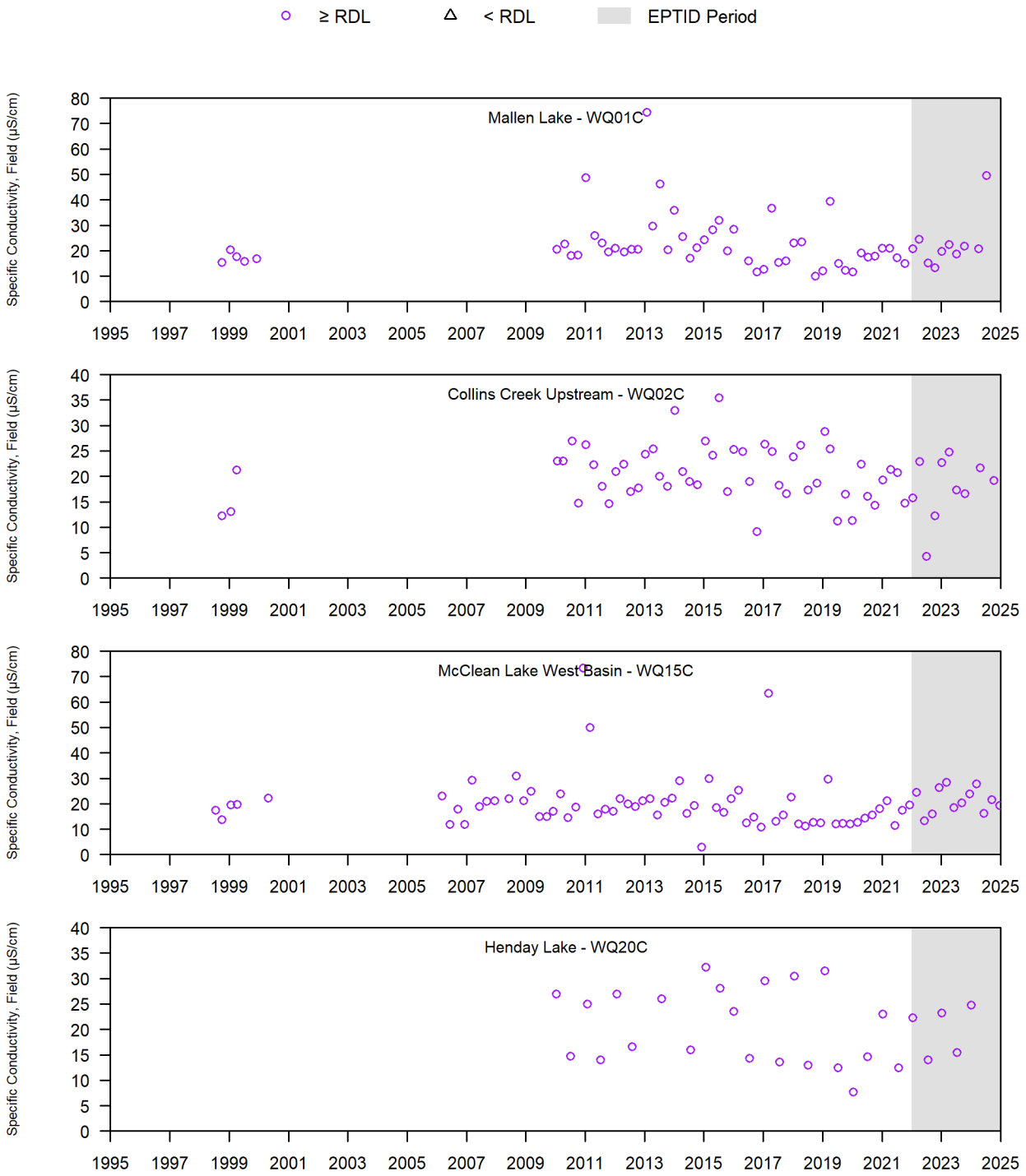


Figure 4.3-6 (20 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

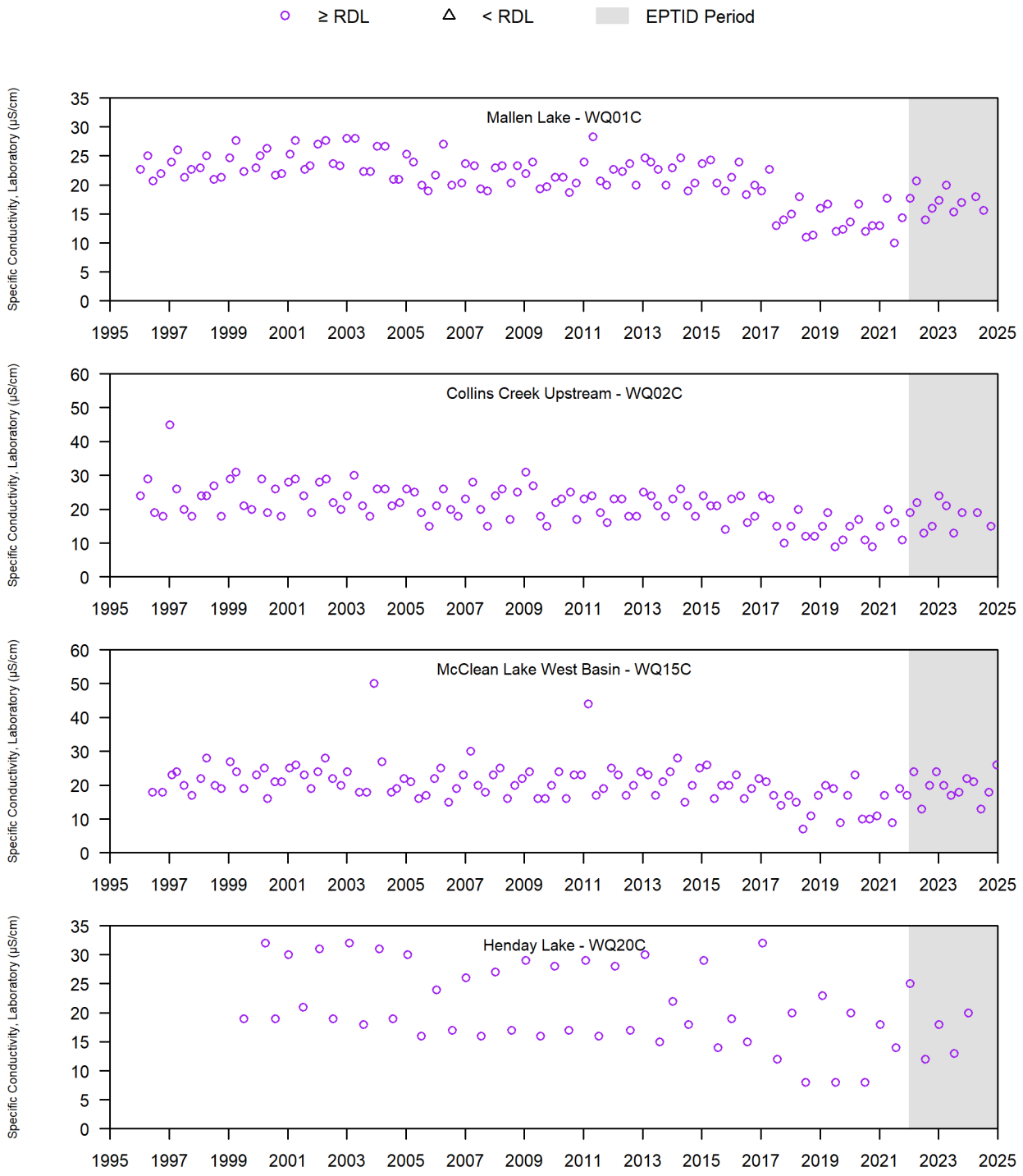


Figure 4.3-6 (21 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

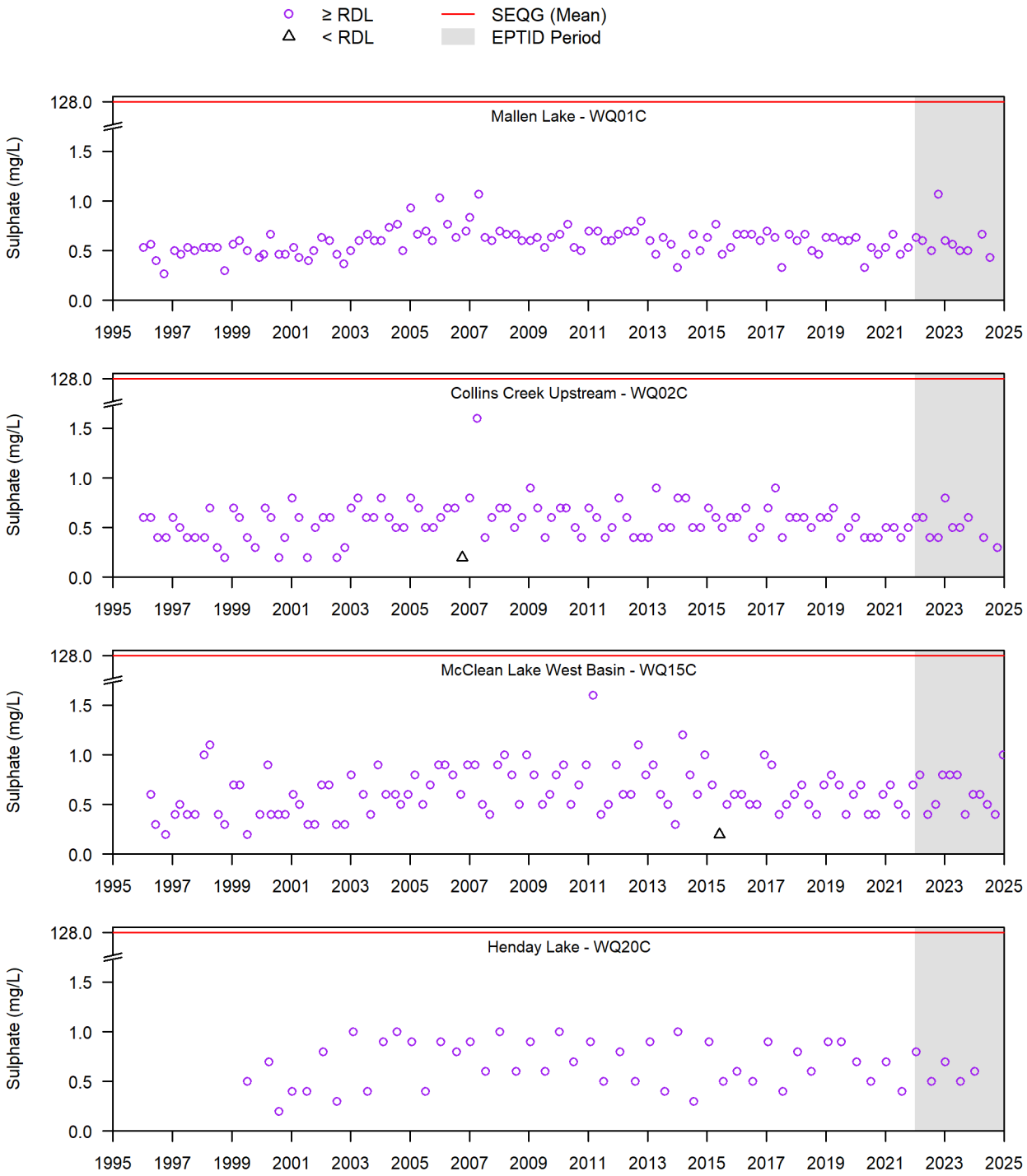


Figure 4.3-6 (22 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

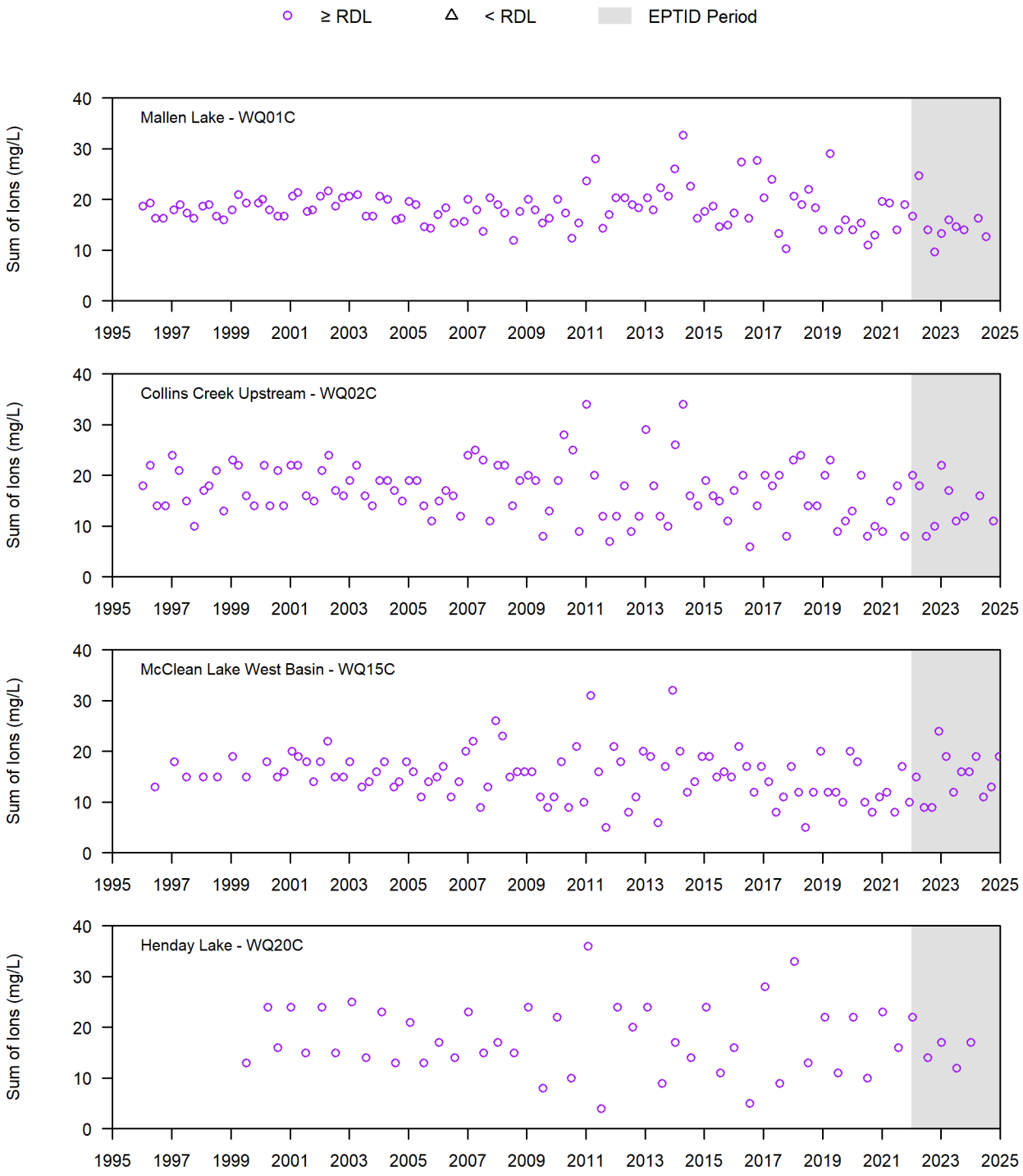


Figure 4.3-6 (23 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

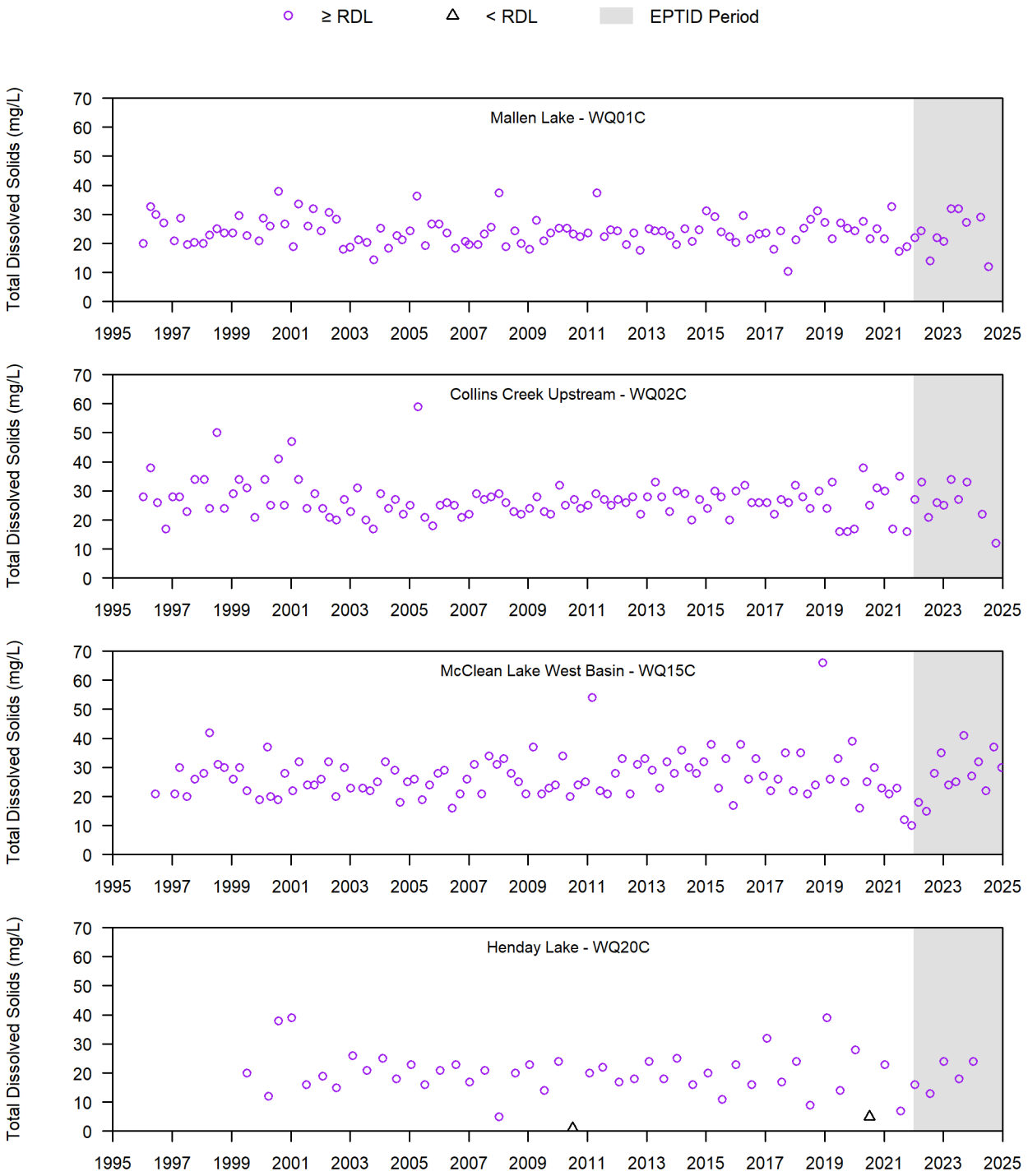


Figure 4.3-6 (24 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

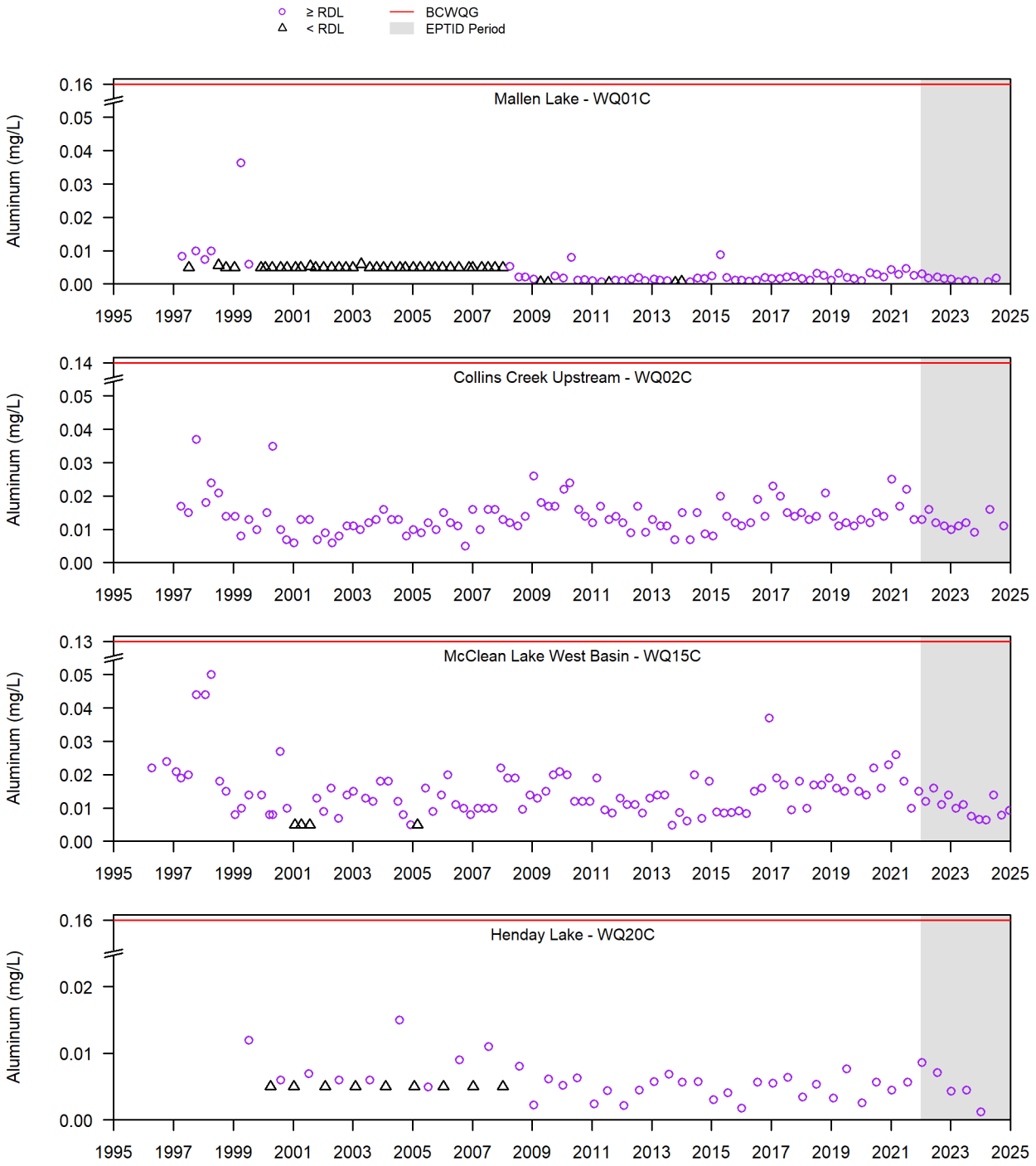


Figure 4.3-6 (25 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

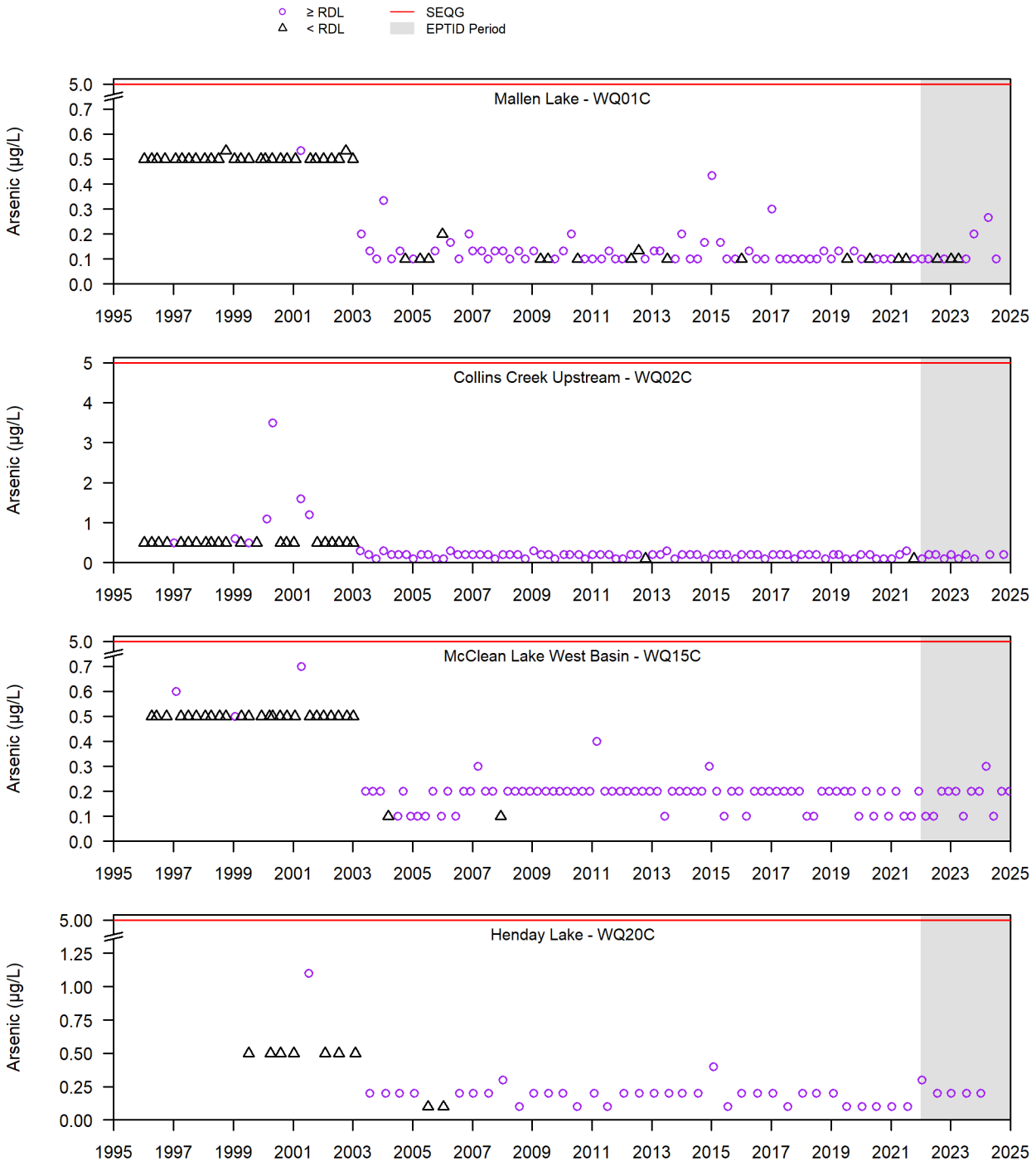


Figure 4.3-6 (26 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

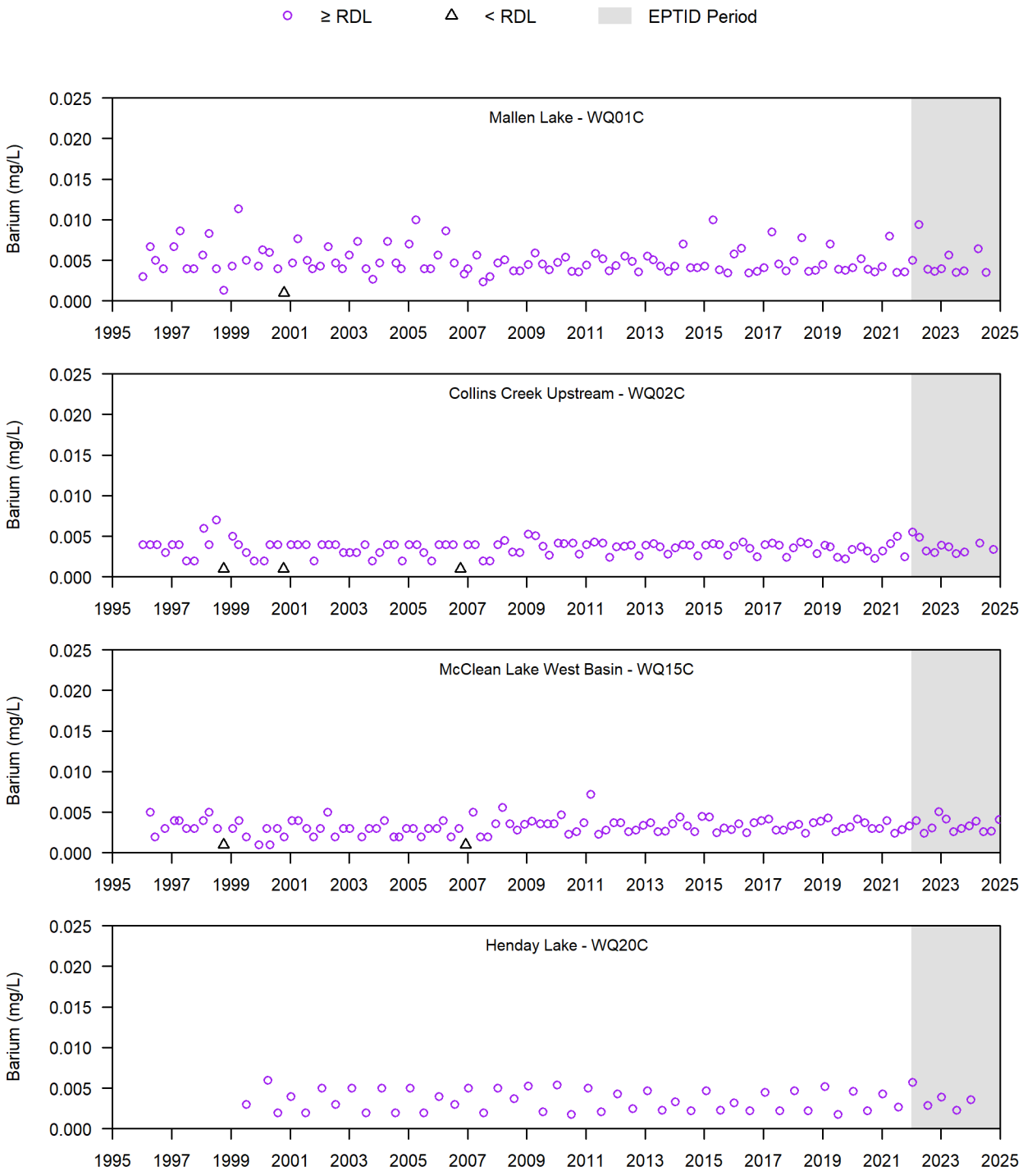


Figure 4.3-6 (27 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

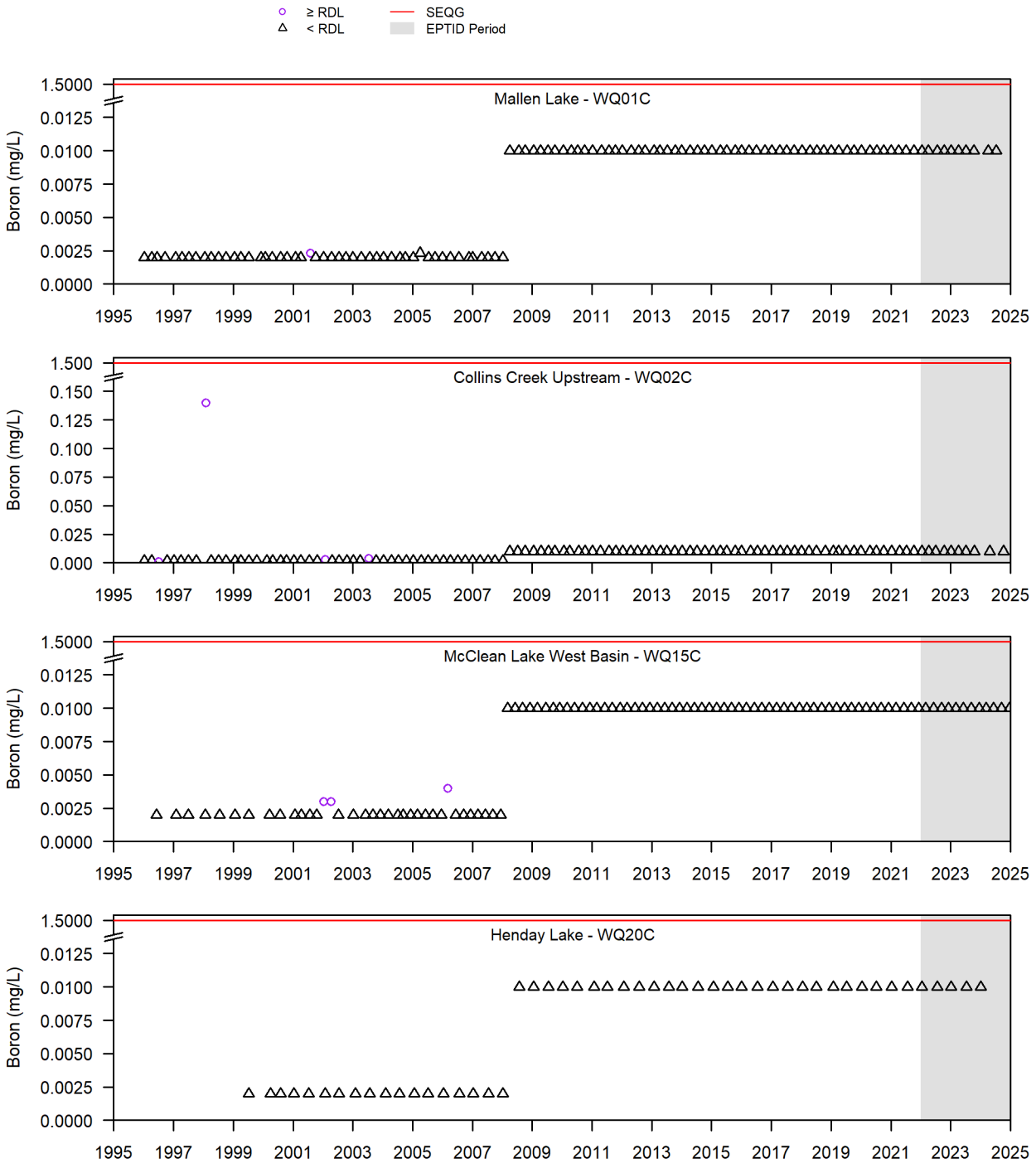


Figure 4.3-6 (28 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

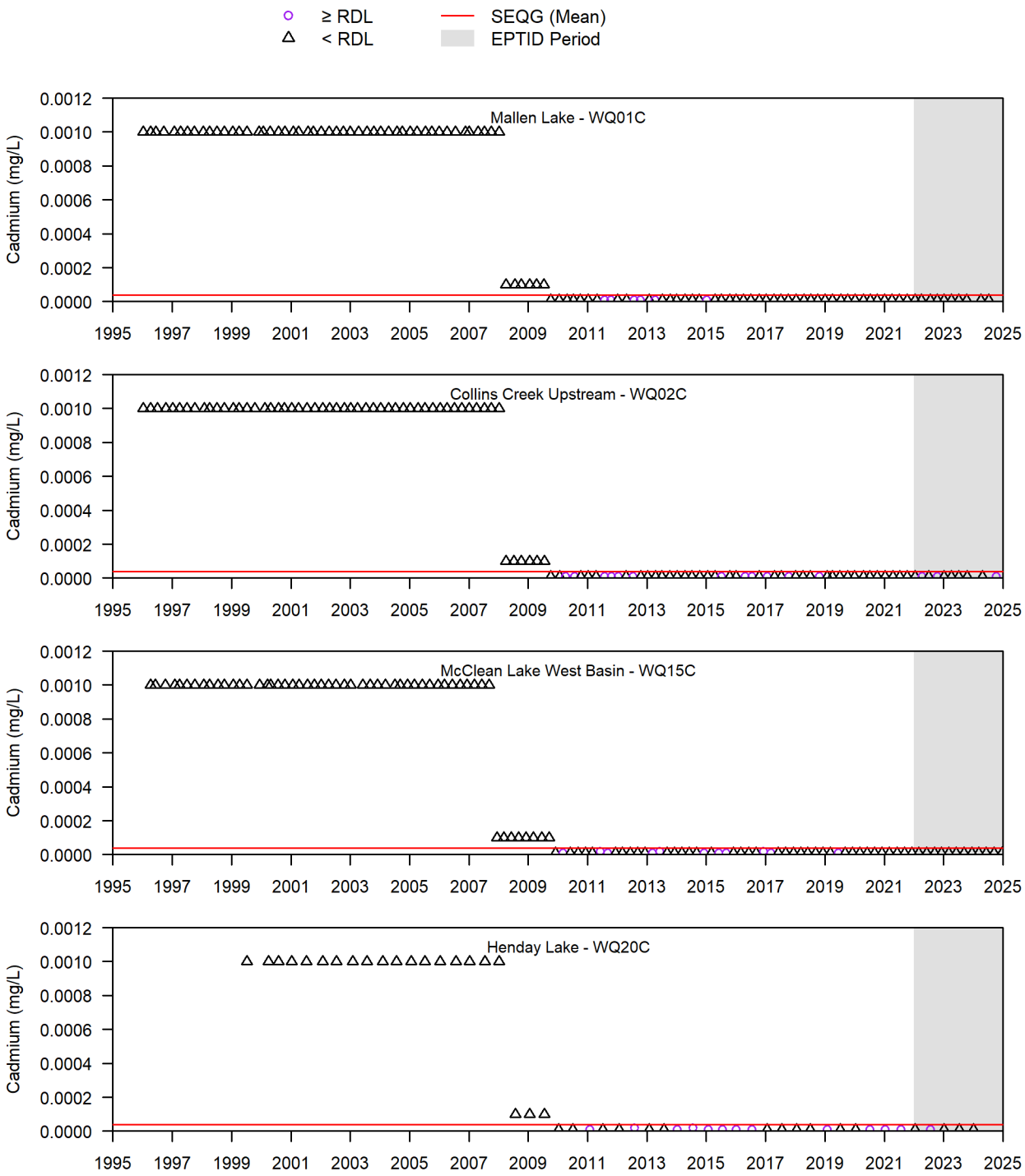


Figure 4.3-6 (29 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

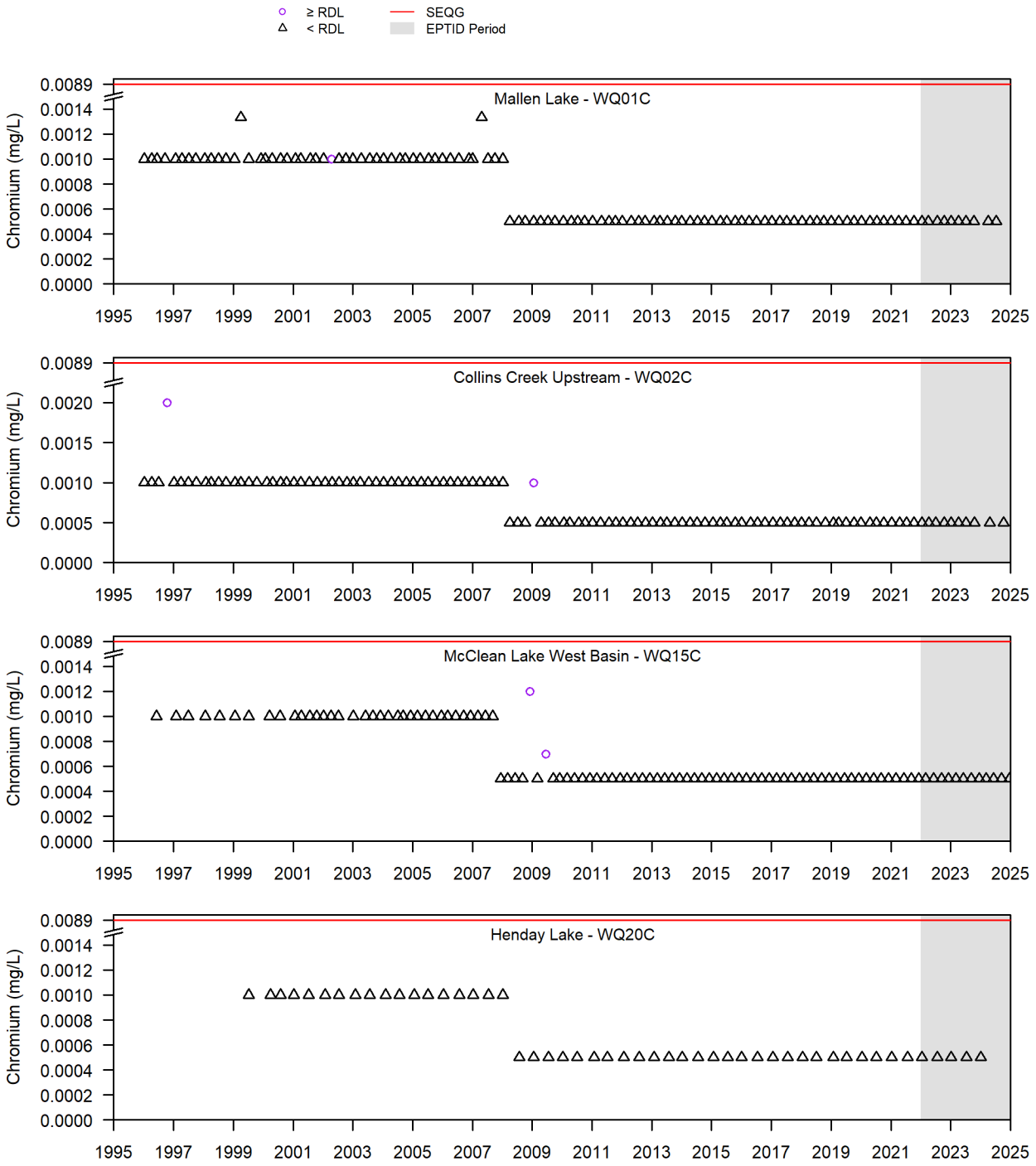


Figure 4.3-6 (30 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

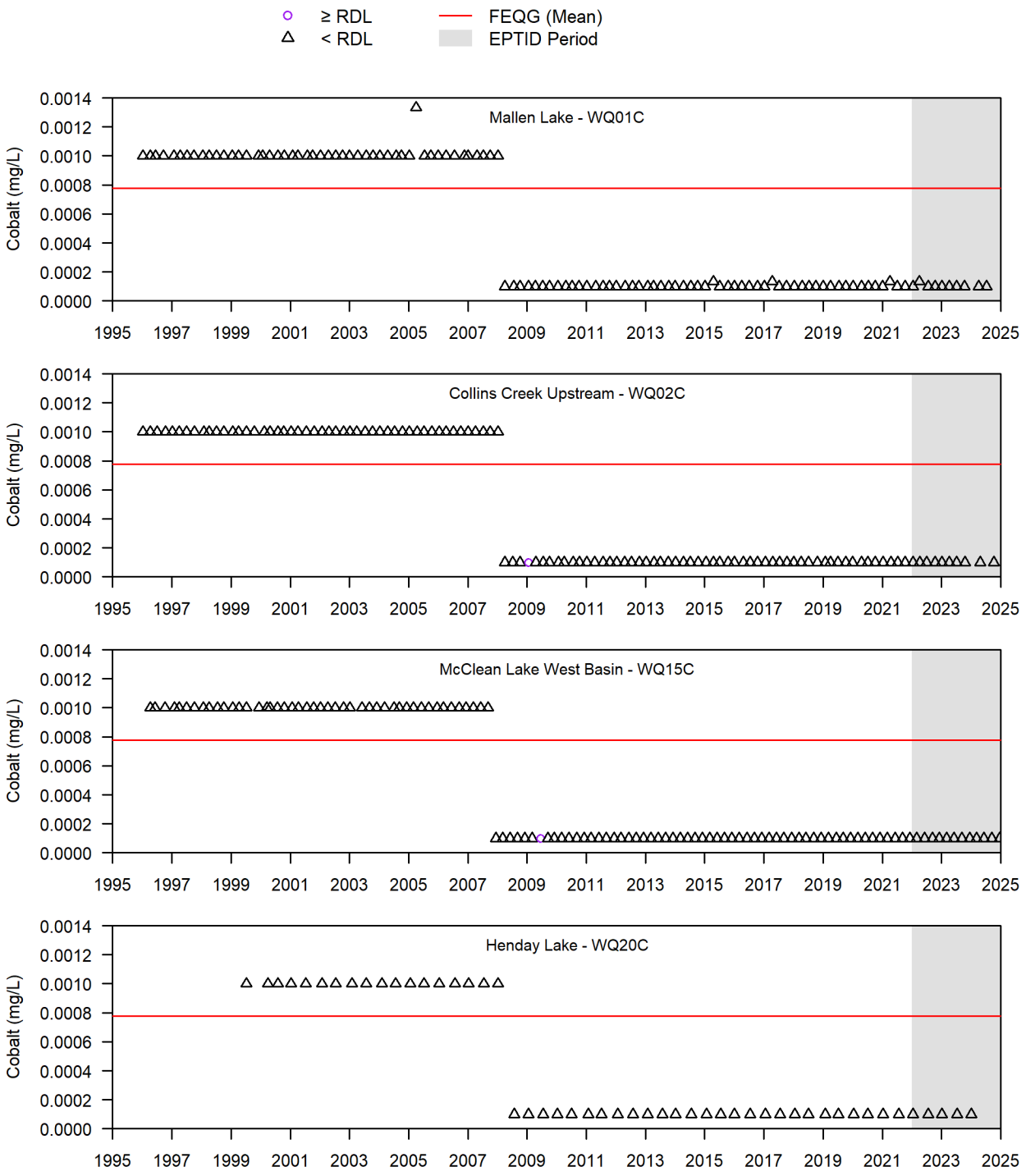


Figure 4.3-6 (31 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

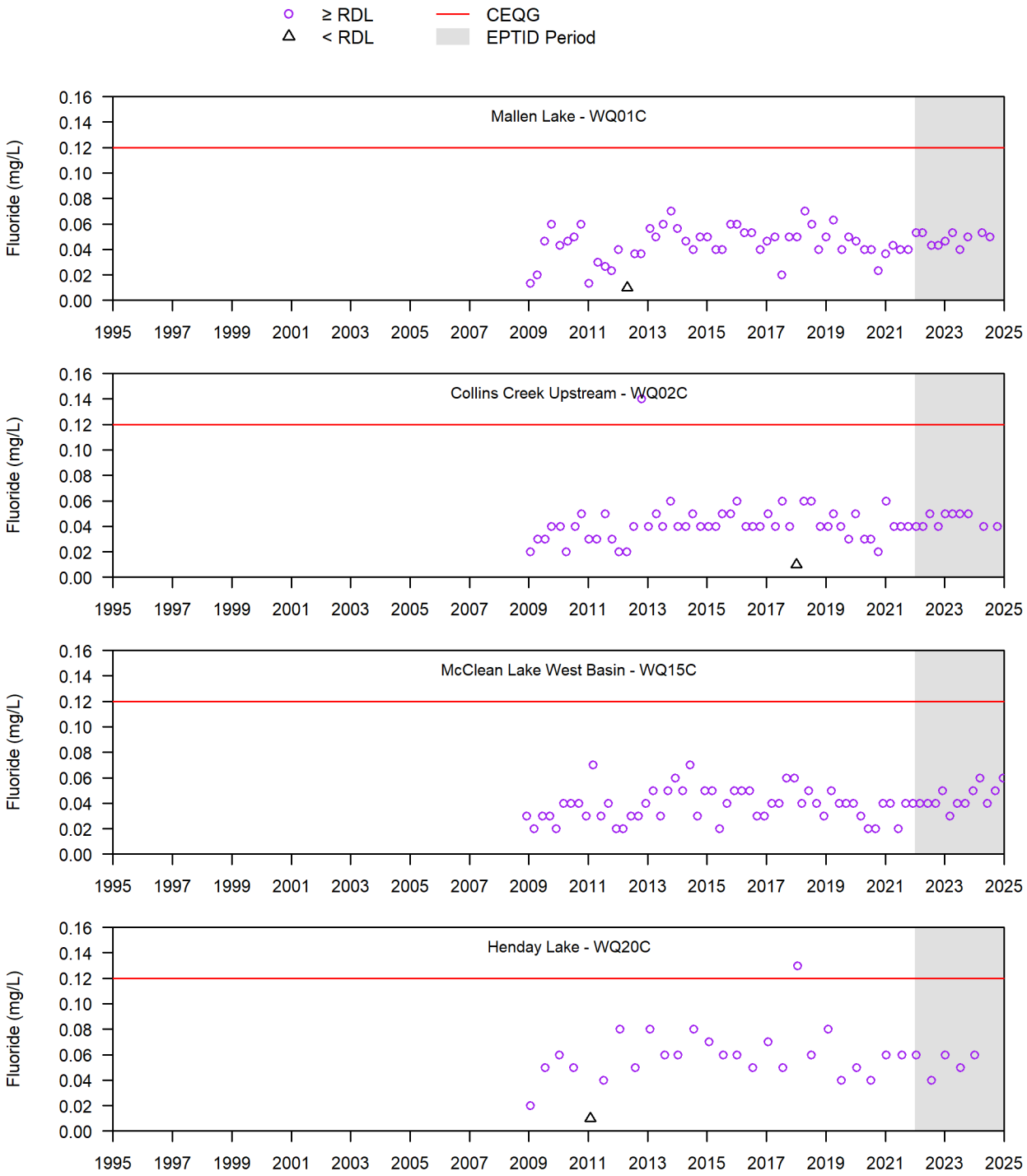


Figure 4.3-6 (32 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

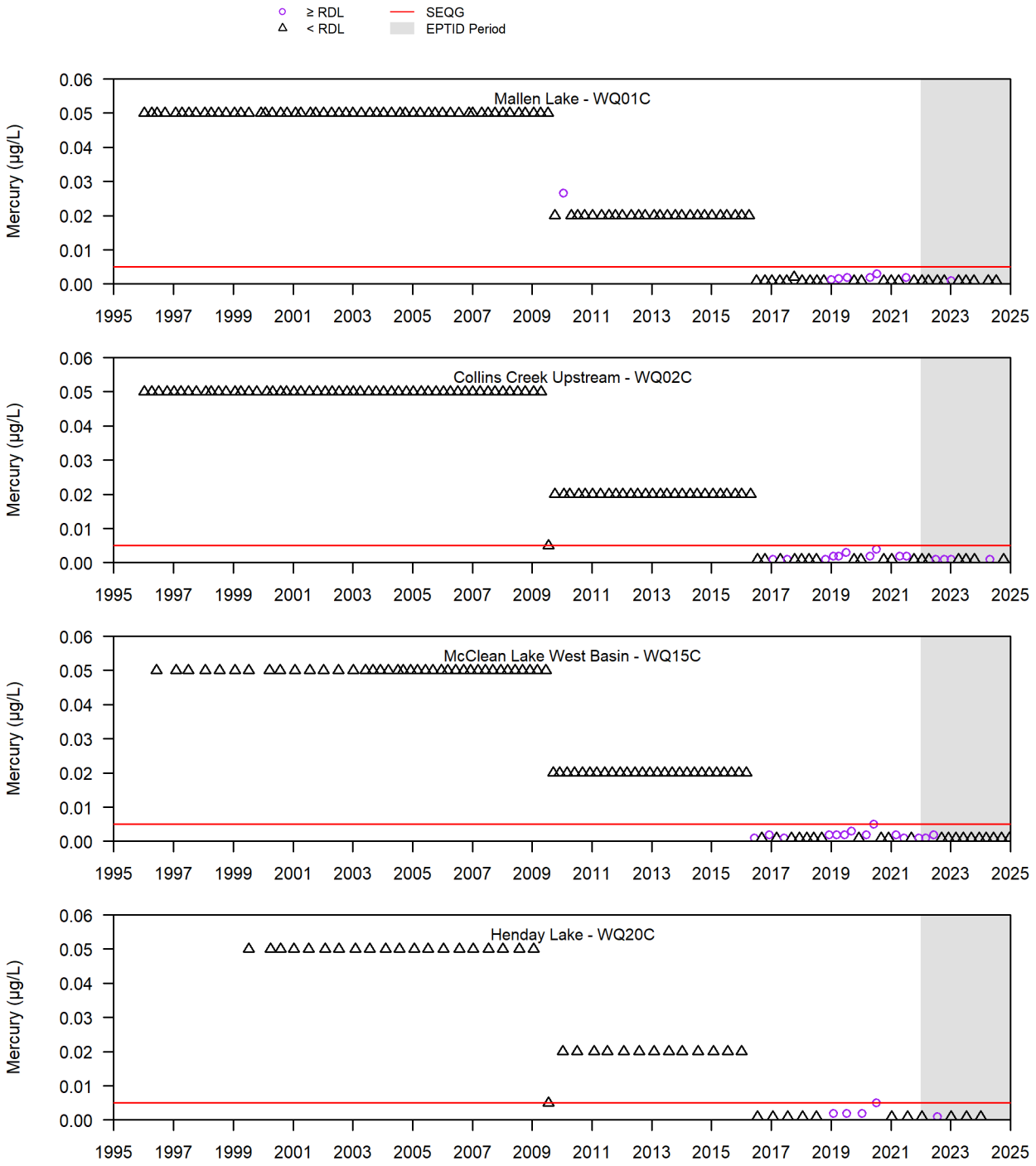


Figure 4.3-6 (33 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

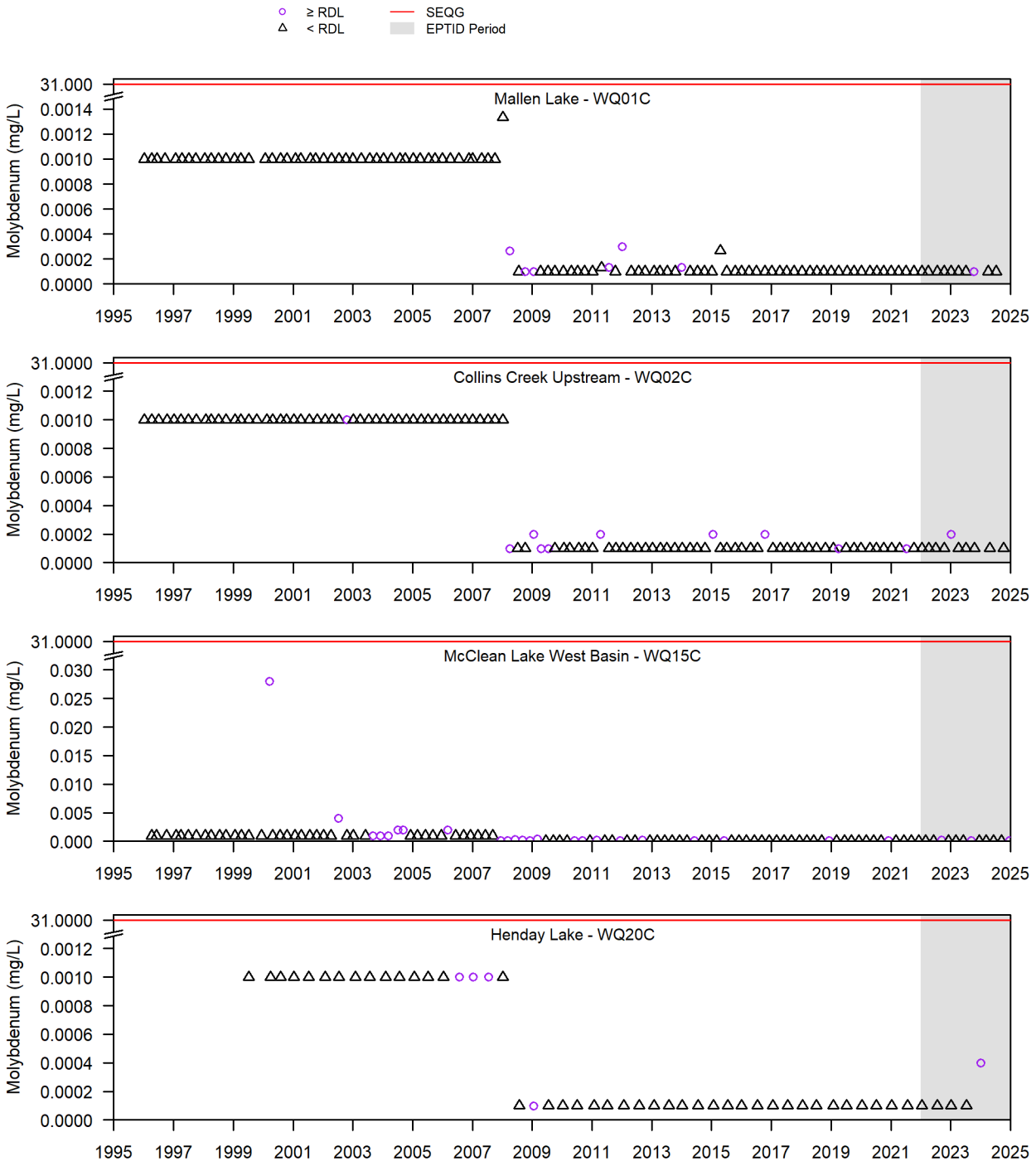


Figure 4.3-6 (34 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

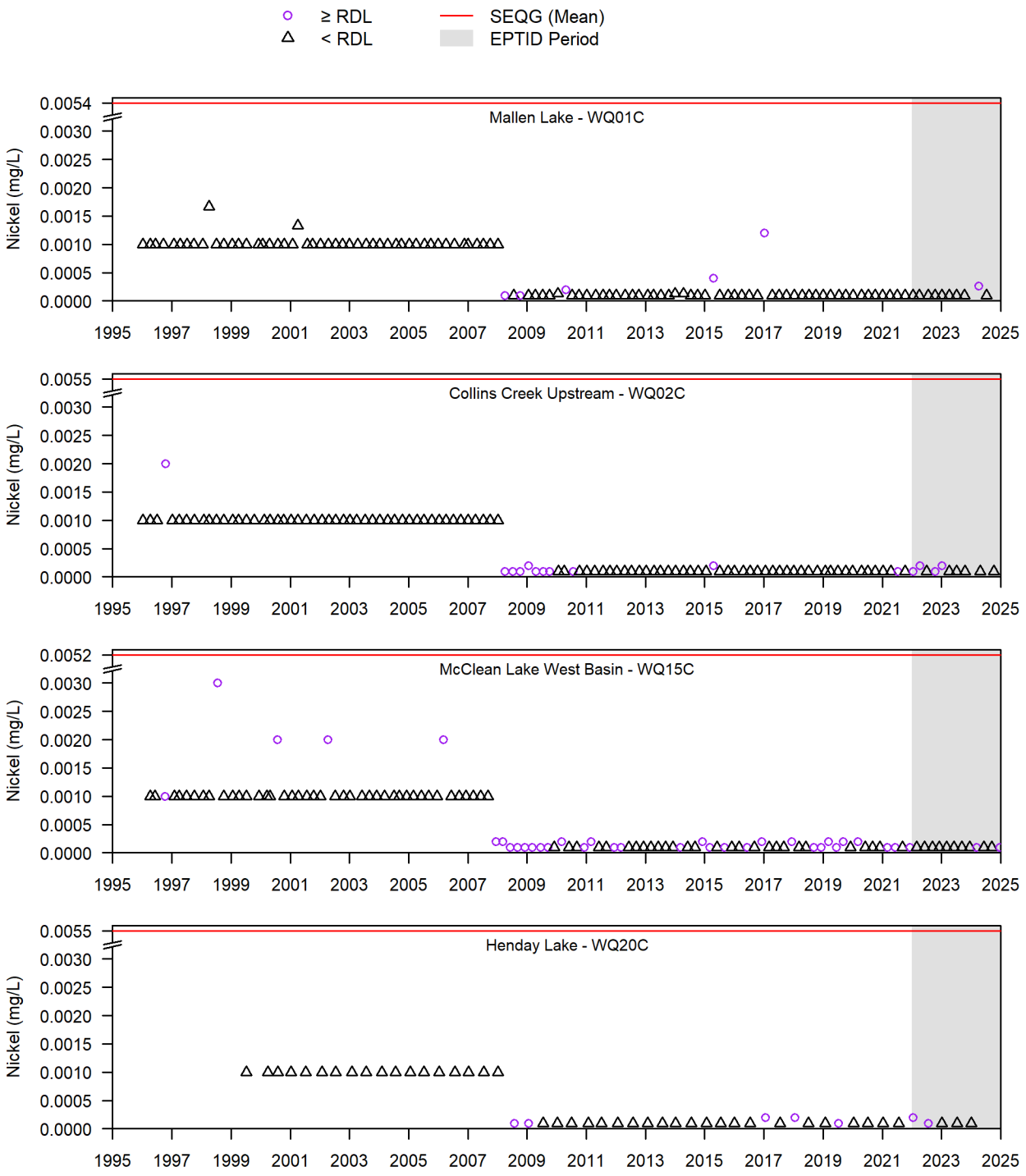


Figure 4.3-6 (35 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

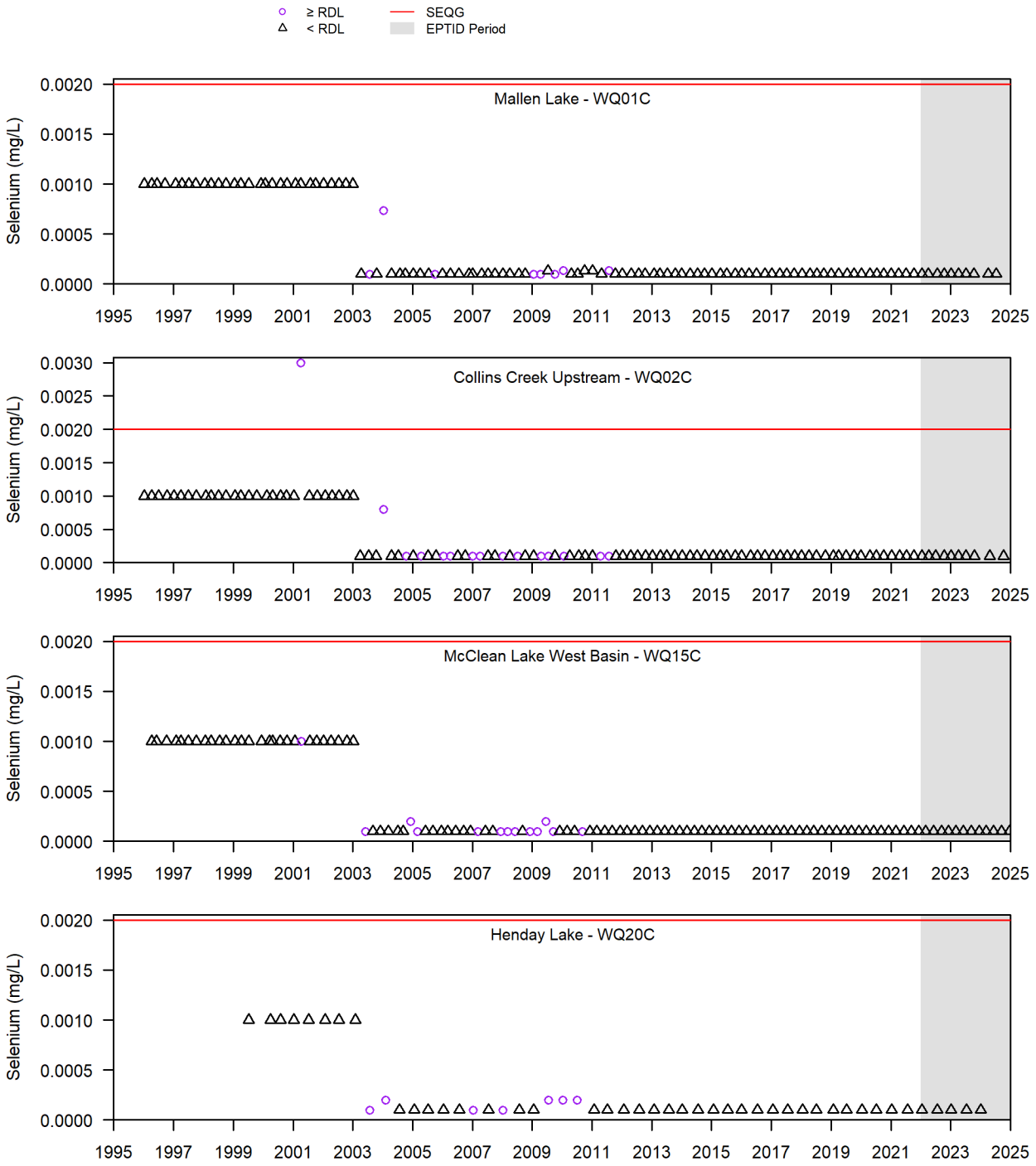


Figure 4.3-6 (36 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

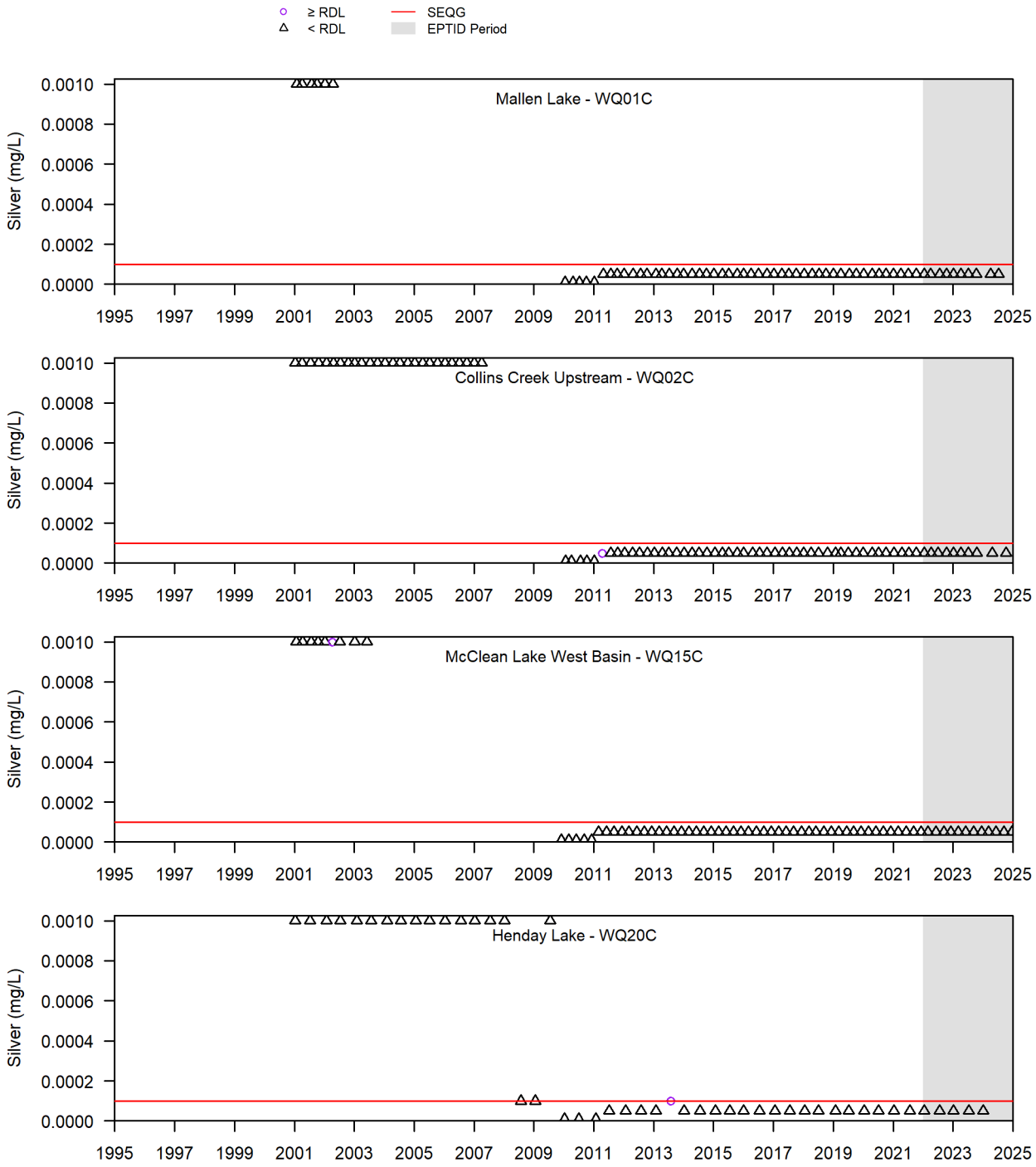


Figure 4.3-6 (37 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

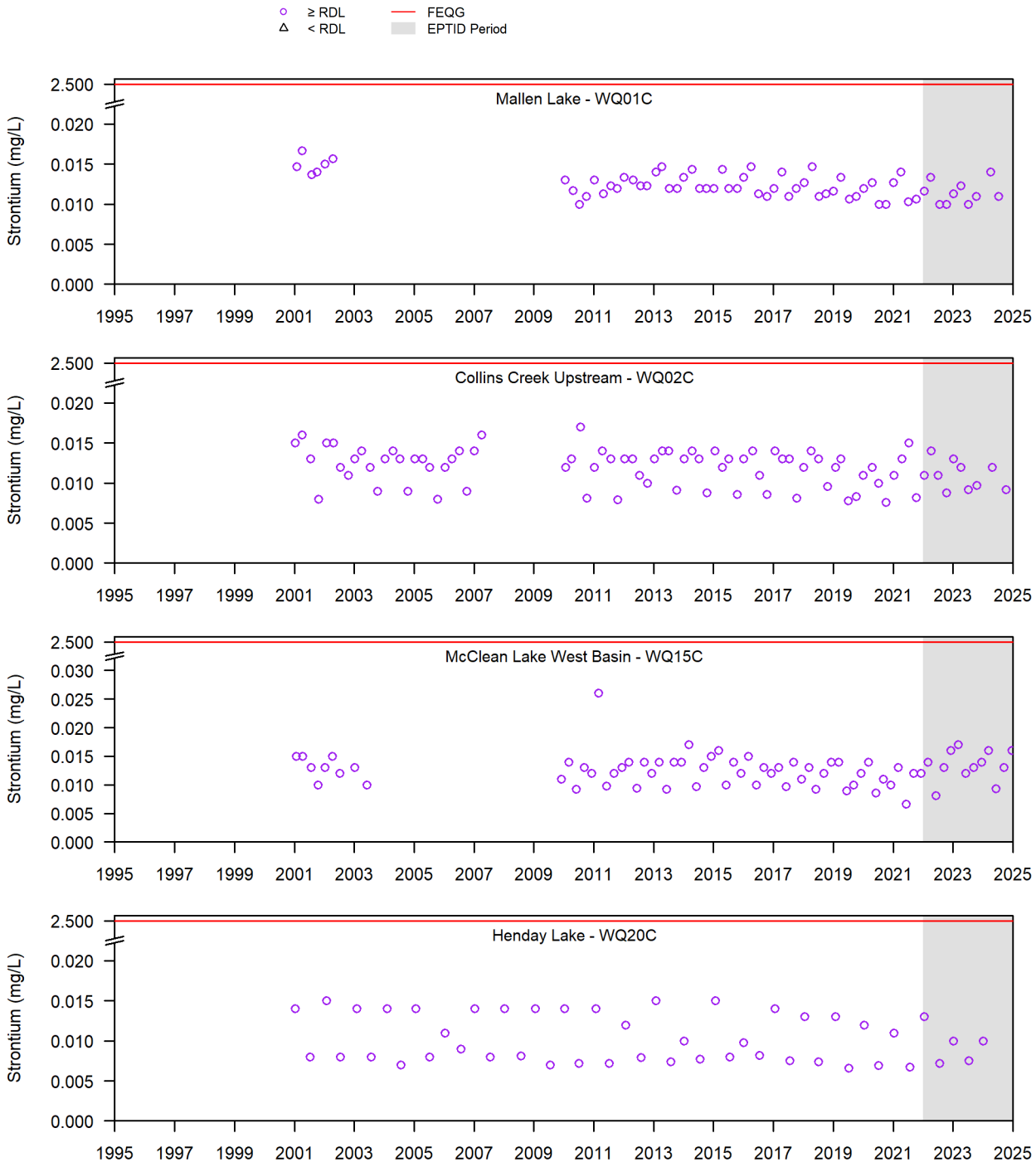


Figure 4.3-6 (38 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

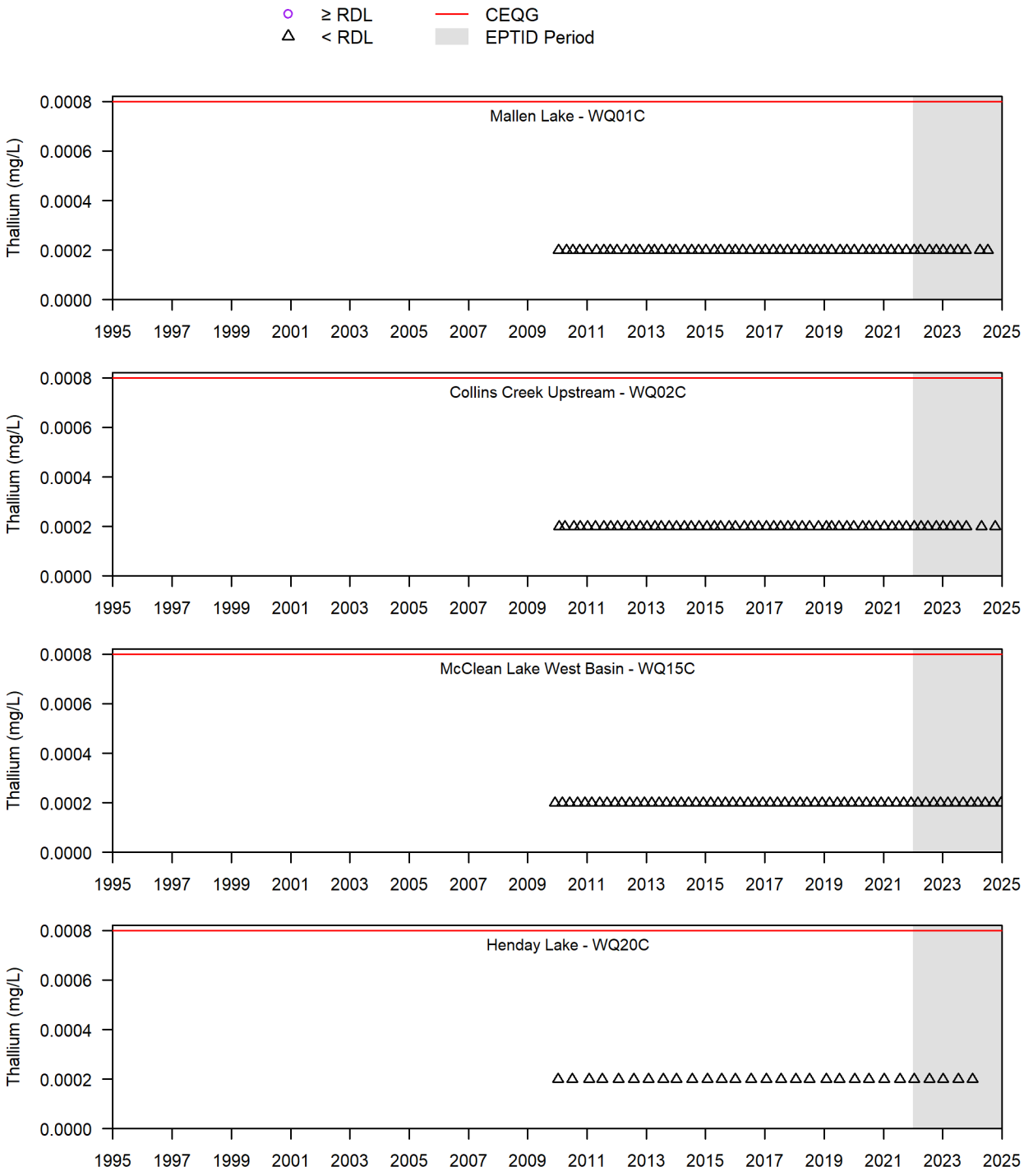


Figure 4.3-6 (39 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

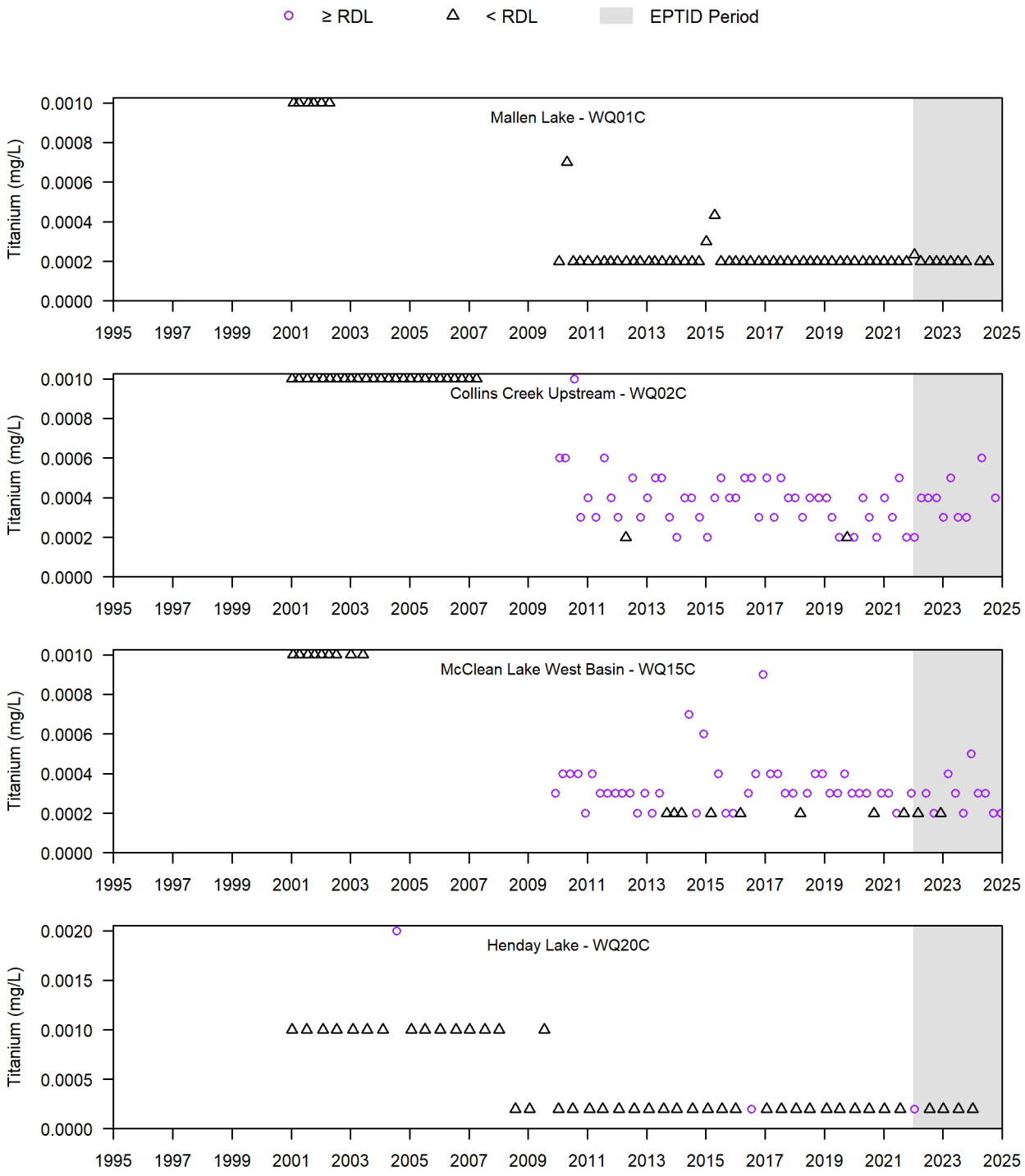


Figure 4.3-6 (40 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

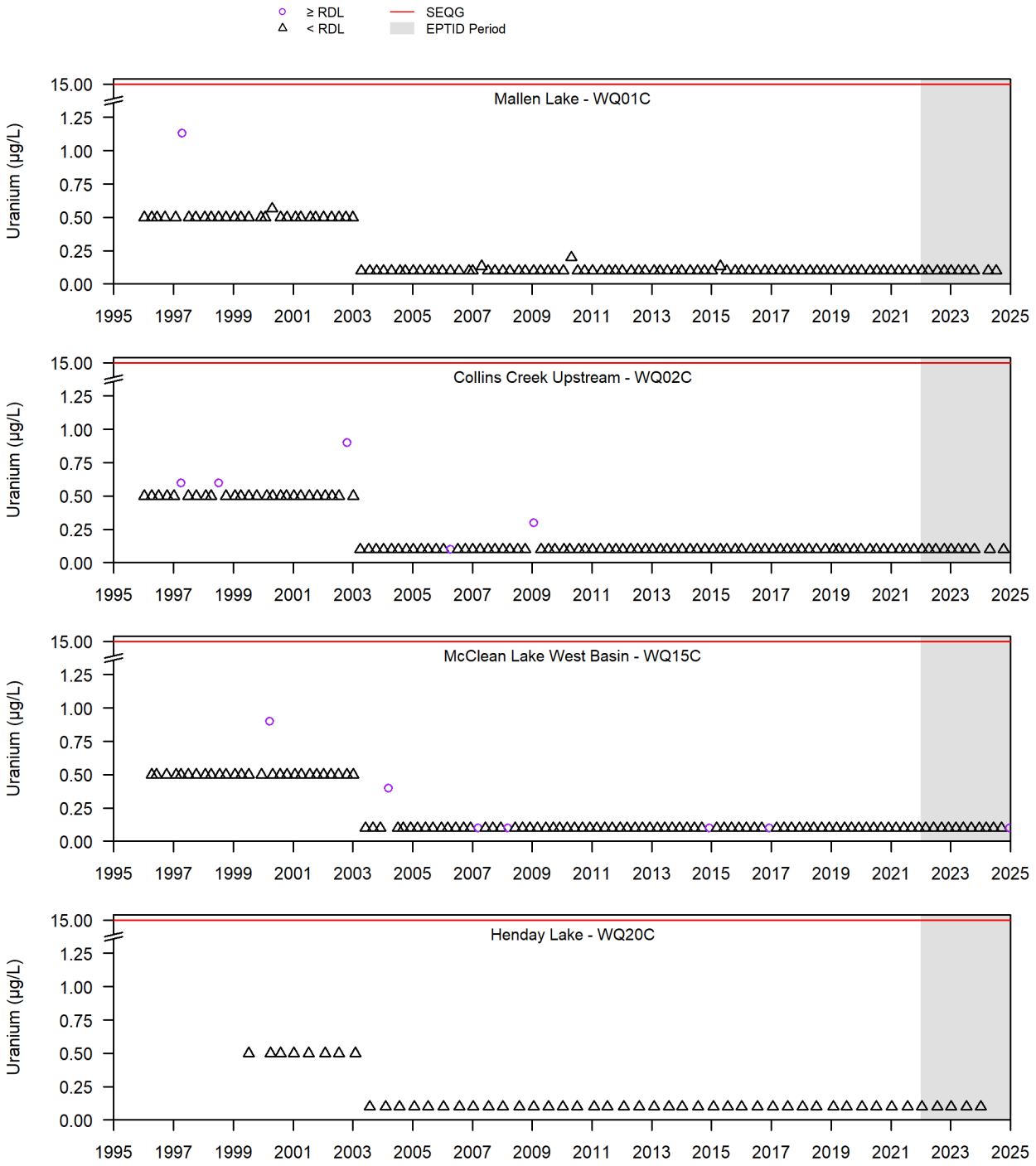


Figure 4.3-6 (41 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

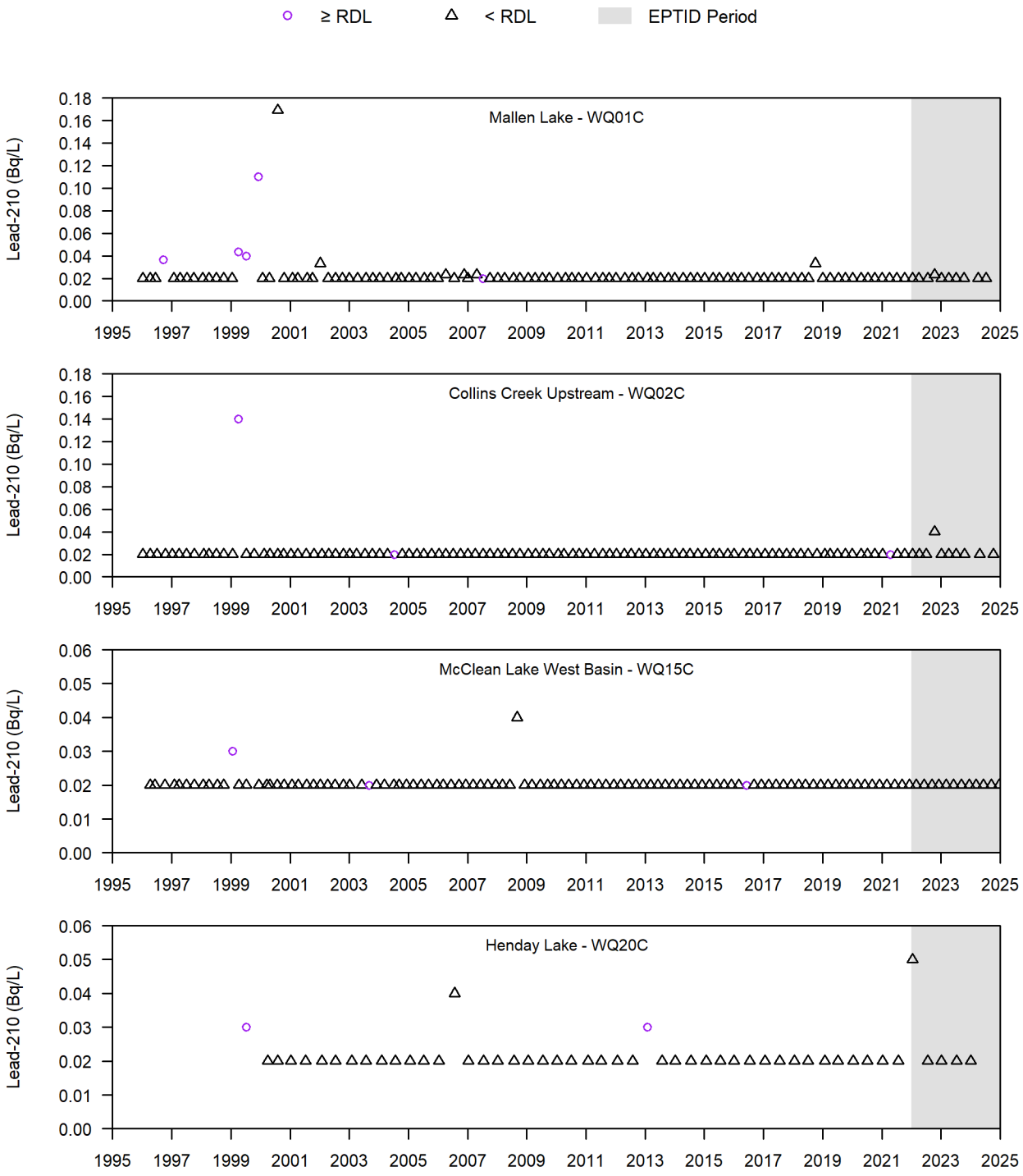


Figure 4.3-6 (42 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

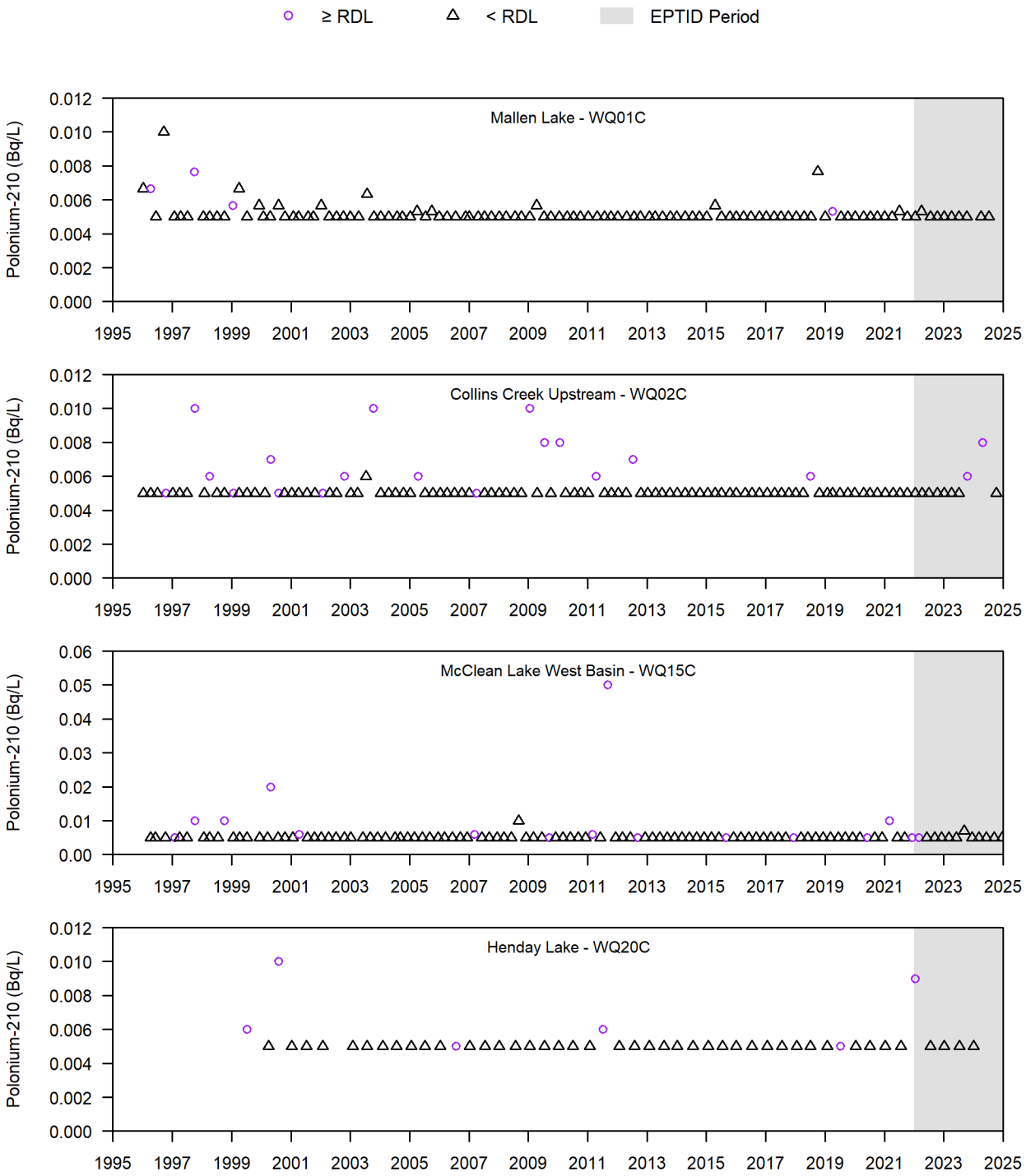


Figure 4.3-6 (43 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.

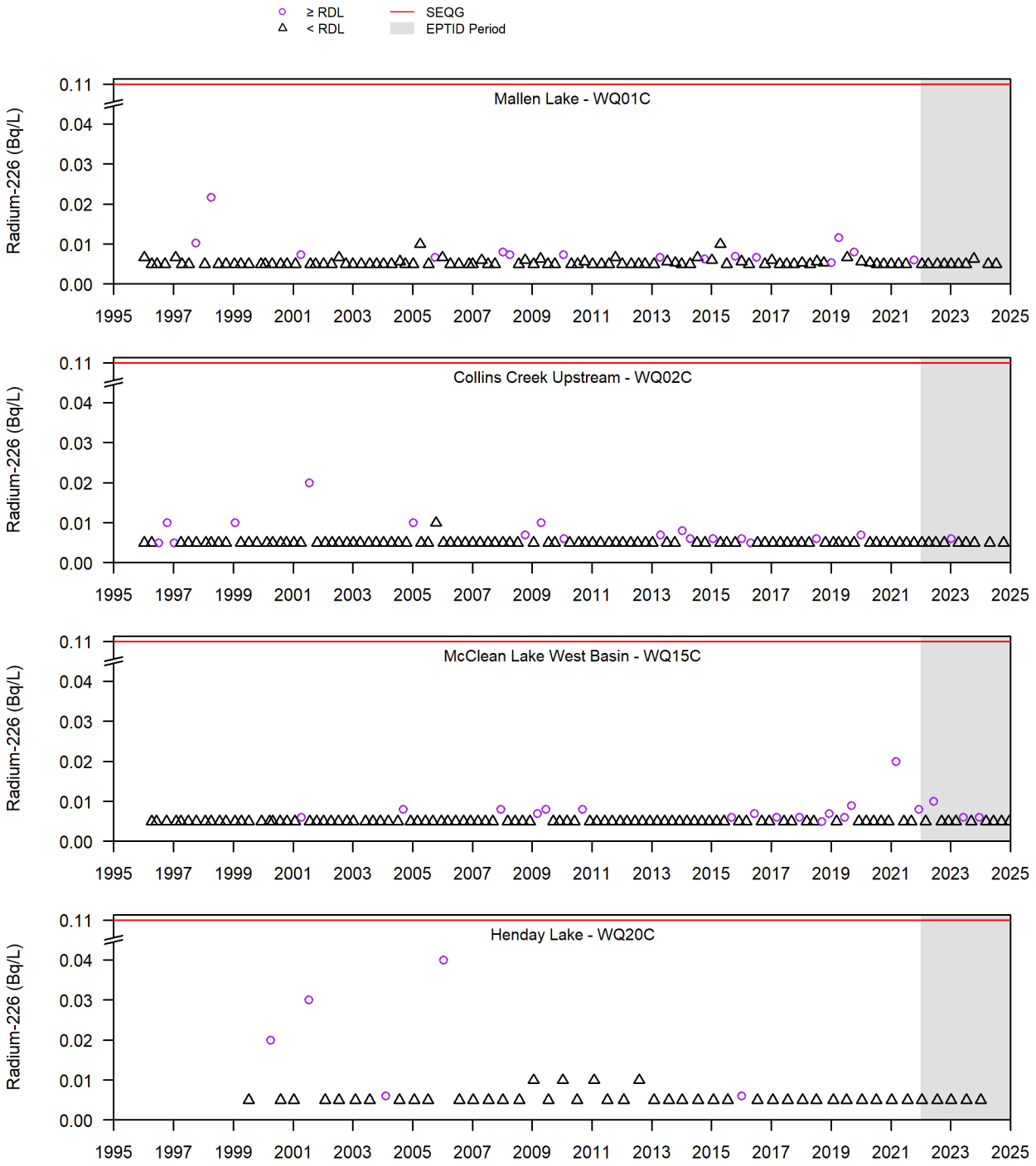
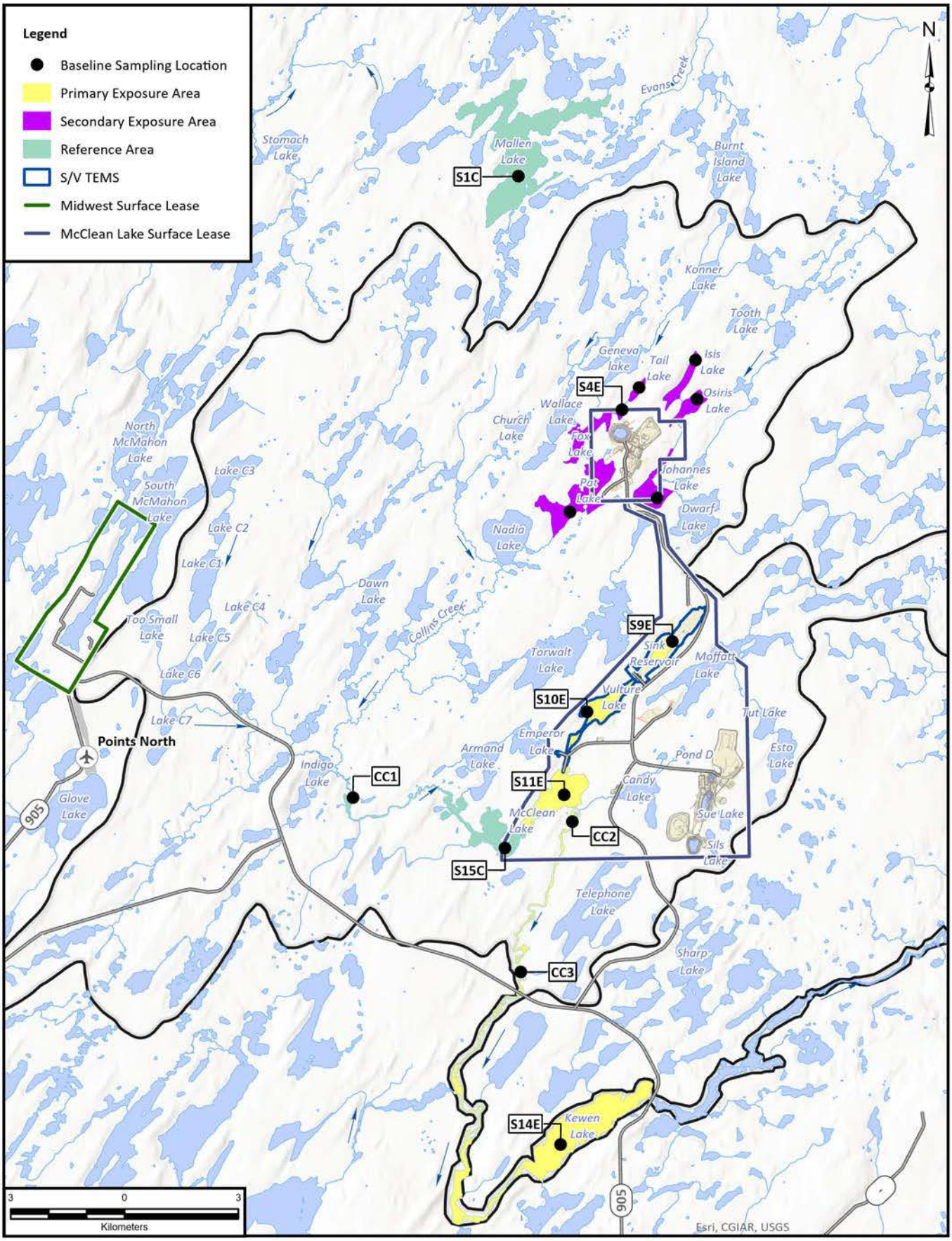


Figure 4.3-6 (44 of 44) COPC Levels in the Reference Area Surface Water with Associated Guidelines.



Projection: NAD 1983 UTM Zone 13N
Drawn: TL
Date: 2025-07-10 Scale: 1:140,000
Data Sources: Natural Resources Canada, ORANO Canada Inc.

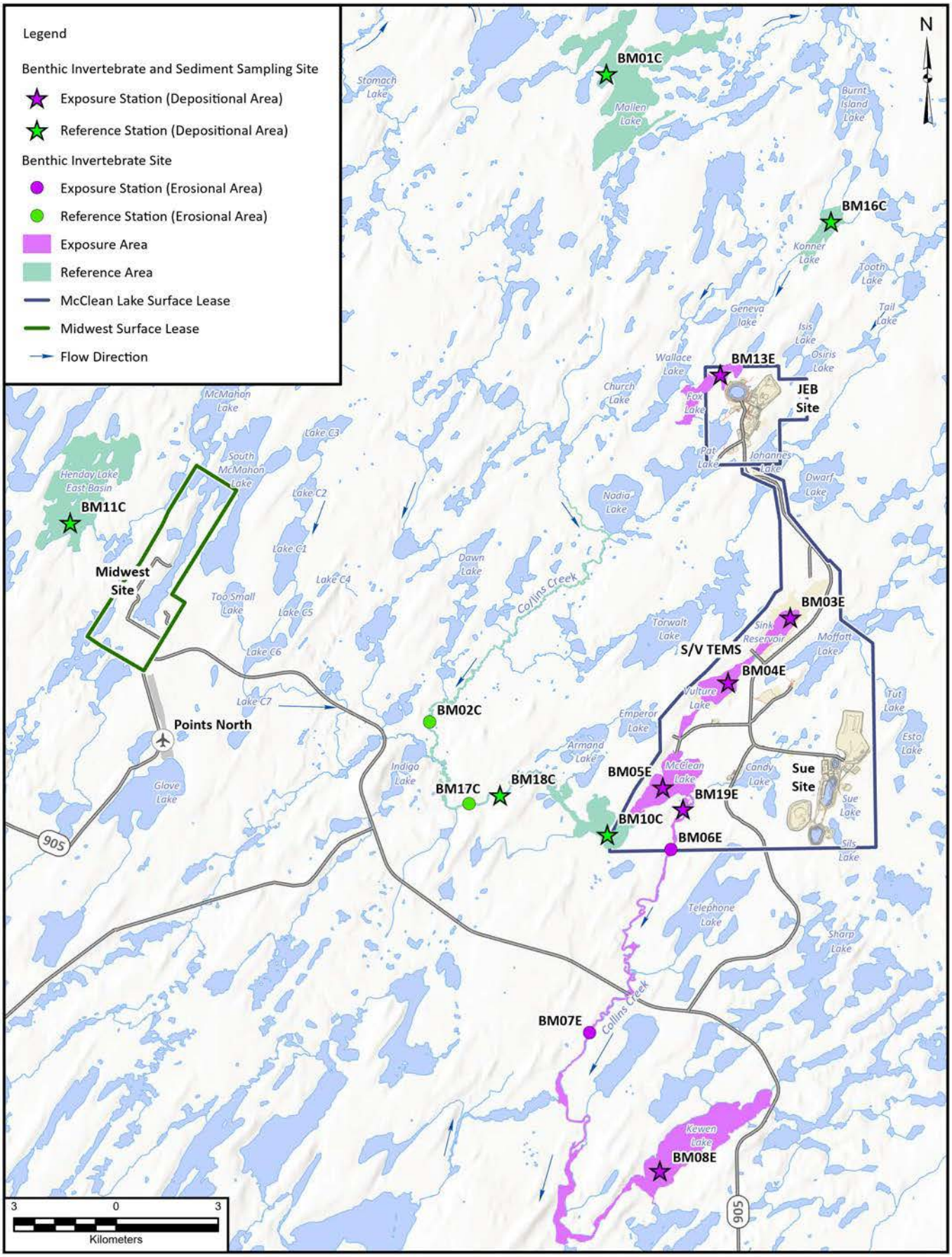
McCLEAN LAKE OPERATION

FIGURE 4.4-1
BASELINE SEDIMENT SAMPLING AREAS
FOR THE McCLEAN LAKE OPERATION

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 4\EPTID Section 4.aprx



Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-10-27 11:41 AM Scale: 1:130,000
Data Sources: Natural Resources Canada, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 4.4-2
BENTHIC INVERTEBRATE AND SEDIMENT SAMPLING AREAS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 4\EPTID Section 4.aprx

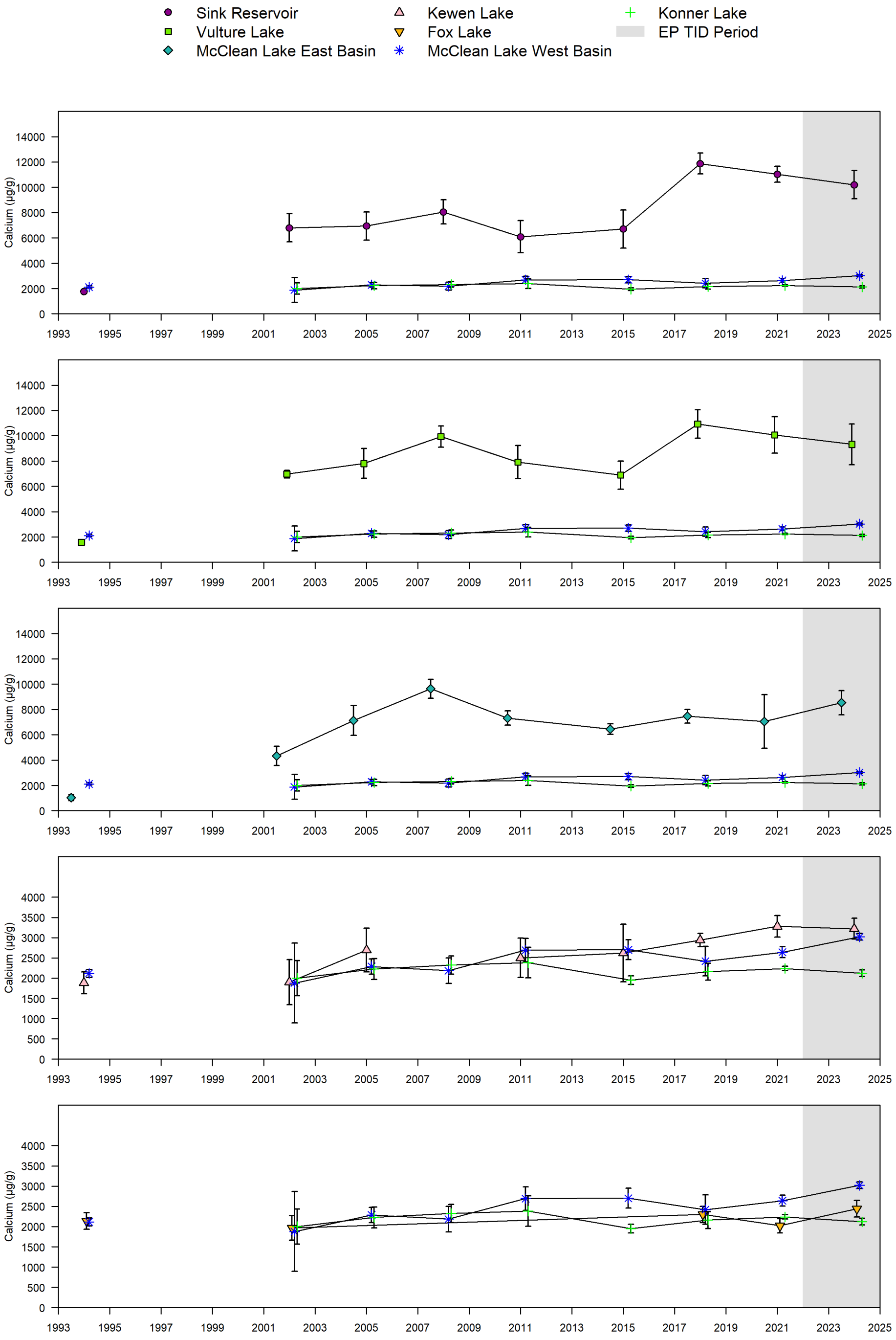


Figure 4.4-3 (1 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

Note: A break in a line represents a monitoring year with data available for some parameters, but not this specific COPC.

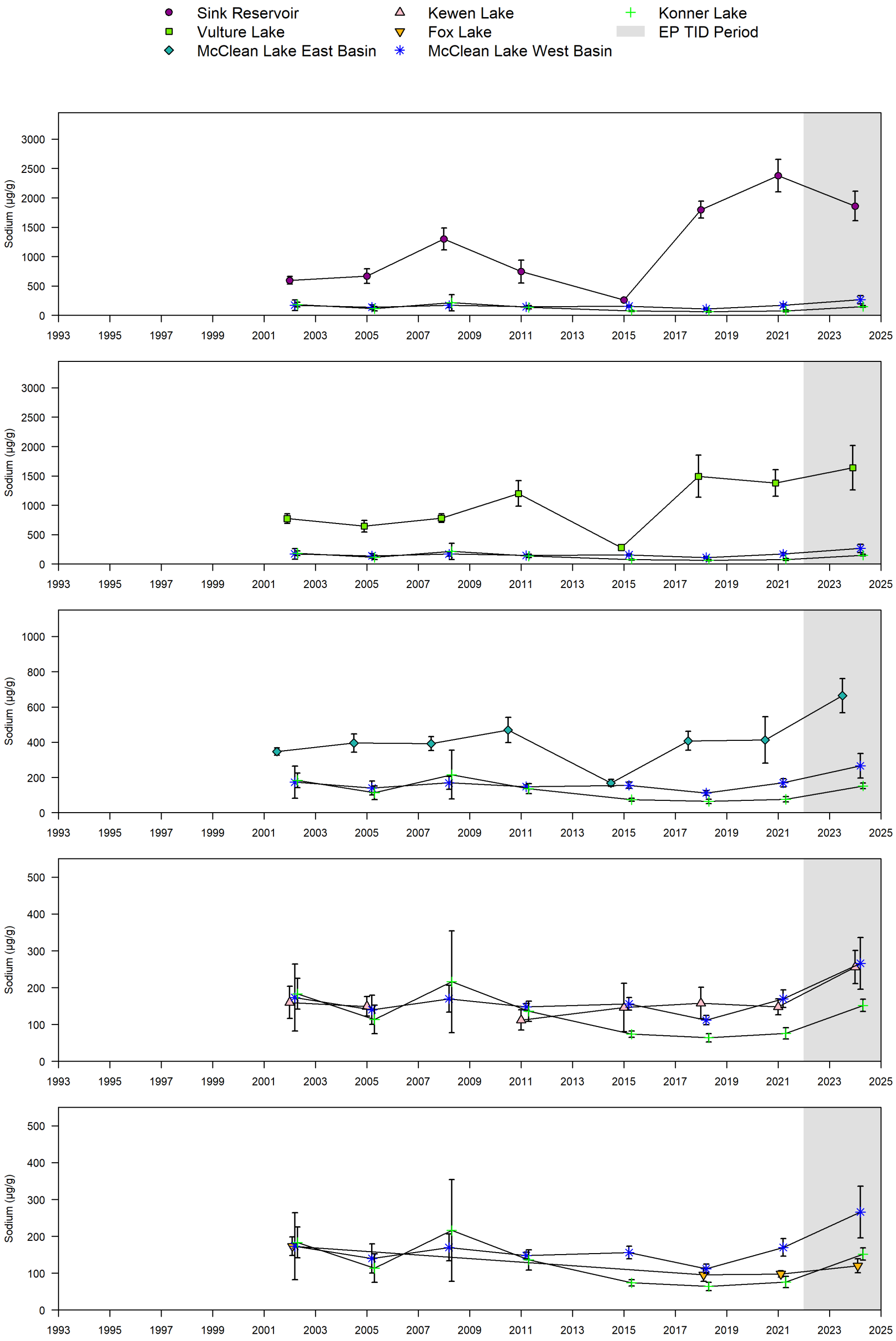


Figure 4.4-3 (2 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

Note: A break in a line represents a monitoring year with data available for some parameters, but not this specific COPC.

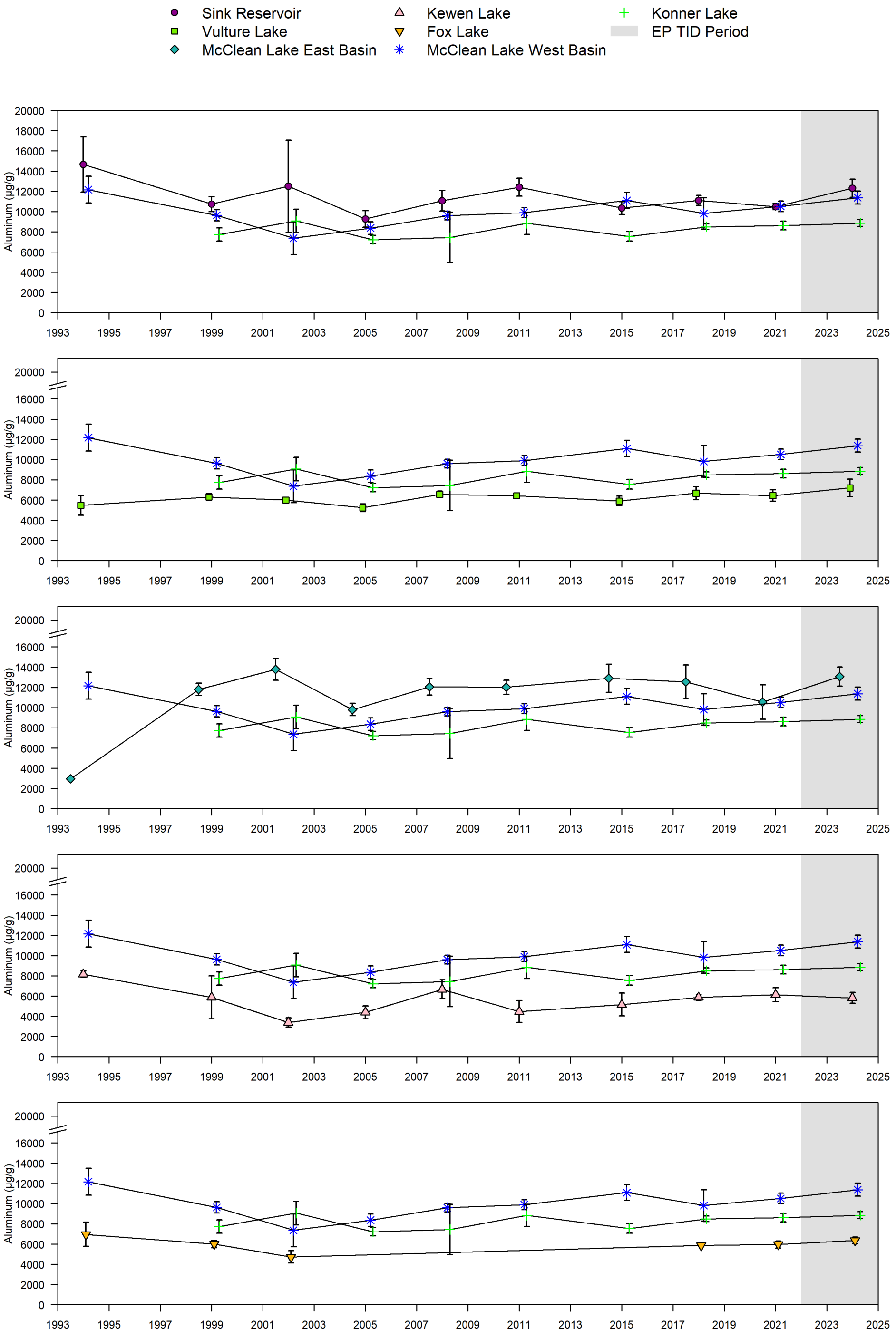


Figure 4.4-3 (3 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

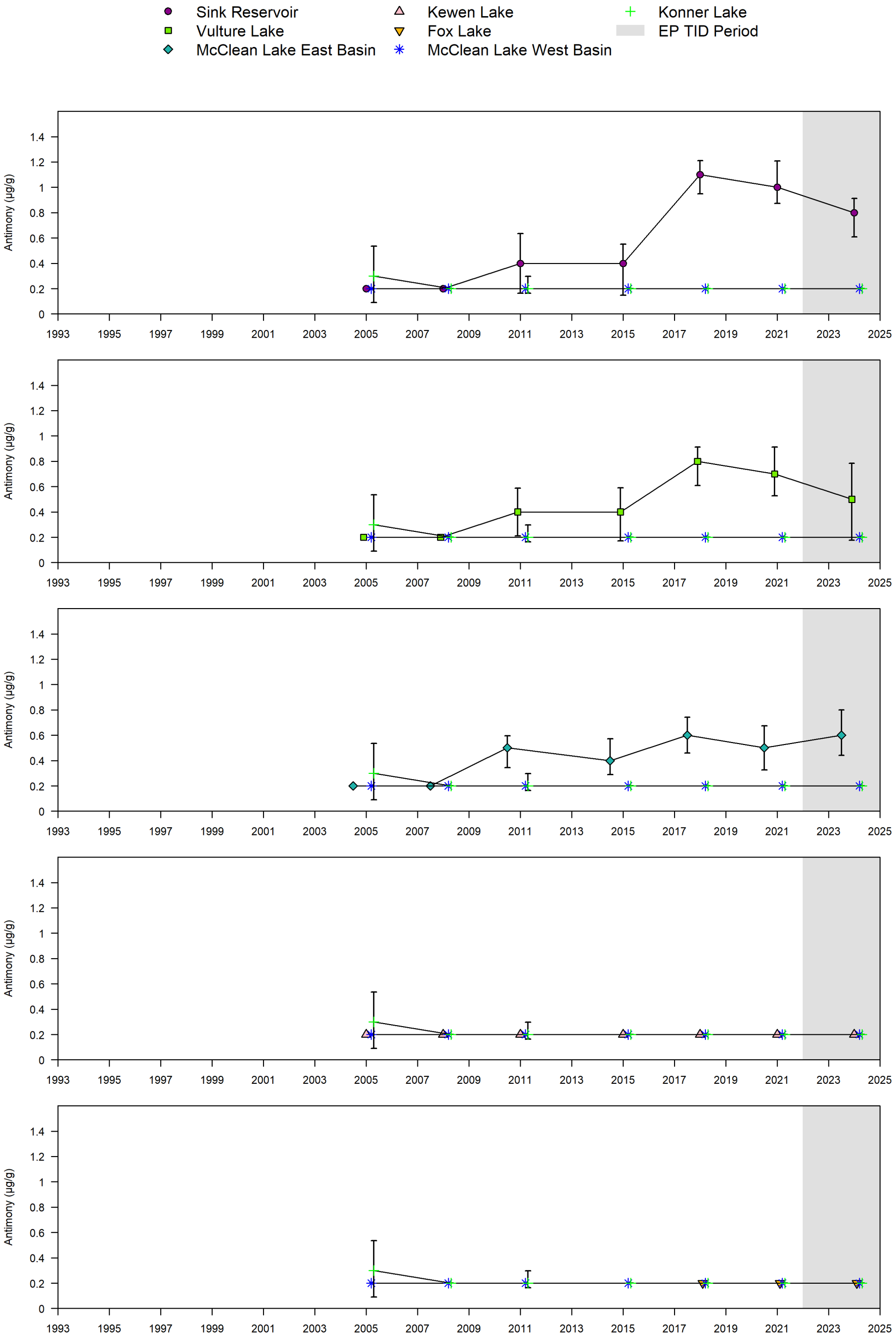


Figure 4.4-3 (4 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

Figure 4.4-3 (5 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

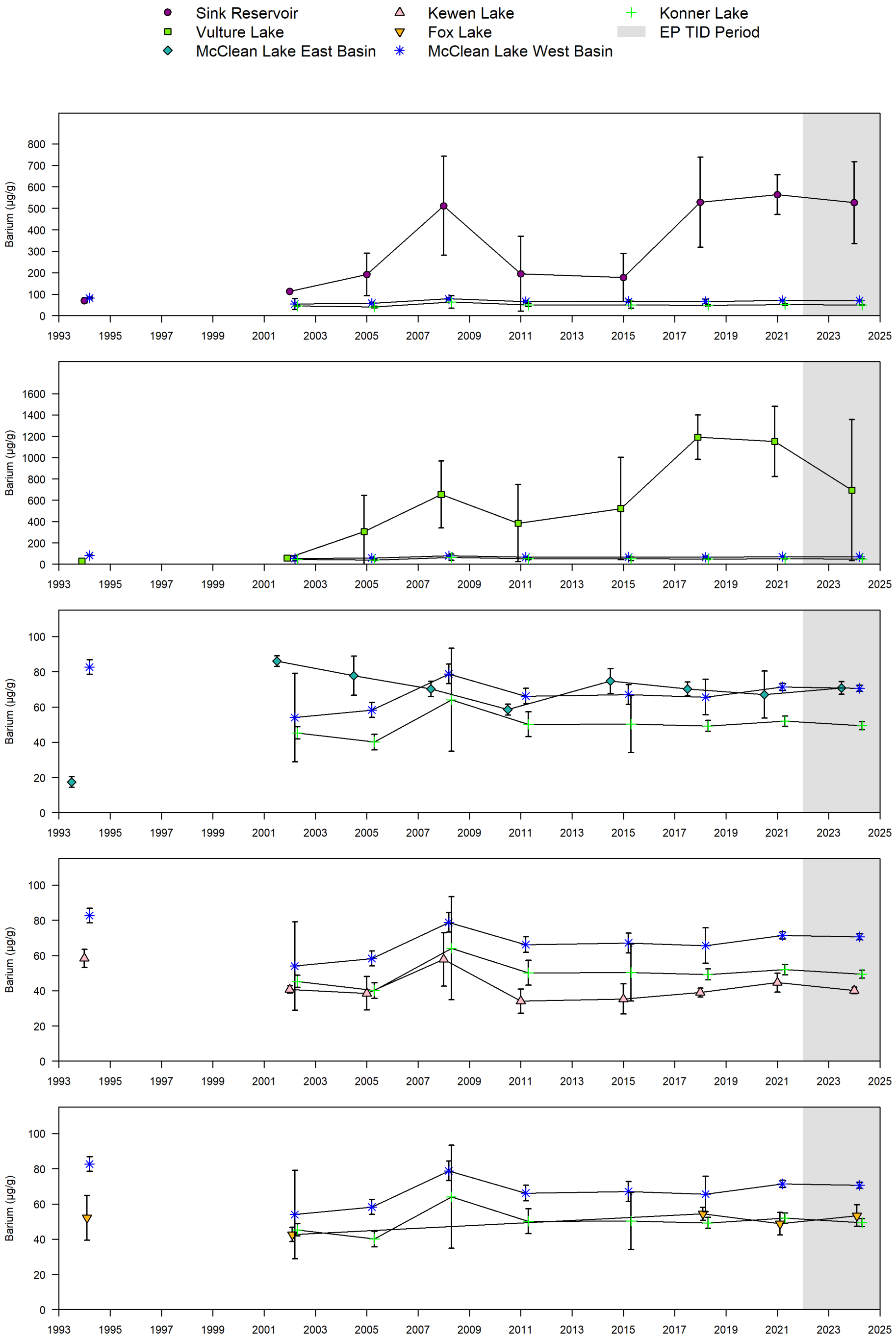


Figure 4.4-3 (6 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

Note: A break in a line represents a monitoring year with data available for some parameters, but not this specific COPC.

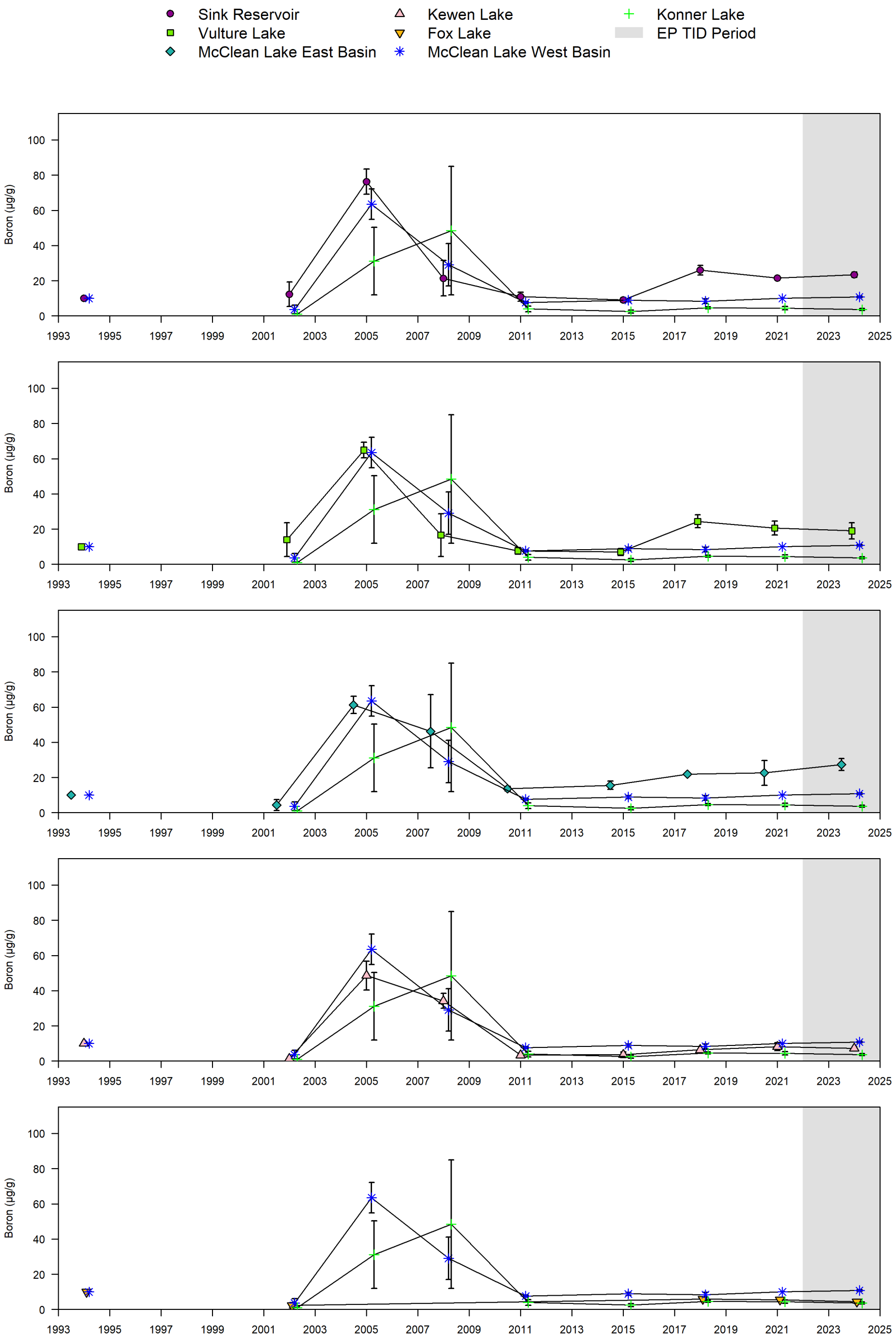


Figure 4.4-3 (7 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

Note: A break in a line represents a monitoring year with data available for some parameters, but not this specific COPC.

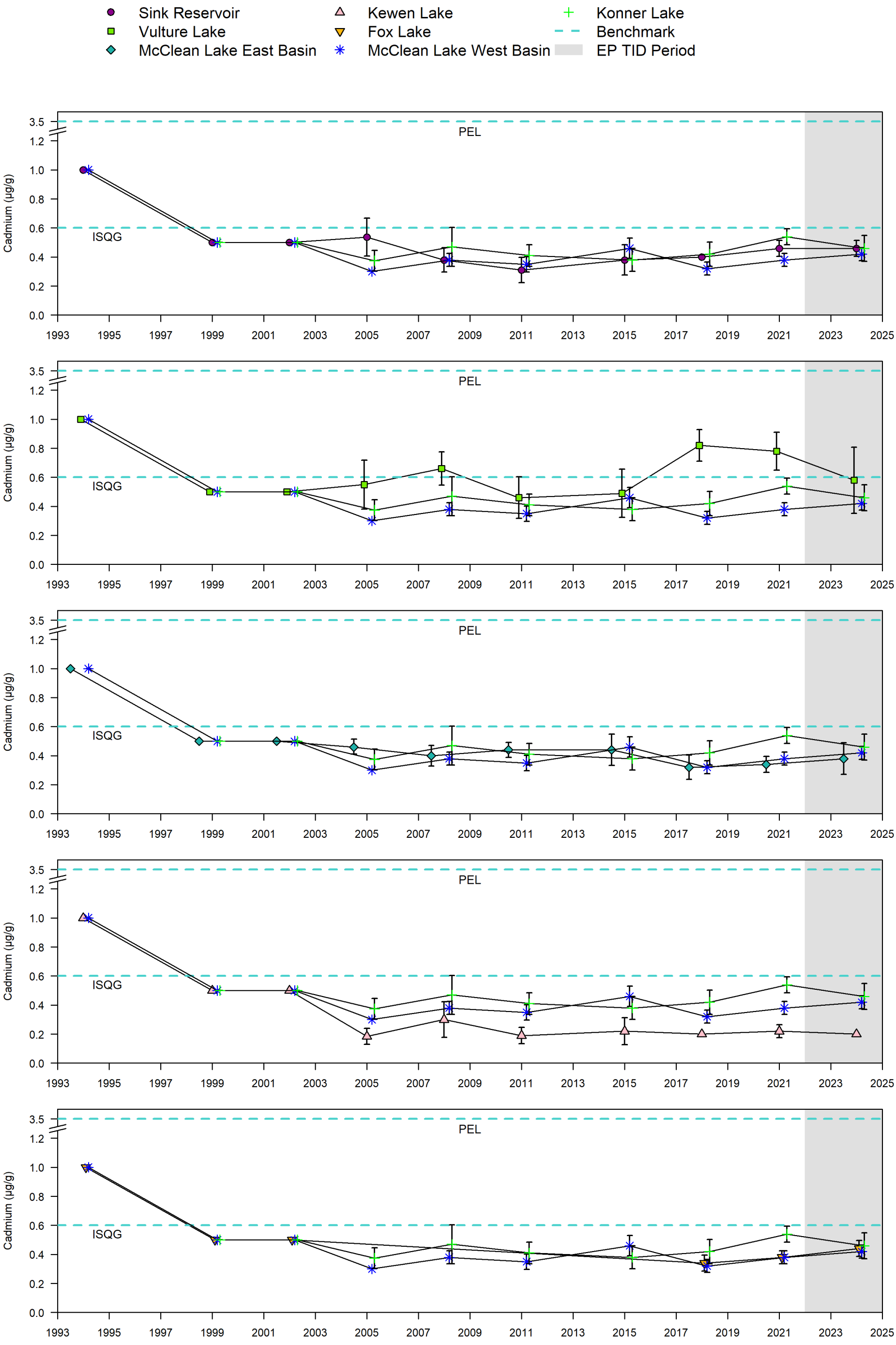


Figure 4.4-3 (8 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

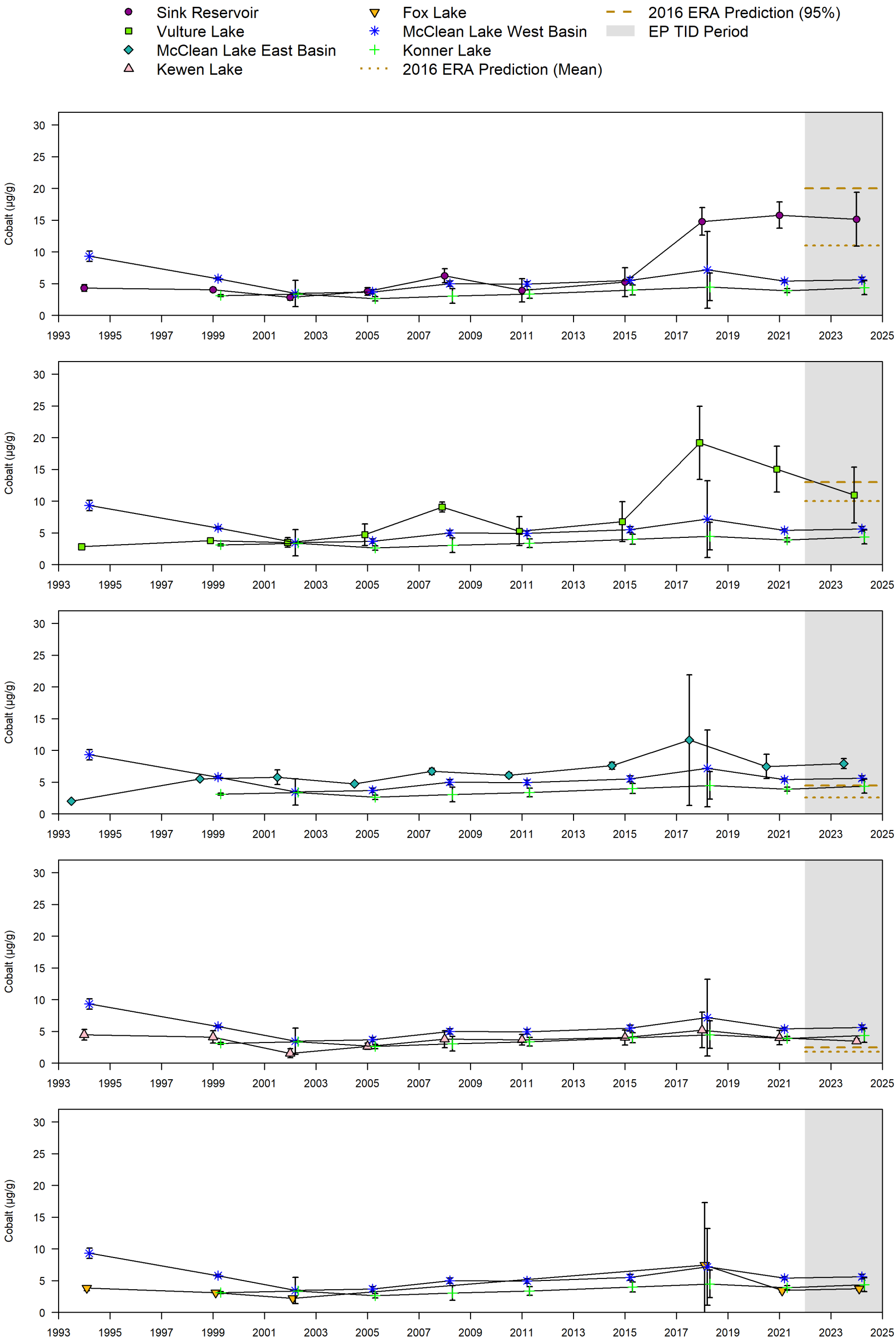


Figure 4.4-3 (9 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

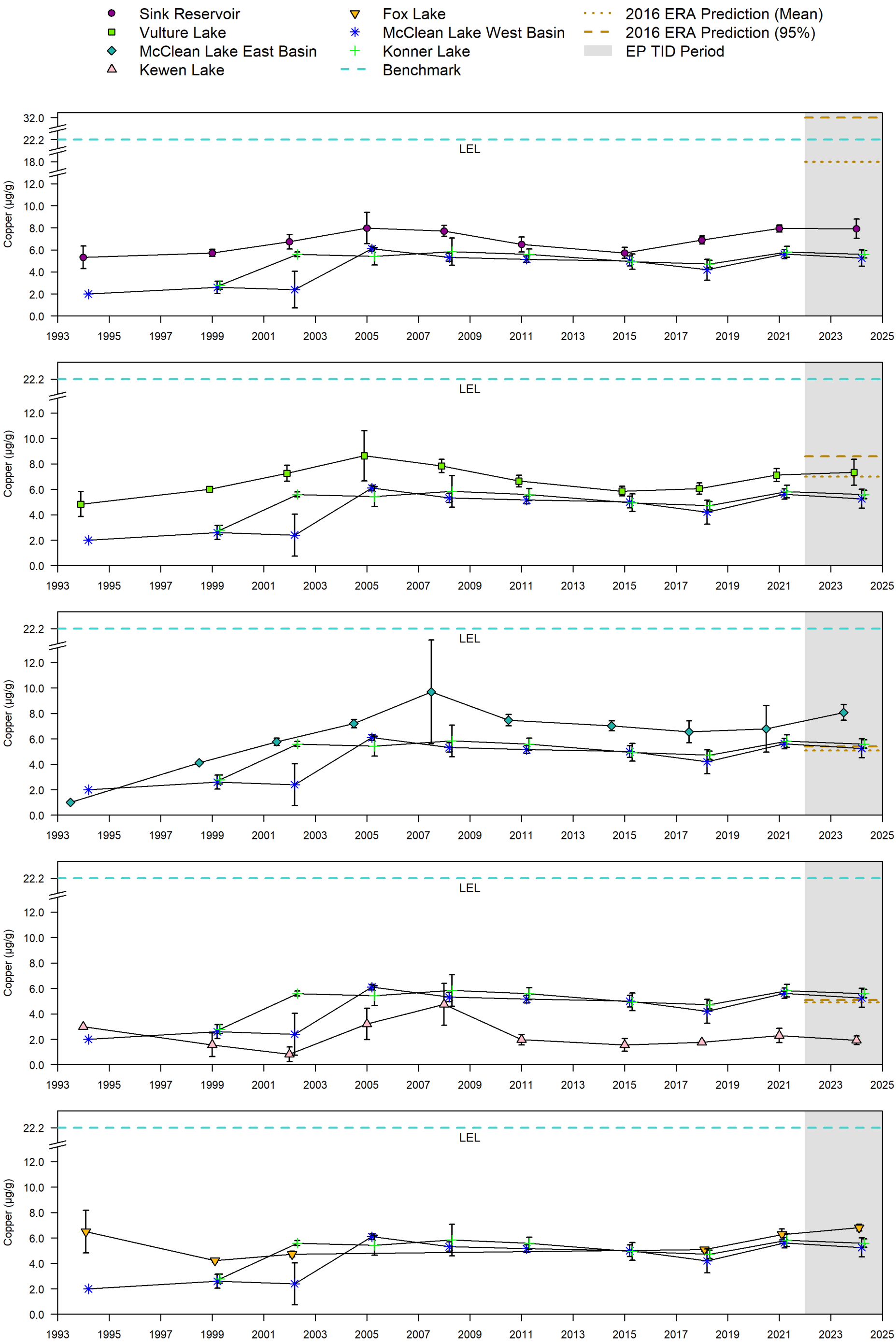


Figure 4.4-3 (10 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

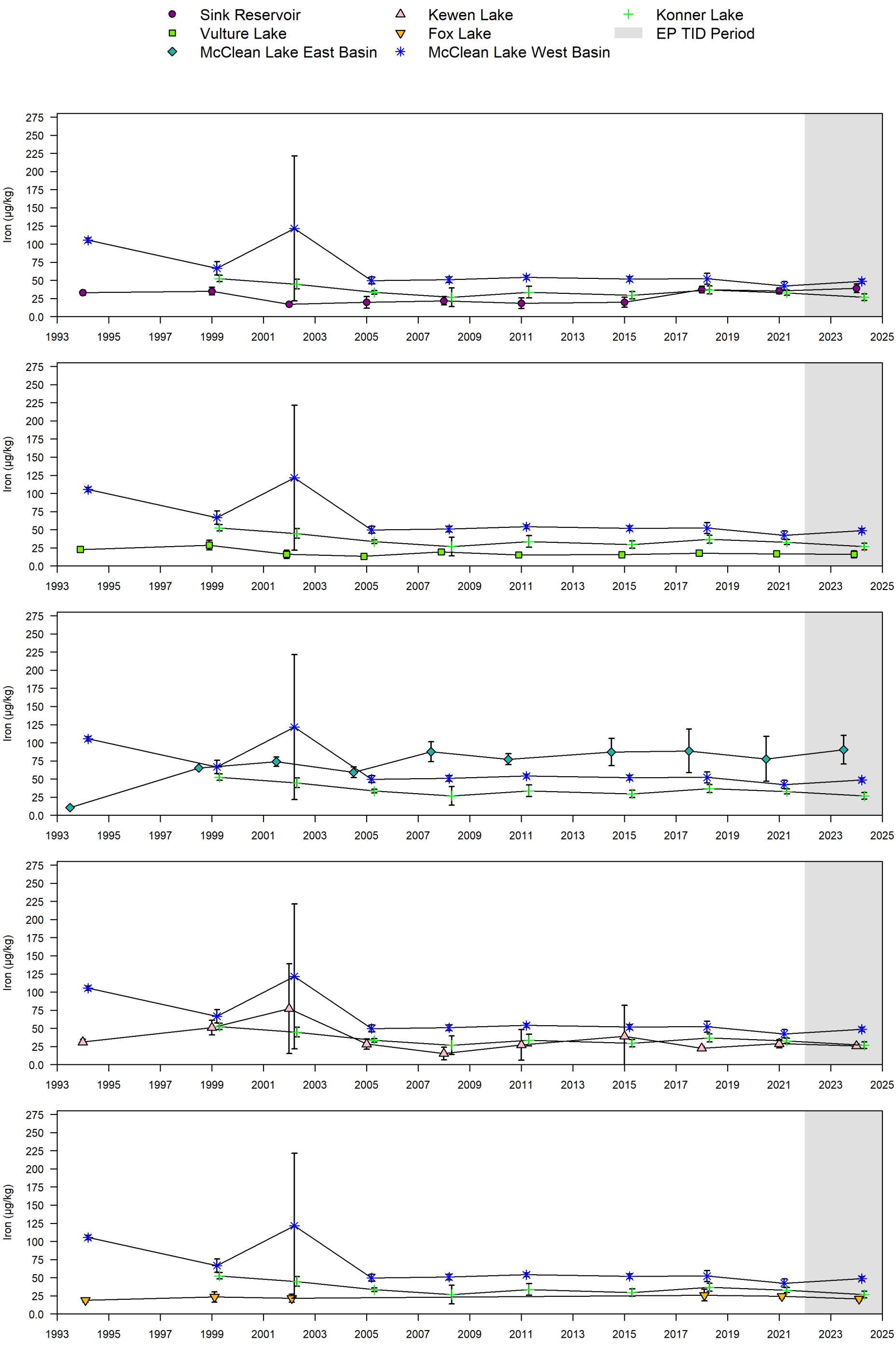


Figure 4.4-3 (11 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

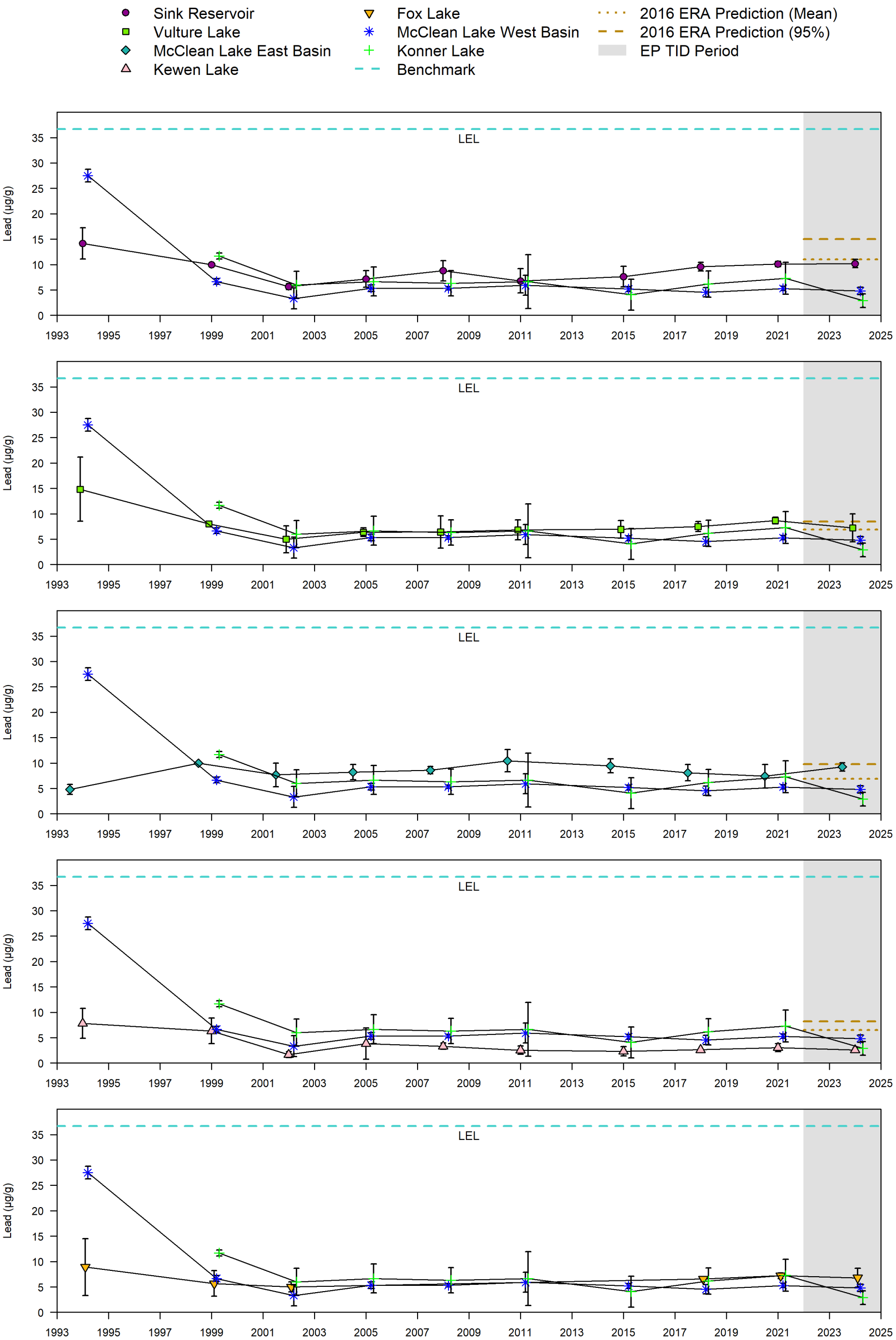


Figure 4.4-3 (12 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

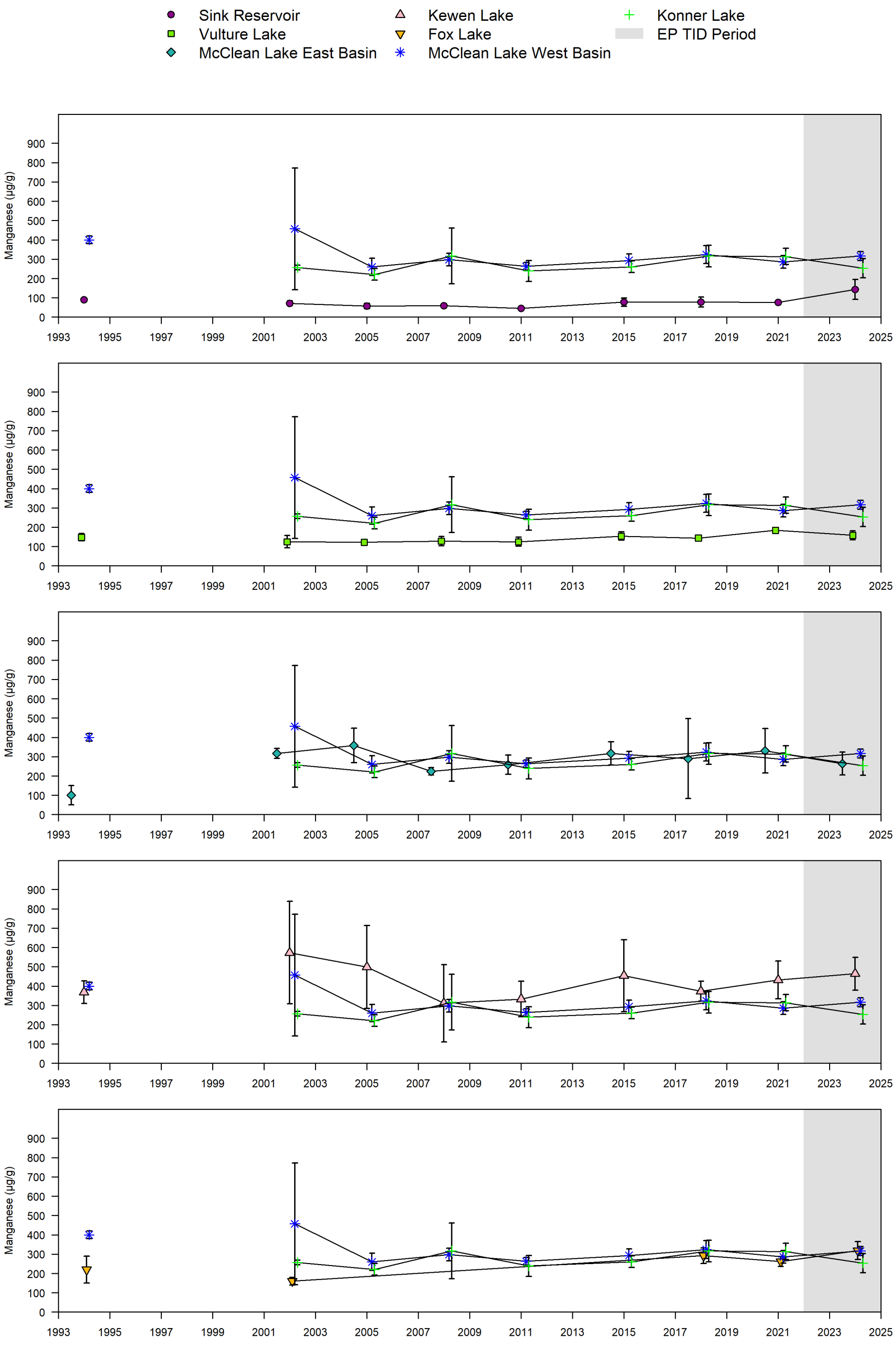


Figure 4.4-3 (13 of 28) Mean and Standard Deviation COPC Levels in the Sediment.

Note: A break in a line represents a monitoring year with data available for some parameters, but not this specific COPC.

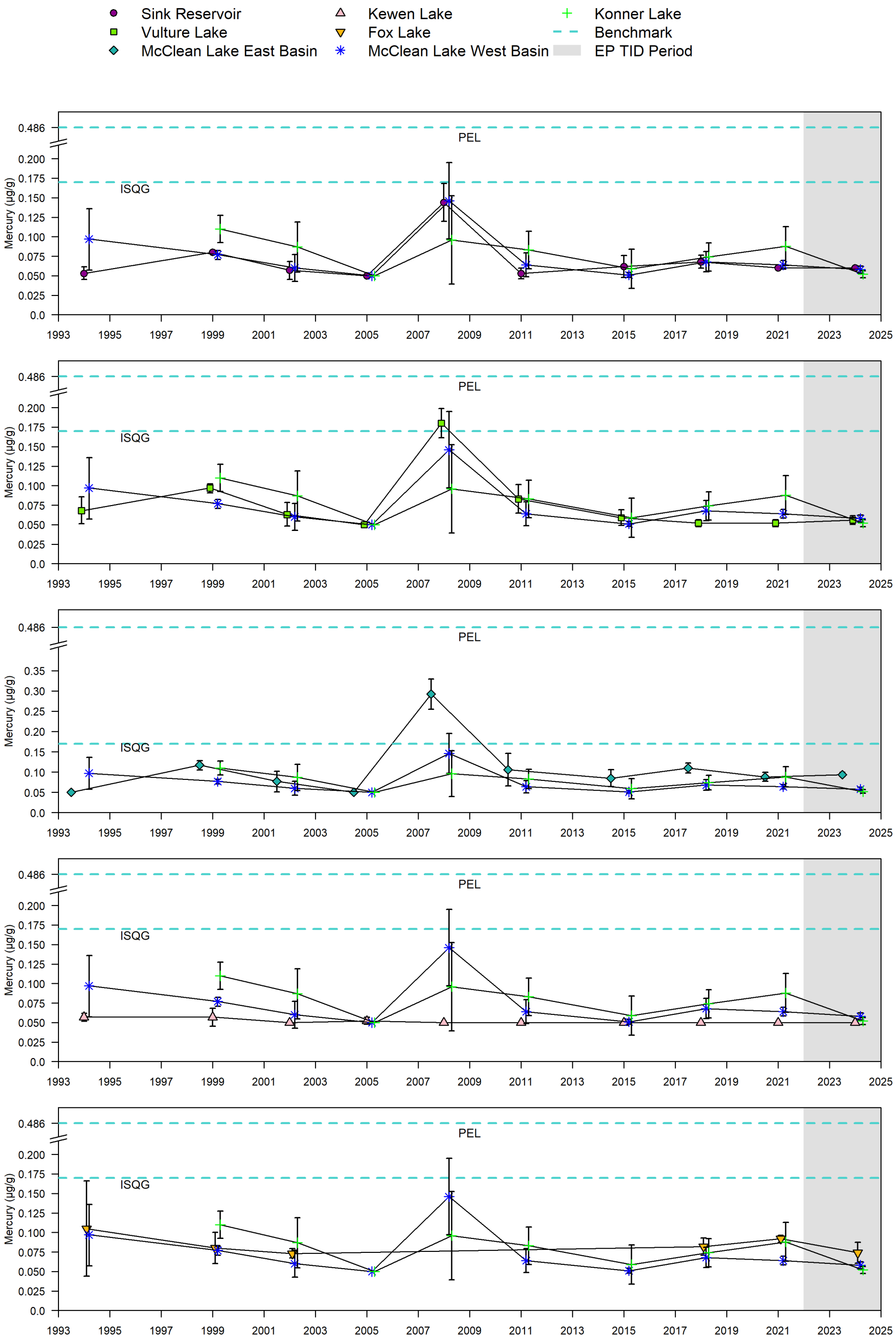


Figure 4.4-3 (14 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

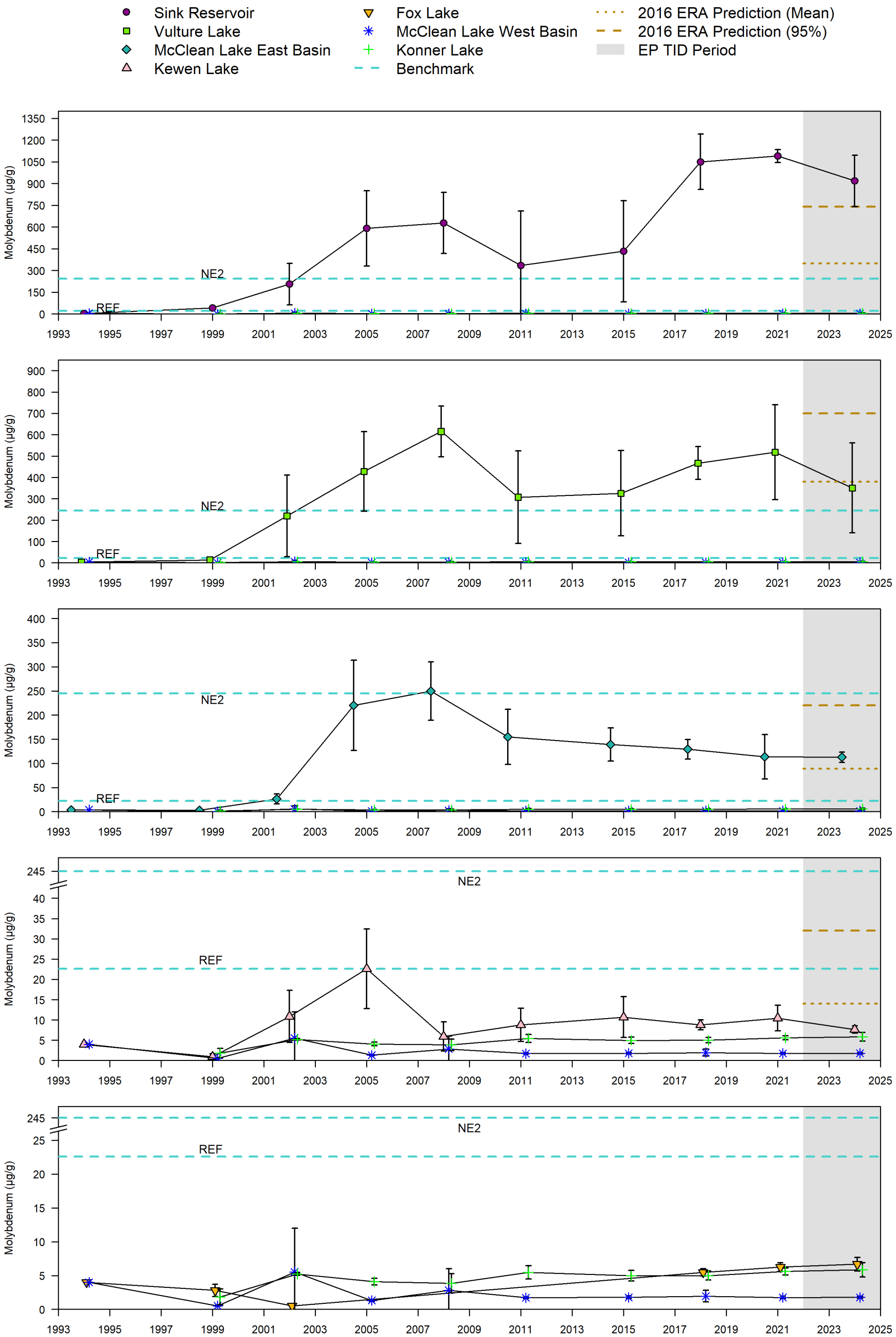


Figure 4.4-3 (15 of 28) Mean and Standard Deviation COPC Levels in the Sediment.

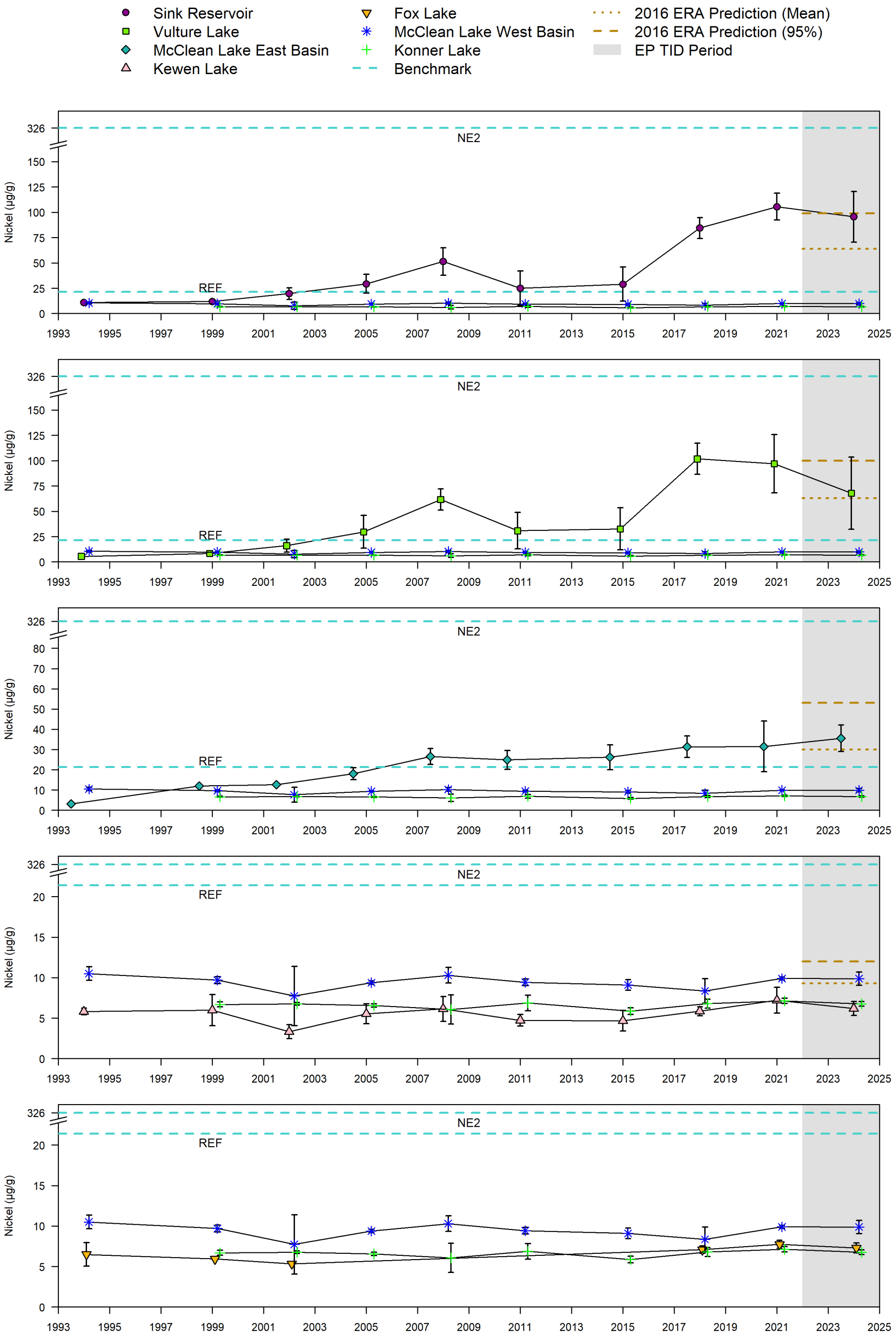


Figure 4.4-3 (16 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

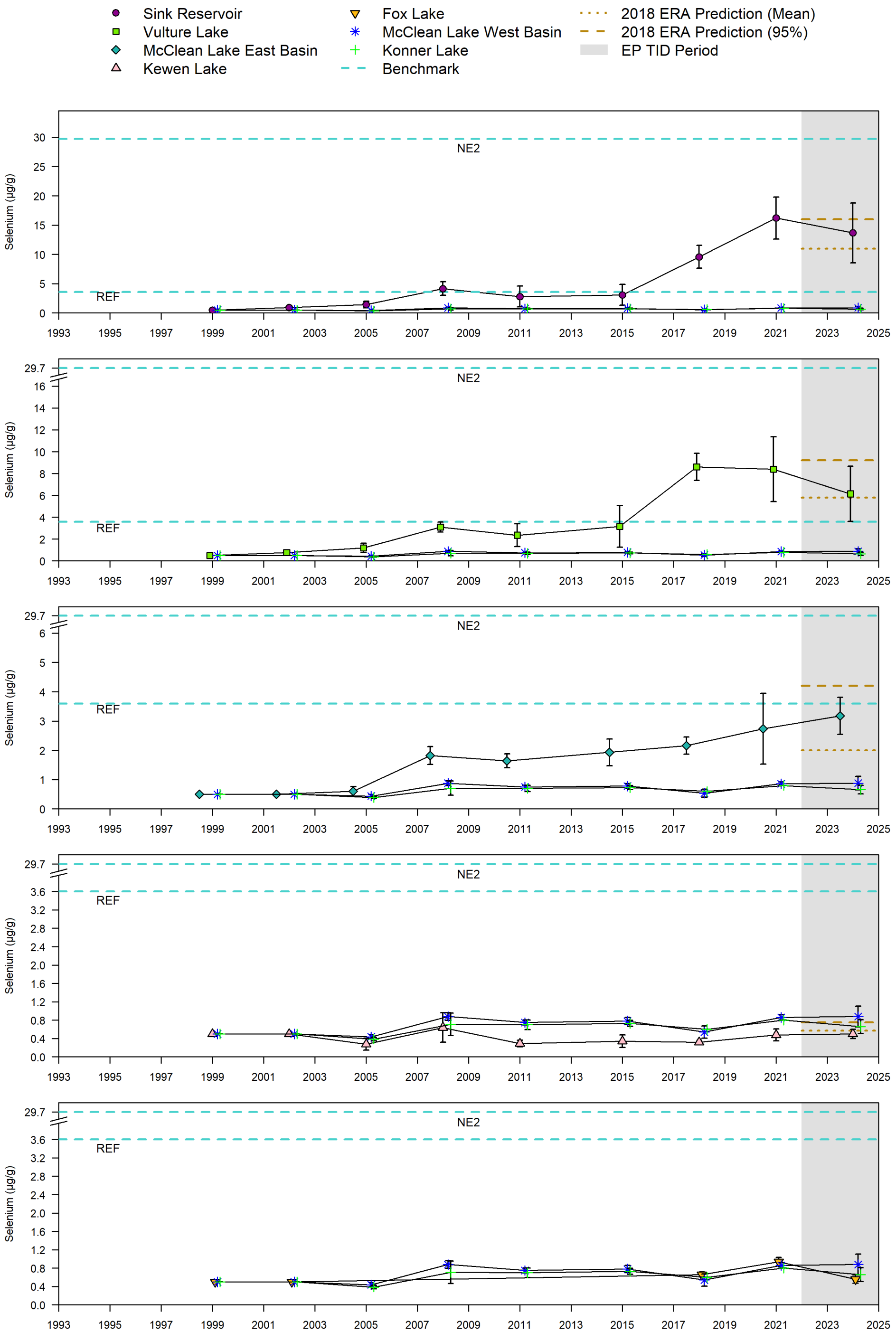


Figure 4.4-3 (17 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

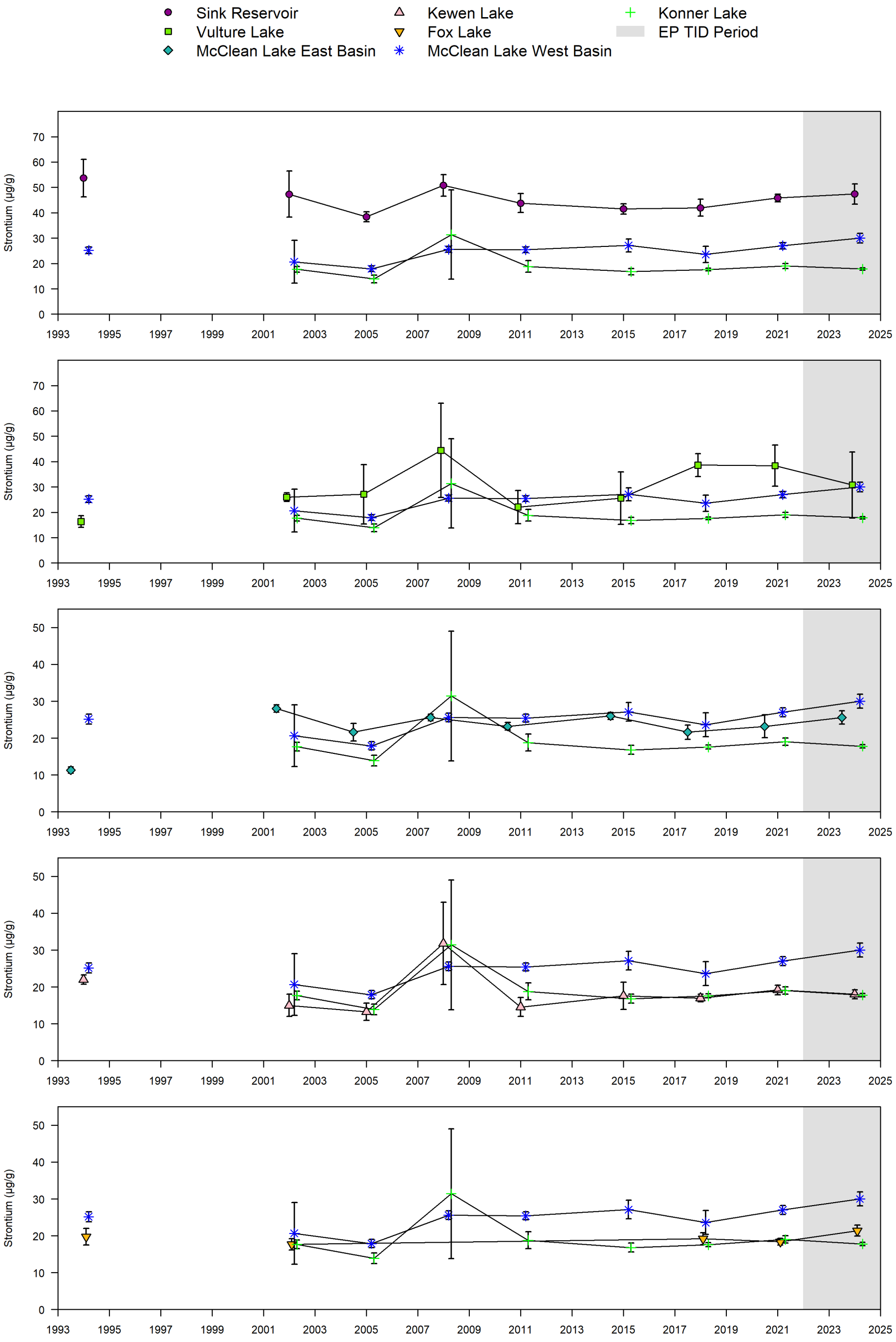


Figure 4.4-3 3 (18 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

Note: A break in a line represents a monitoring year with data available for some parameters, but not this specific COPC.

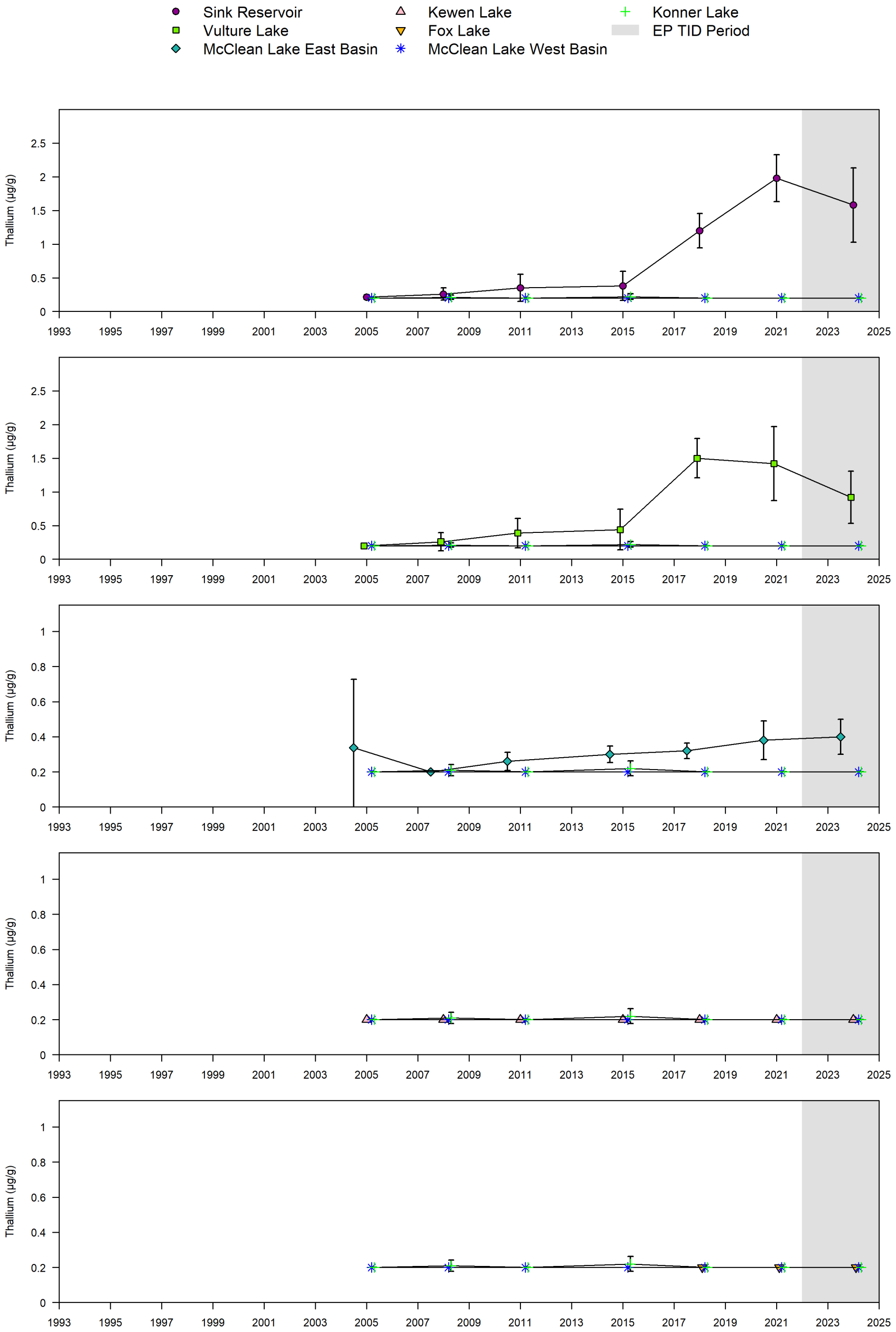


Figure 4.4-3 3 (19 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

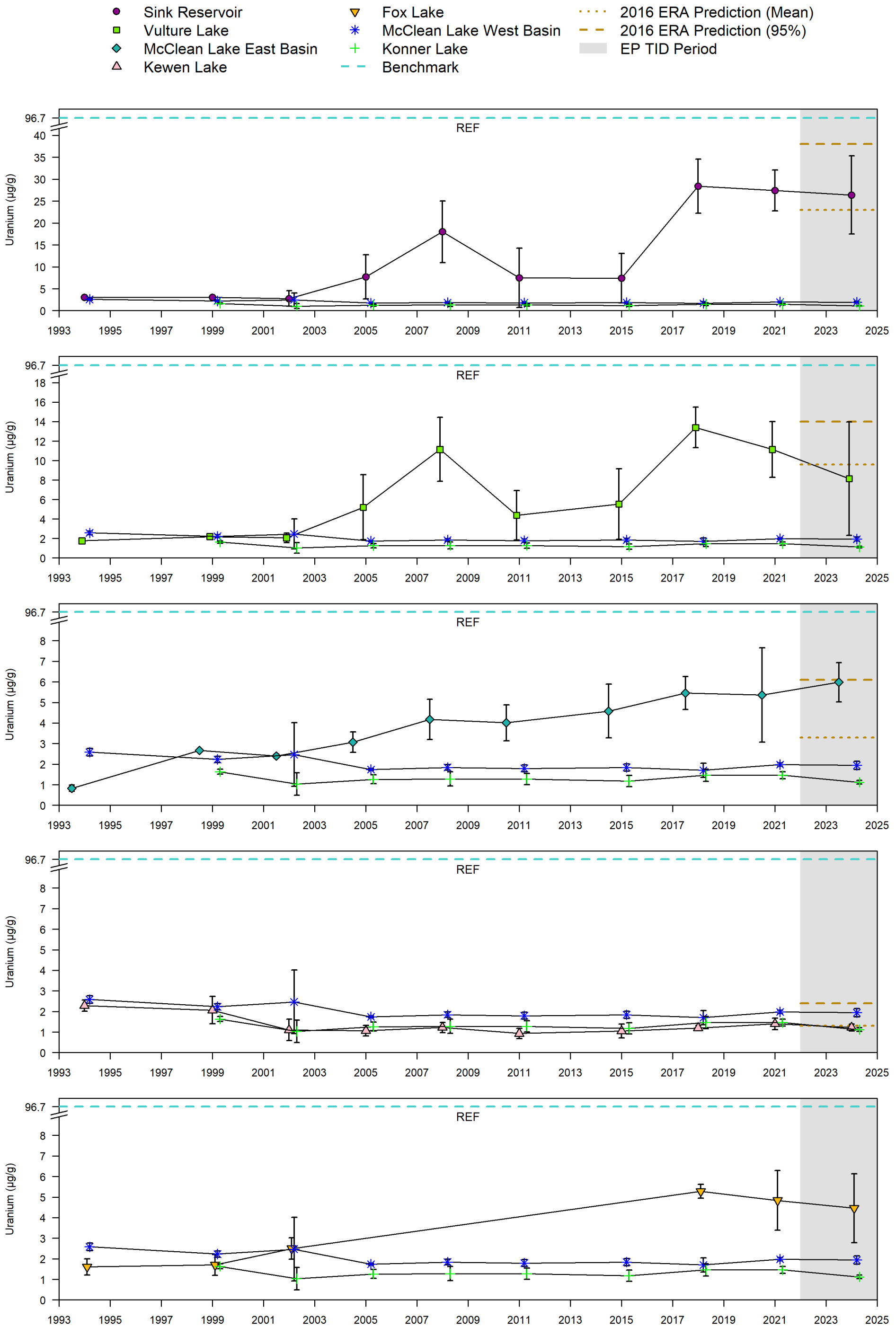


Figure 4.4-3 (20 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

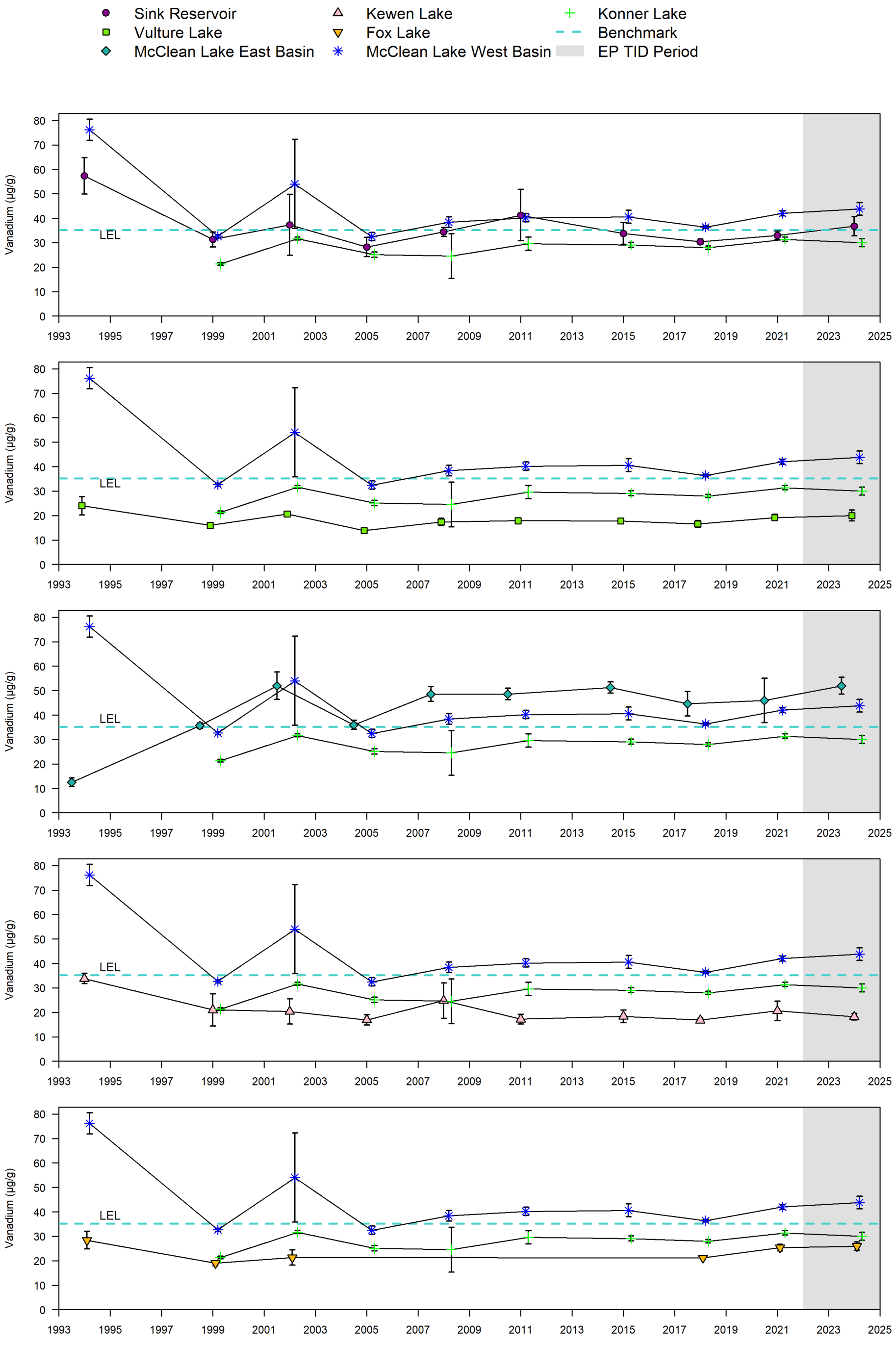


Figure 4.4-3 (21 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

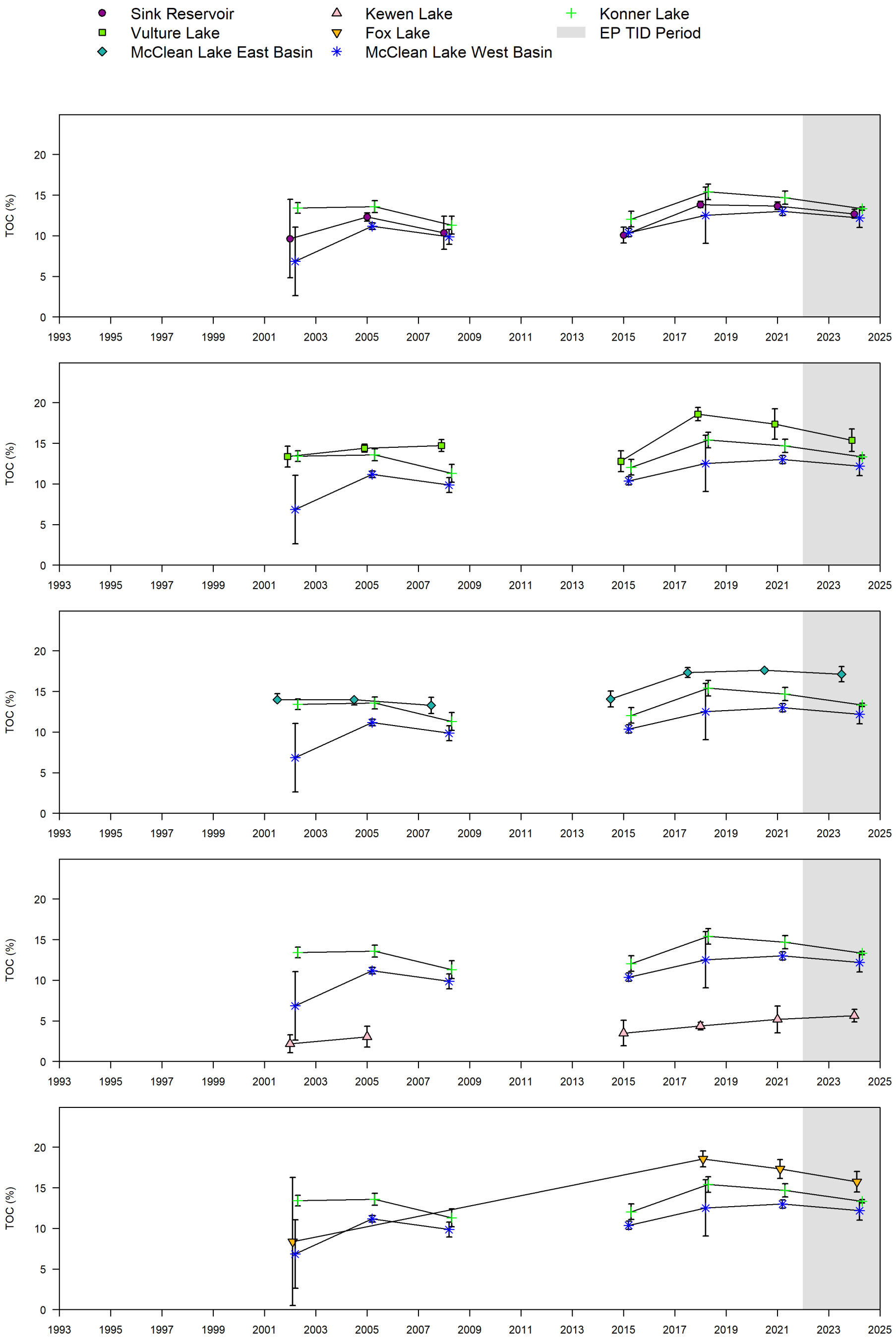


Figure 4.4-3 (22 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

Note: A break in a line represents a monitoring year with data available for some parameters, but not this specific COPC.

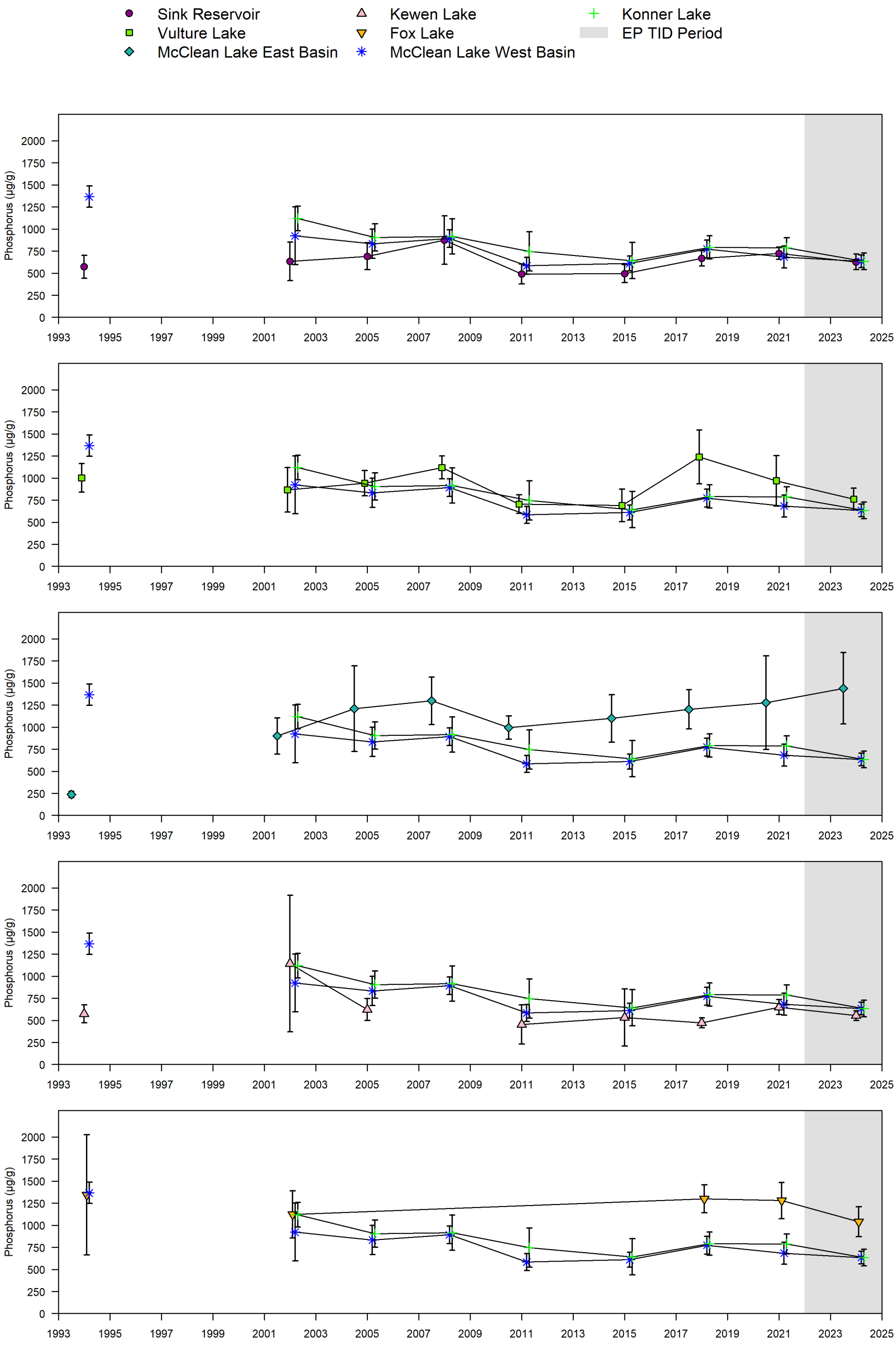


Figure 4.4-3 (23 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

Note: A break in a line represents a monitoring year with data available for some parameters, but not this specific COPC.

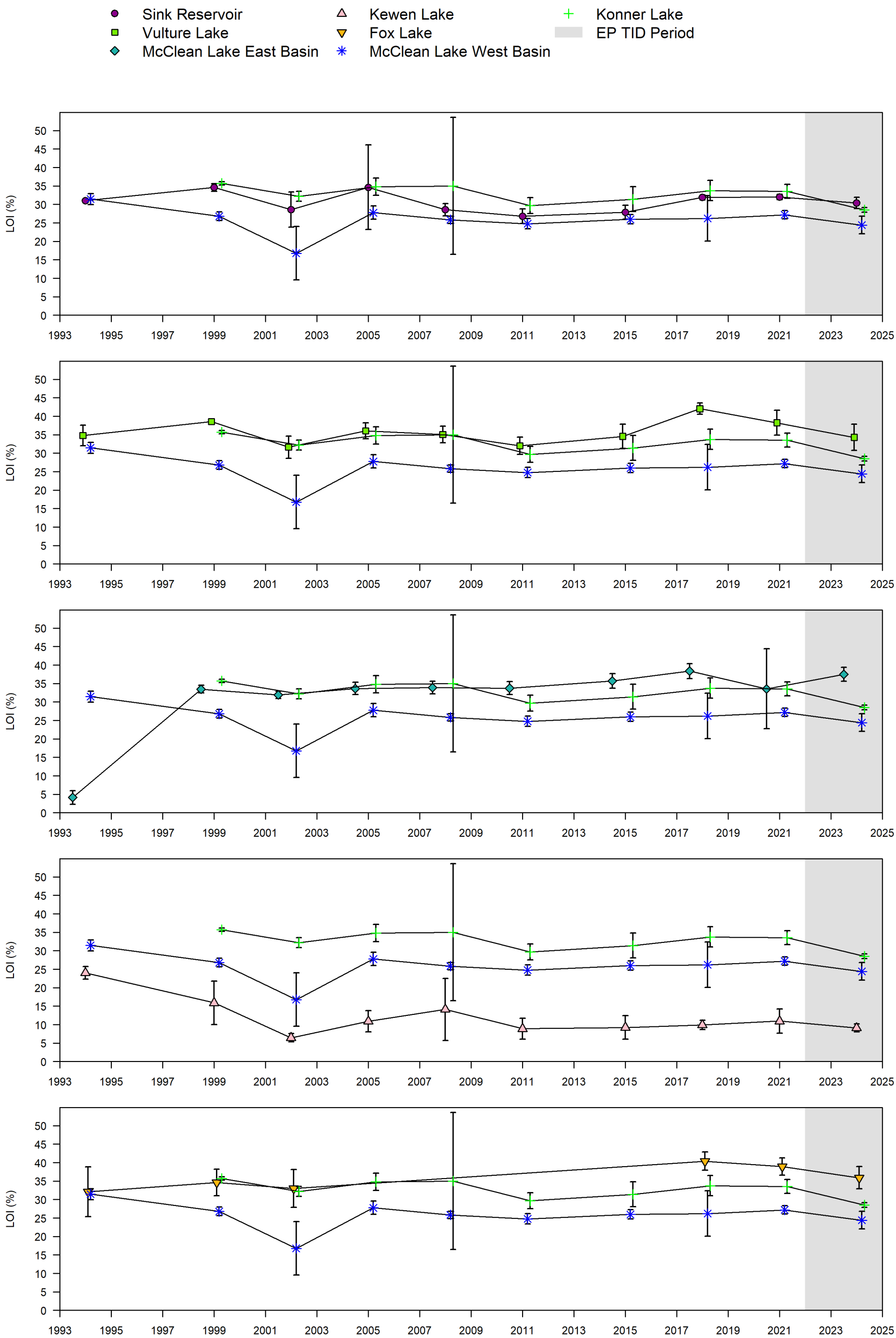


Figure 4.4-3 (24 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

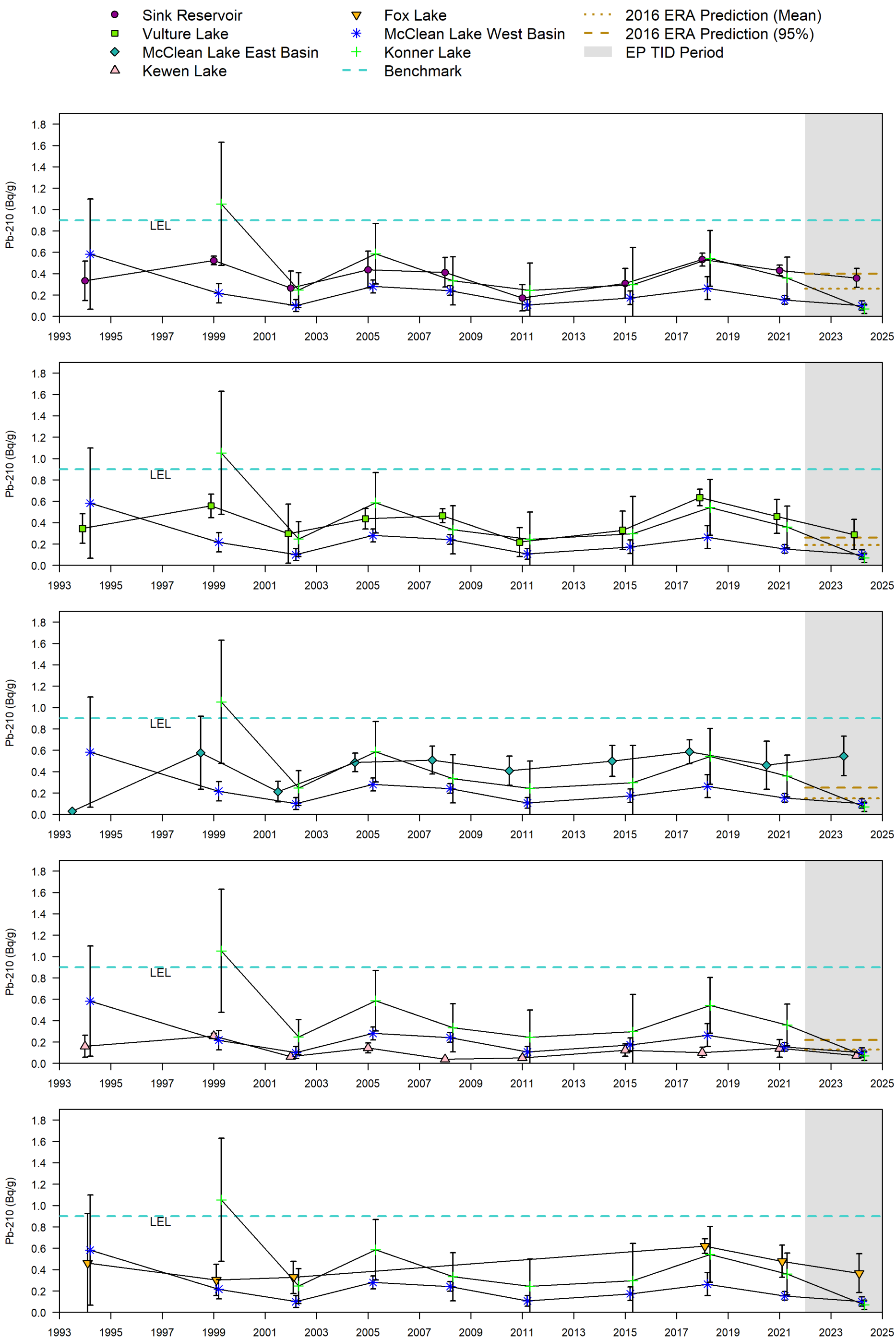


Figure 4.4-3 (25 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

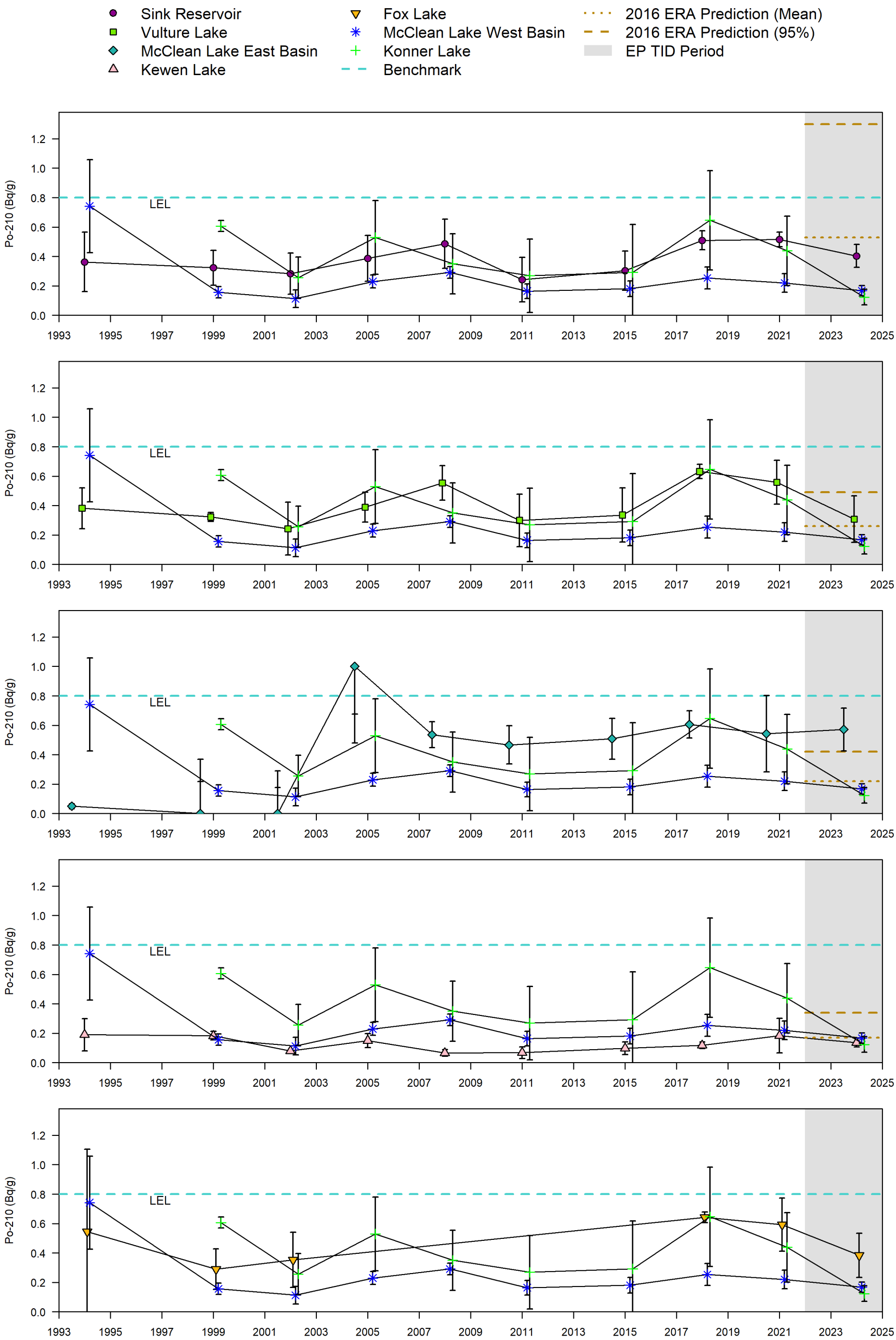


Figure 4.4-3 (26 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

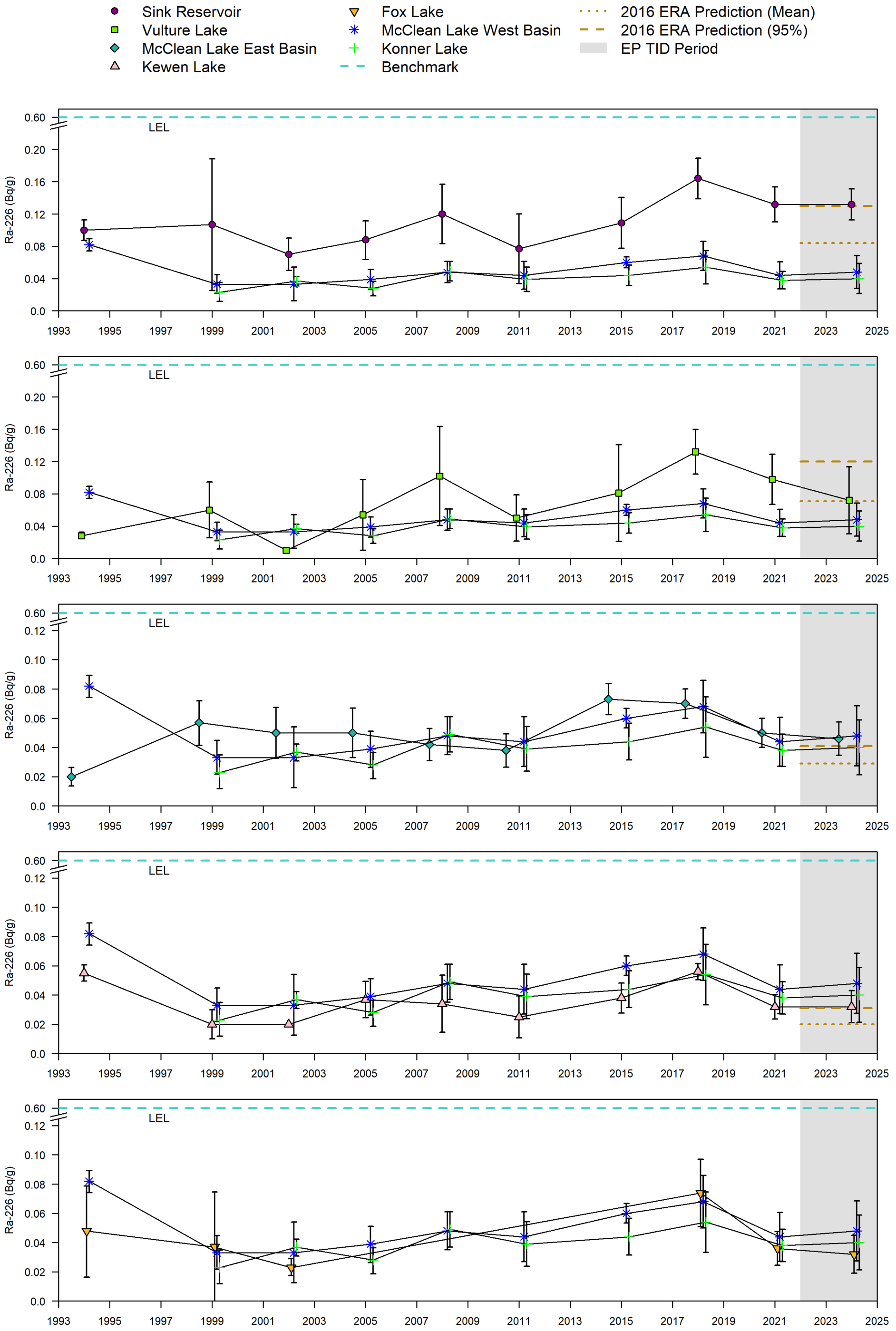


Figure 4.4-3 (27 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

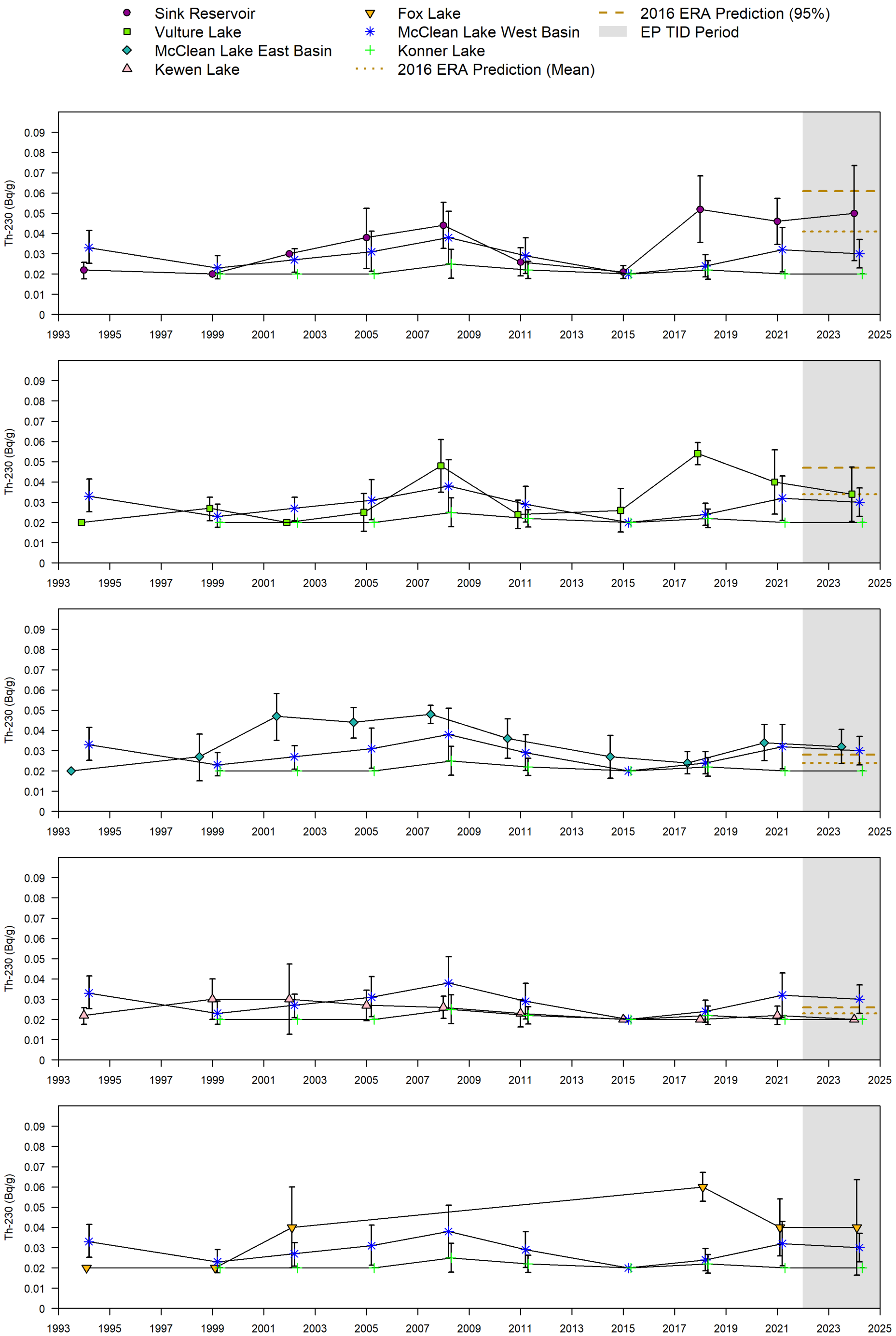


Figure 4.4-3 (28 of 28): Mean and Standard Deviation COPC Levels in the Sediment.

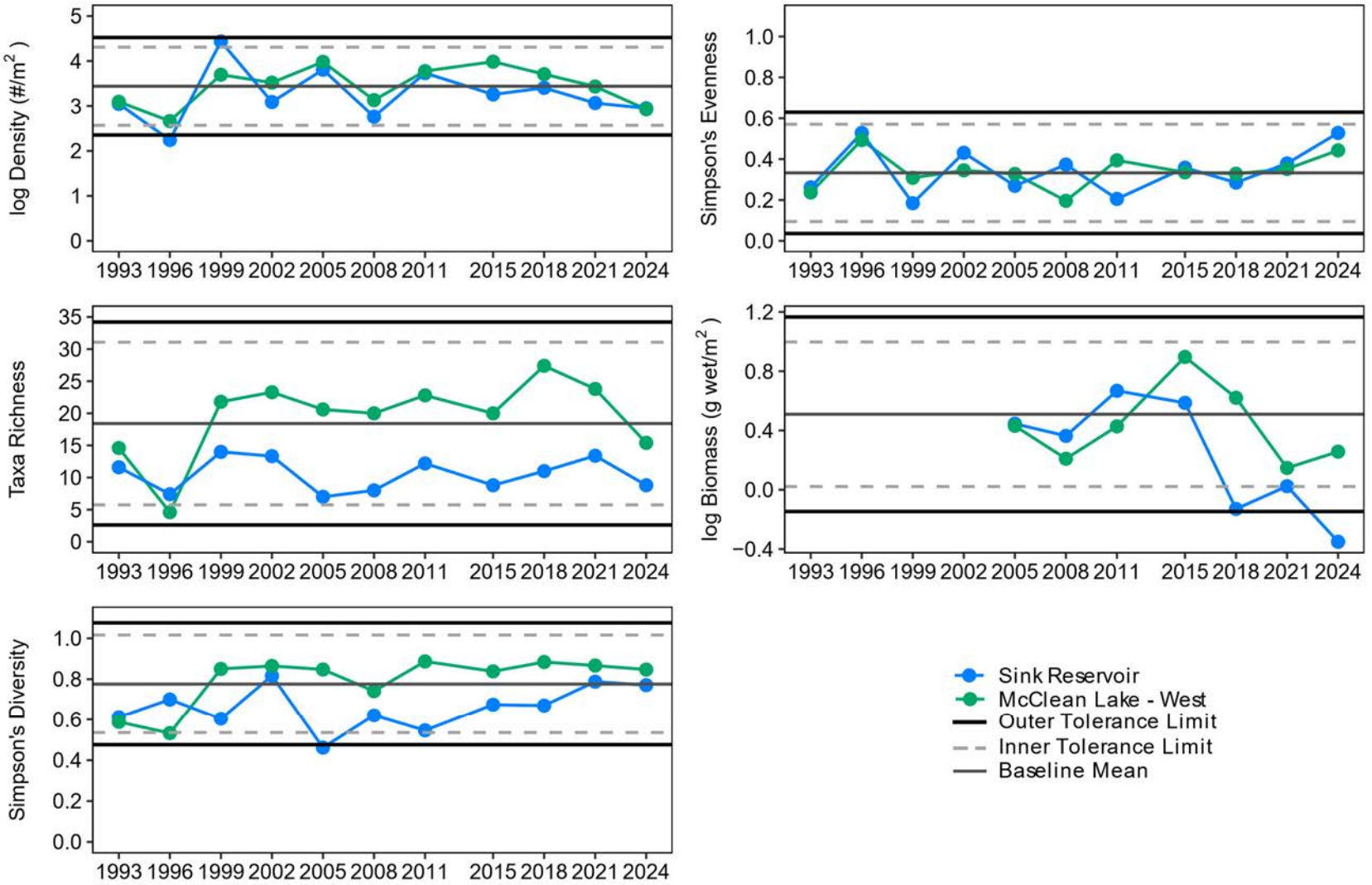


Figure 4.5-1 Variations in Indices of Benthic Community Composition for Lake Benthos Samples in Sink Reservoir.

Note: Reference location denoted by green symbols; exposure locations denoted by blue symbols. Horizontal lines represent inner and outer tolerance limits based on reference area data. Limits are calculated using the non-central t-distribution to define the expected range of normal values, accounting for sample size and variability.

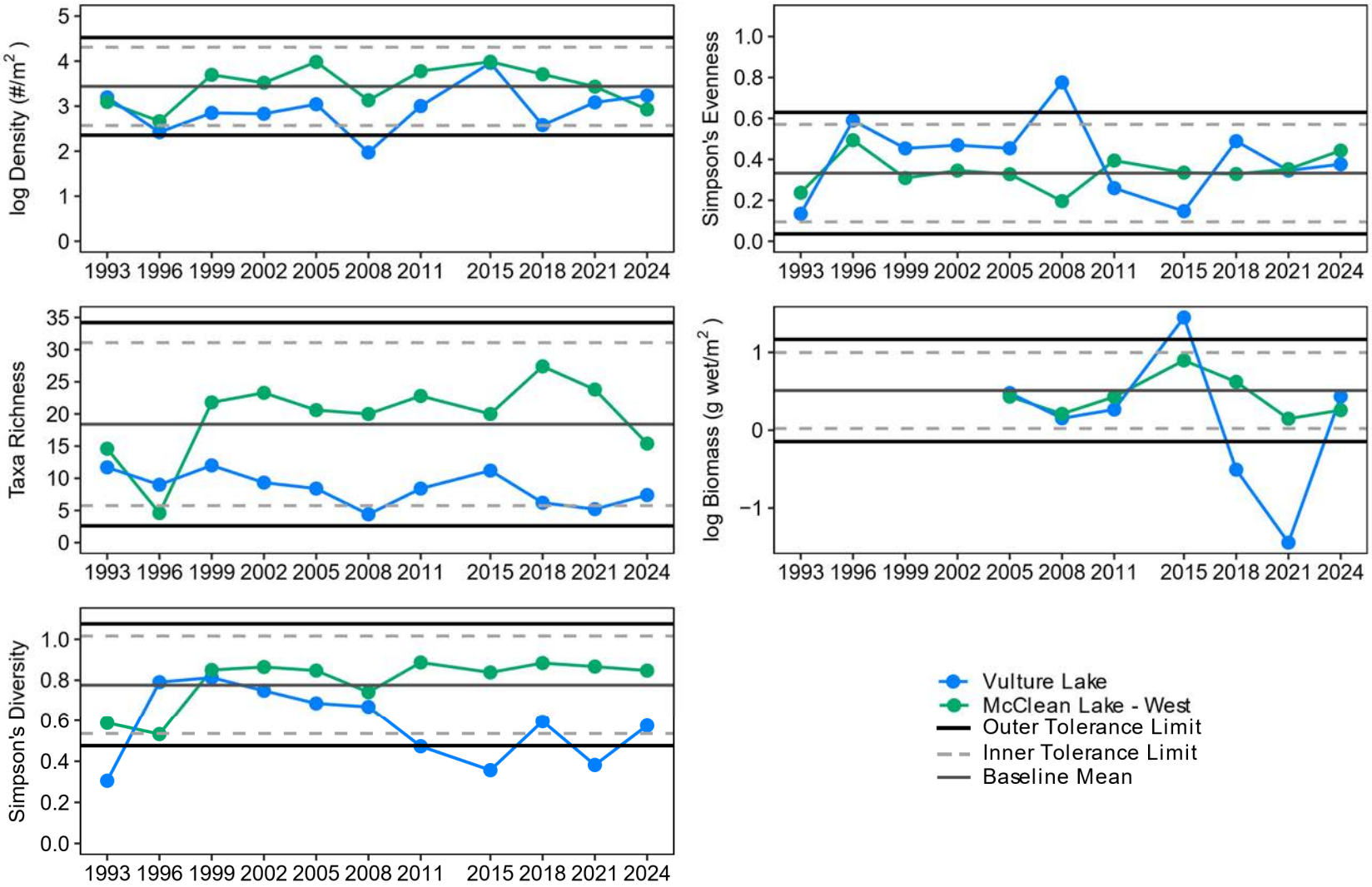


Figure 4.5-2 Variations in Indices of Benthic Community Composition for Lake Benthos Samples in Vulture Lake.

Note: Reference location denoted by green symbols; exposure locations denoted by blue symbols. Horizontal lines represent inner and outer tolerance limits based on reference area data. Limits are calculated using the non-central t-distribution to define the expected range of normal values, accounting for sample size and variability.

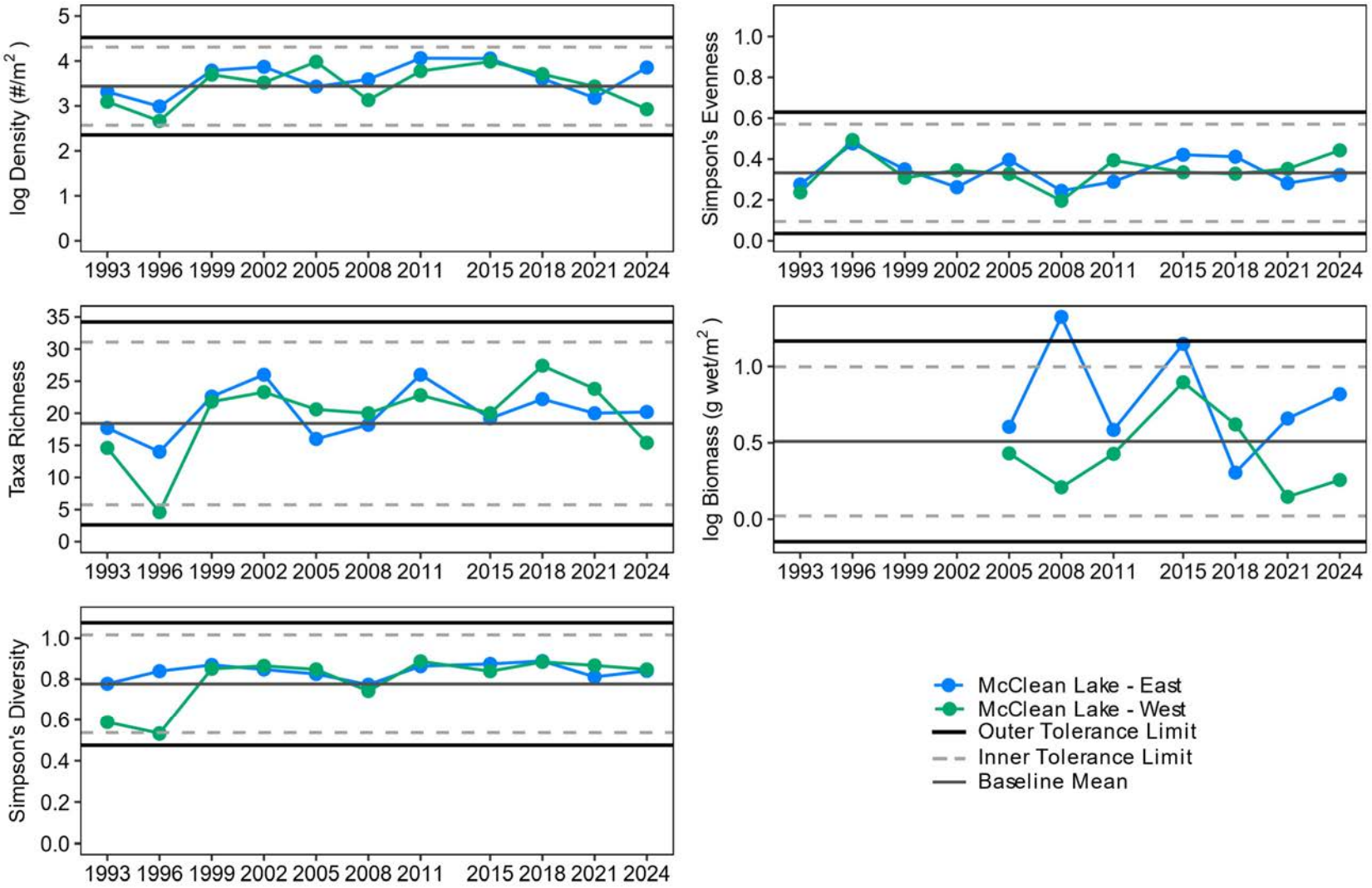


Figure 4.5-3 Variations in Indices of Benthic Community Composition for Lake Benthos Samples in McClean Lake – East.

Note: Reference location denoted by green symbols; exposure locations denoted by blue symbols. Horizontal lines represent inner and outer tolerance limits based on reference area data. Limits are calculated using the non-central t-distribution to define the expected range of normal values, accounting for sample size and variability.

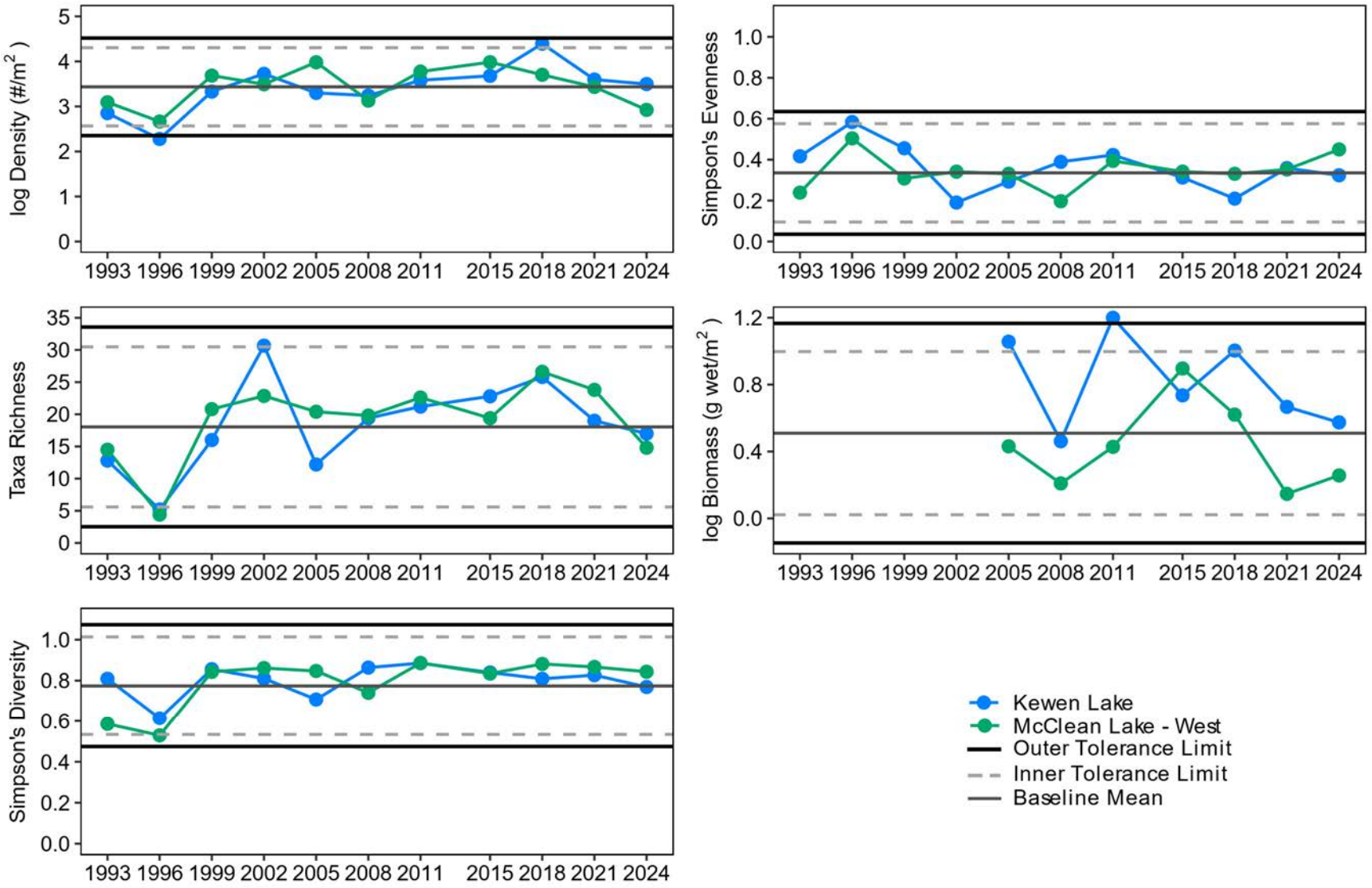


Figure 4.5-4 Variations in Indices of Benthic Community Composition for Lake Benthos Samples in Kewen Lake.

Note: Reference location denoted by green symbols; exposure locations denoted by blue symbols. Horizontal lines represent inner and outer tolerance limits based on reference area data. Limits are calculated using the non-central t-distribution to define the expected range of normal values, accounting for sample size and variability.

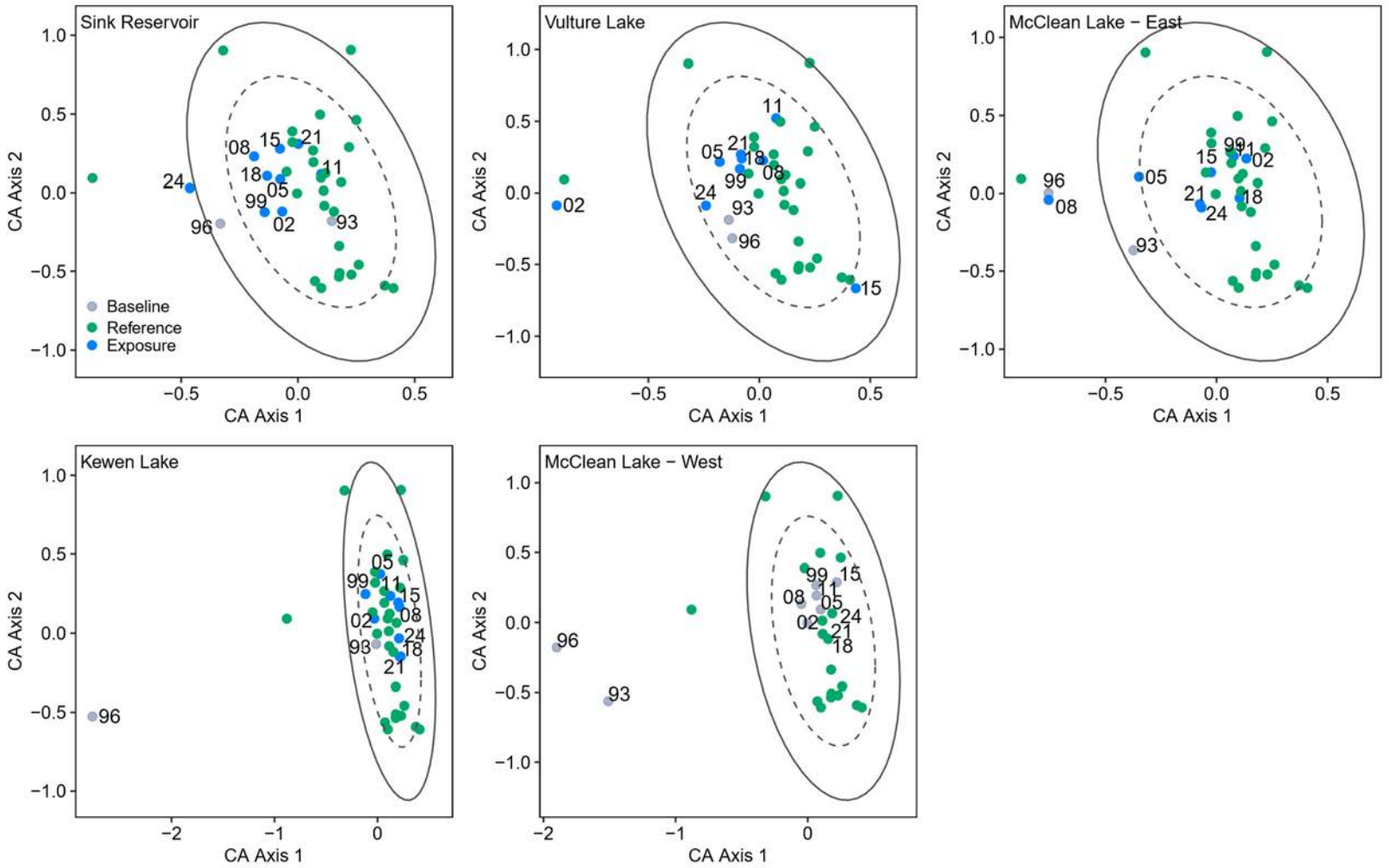


Figure 4.5-5 Correspondence Analysis Axis Scores for Lake Benthos Samples at the Four Exposure Lakes (Sink, Vulture, McClean East Basin, and Kewen) and the Reference Lake (McClean West Basin).

Note: Reference locations denoted by green symbols; exposure locations denoted by blue symbols. Ellipses represent the inner and outer tolerance limits for the reference lakes and pre-operational years.

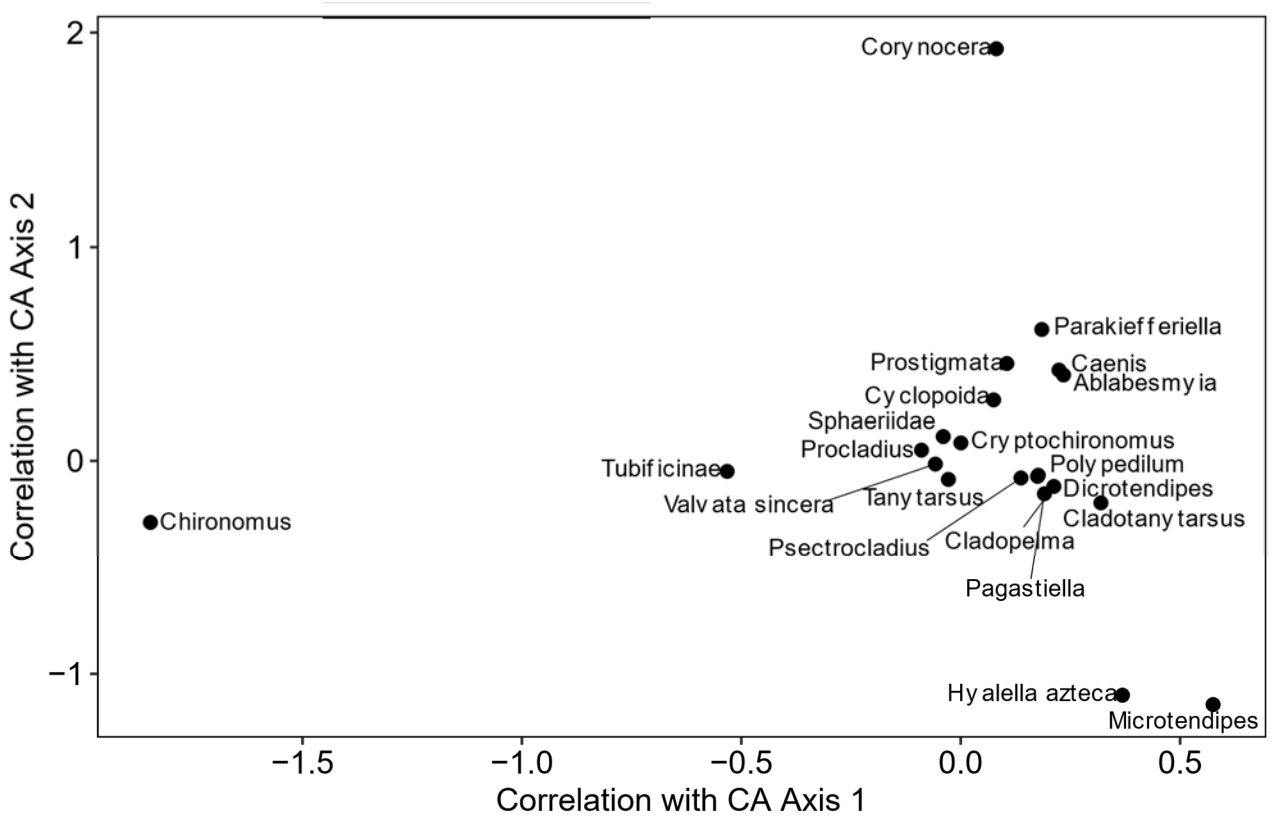


Figure 4.5-6 Correspondence Analysis Taxa Scores for Lake Benthos Samples.

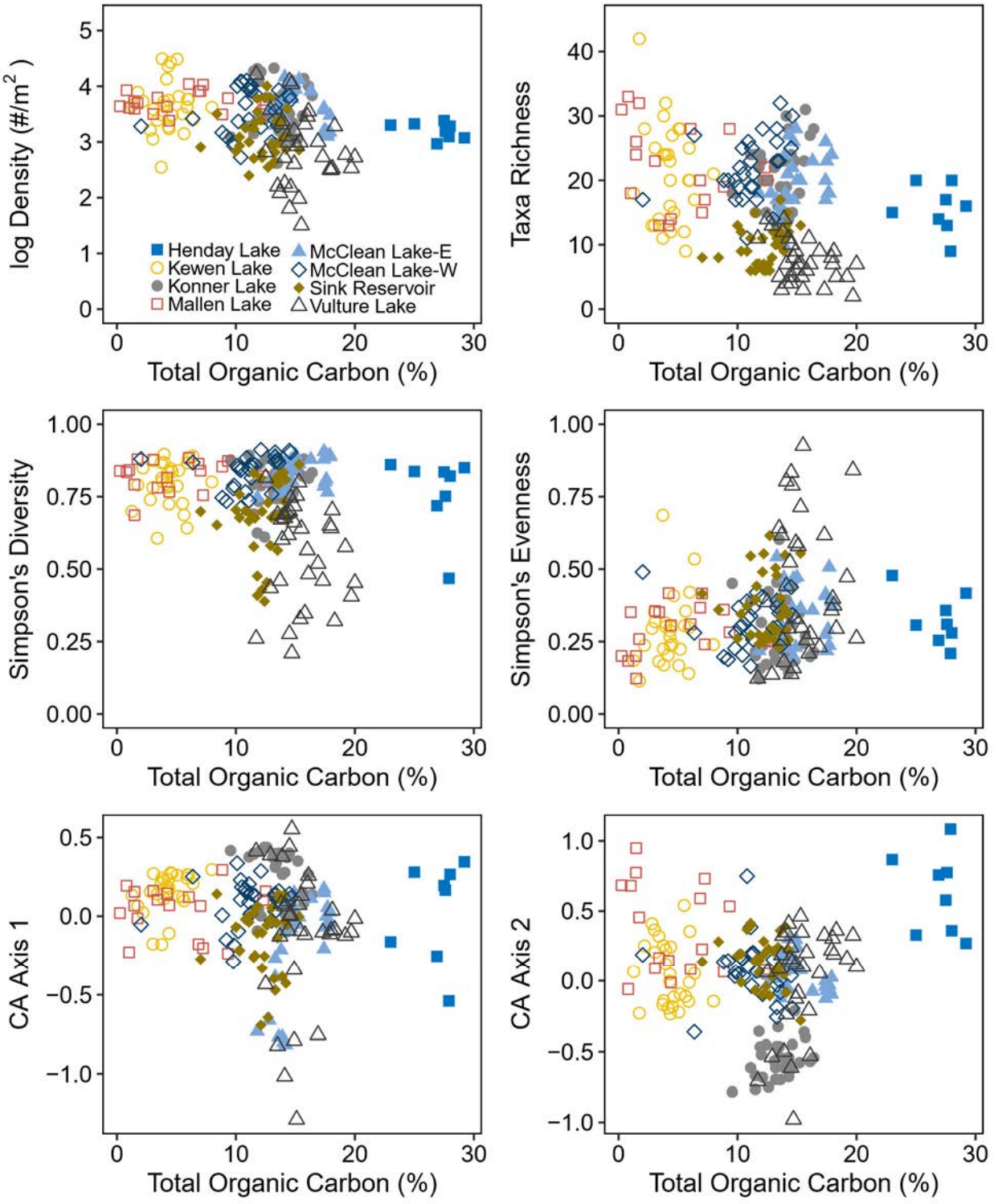


Figure 4.5-7 Scatterplots of Indices of Benthic Community Composition in Relation to Total Organic Carbon in Lake Sediments.

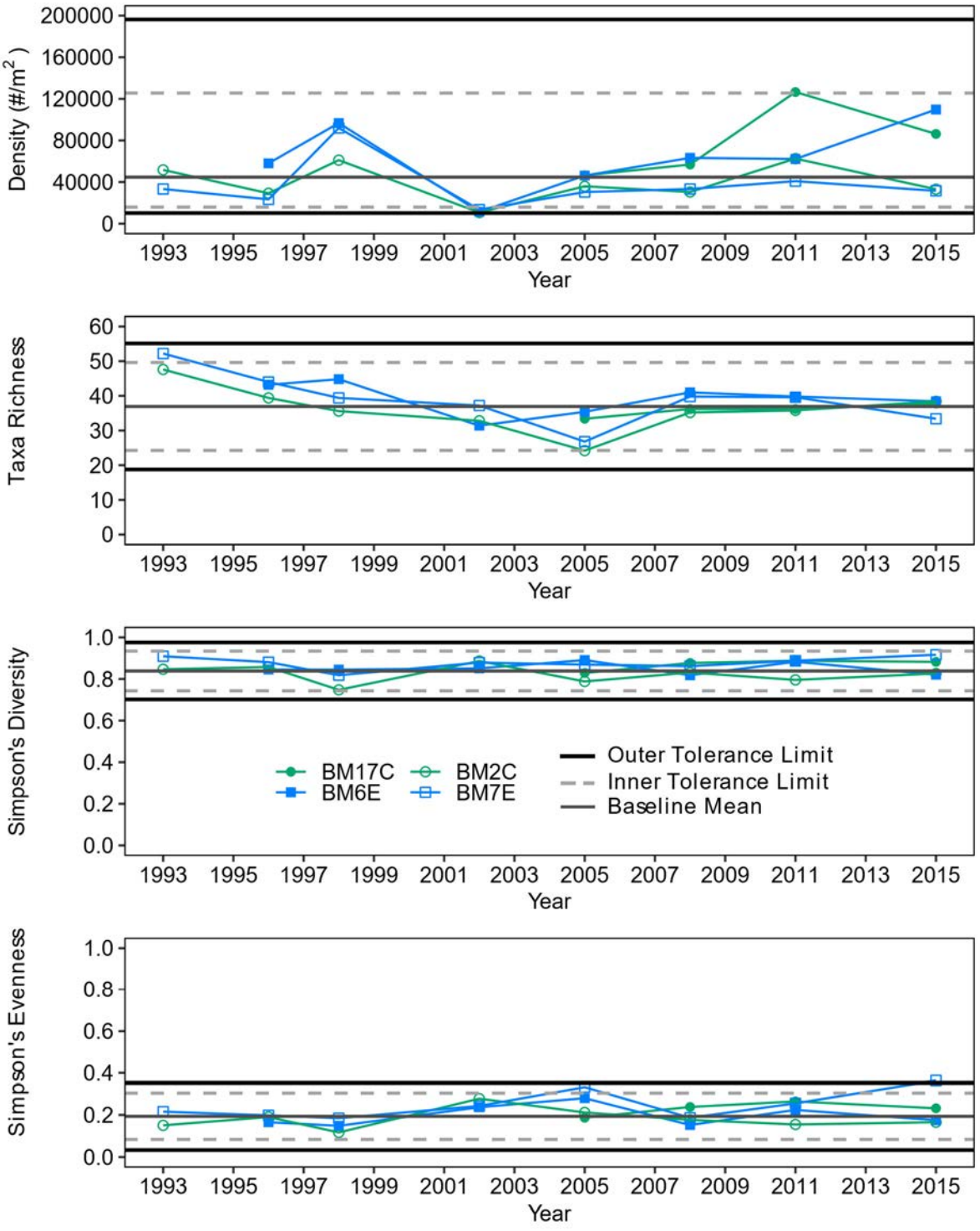


Figure 4.5-8 Variations in Indices of Benthic Community Composition in Riverine Erosional Habitats in Collins Creek.

Note: Horizontal lines represent inner and outer tolerance limits based on reference area data. Limits are calculated using the non-central t-distribution to define the expected range of normal values, accounting for sample size and variability.

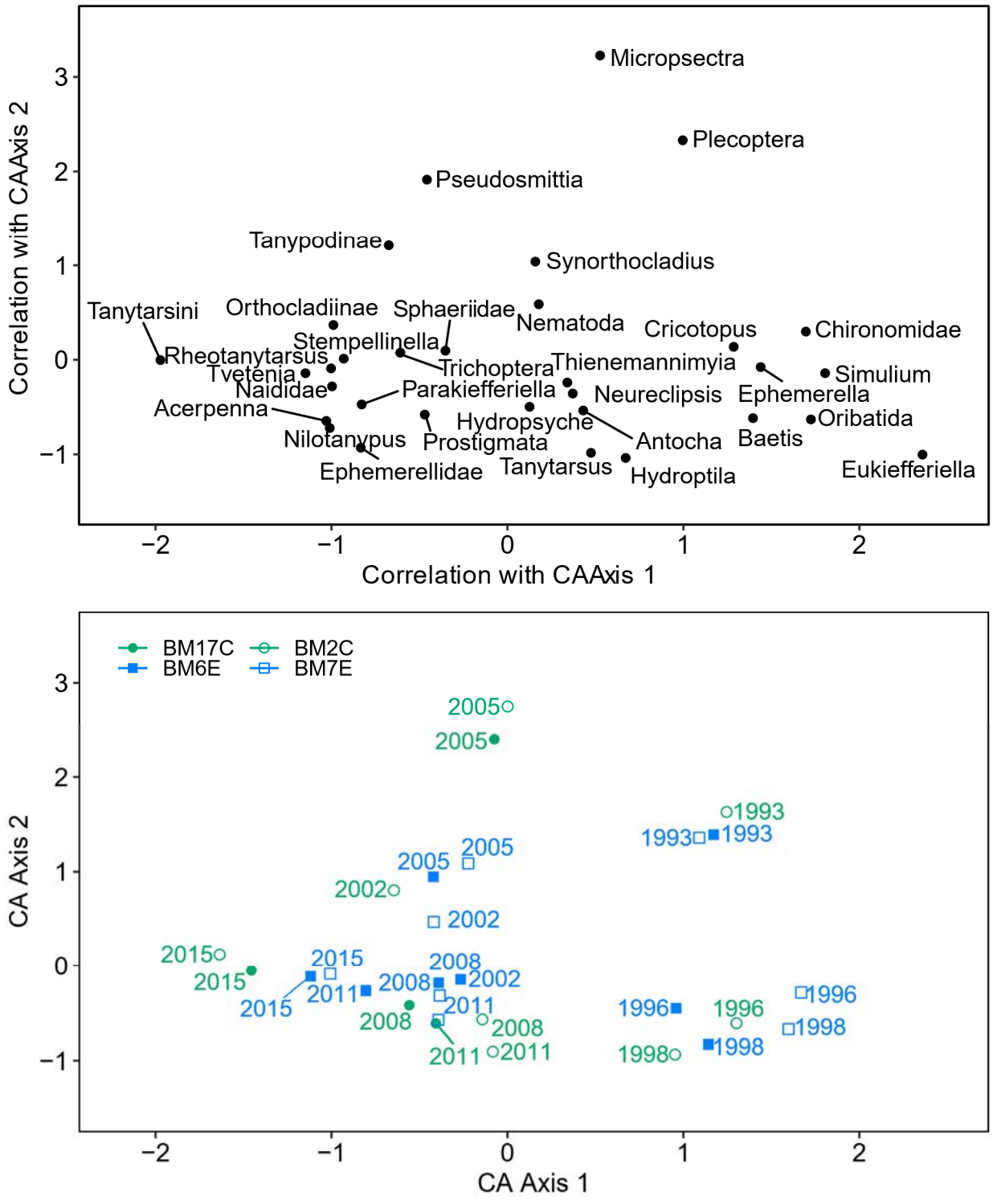


Figure 4.5-9 Biplot of Riverine Erosional Benthic Invertebrate CA Axis Scores in Collins Creek**.**

Note: Reference location denoted by green symbols; exposure locations denoted by blue symbols.

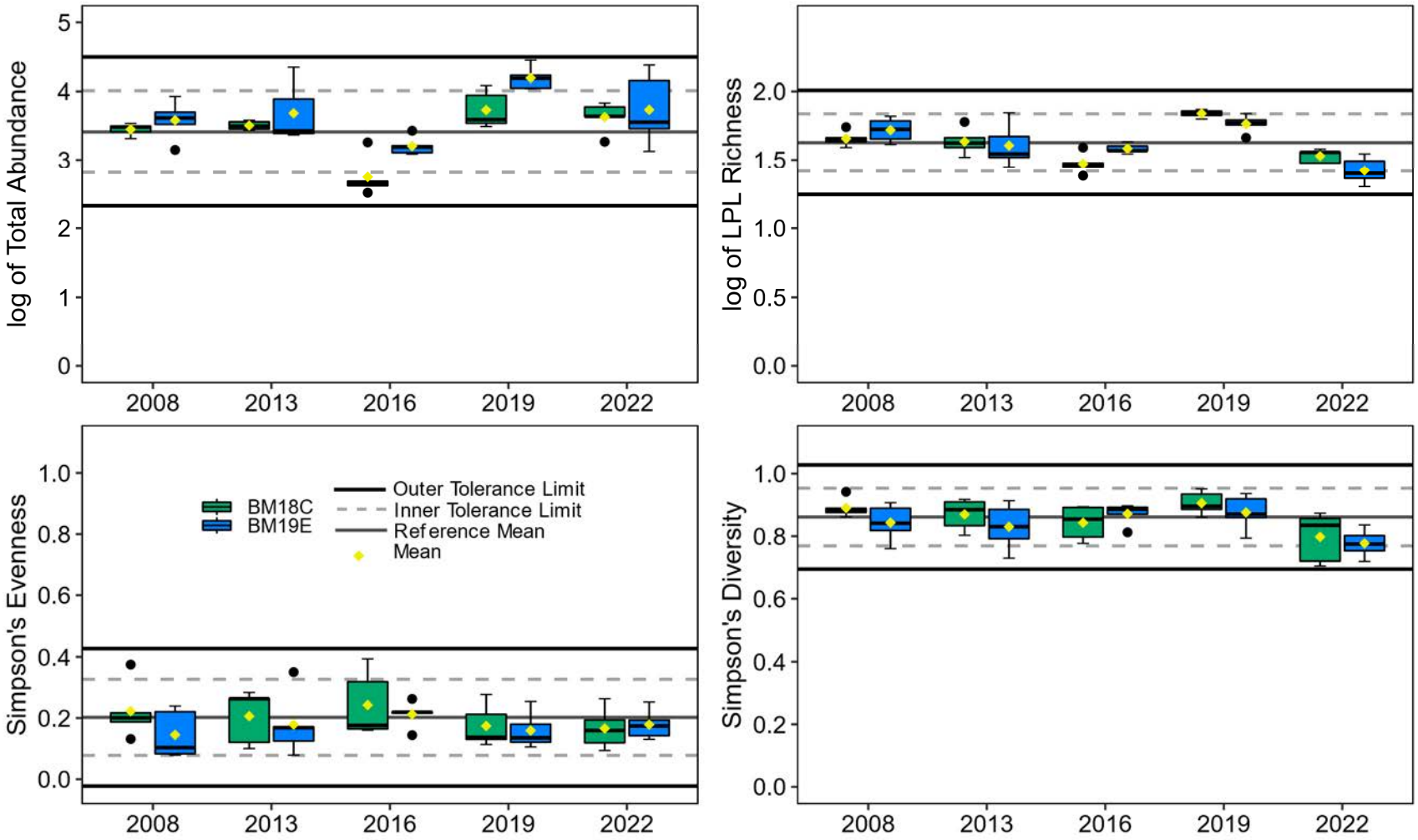


Figure 4.5-10 Box Plot and Mean Indices of Benthic Community Composition for Riverine Depositional Benthos Samples from Collins Creek Calculated at the Lowest Practical Level.

Note: Horizontal lines represent inner and outer tolerance limits based on reference area data. Limits are calculated using the non-central t-distribution to define the expected range of normal values, accounting for sample size and variability.

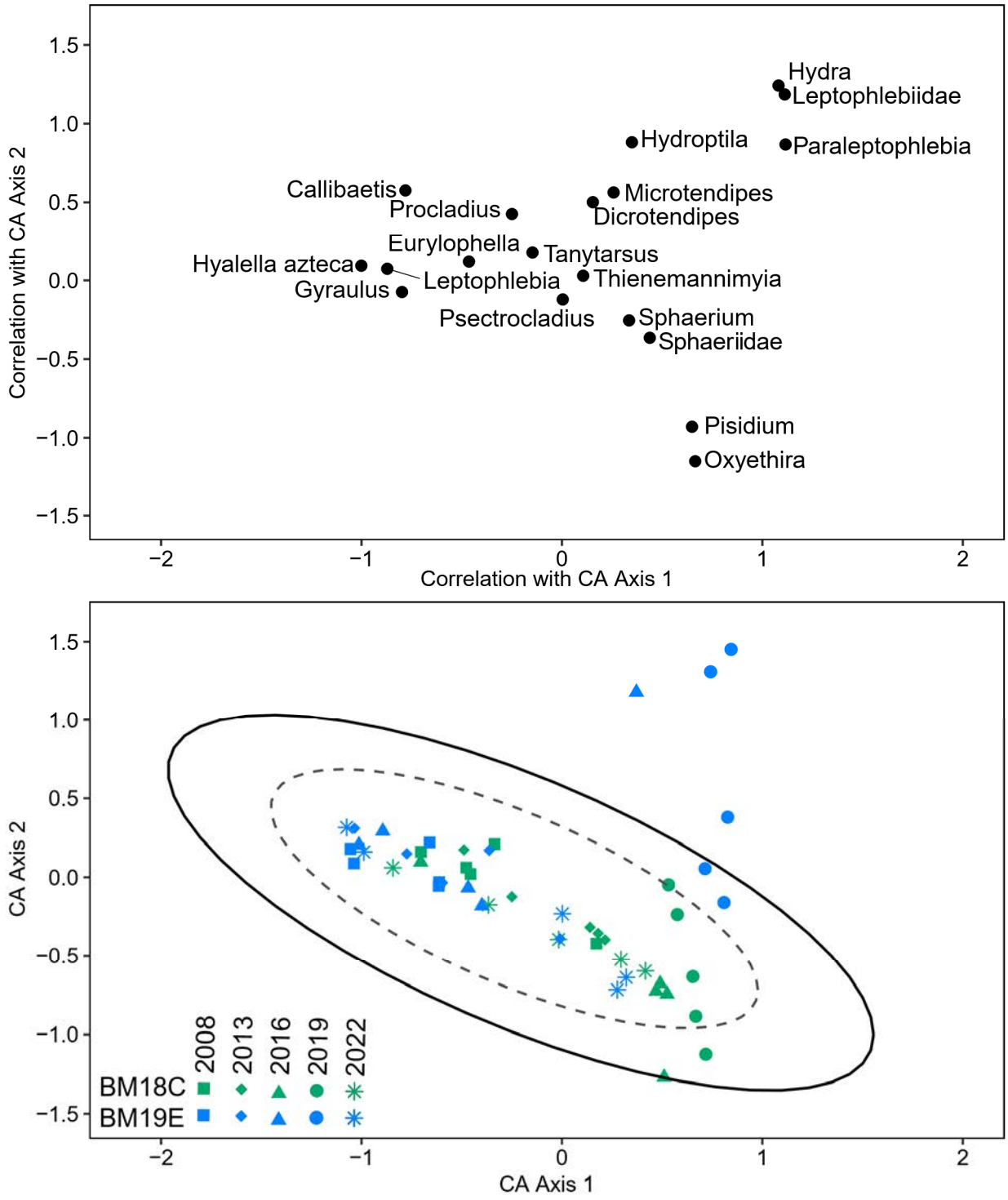
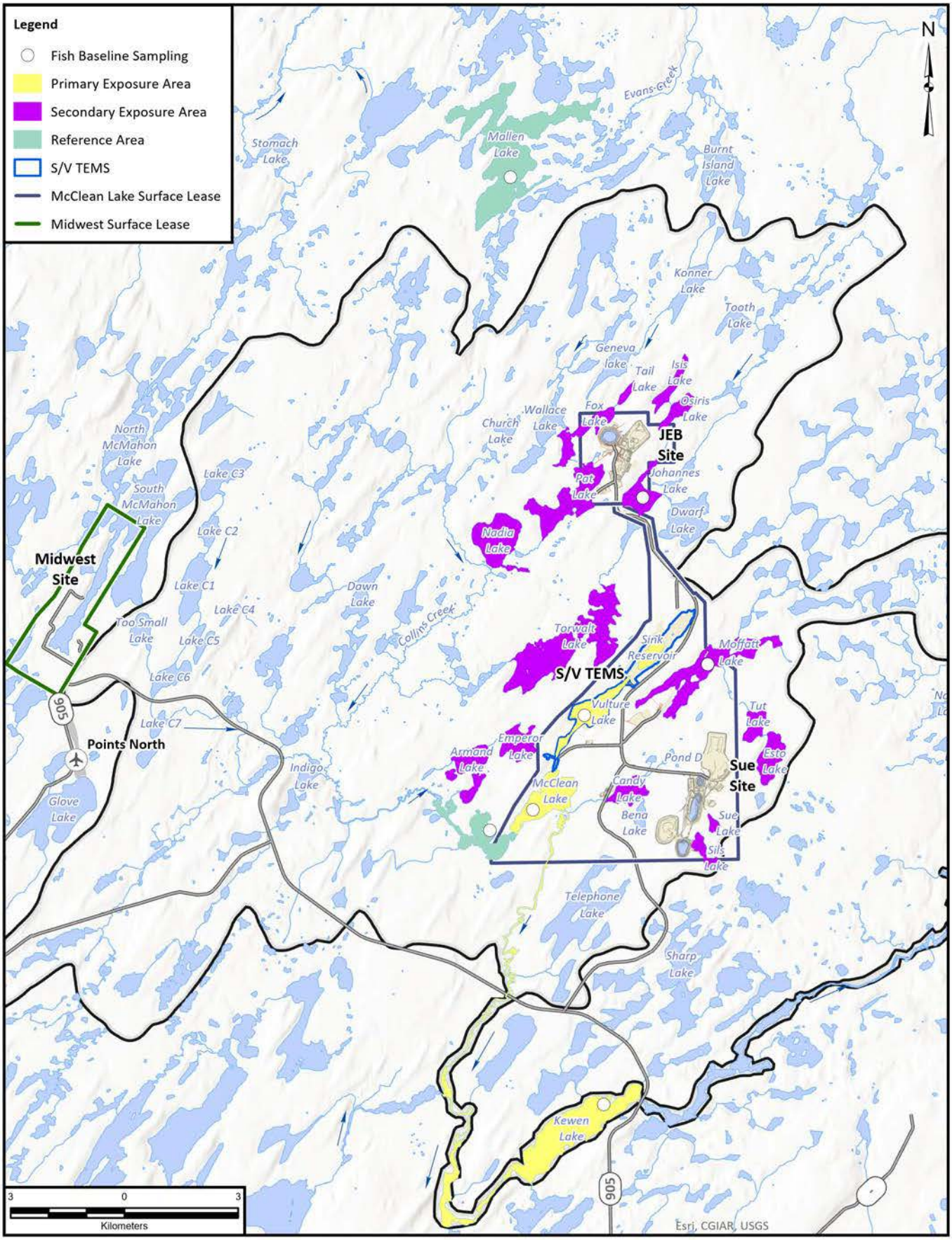


Figure 4.5-11 Biplot of Riverine Depositional Benthic Invertebrate CA Axis Scores Calculated at the Lowest Practical Level.

Note: Reference locations denoted by green symbols; exposure locations denoted by blue symbols. Ellipses represent the inner and outer tolerance limits for the reference area data.



Projection: NAD 1983 UTM Zone 13N
Drawn: TL
Date: 2025-07-10 Scale: 1:140,000
Data Sources: Natural Resources Canada, ORANO Canada Inc.

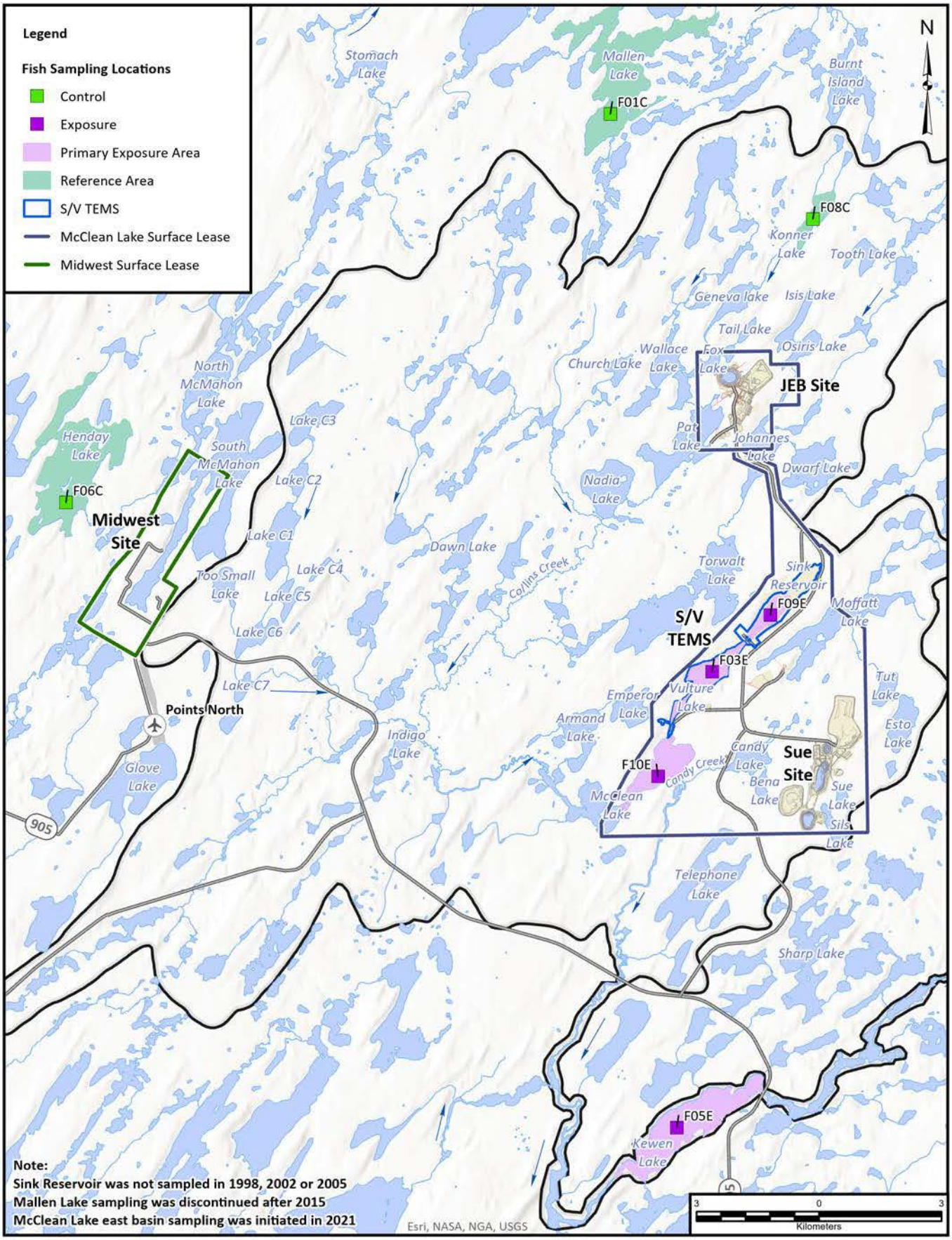
McCLEAN LAKE OPERATION

FIGURE 4.6-1
BASELINE FISH SAMPLING AREAS
FOR THE McCLEAN LAKE OPERATION

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 4\EPTID Section 4.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-07-10 10:01 AM Scale: 1:130,000
Data Sources: Natural Resources Canada, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 4.6-2
LOCATIONS OF WATERBODIES SAMPLED
FOR THE FISH CHEMISTRY PROGRAM

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 4\EPTID Section 4.aprx

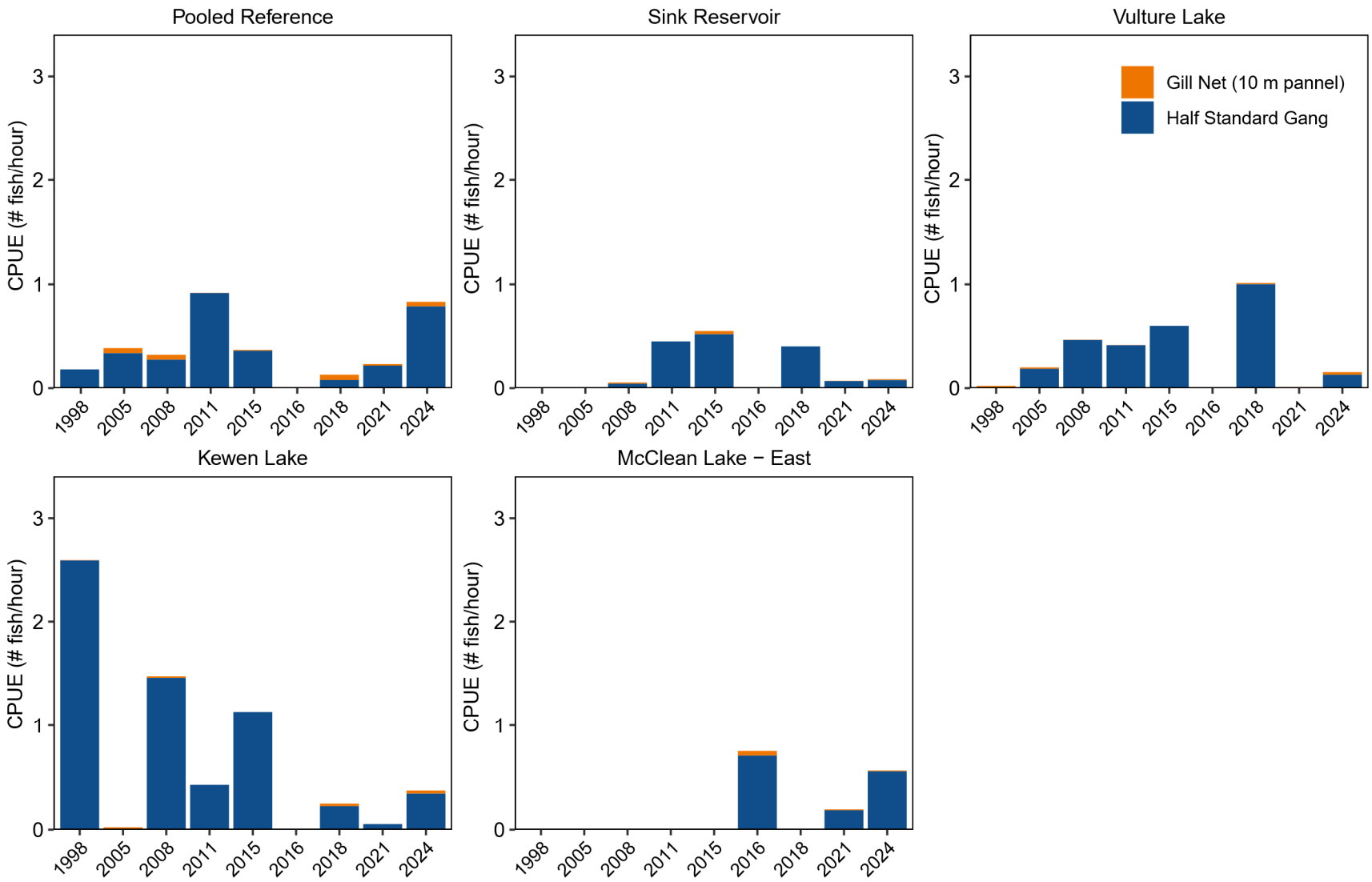


Figure 4.6-3 Catch Per Unit Effort (CPUE) of Northern Pike for the Fish Chemistry Monitoring Program, 1998 to 2024.

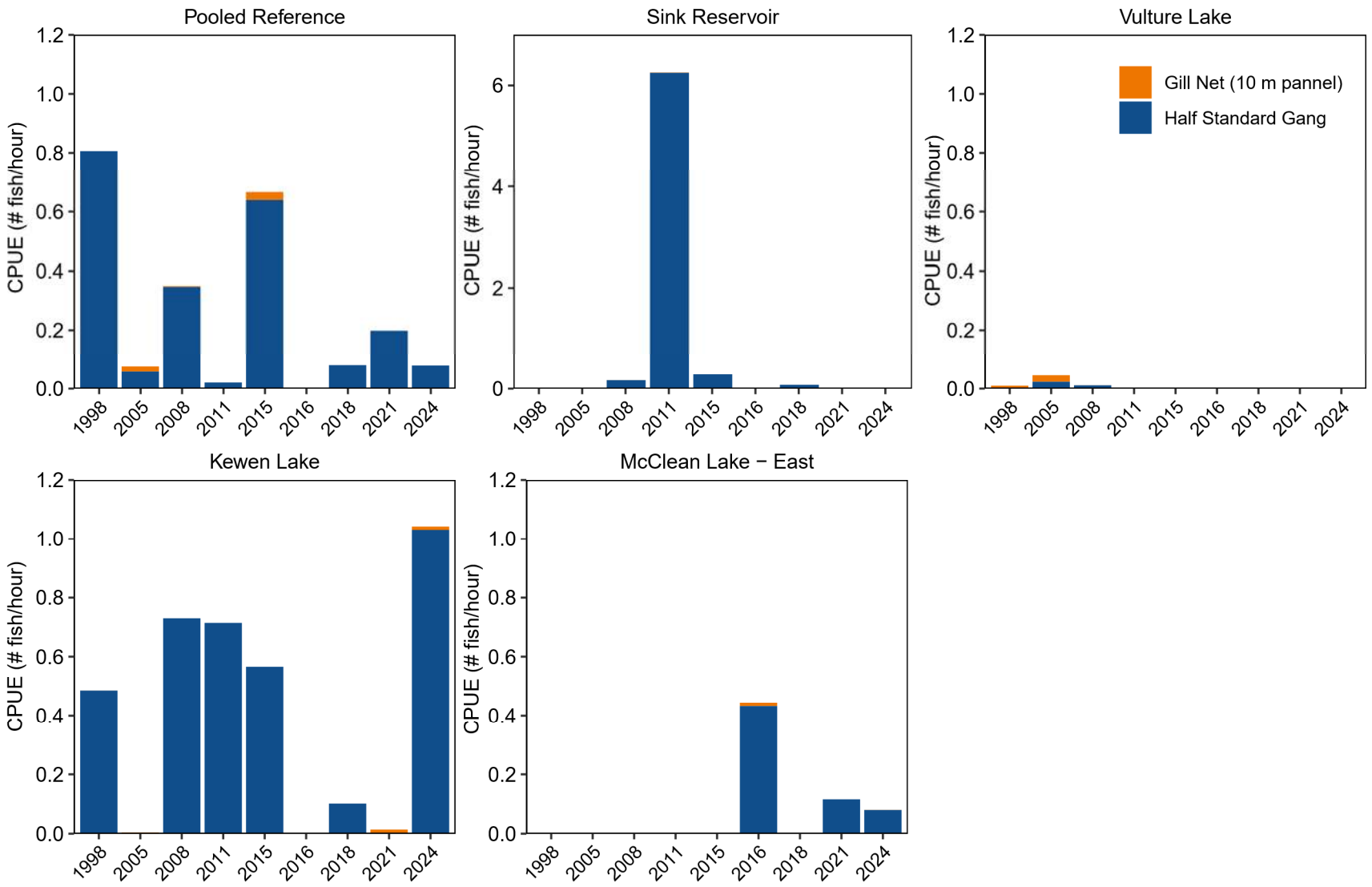


Figure 4.6-4 Catch Per Unit Effort (CPUE) of White Sucker for the Fish Chemistry Monitoring Program, 1998 to 2024.

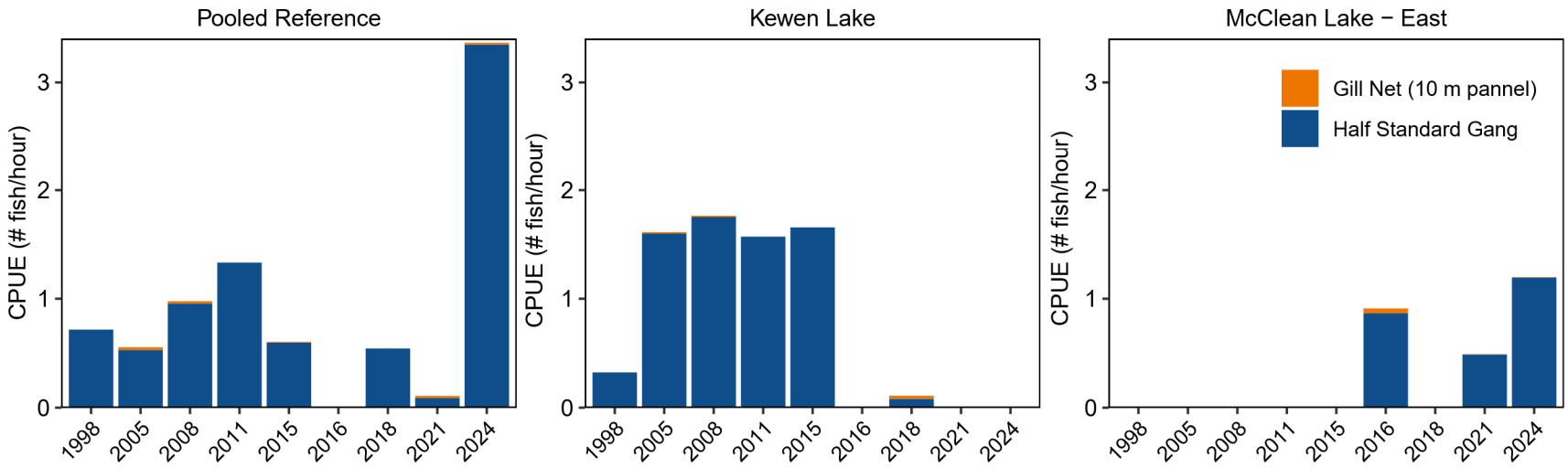


Figure 4.6-5 Catch Per Unit Effort (CPUE) of Lake Whitefish for the Fish Chemistry Monitoring Program, 1998 to 2024.

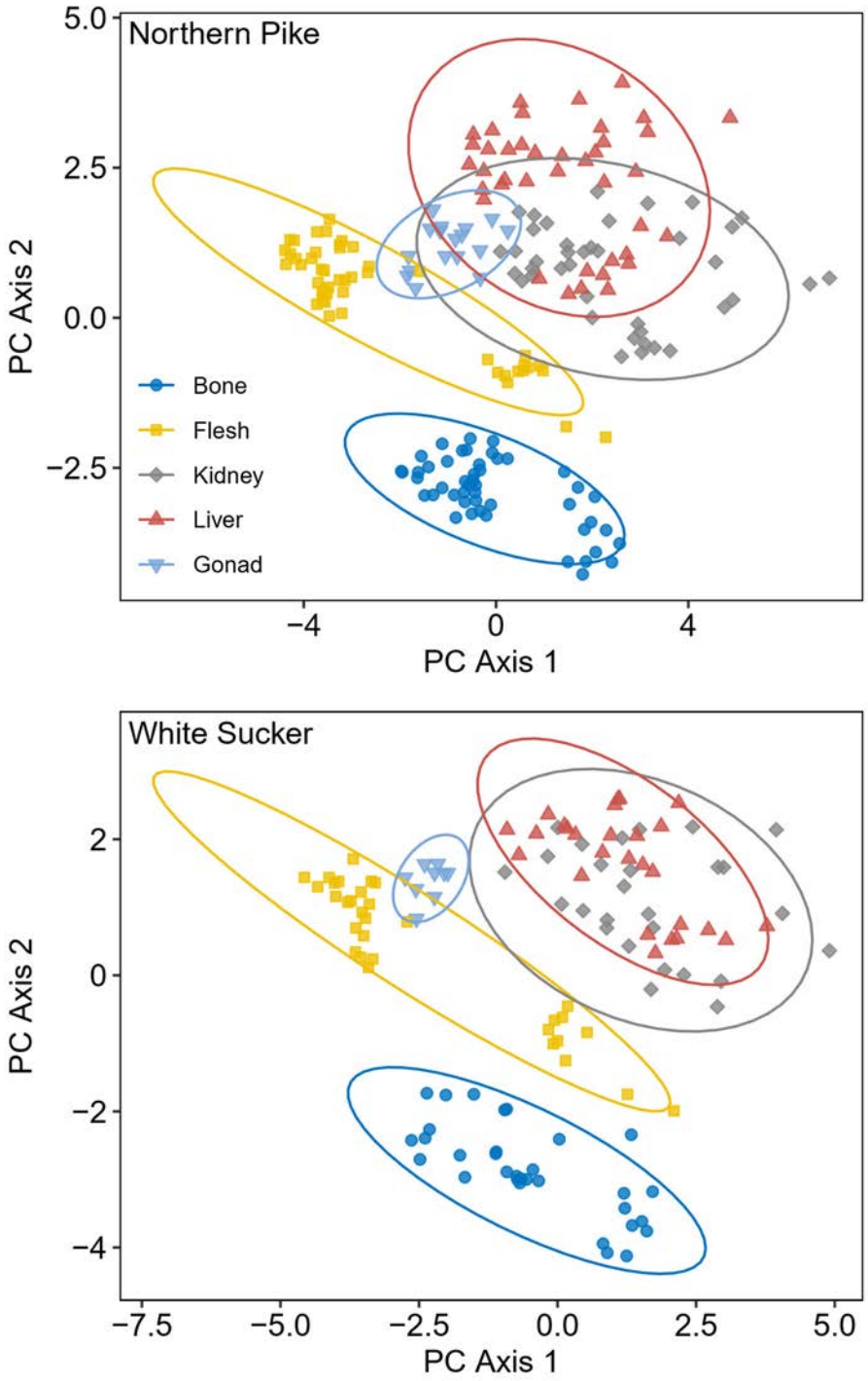


Figure 4.6-6 Axes 1 And 2 Samples Scores From Principal Component Analysis (PCA) Carried Out On Fish Tissue Chemistry For Northern Pike (Top Panel) And White Sucker (Lower Panel) From Reference Lakes (Mallen, Henday, Konner), All Years, And Baseline Years, All Lakes.

Note: ellipses denote the 95% confidence interval for each corresponding data set.

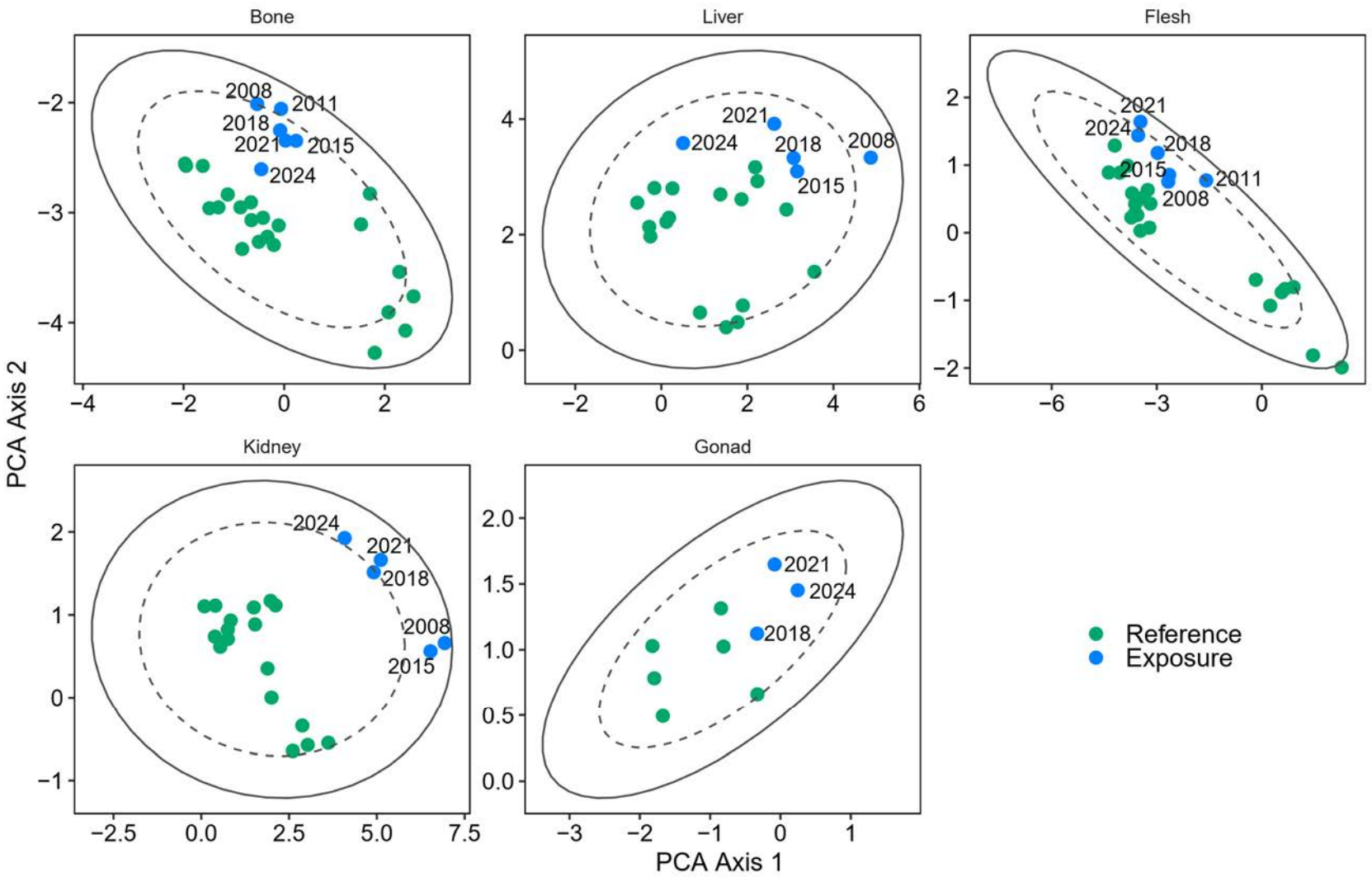


Figure 4.6-7 Principal Component Analysis Scores for Northern Pike Tissue Chemistry from Sink Reservoir.

Note: Reference locations denoted by green symbols; exposure locations denoted by blue symbols. Ellipses represent the inner and outer tolerance limits for the reference lakes and pre-operational years.

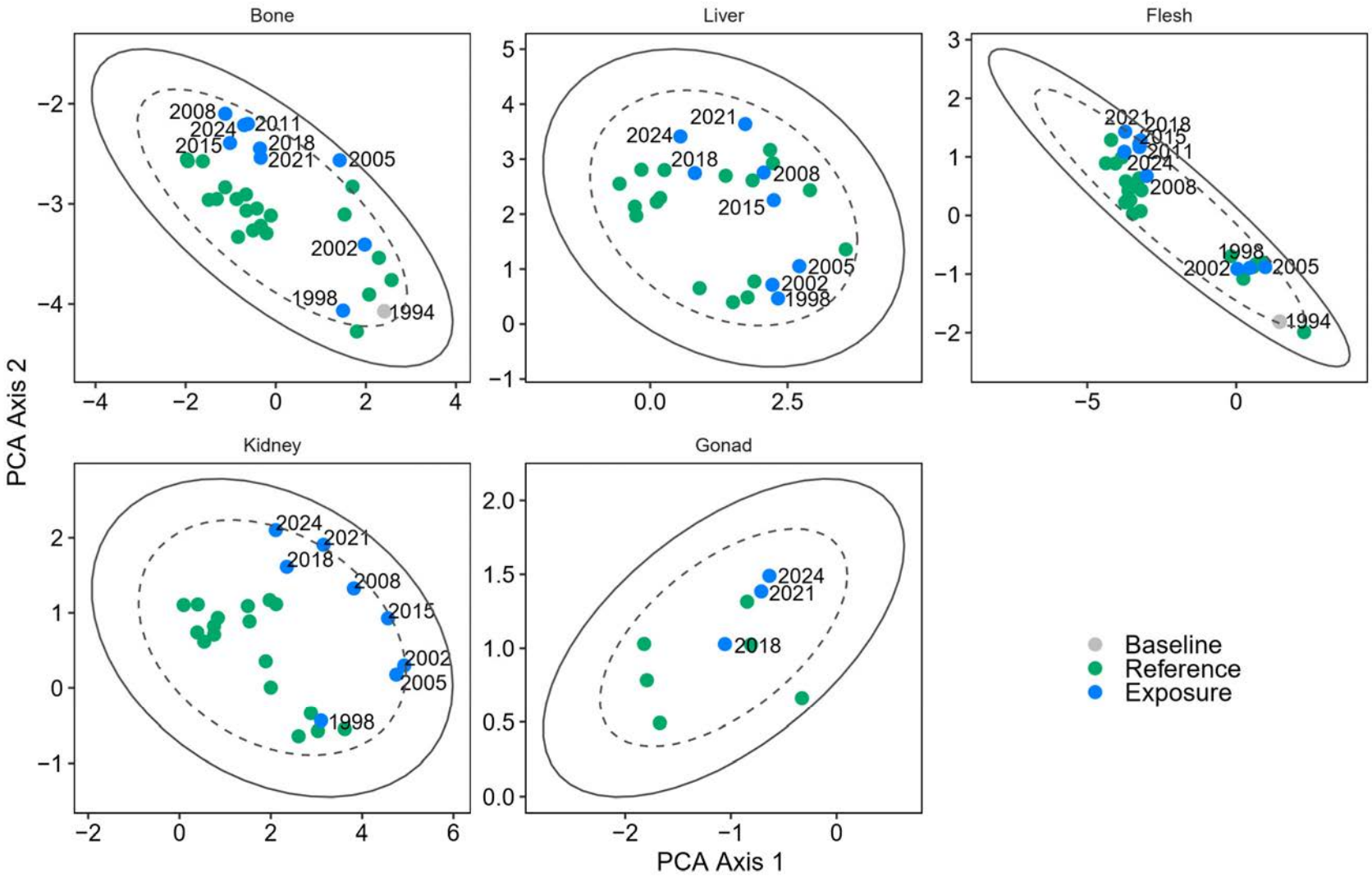


Figure 4.6-8 Principal Component Analysis Scores for Northern Pike Tissue Chemistry from Vulture Lake.

Note: Reference locations denoted by green symbols; exposure locations denoted by blue symbols. Ellipses represent the inner and outer tolerance limits for the reference lakes and pre-operational years.

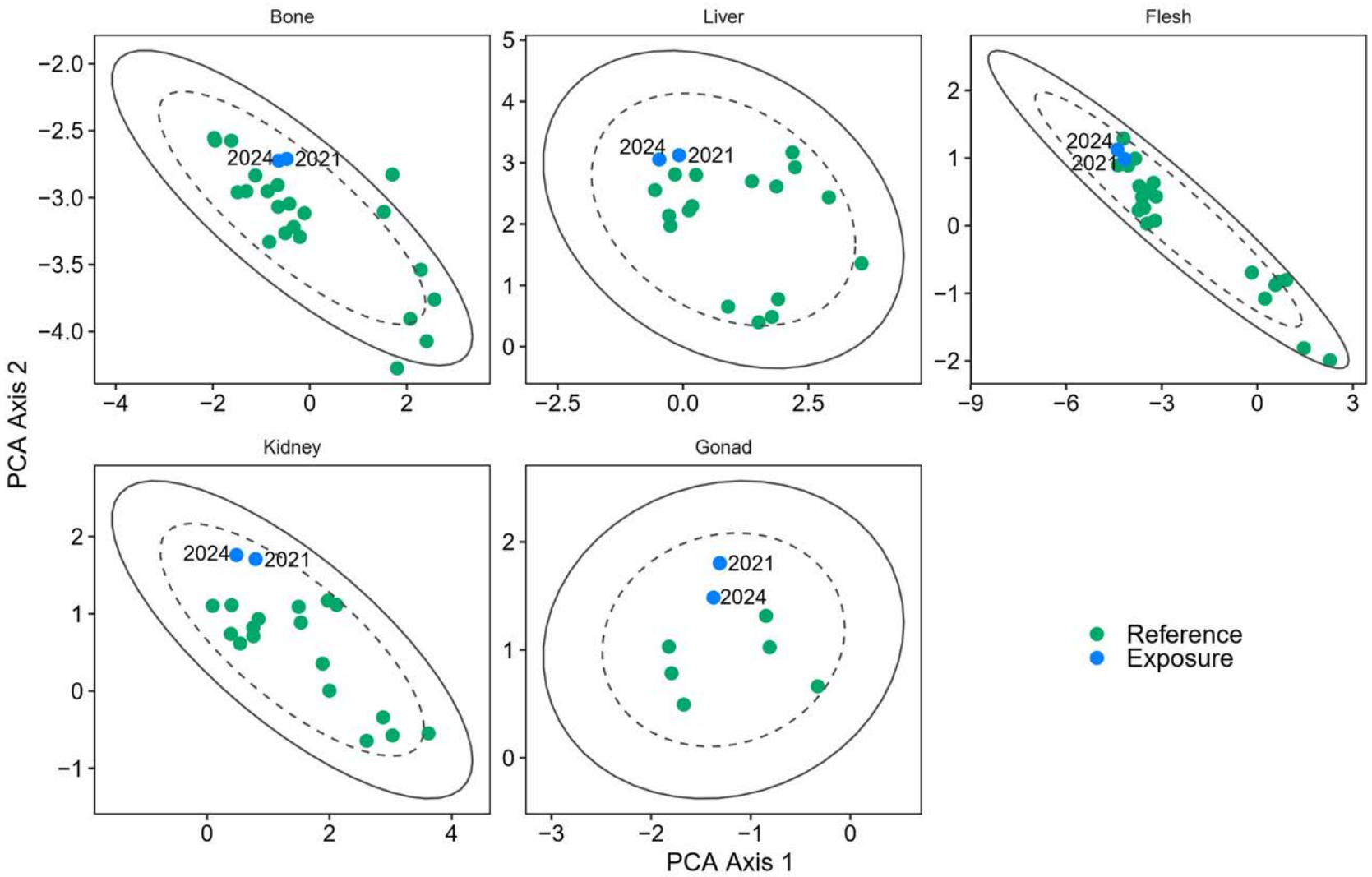


Figure 4.6-9 Principal Component Analysis Scores for Northern Pike Tissue Chemistry from McClean Lake - East.

Note: Reference locations denoted by green symbols; exposure locations denoted by blue symbols. Ellipses represent the inner and outer tolerance limits for the reference lakes and pre-operational years.

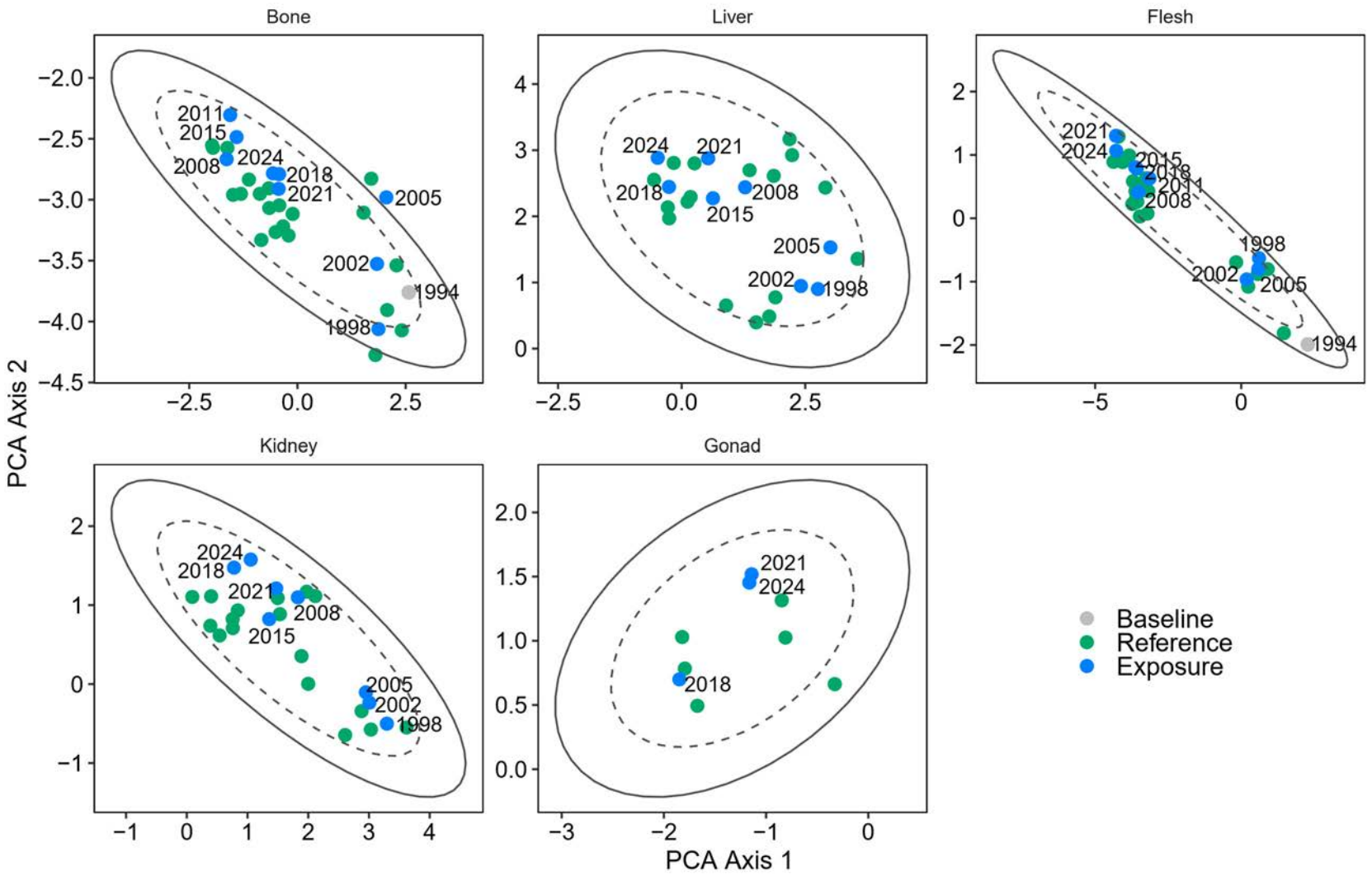


Figure 4.6-10 Principal Component Analysis Scores for Northern Pike Tissue Chemistry from Kewen Lake.

Note: Reference locations denoted by green symbols; exposure locations denoted by blue symbols. Ellipses represent the inner and outer tolerance limits for the reference lakes and pre-operational years.

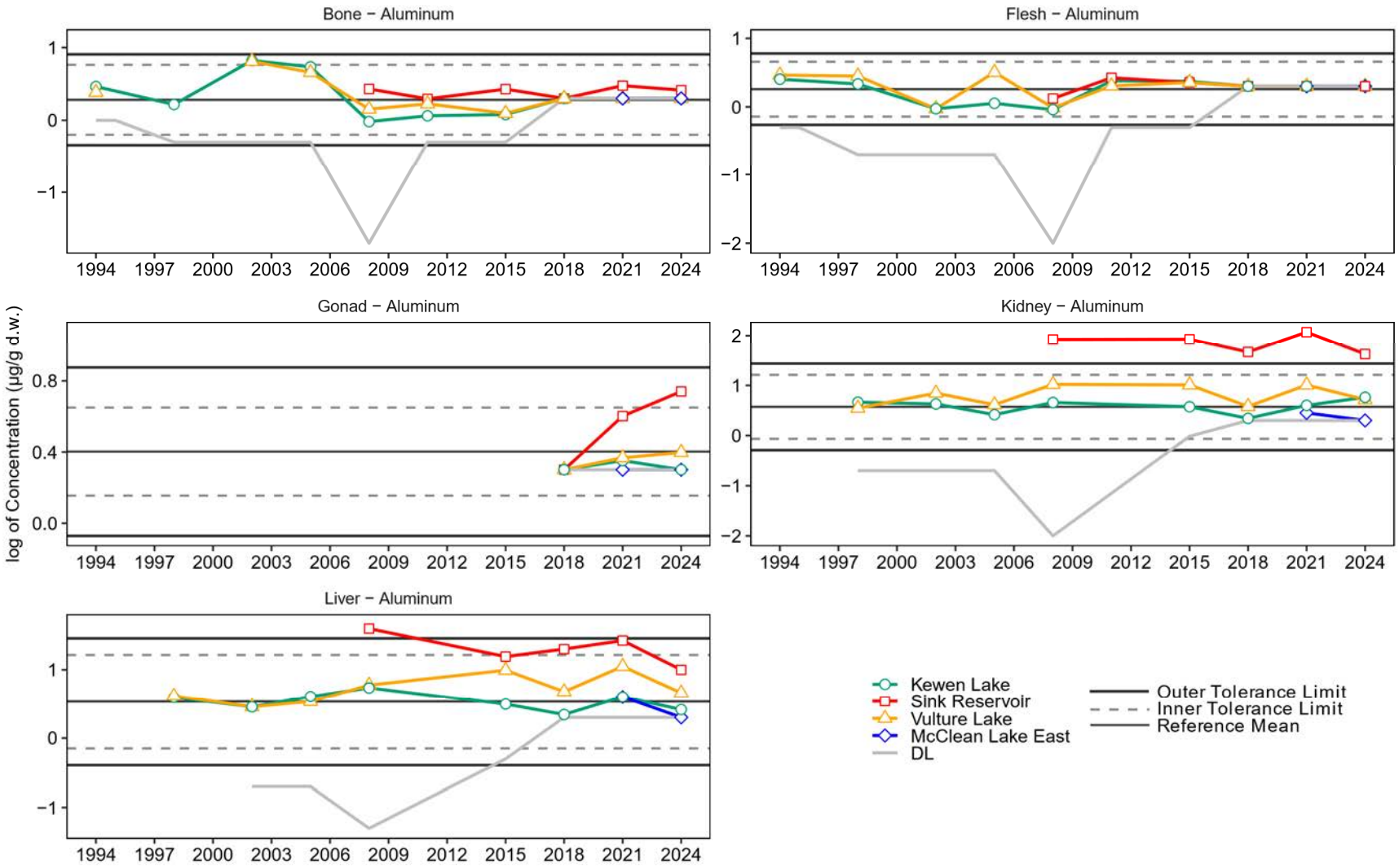


Figure 4.6-11 (1 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024.

Figure Note: Aluminum concentrations in various fish tissue samples are shown.

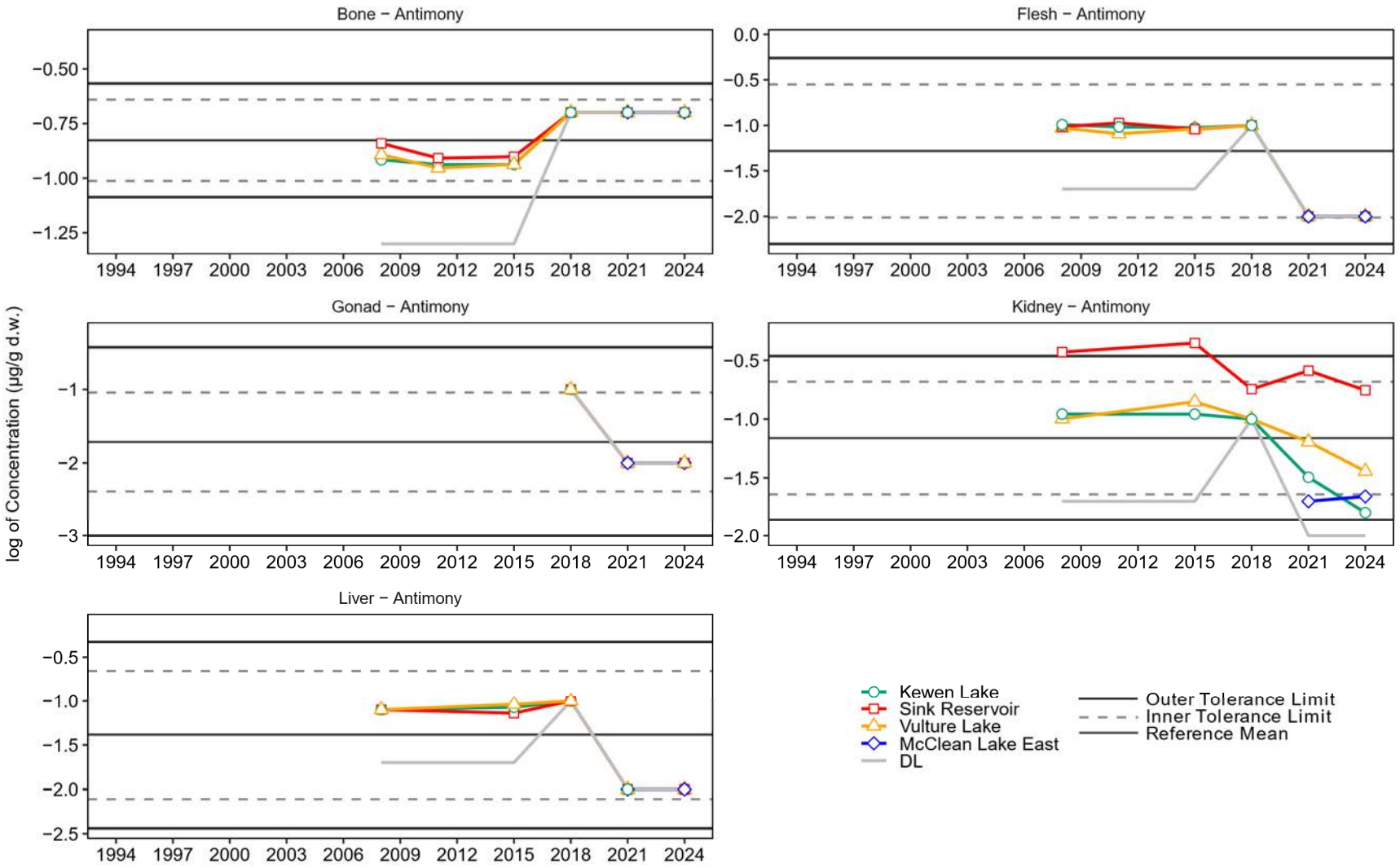


Figure 4.6-11 (2 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Antimony concentrations in various fish tissue samples are shown.

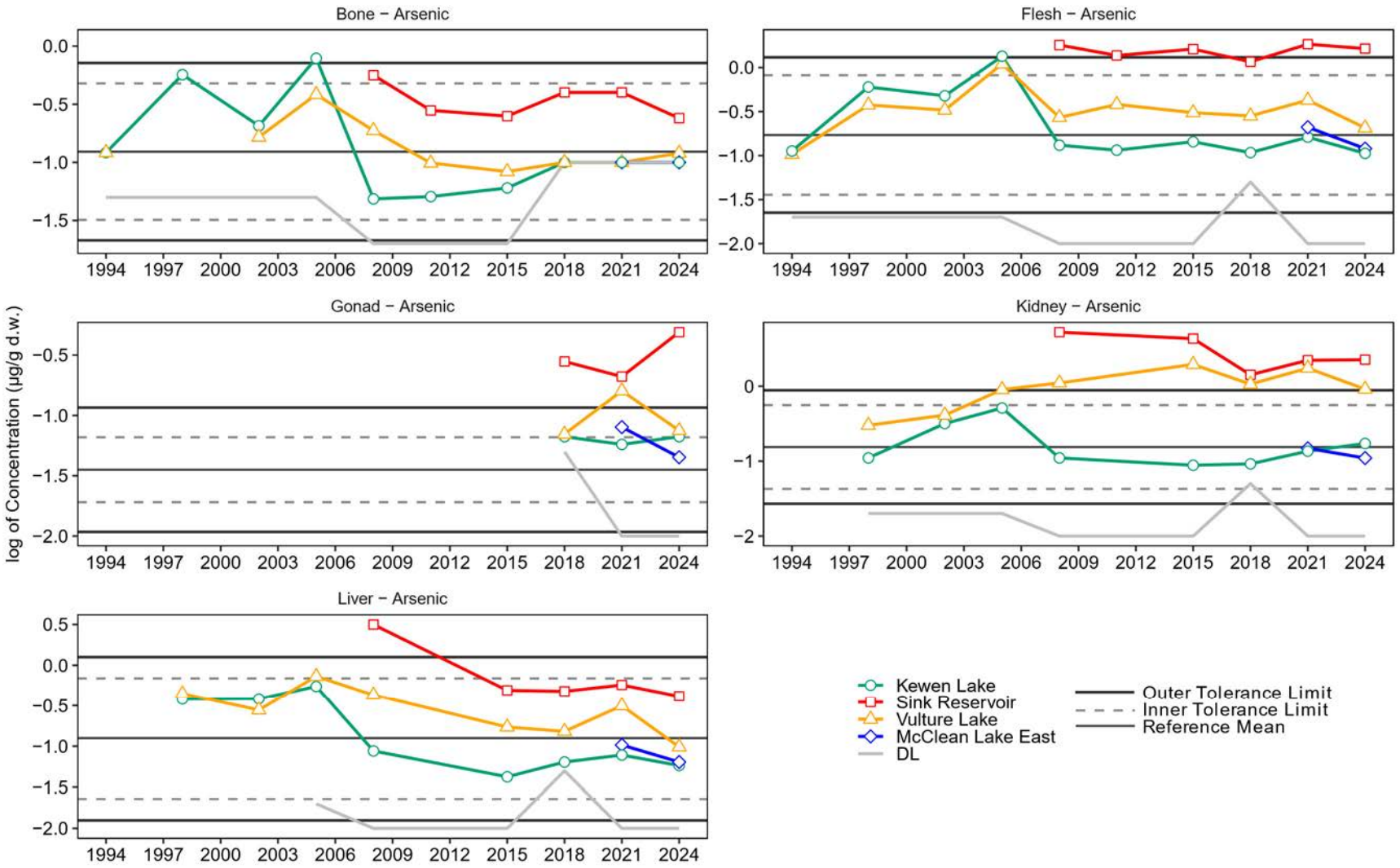


Figure 4.6-11 (3 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Arsenic concentrations in various fish tissue samples are shown.

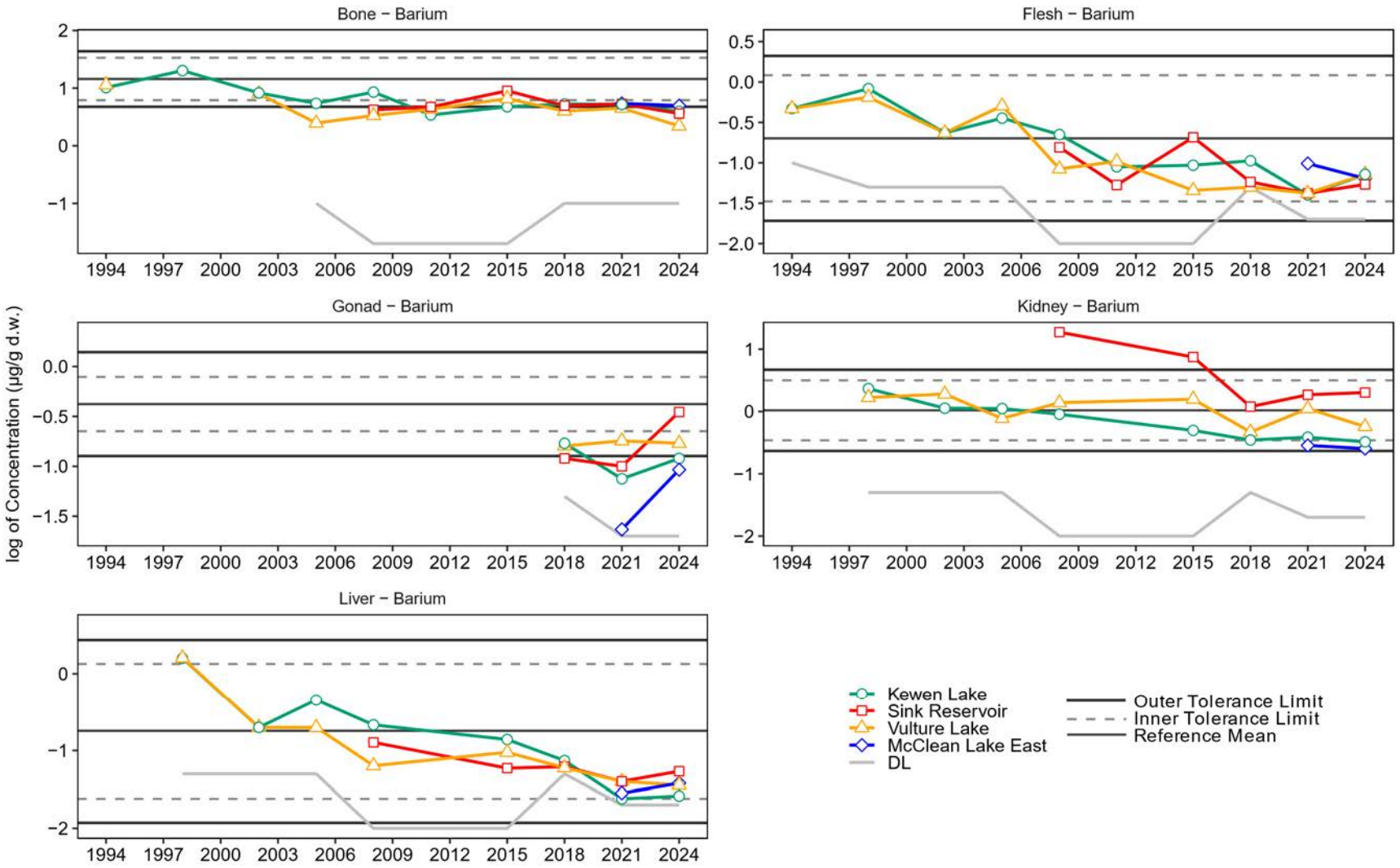


Figure 4.6-11 (4 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Barium concentrations in various fish tissue samples are shown.

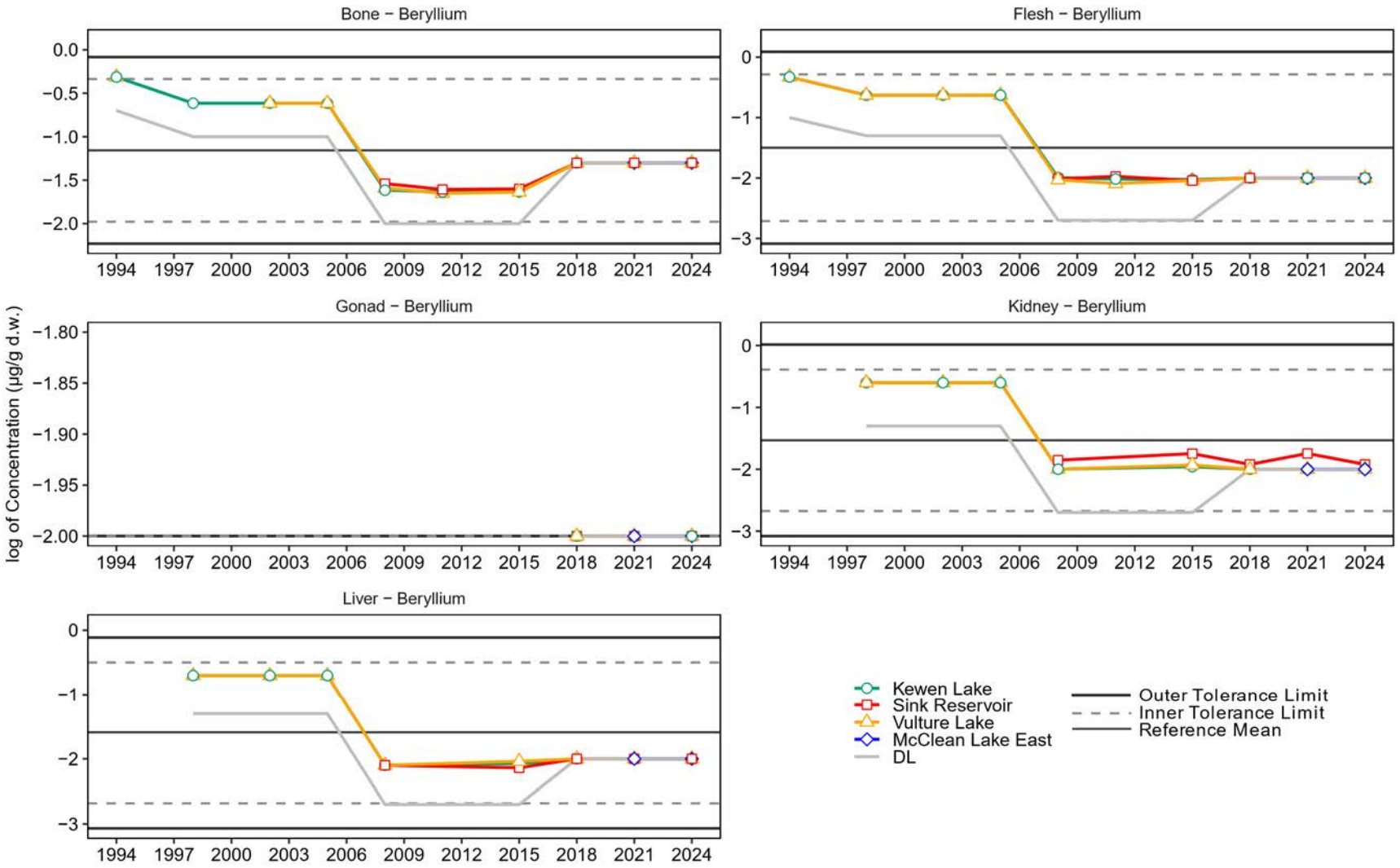


Figure 4.6-11 (5 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Beryllium concentrations in various fish tissue samples are shown.

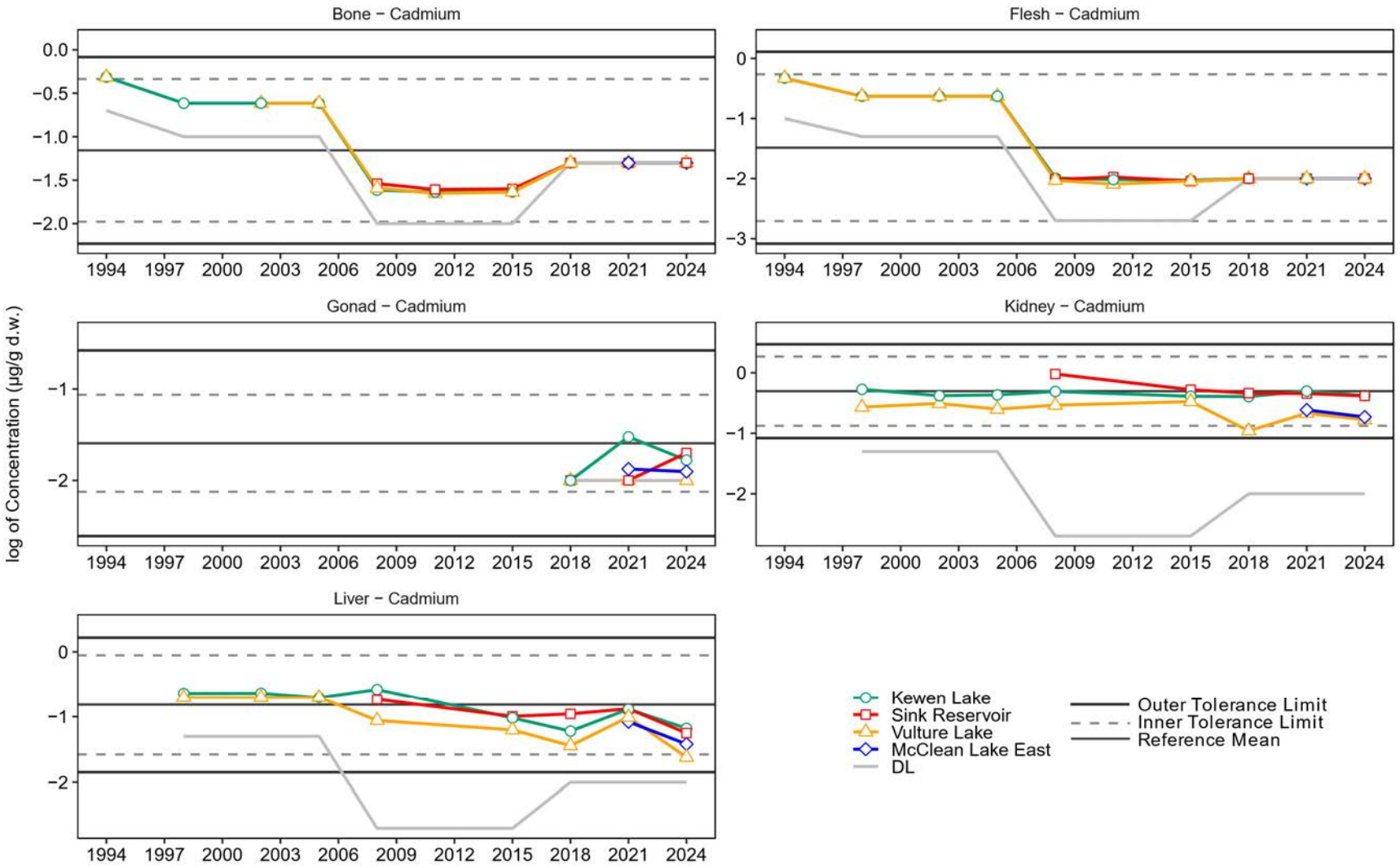


Figure 4.6-11 (6 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Cadmium concentrations in various fish tissue samples are shown.

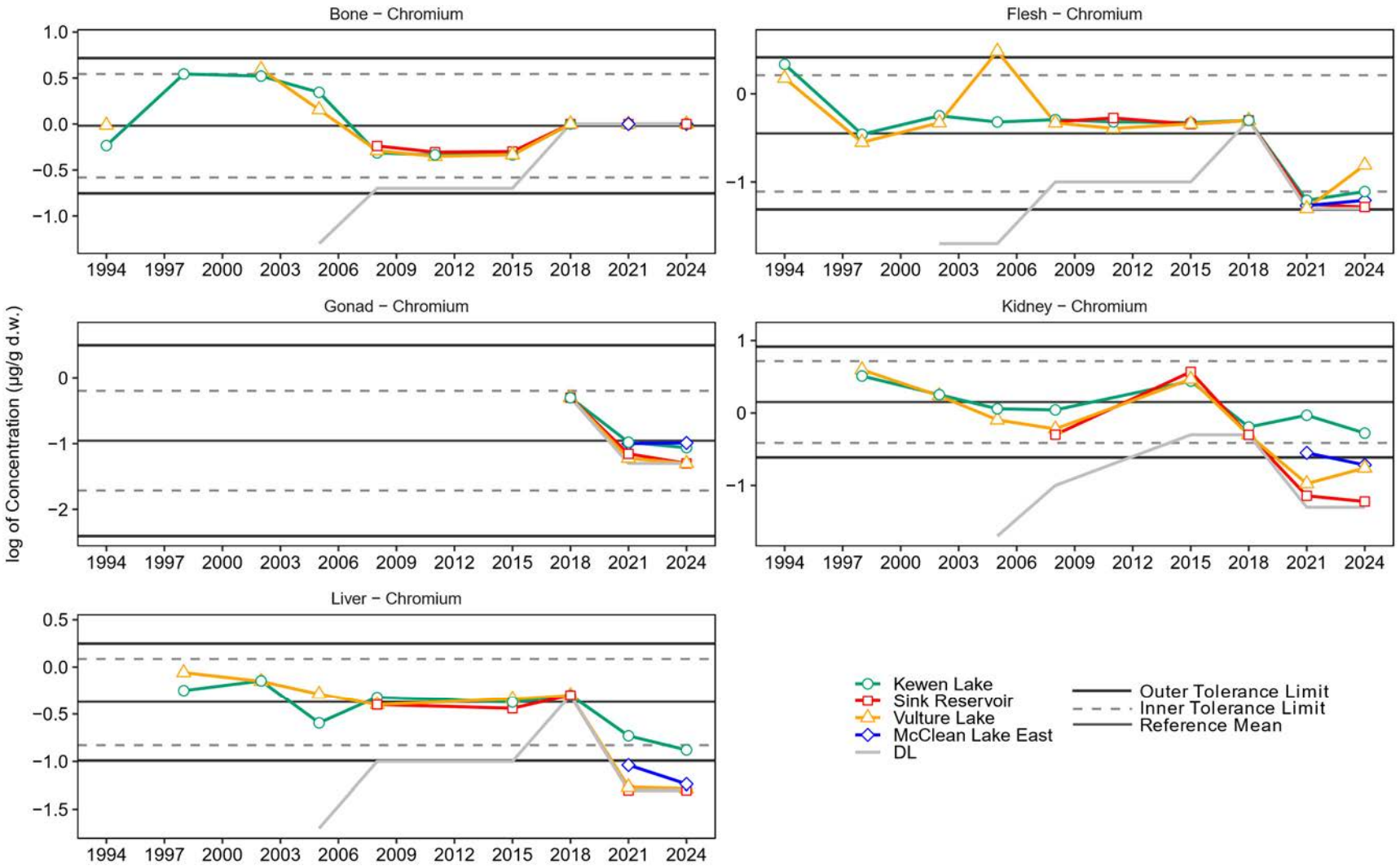


Figure 4.6-11 (7 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Chromium concentrations in various fish tissue samples are shown.

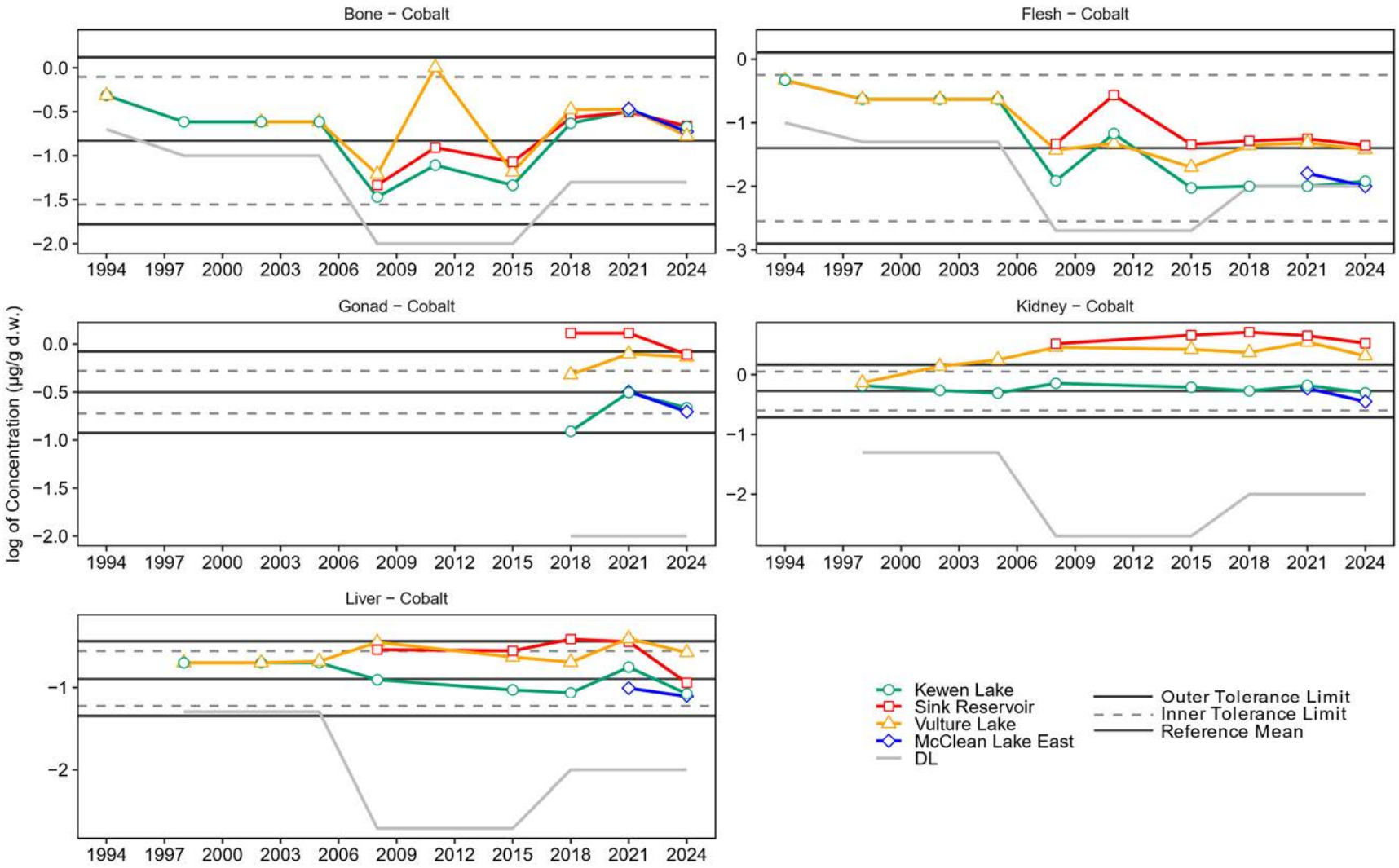


Figure 4.6-11 (8 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Cobalt concentrations in various fish tissue samples are shown.

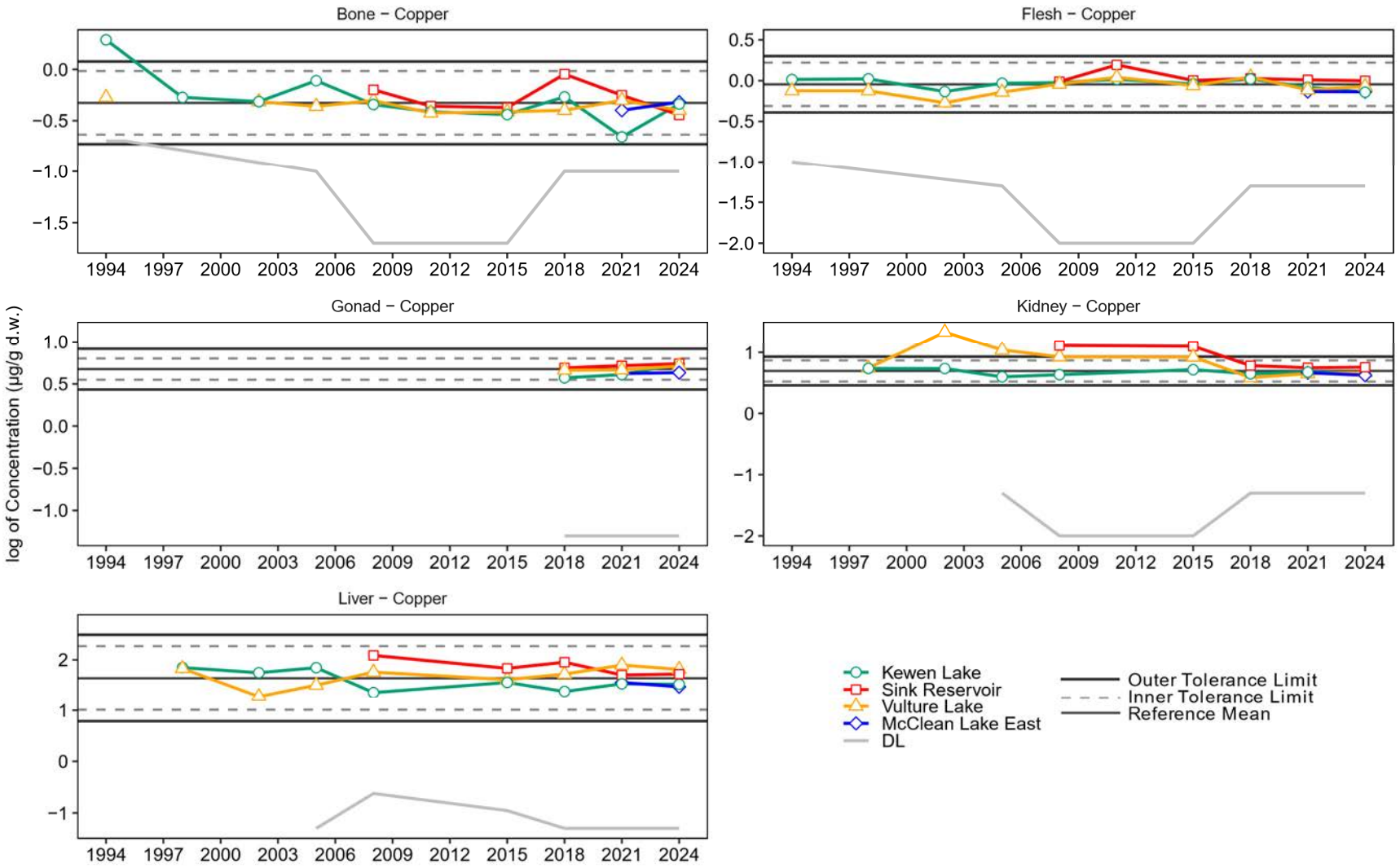


Figure 4.6-11 (9 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Copper concentrations in various fish tissue samples are shown.

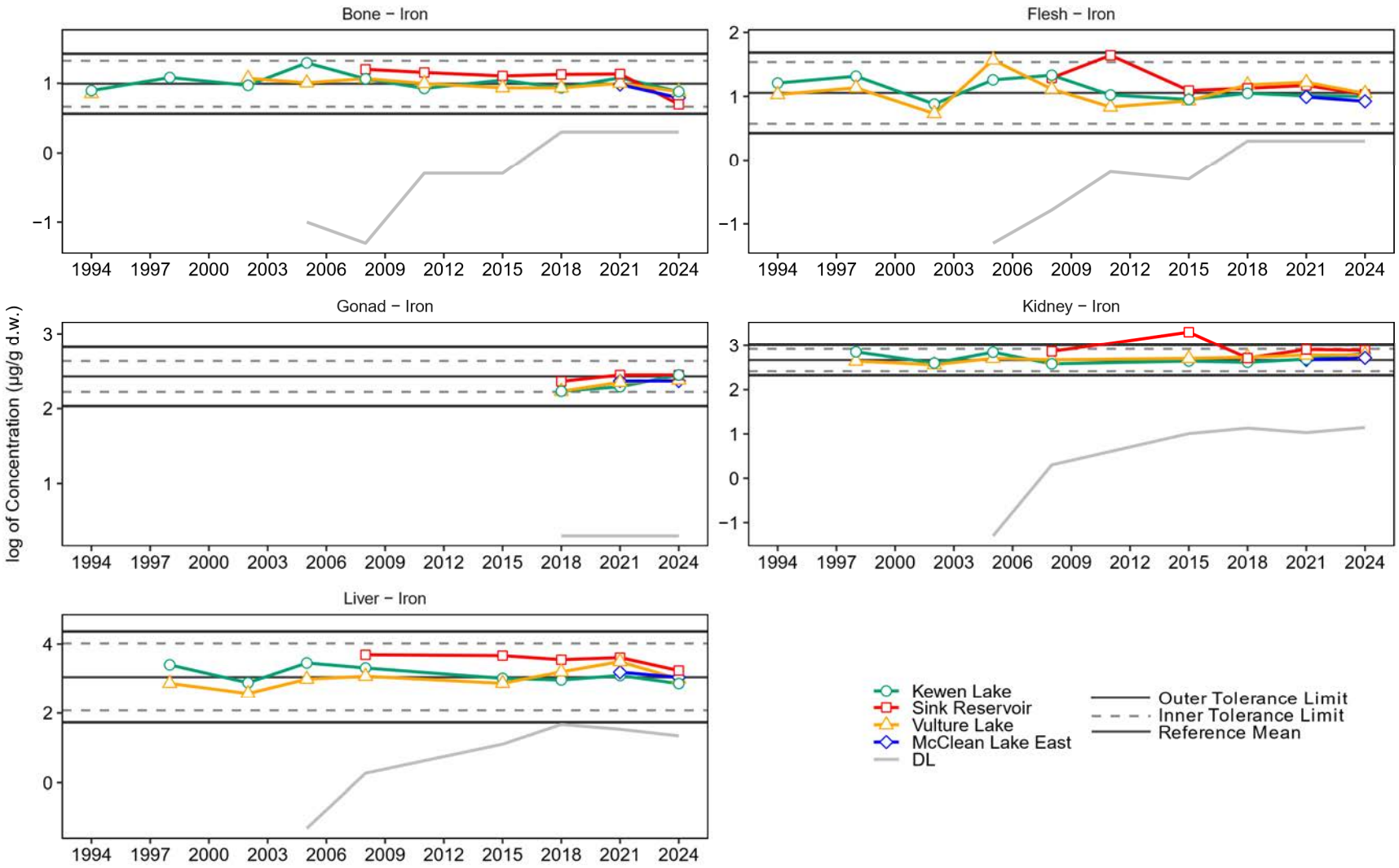


Figure 4.6-11 (10 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Iron concentrations in various fish tissue samples are shown.

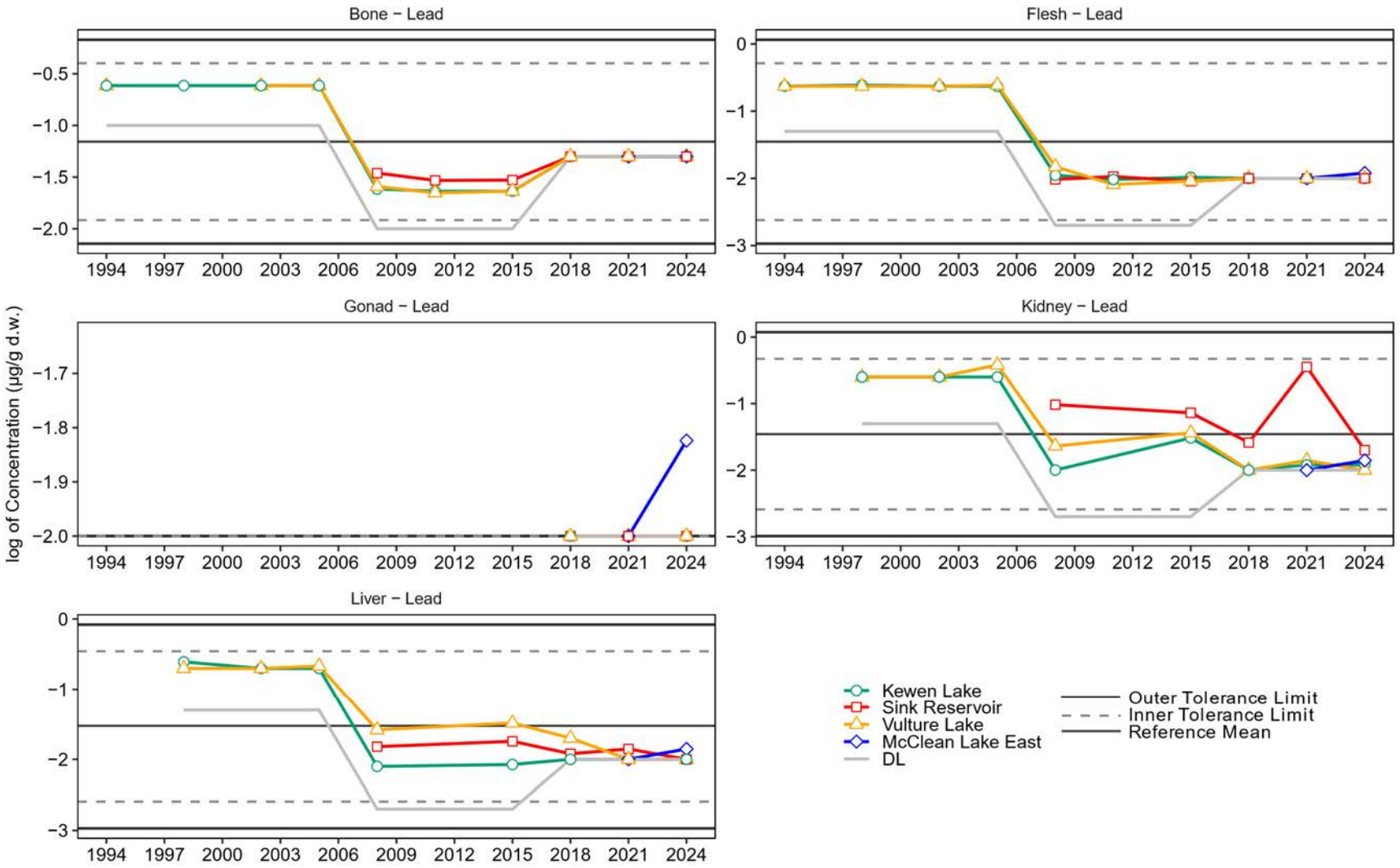


Figure 4.6-11 (11 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Lead concentrations in various fish tissue samples are shown.

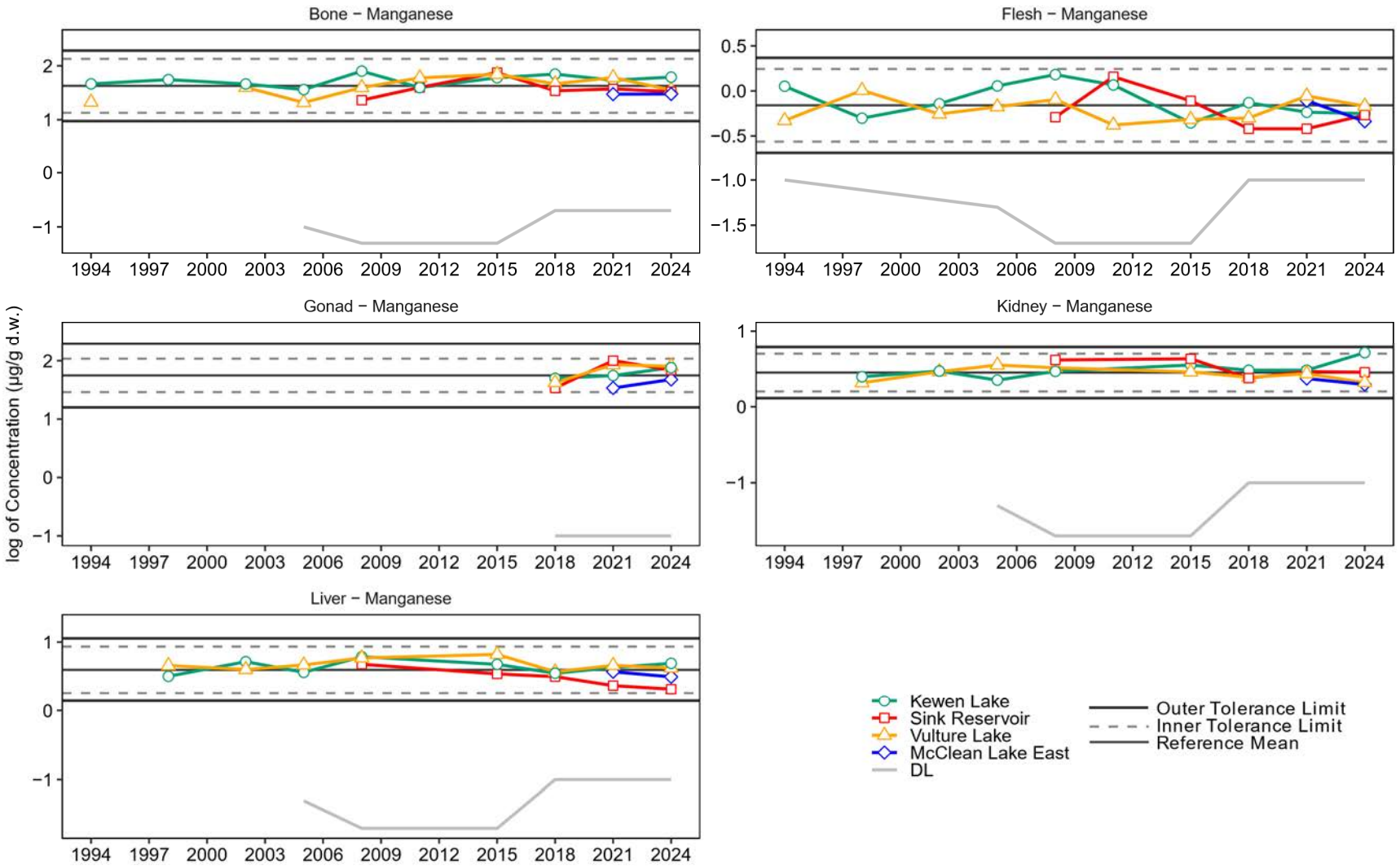


Figure 4.6-11 (12 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Manganese concentrations in various fish tissue samples are shown.

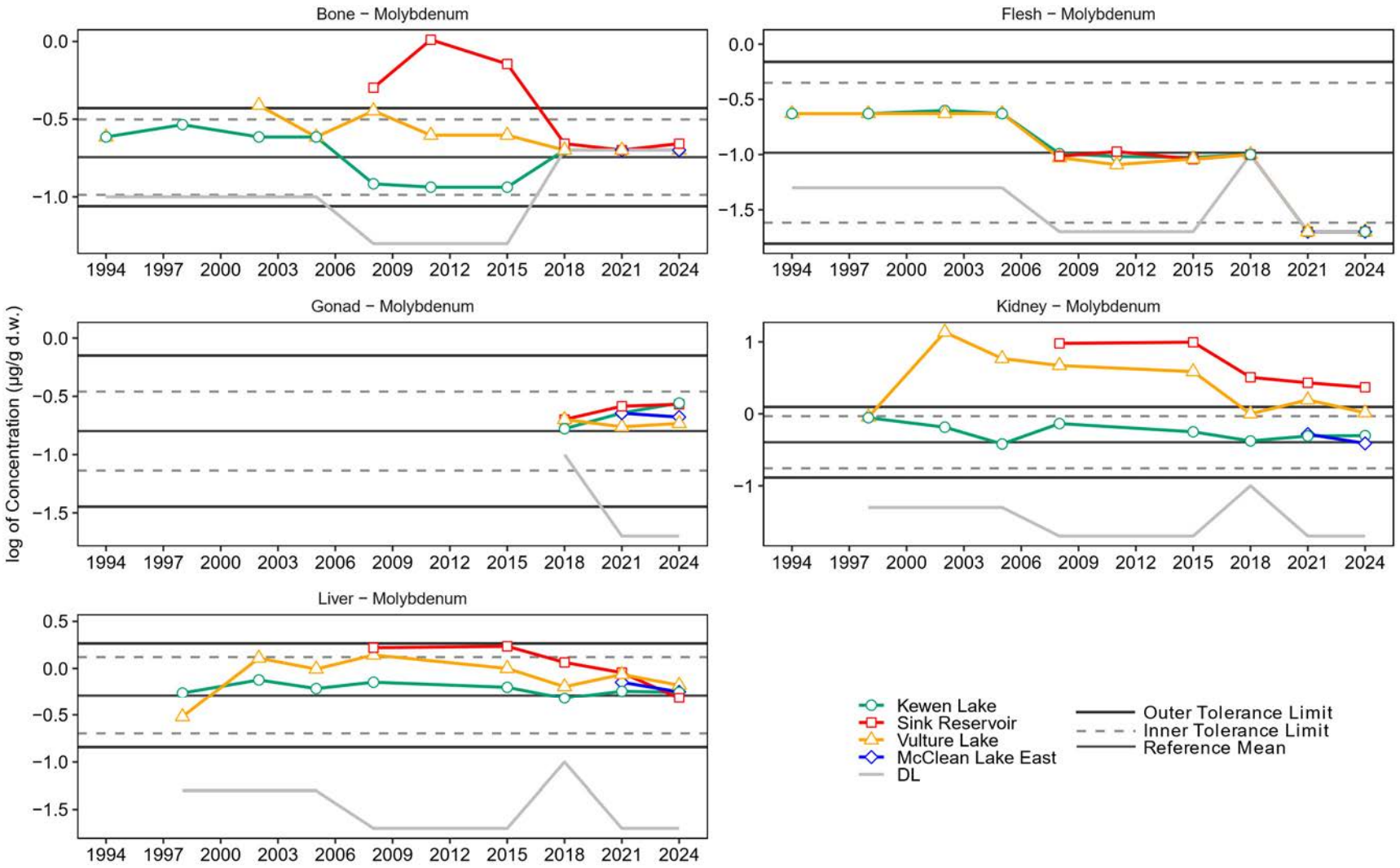


Figure 4.6-11 (13 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Molybdenum concentrations in various fish tissue samples are shown.

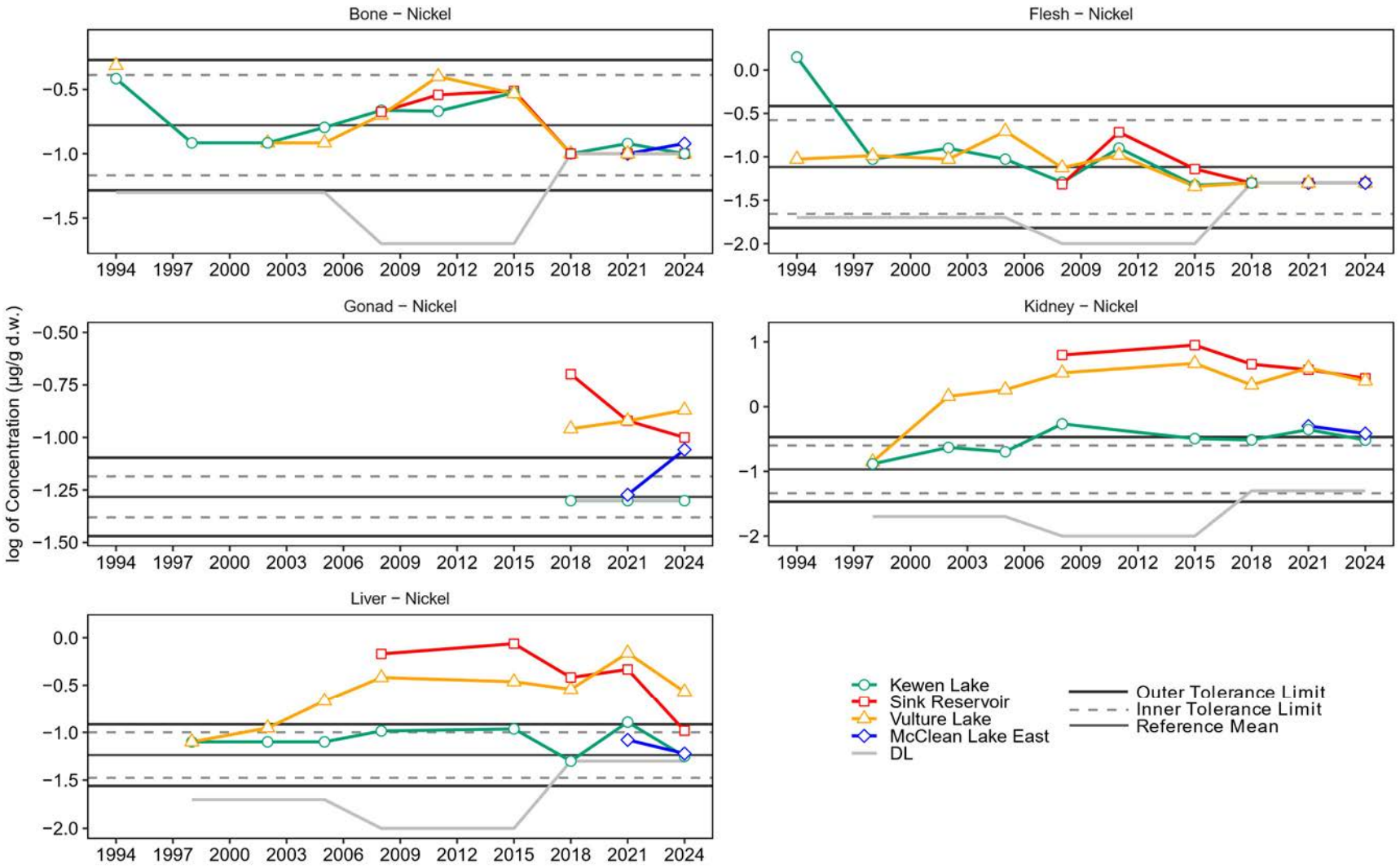


Figure 4.6-11 (14 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Nickel concentrations in various fish tissue samples are shown.

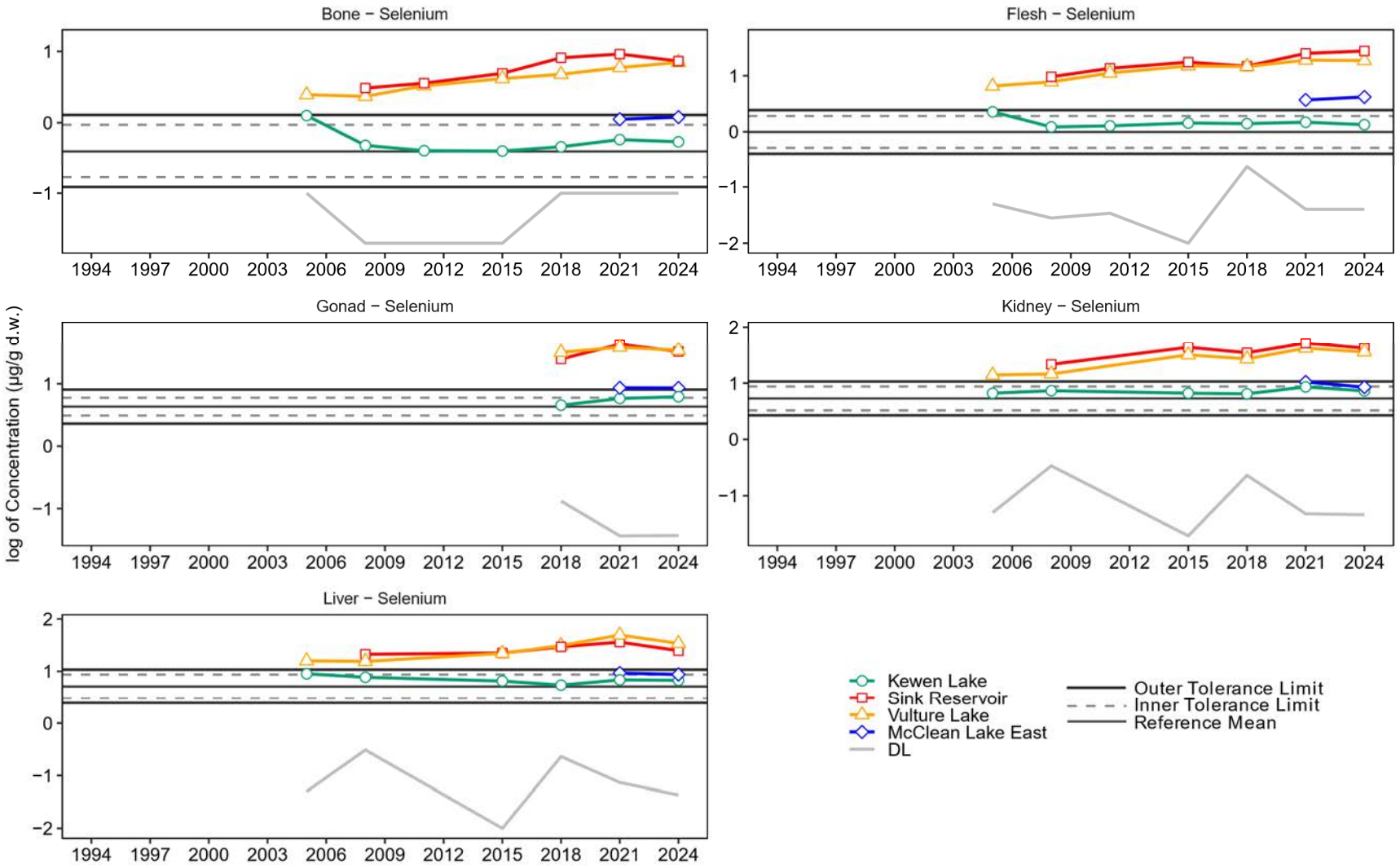


Figure 4.6-11 (15 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Selenium concentrations in various fish tissue samples are shown.

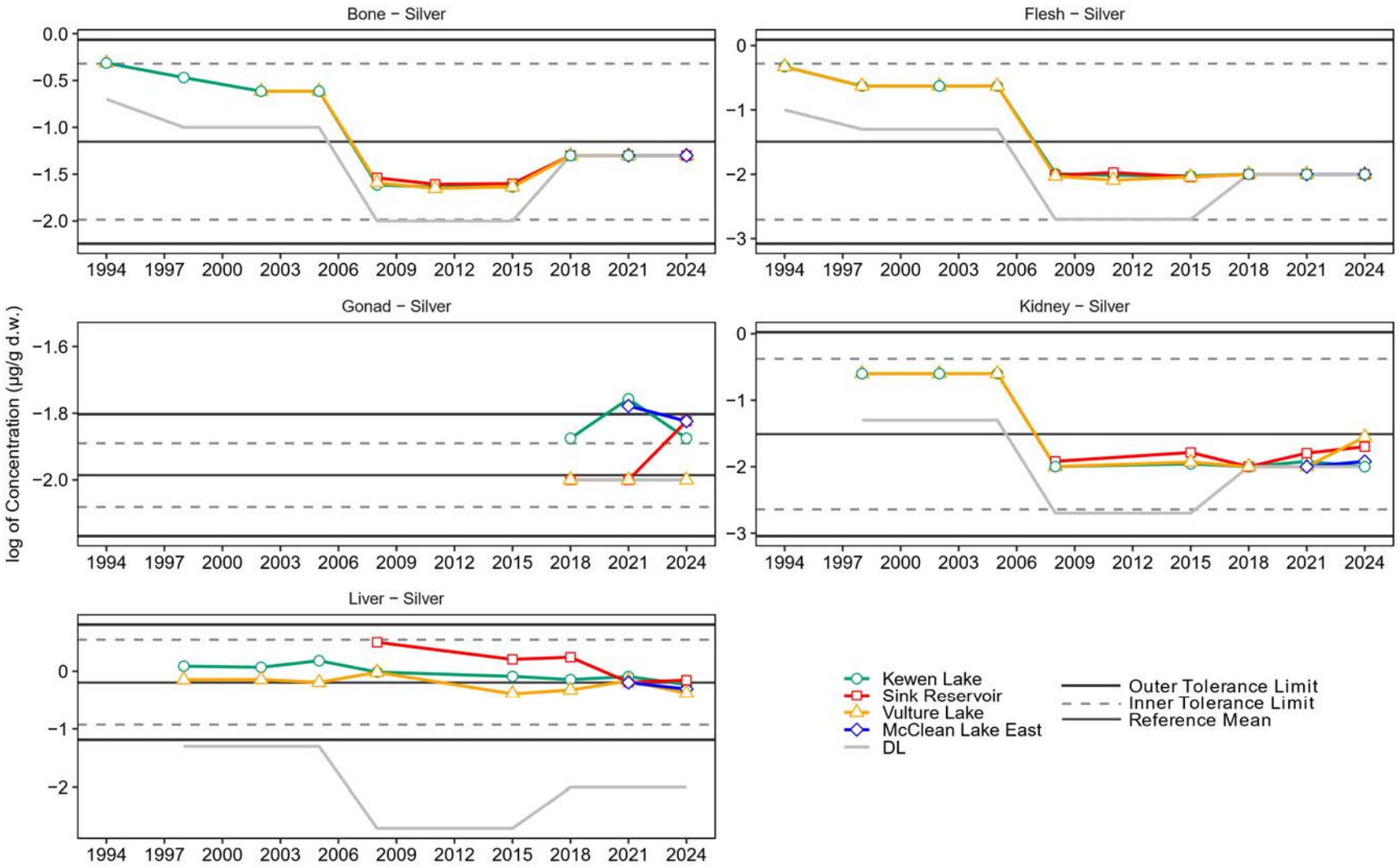


Figure 4.6-11 (16 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Silver concentrations in various fish tissue samples are shown.

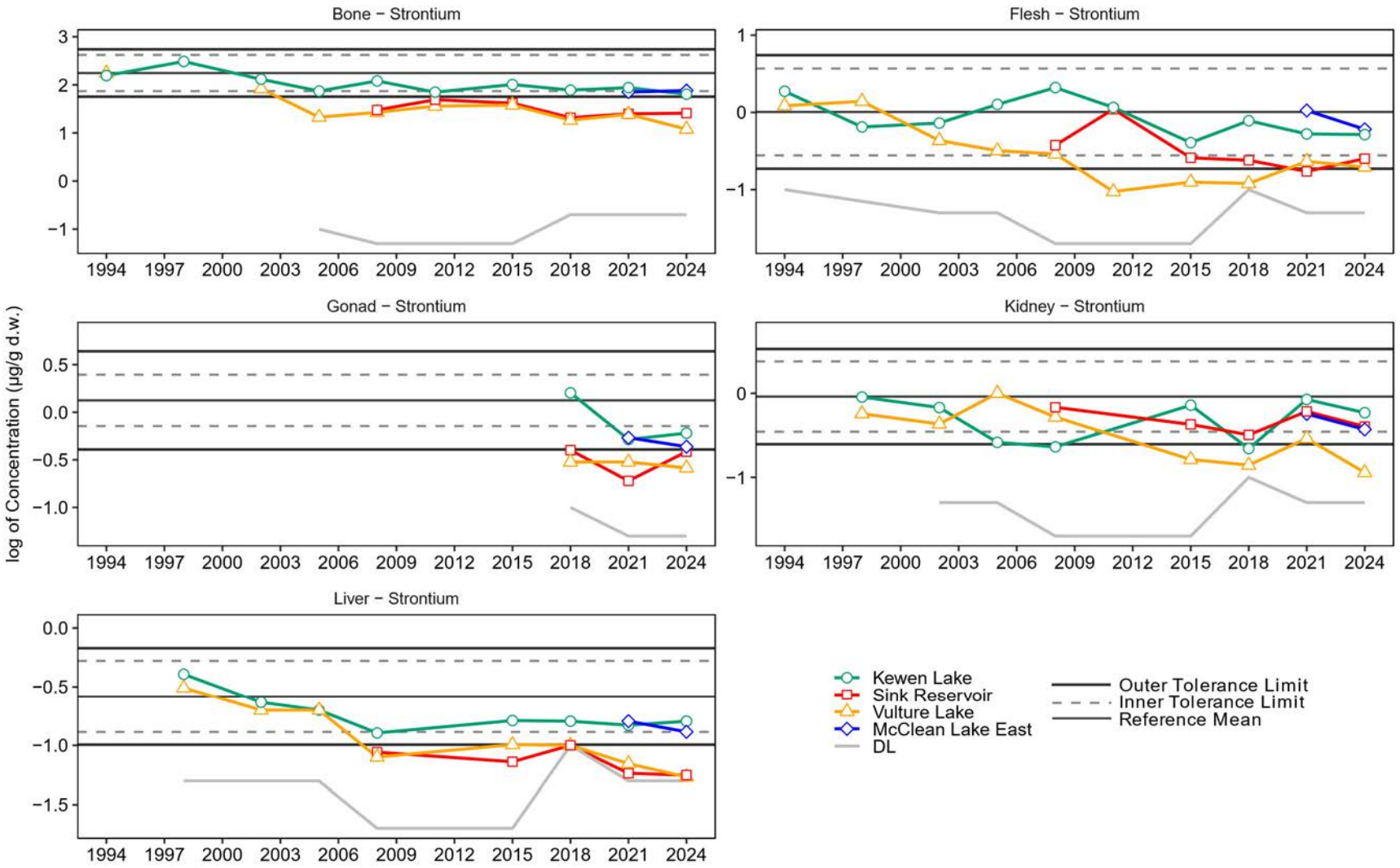


Figure 4.6-11 (17 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Strontium concentrations in various fish tissue samples are shown.

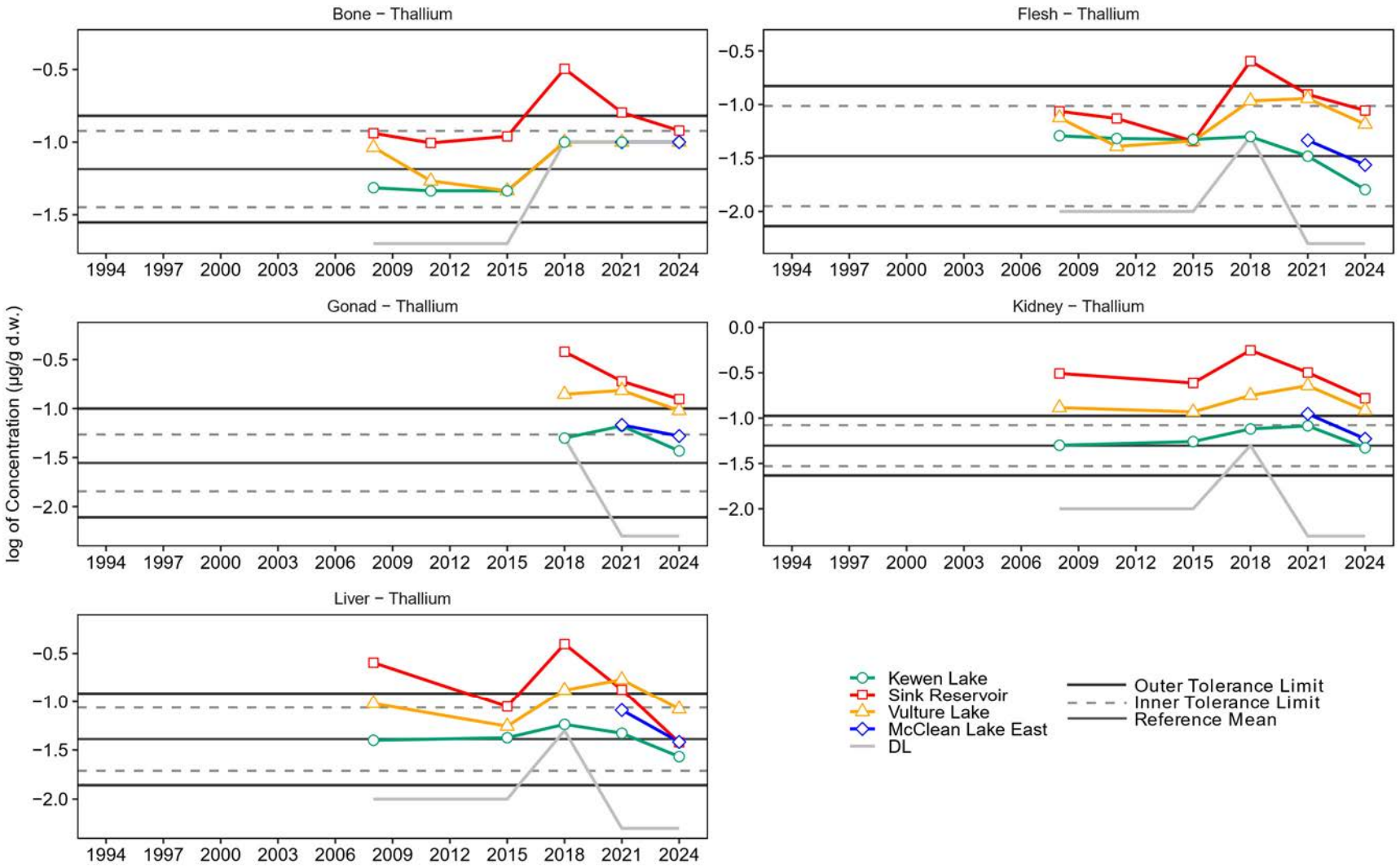


Figure 4.6-11 (18 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Thallium concentrations in various fish tissue samples are shown.

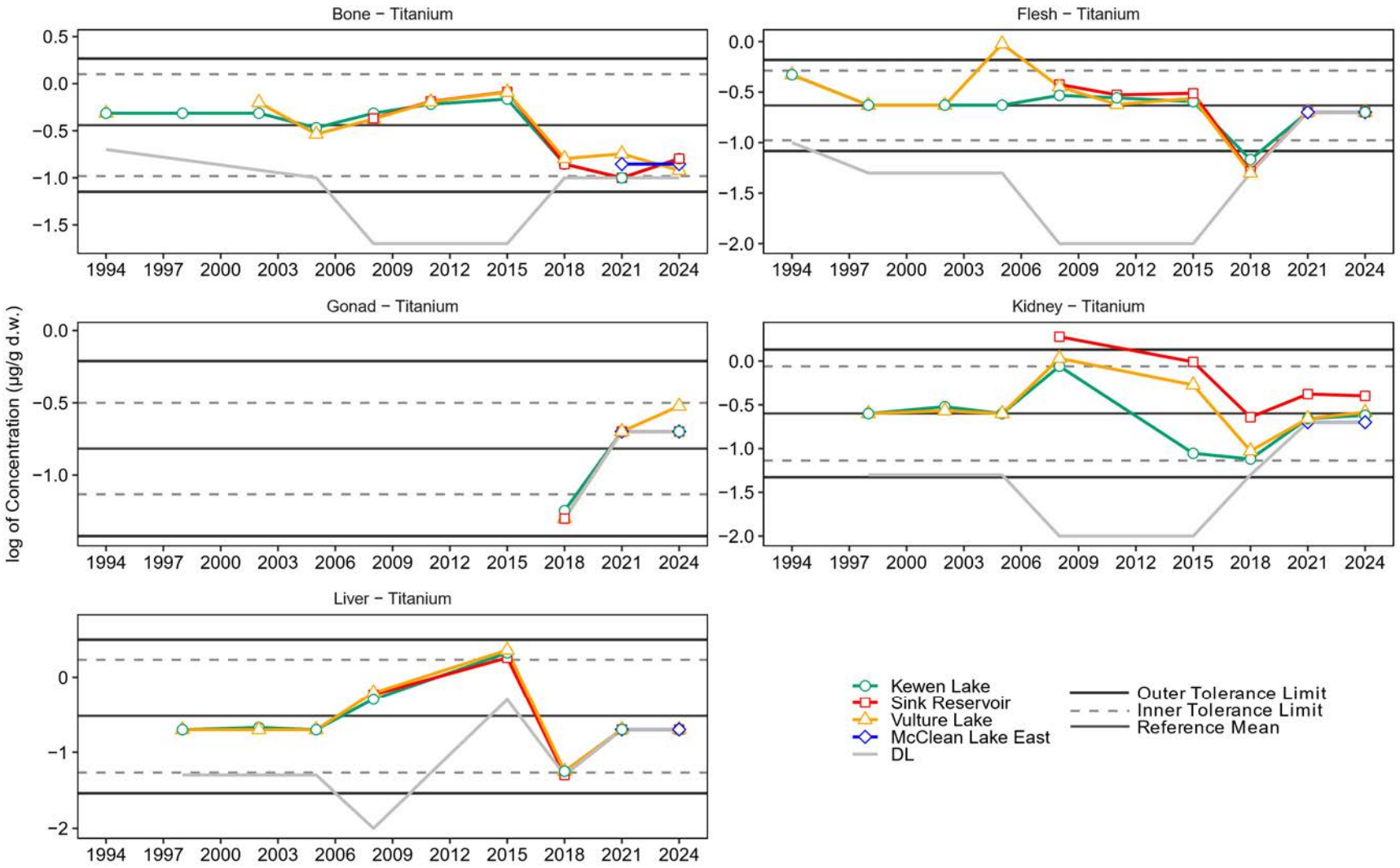


Figure 4.6-11 (19 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Titanium concentrations in various fish tissue samples are shown.

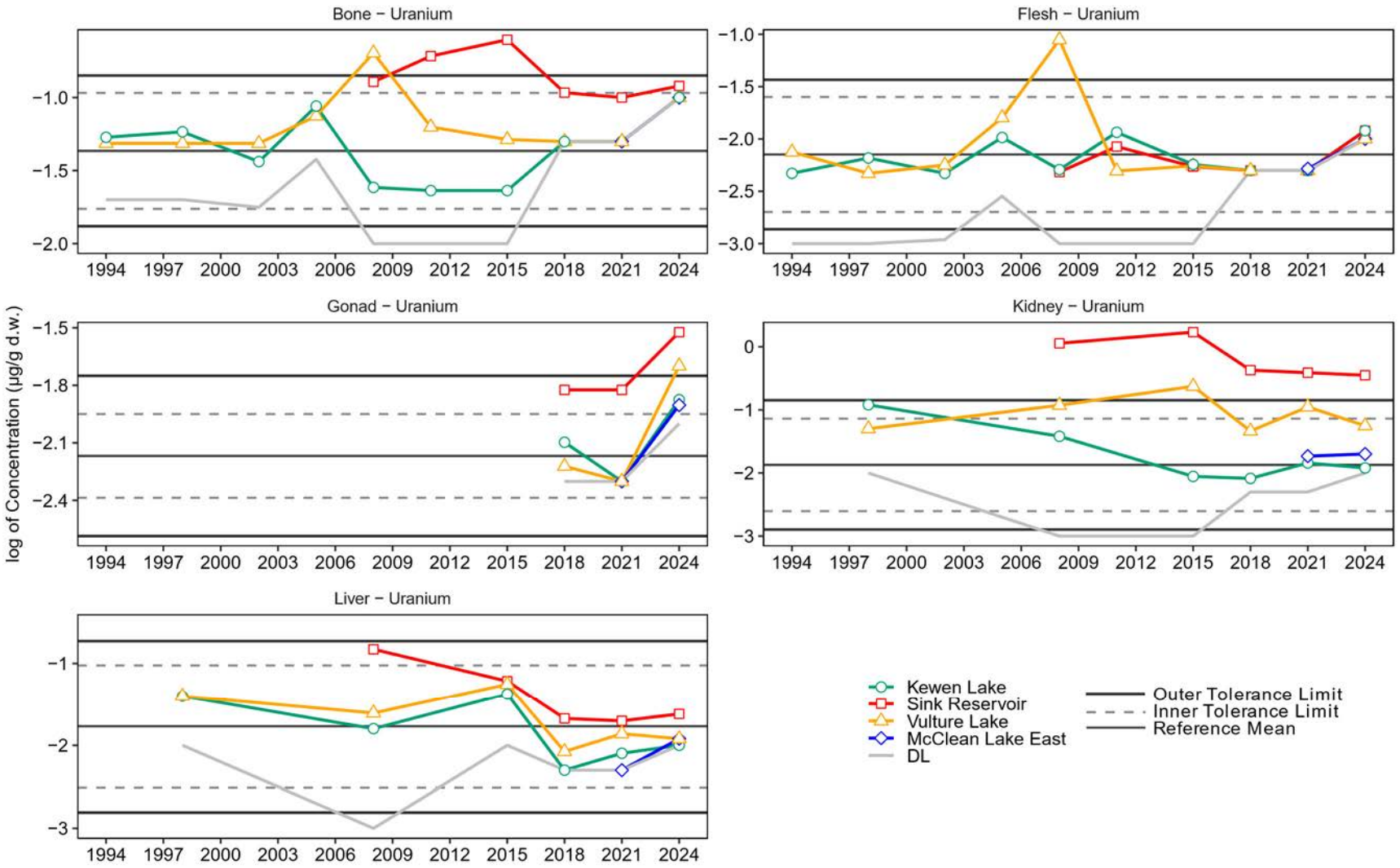


Figure 4.6-11 (20 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: Uranium concentrations in various fish tissue samples are shown.

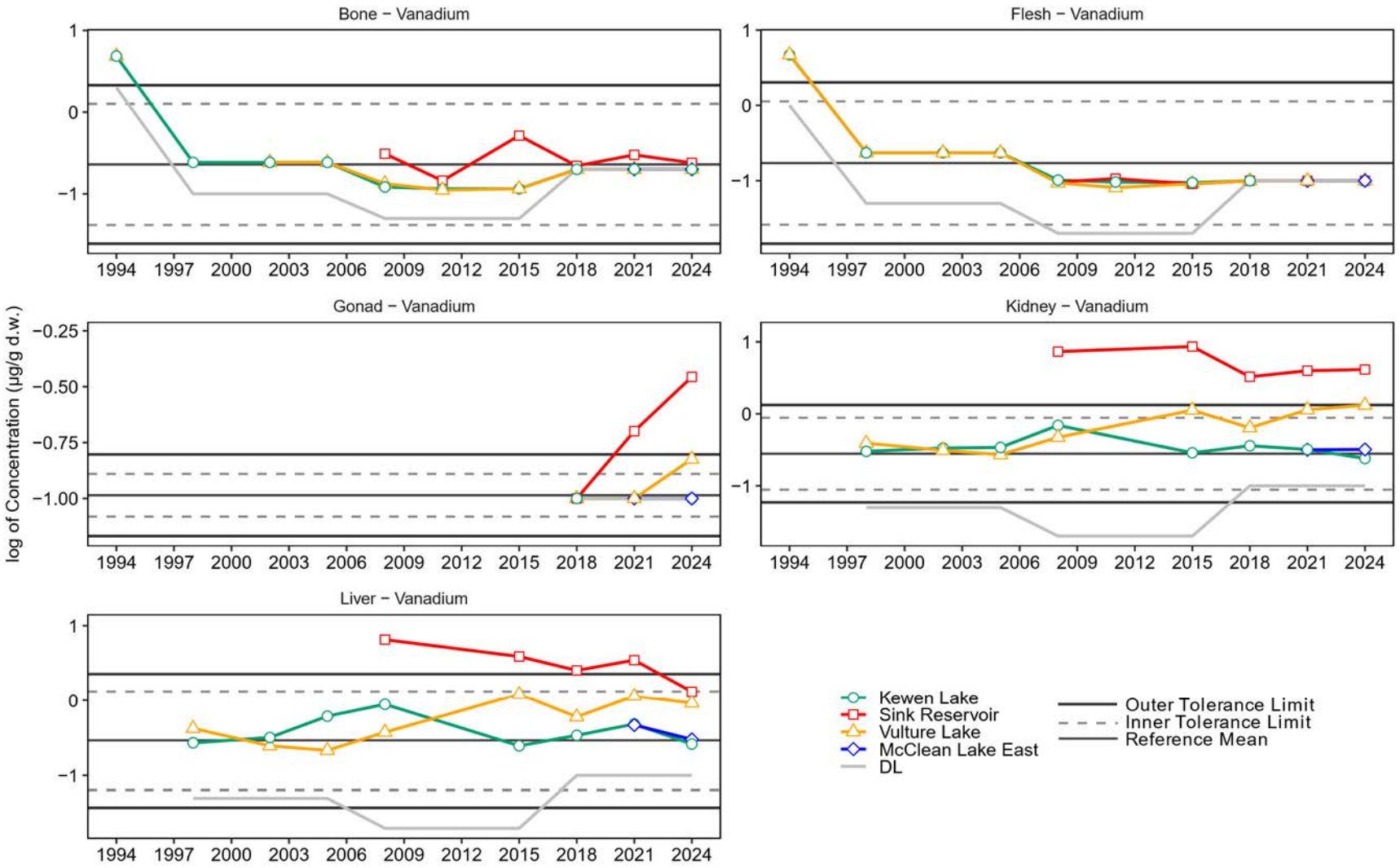


Figure 4.6-11 (21 of 21) Variations in COPCs in Northern Pike collected from Exposure Lakes between 1994 and 2024

Figure Note: *Vanadium concentrations in various fish tissue samples are shown*.

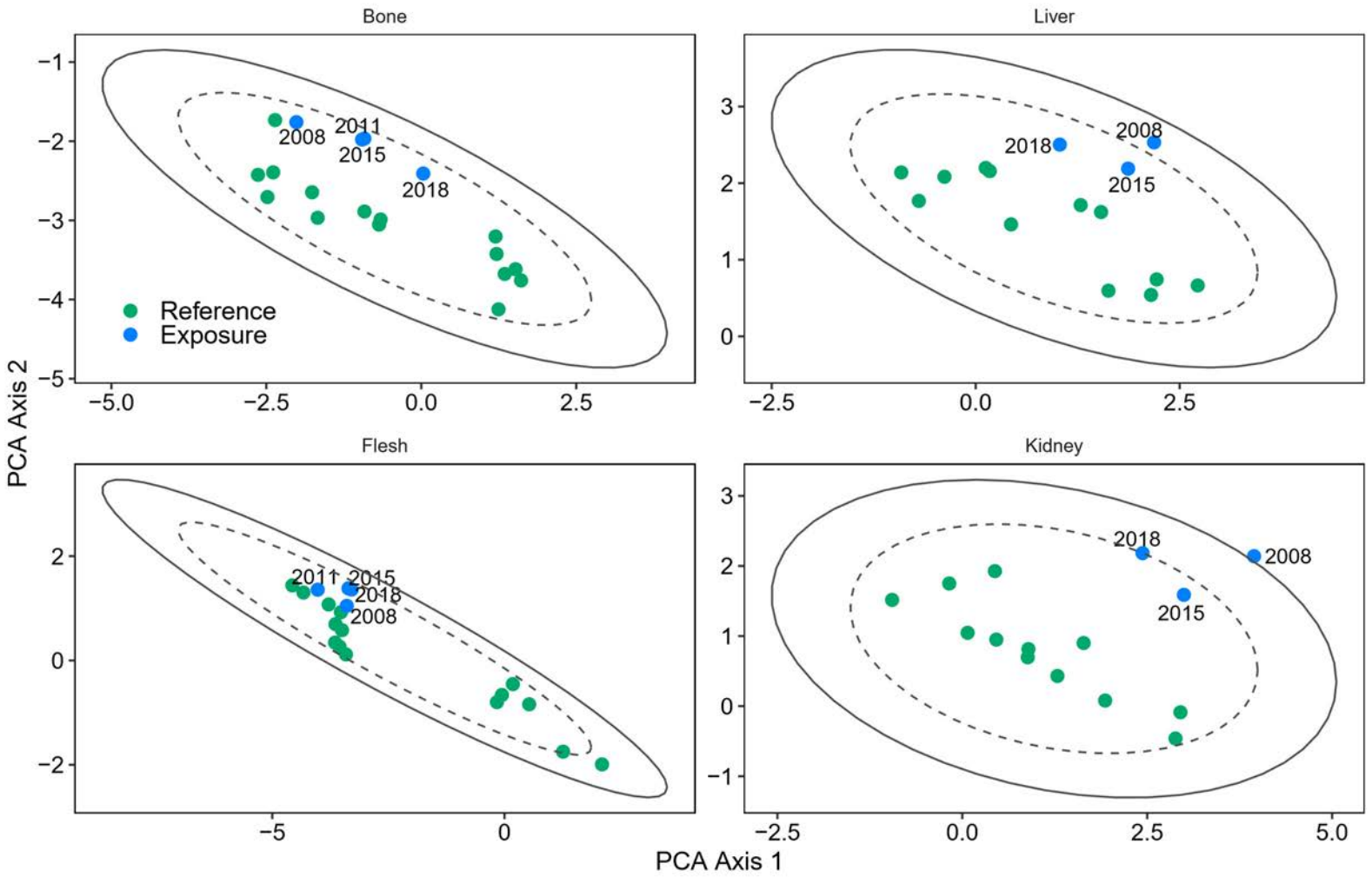


Figure 4.6-12 Principal Component Analysis Scores for White Sucker Tissue Chemistry from Sink Reservoir.

Note: Reference locations denoted by green symbols; exposure locations denoted by blue symbols. Ellipses represent the inner and outer tolerance limits for the reference lakes and pre-operational years. No White Sucker were collected from Sink Reservoir in 2024.

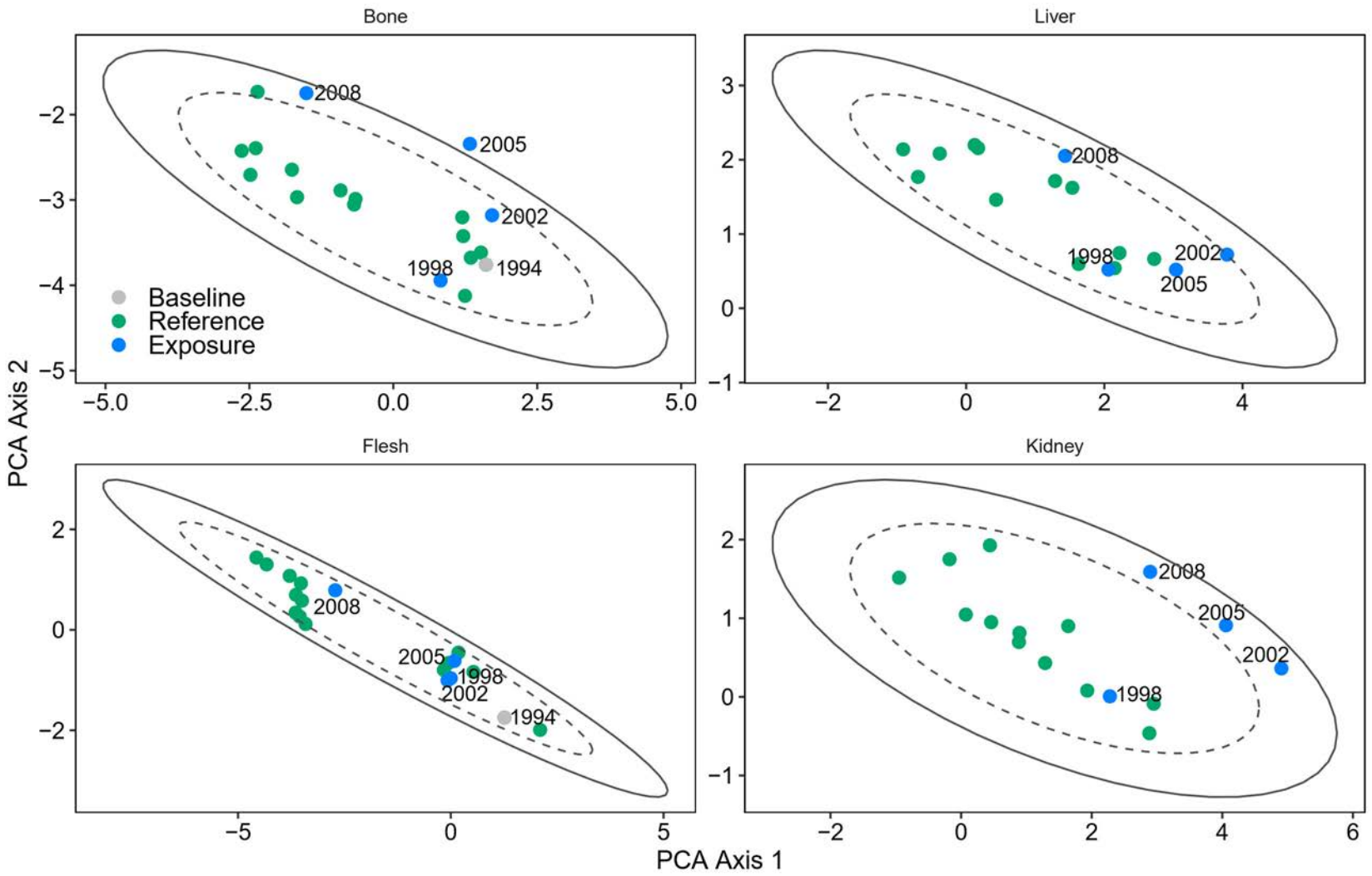


Figure 4.6-13 Principal Component Analysis Scores for White Sucker Tissue Chemistry from Vulture Lake.

Note: Reference locations denoted by green symbols; exposure locations denoted by blue symbols. Ellipses represent the inner and outer tolerance limits for the reference lakes and pre-operational years. No White Sucker were collected from Vulture Lake since 2008

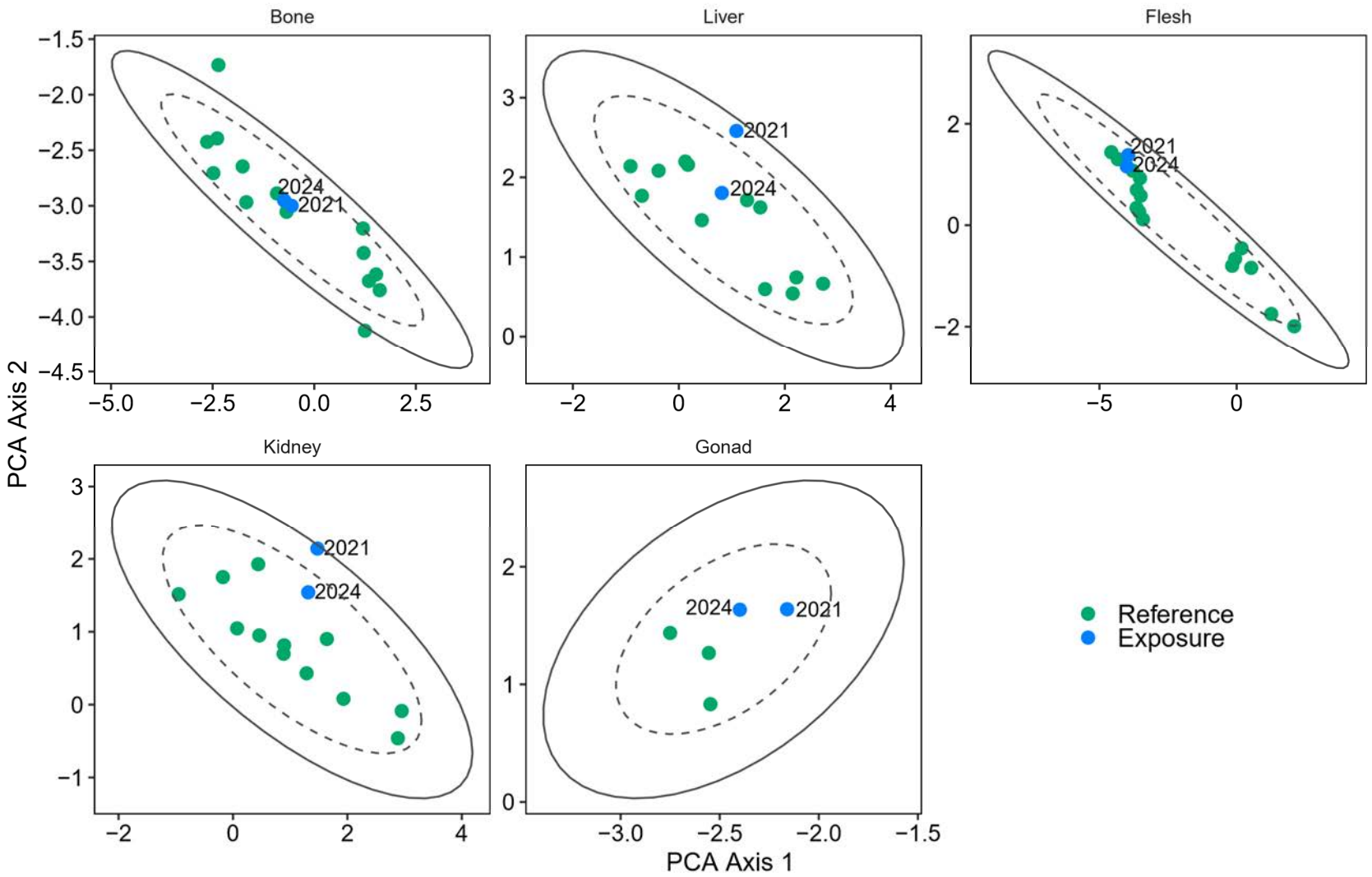


Figure 4.6-14 Principal Component Analysis Scores for White Sucker Tissue Chemistry from McClean Lake - East.

Note: Reference locations denoted by green symbols; exposure locations denoted by blue symbols. Ellipses represent the inner and outer tolerance limits for the reference lakes and pre-operational years.

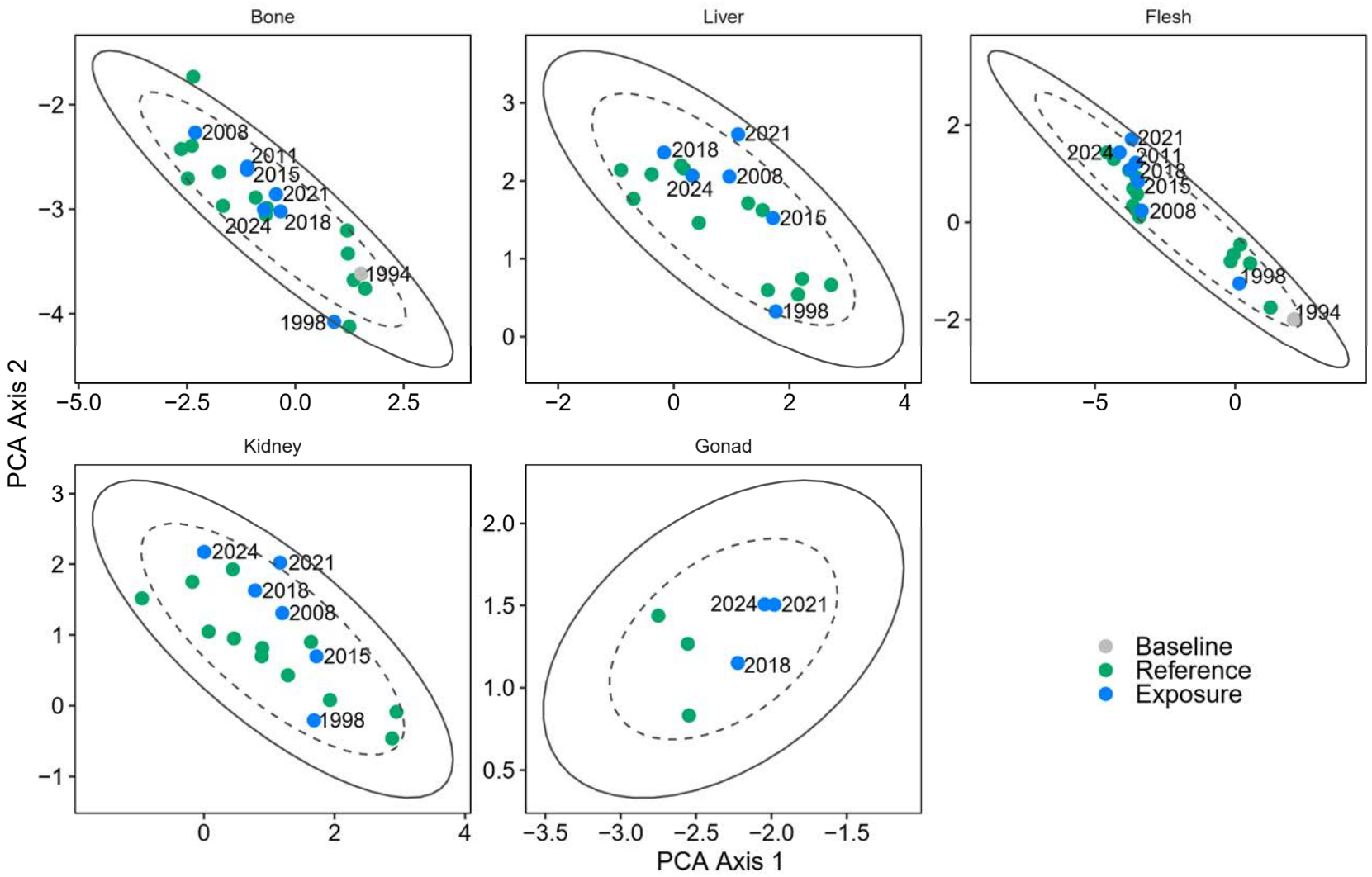


Figure 4.6-15 Principal Component Analysis Scores for White Sucker Tissue Chemistry from Kewen Lake.

Note: Reference locations denoted by green symbols; exposure locations denoted by blue symbols. Ellipses represent the inner and outer tolerance limits for the reference lakes and pre-operational years.

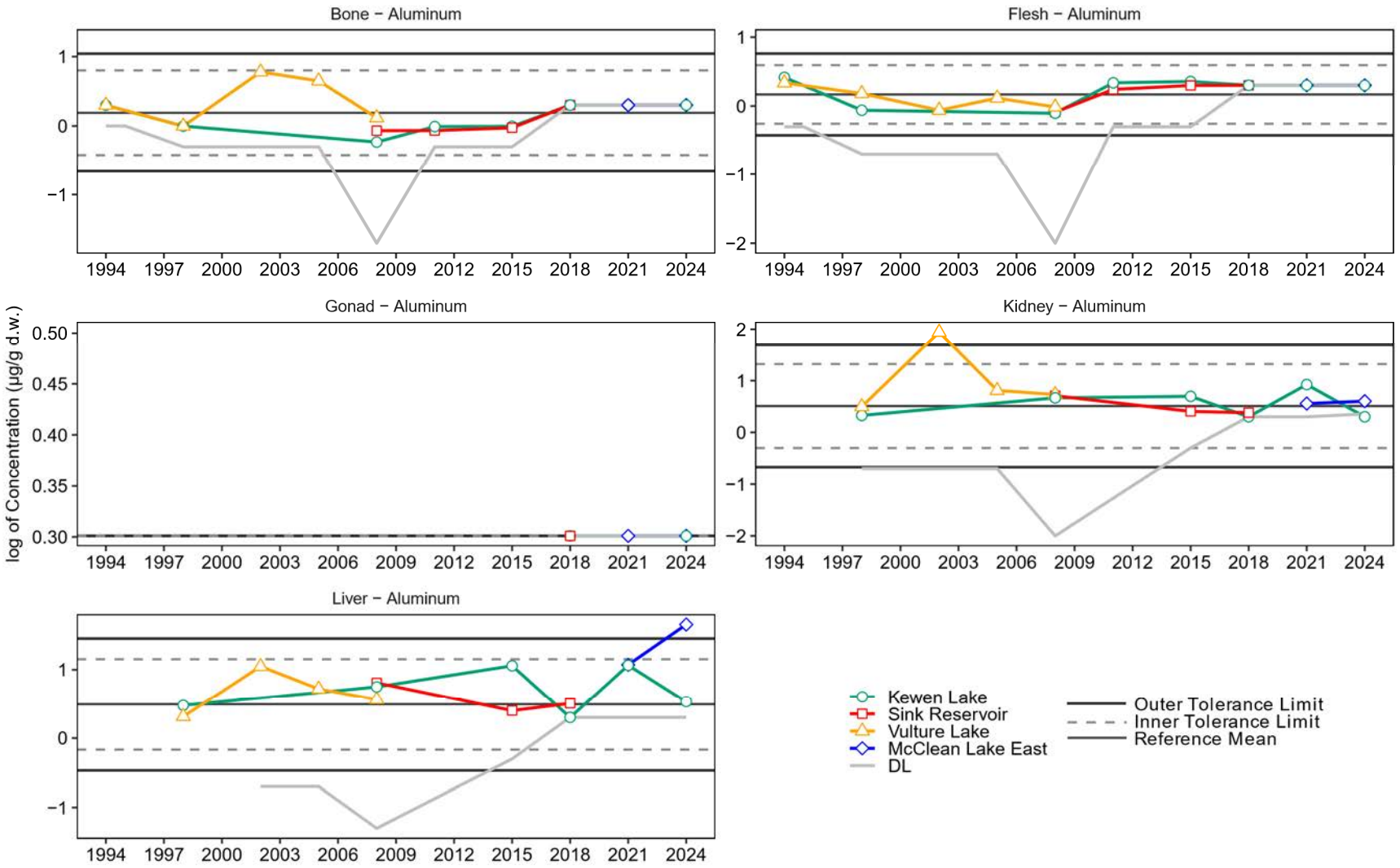


Figure 4.6-16 (1 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024.

Figure Note: Aluminum concentrations in various fish tissue samples are shown.

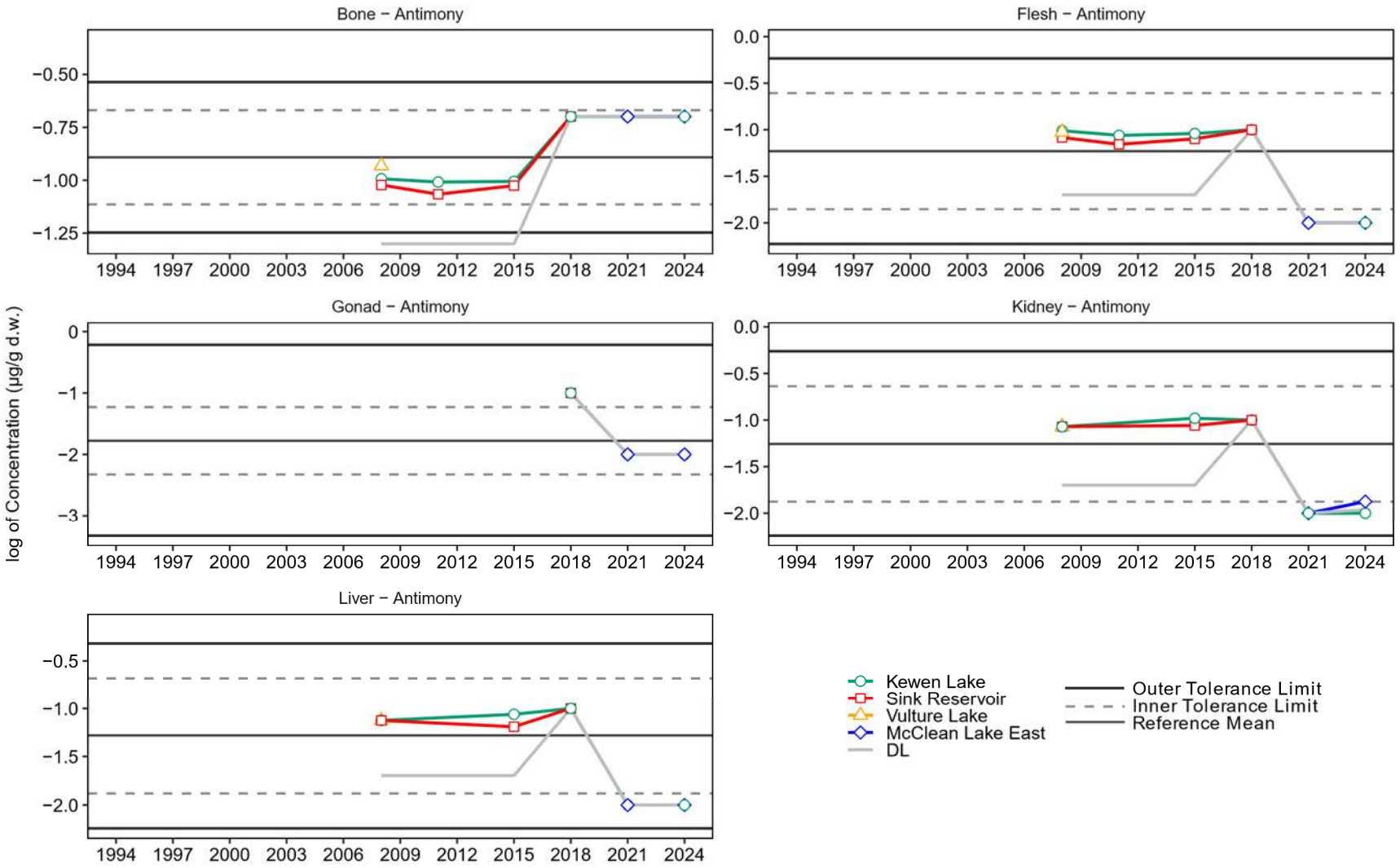


Figure 4.6-16 (2 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Antimony concentrations in various fish tissue samples are shown.

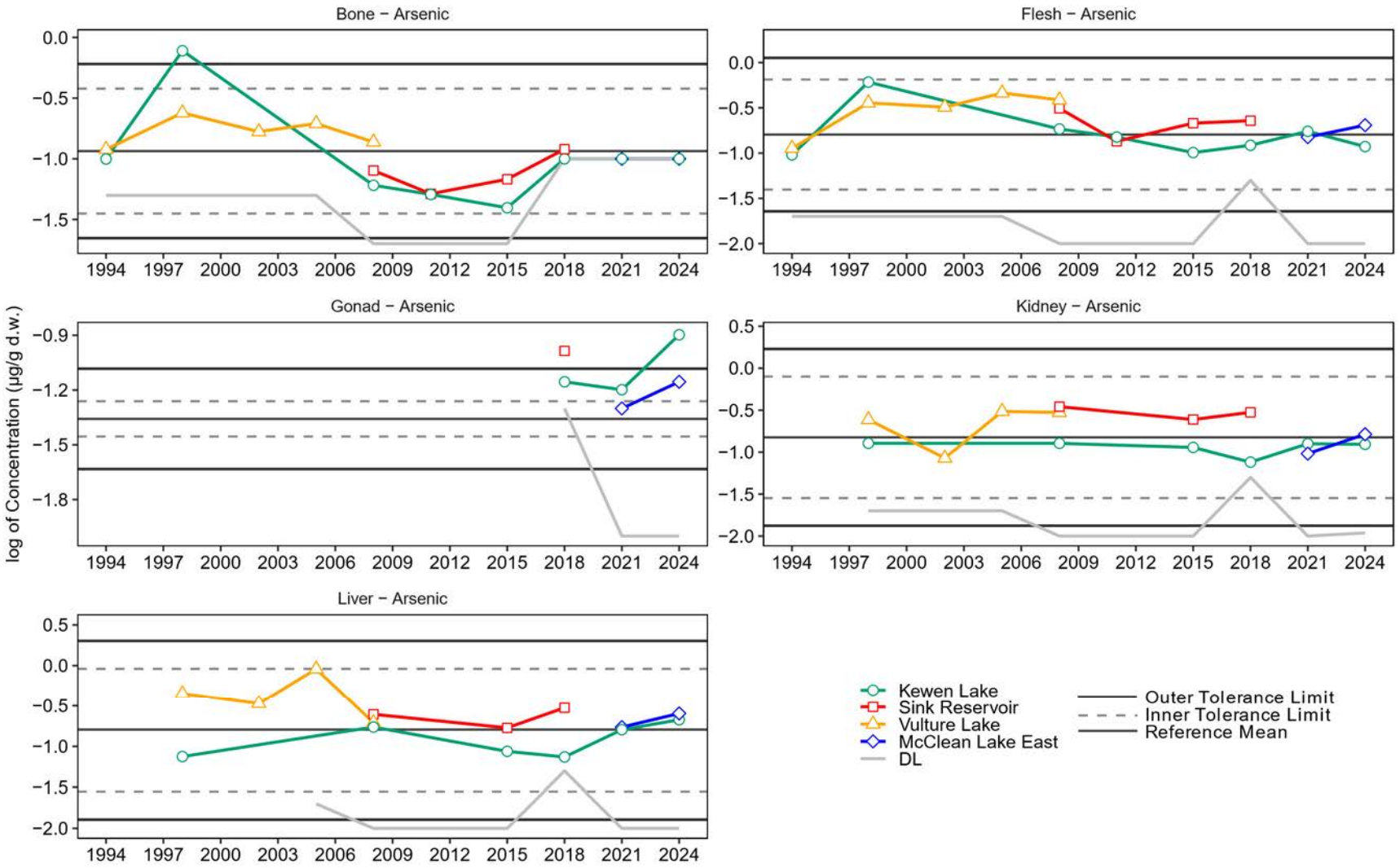


Figure 4.6-16 (3 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Arsenic concentrations in various fish tissue samples are shown.

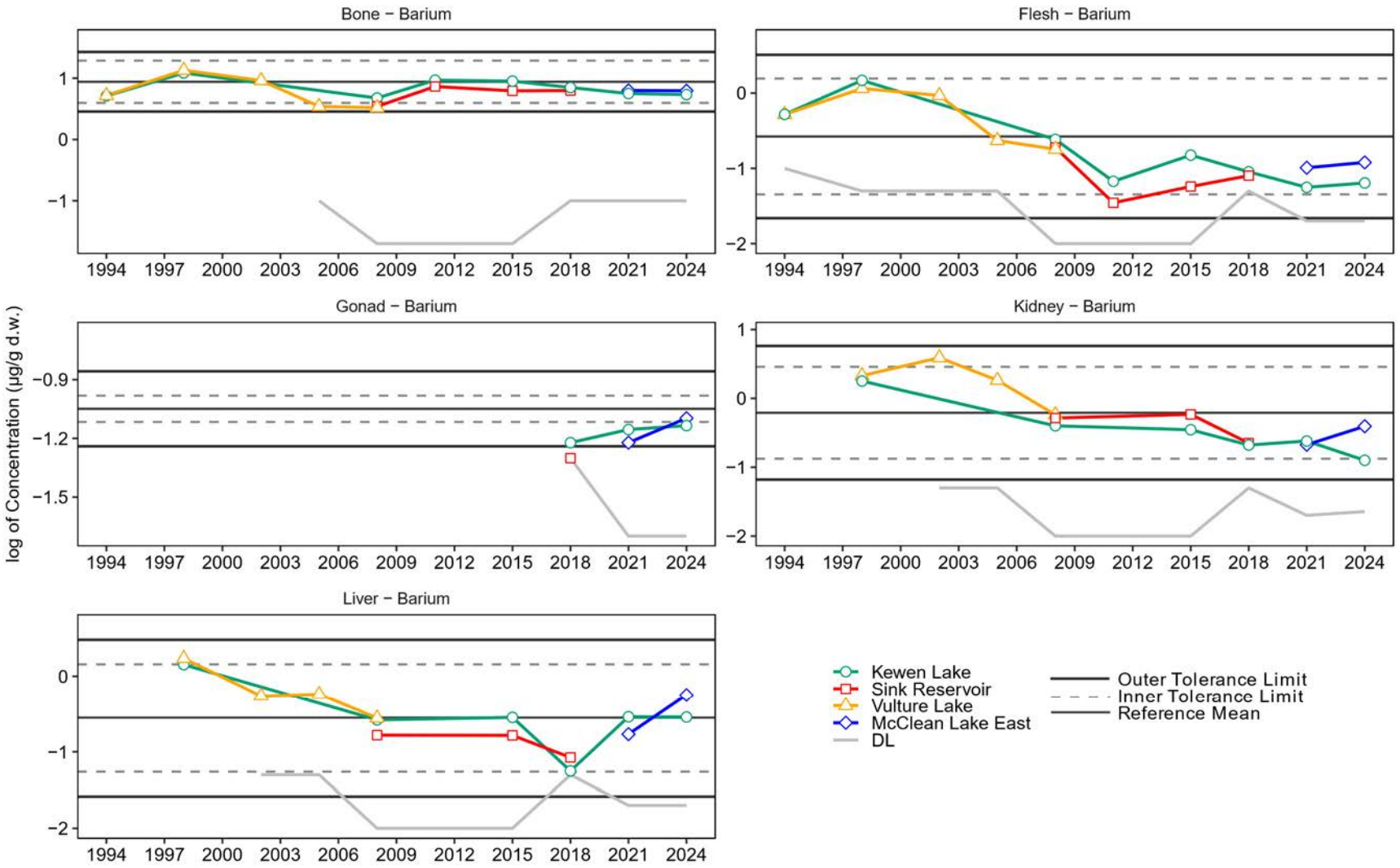


Figure 4.6-16 (4 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Barium concentrations in various fish tissue samples are shown.

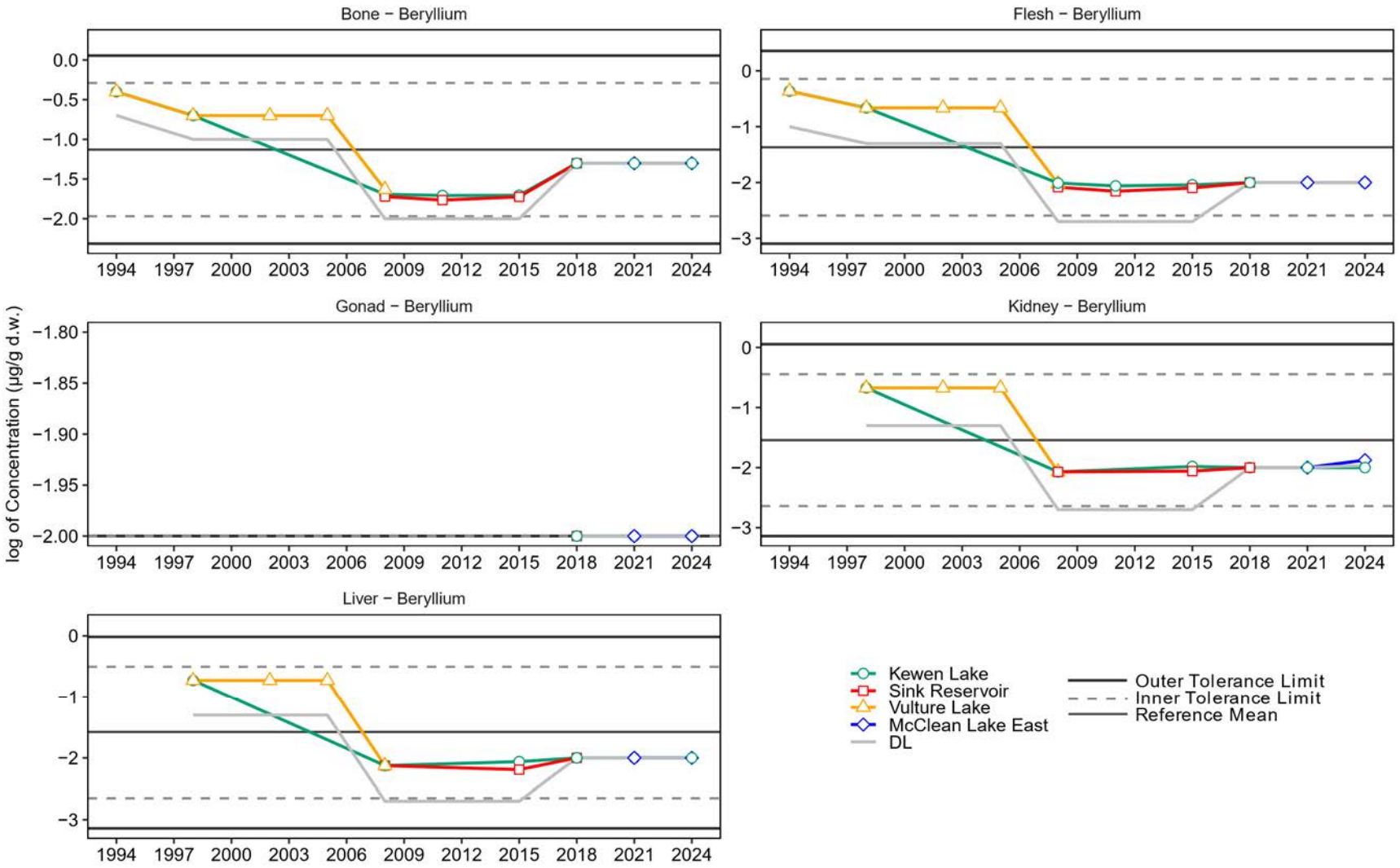


Figure 4.6-16 (5 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Beryllium concentrations in various fish tissue samples are shown.

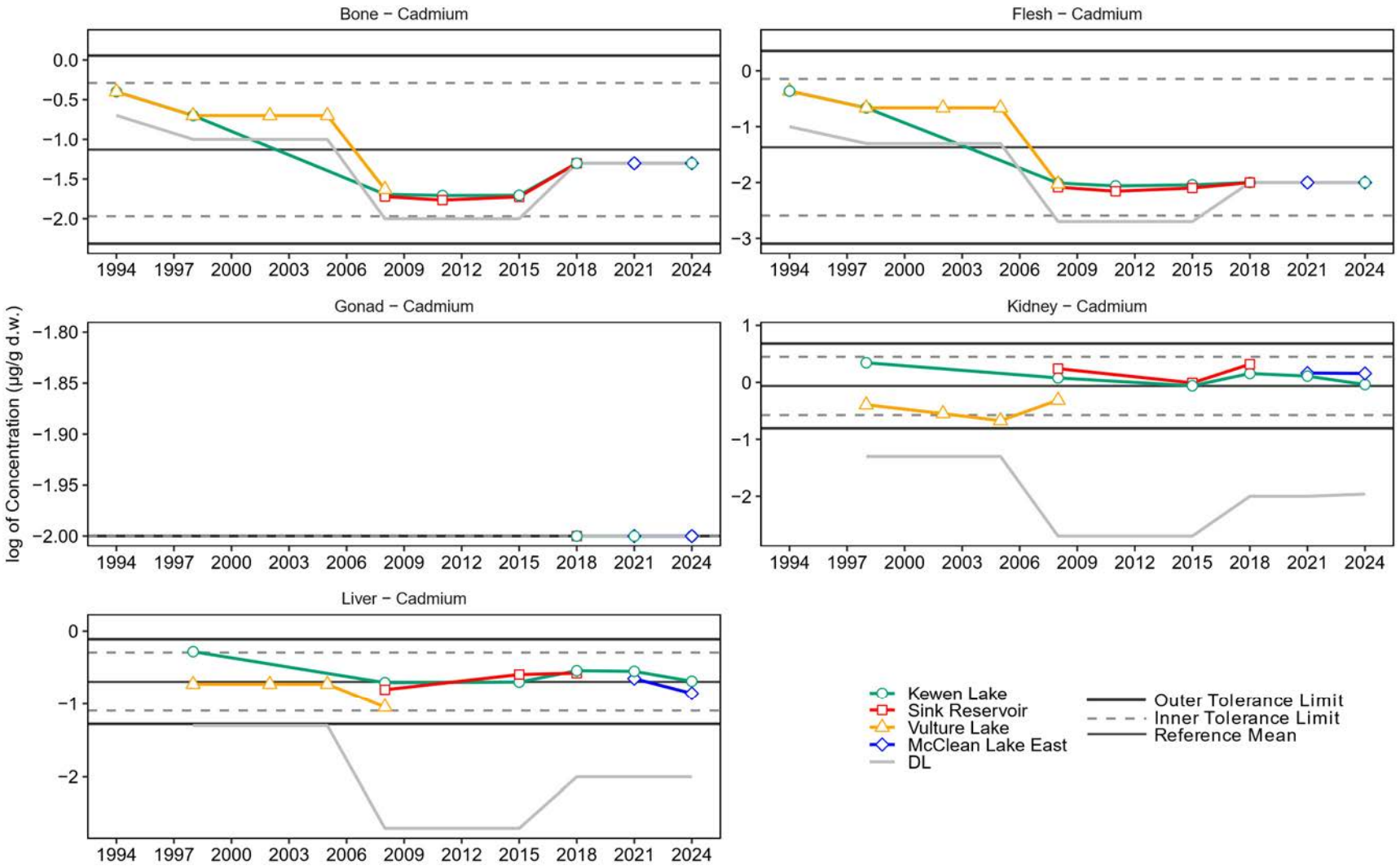


Figure 4.6-16 (6 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Cadmium concentrations in various fish tissue samples are shown.

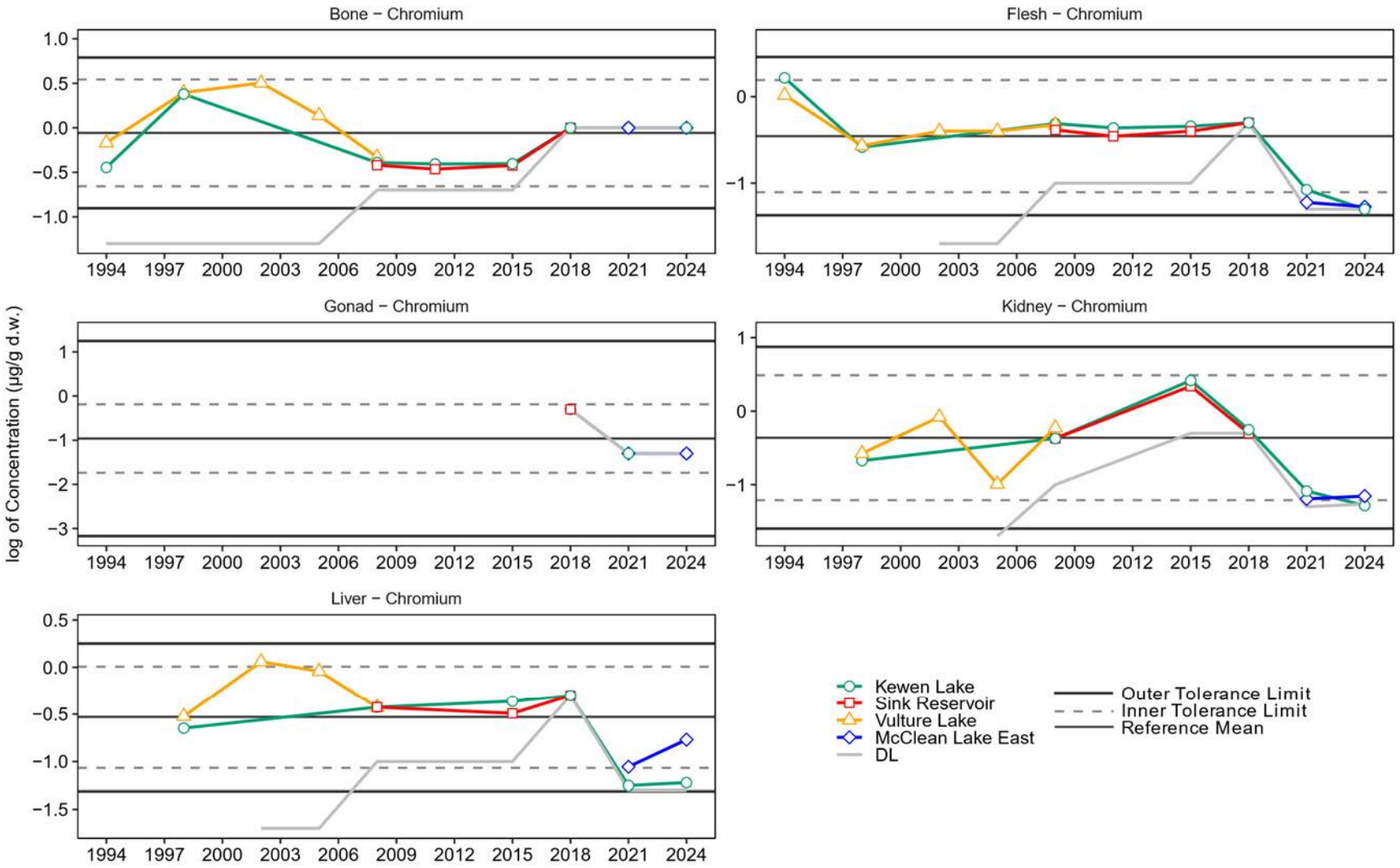


Figure 4.6-16 (7 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Chromium concentrations in various fish tissue samples are shown.

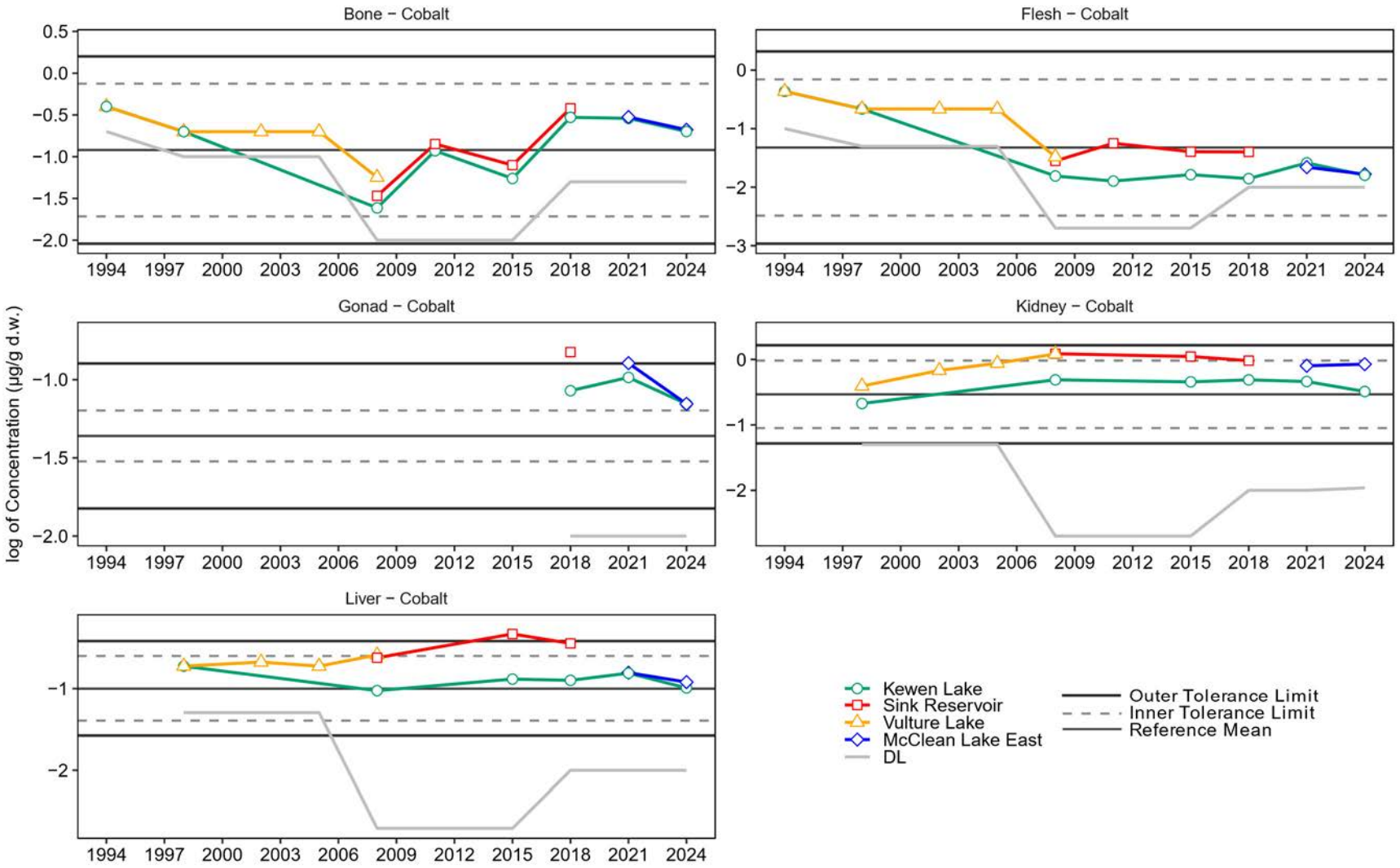


Figure 4.6-16 (8 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Cobalt concentrations in various fish tissue samples are shown.

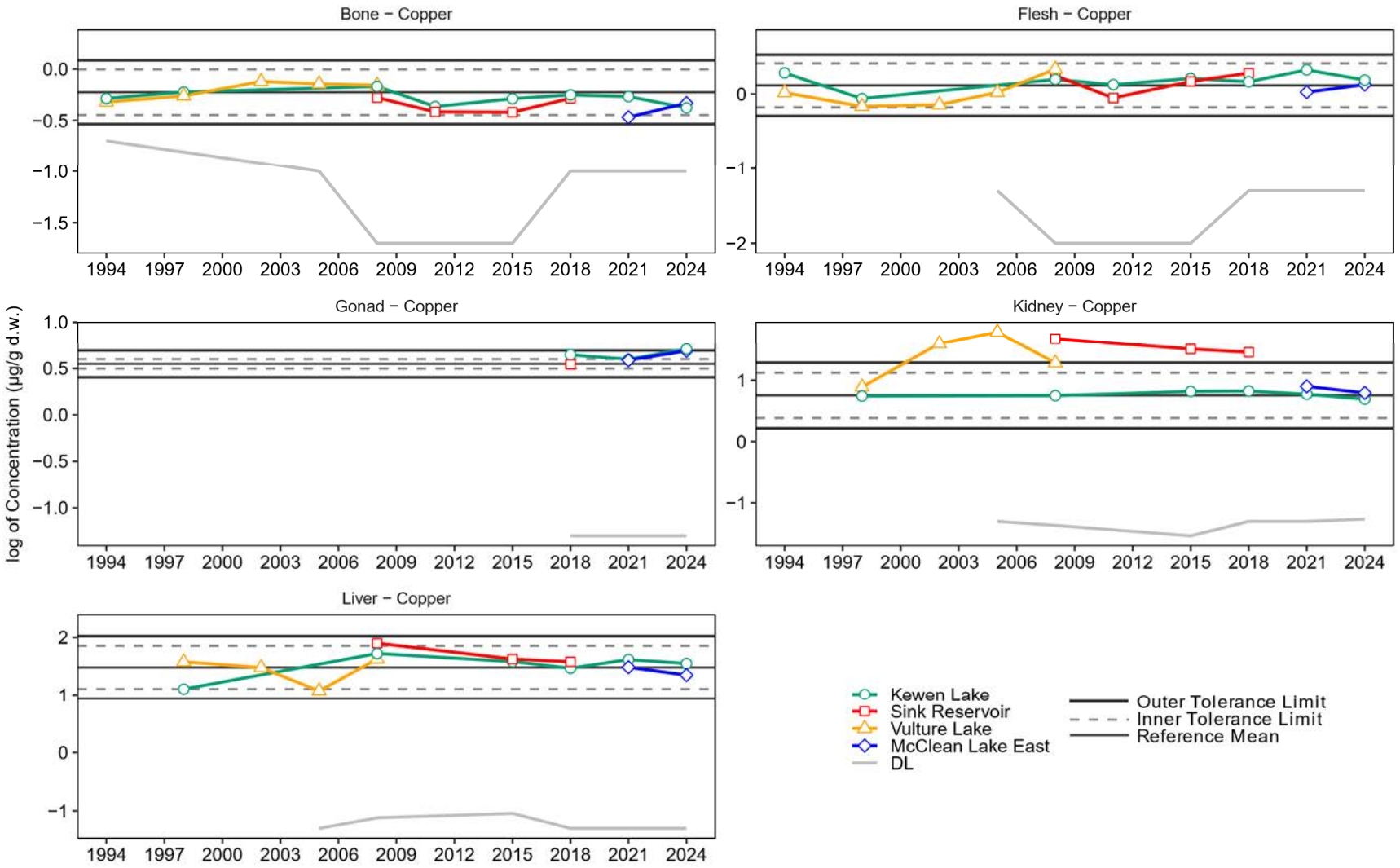


Figure 4.6-16 (9 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Copper concentrations in various fish tissue samples are shown.

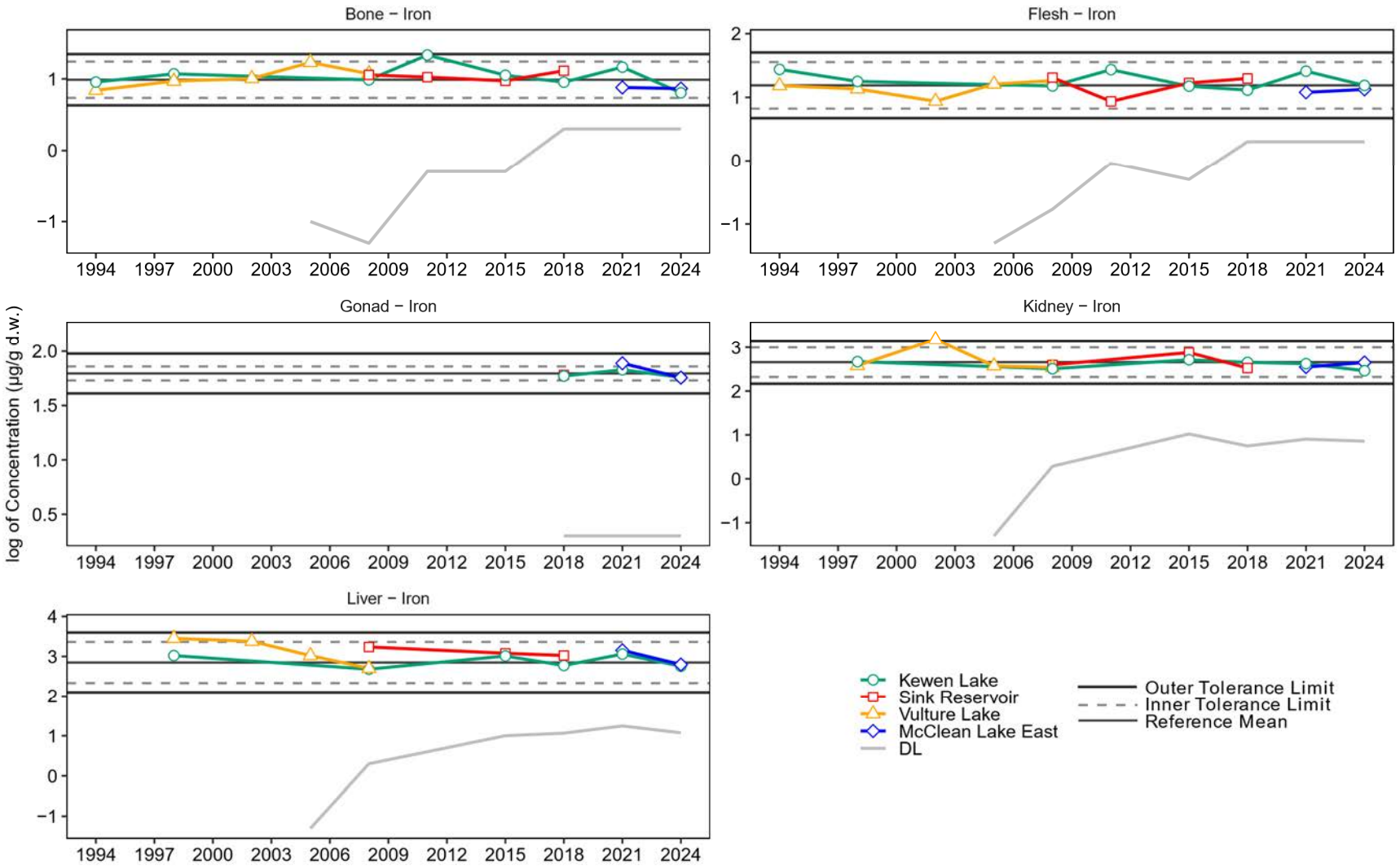


Figure 4.6-16 (10 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Iron concentrations in various fish tissue samples are shown.

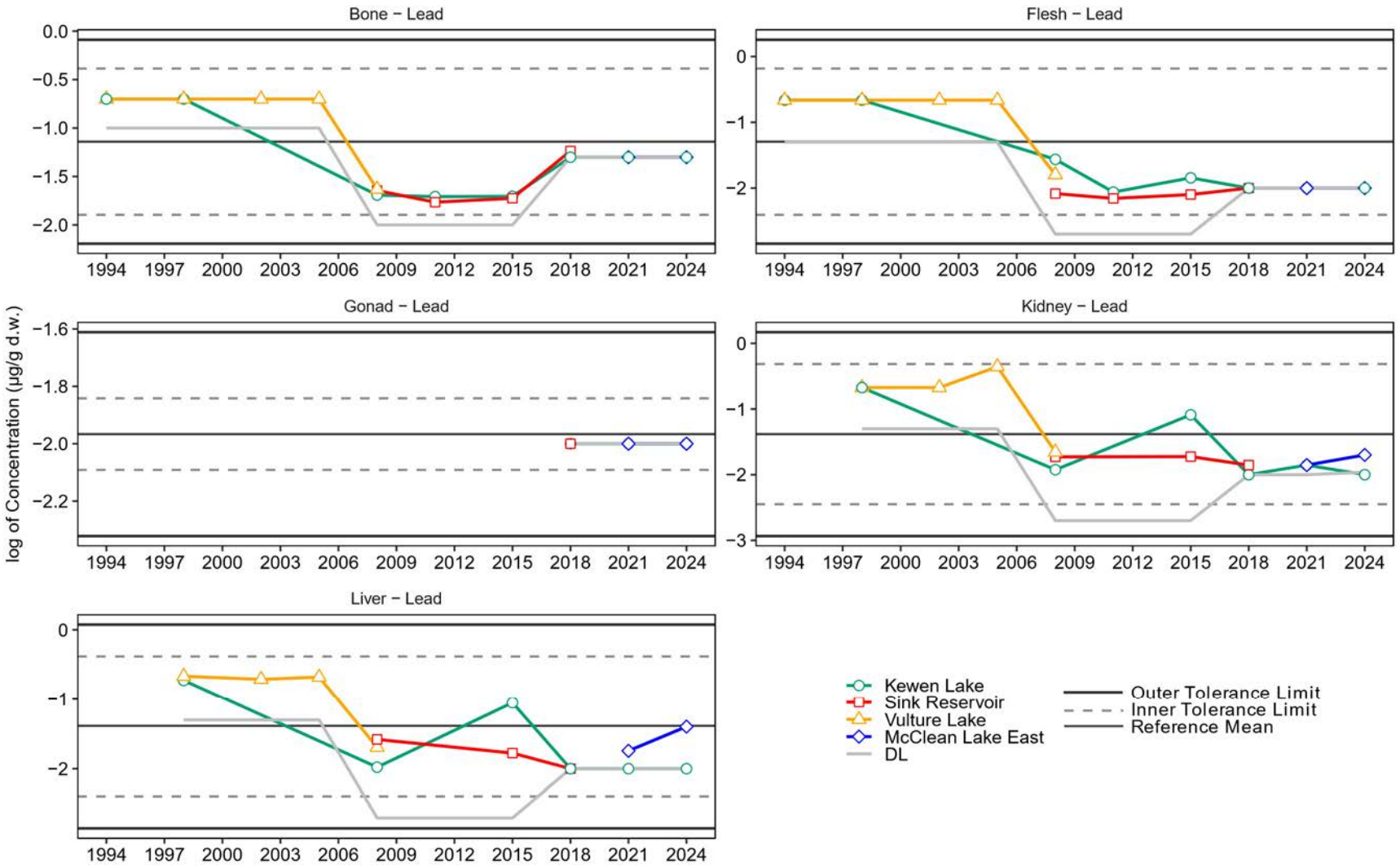


Figure 4.6-16 (11 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Lead concentrations in various fish tissue samples are shown.

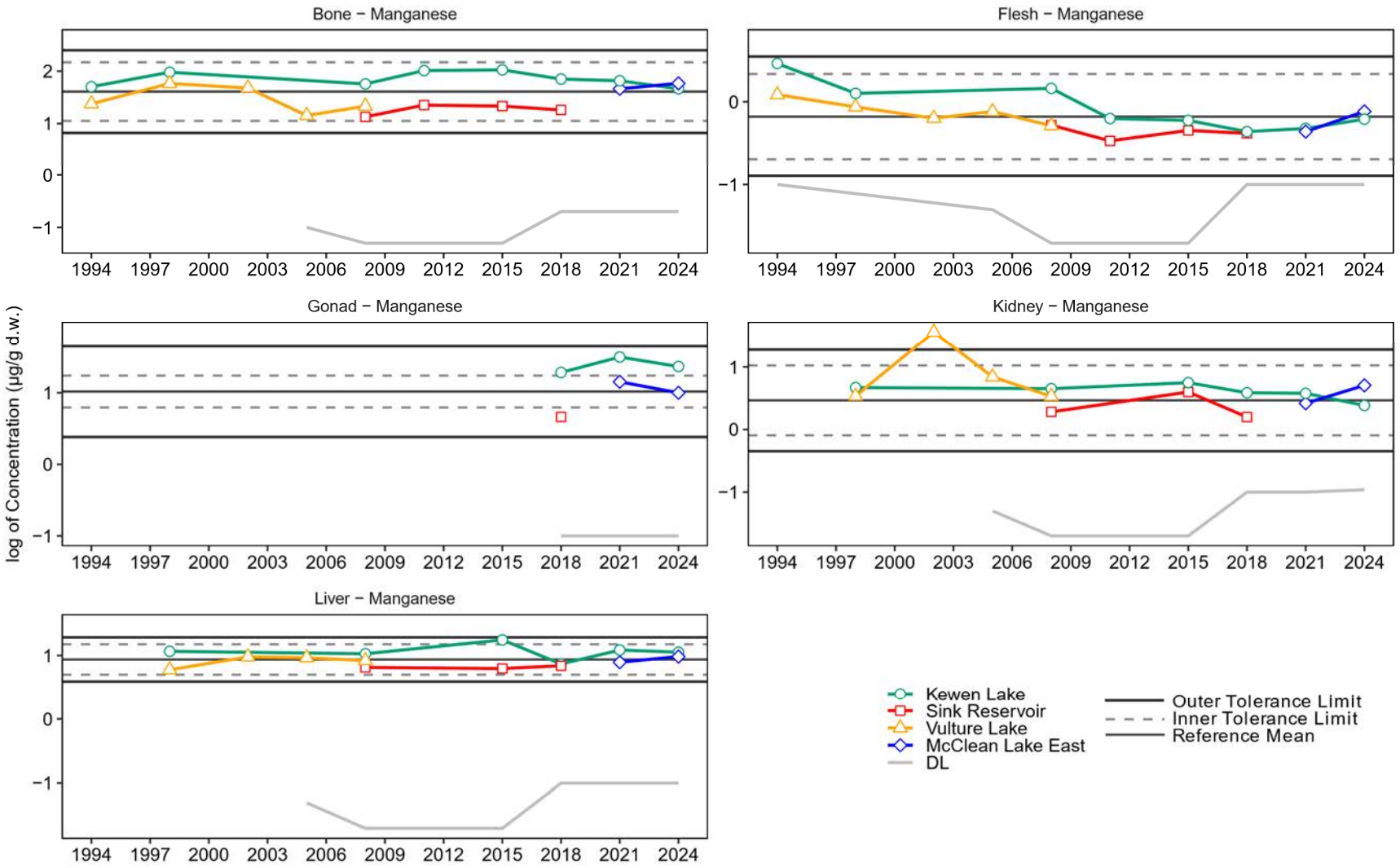


Figure 4.6-16 (12 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Manganese concentrations in various fish tissue samples are shown.

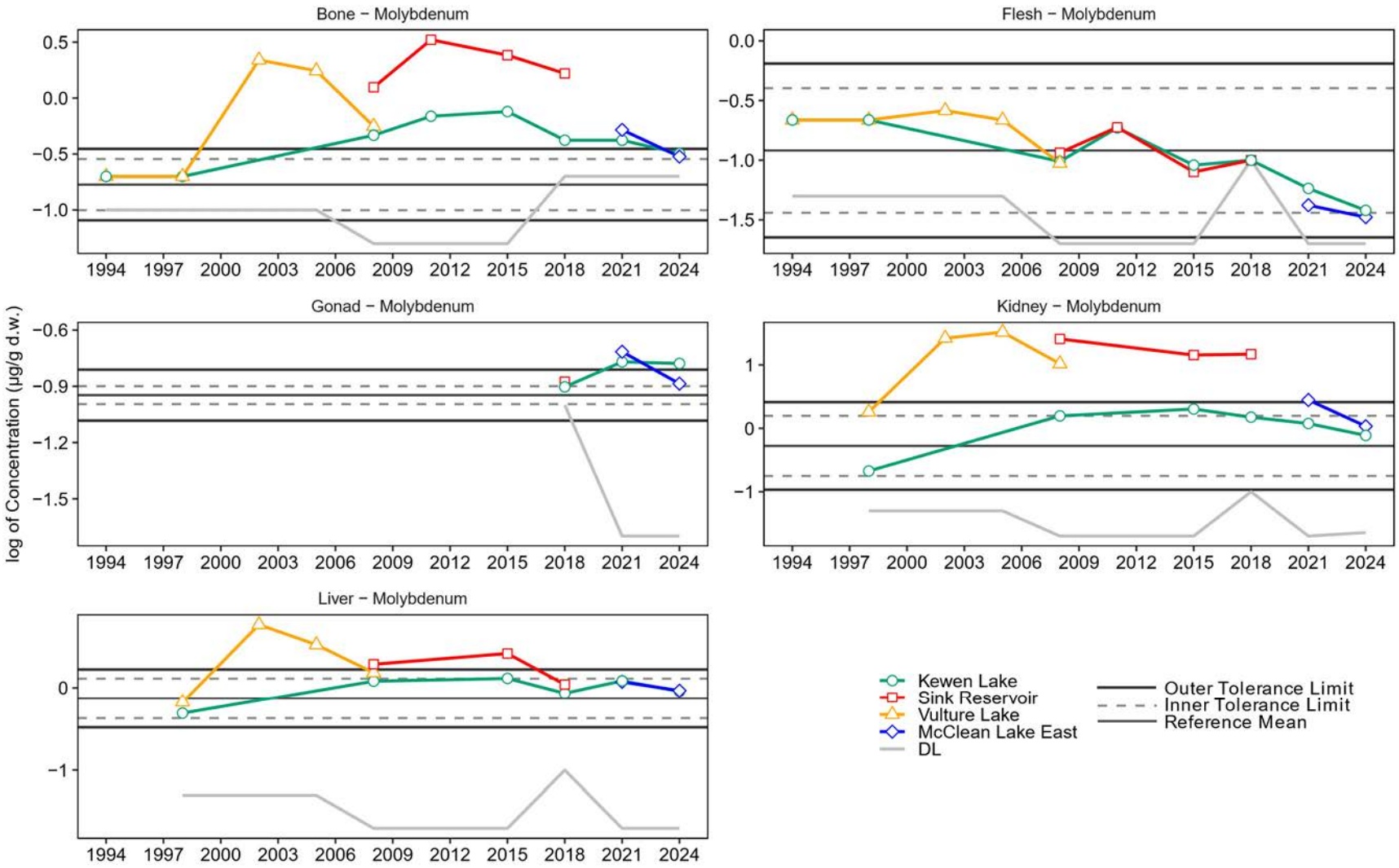


Figure 4.6-16 (13 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Molybdenum concentrations in various fish tissue samples are shown.

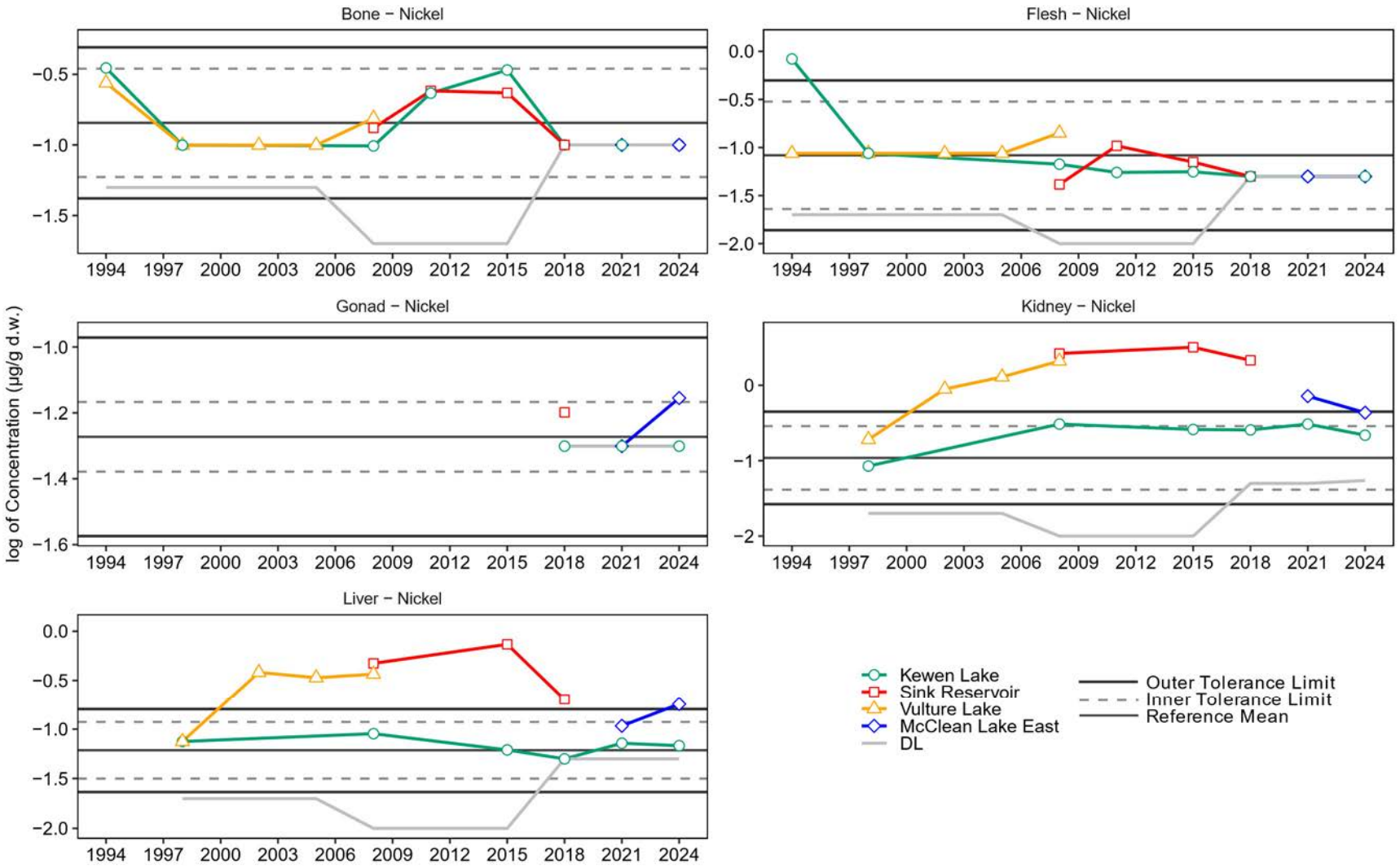


Figure 4.6-16 (14 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Nickel concentrations in various fish tissue samples are shown.

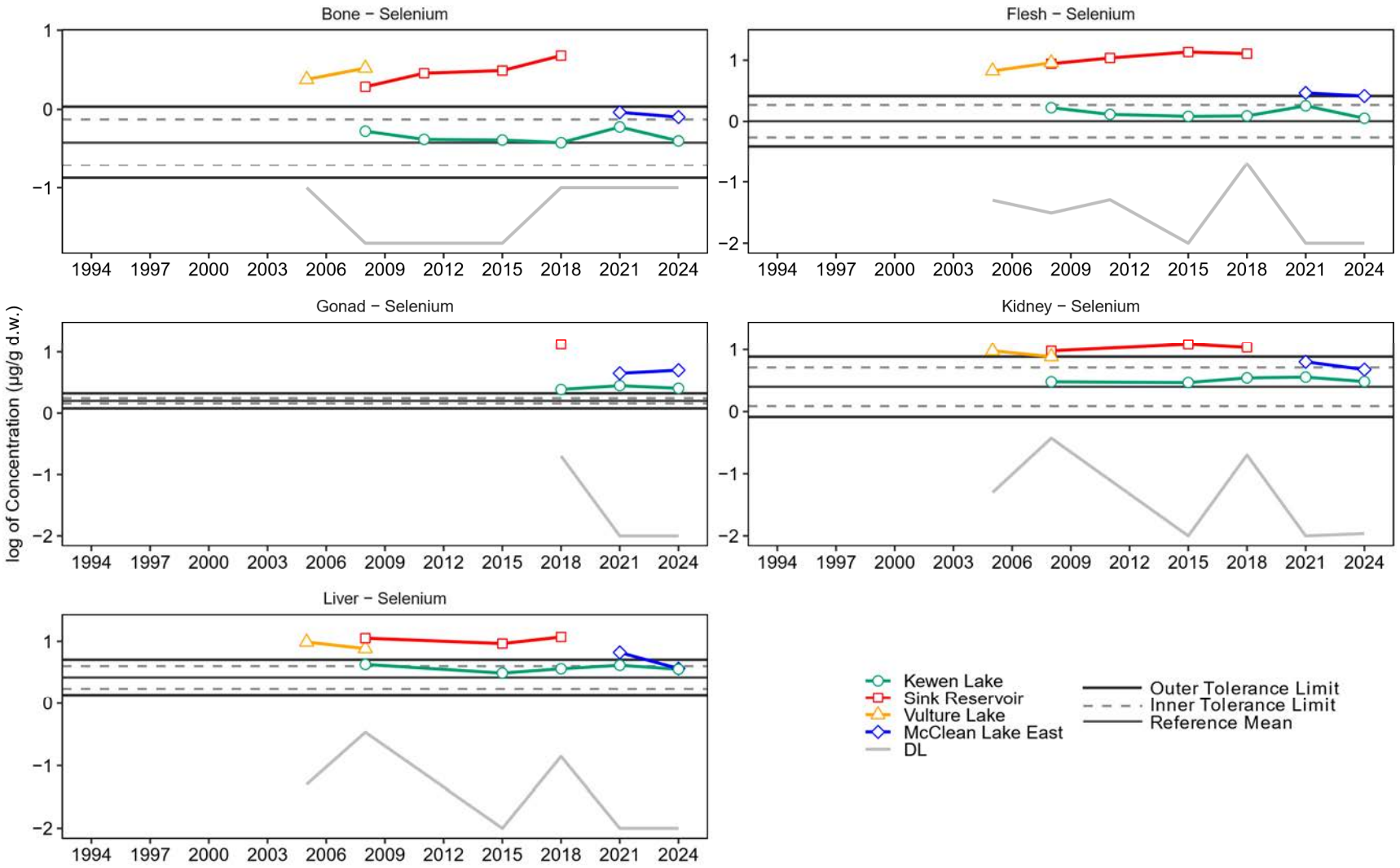


Figure 4.6-16 (15 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Selenium concentrations in various fish tissue samples are shown.

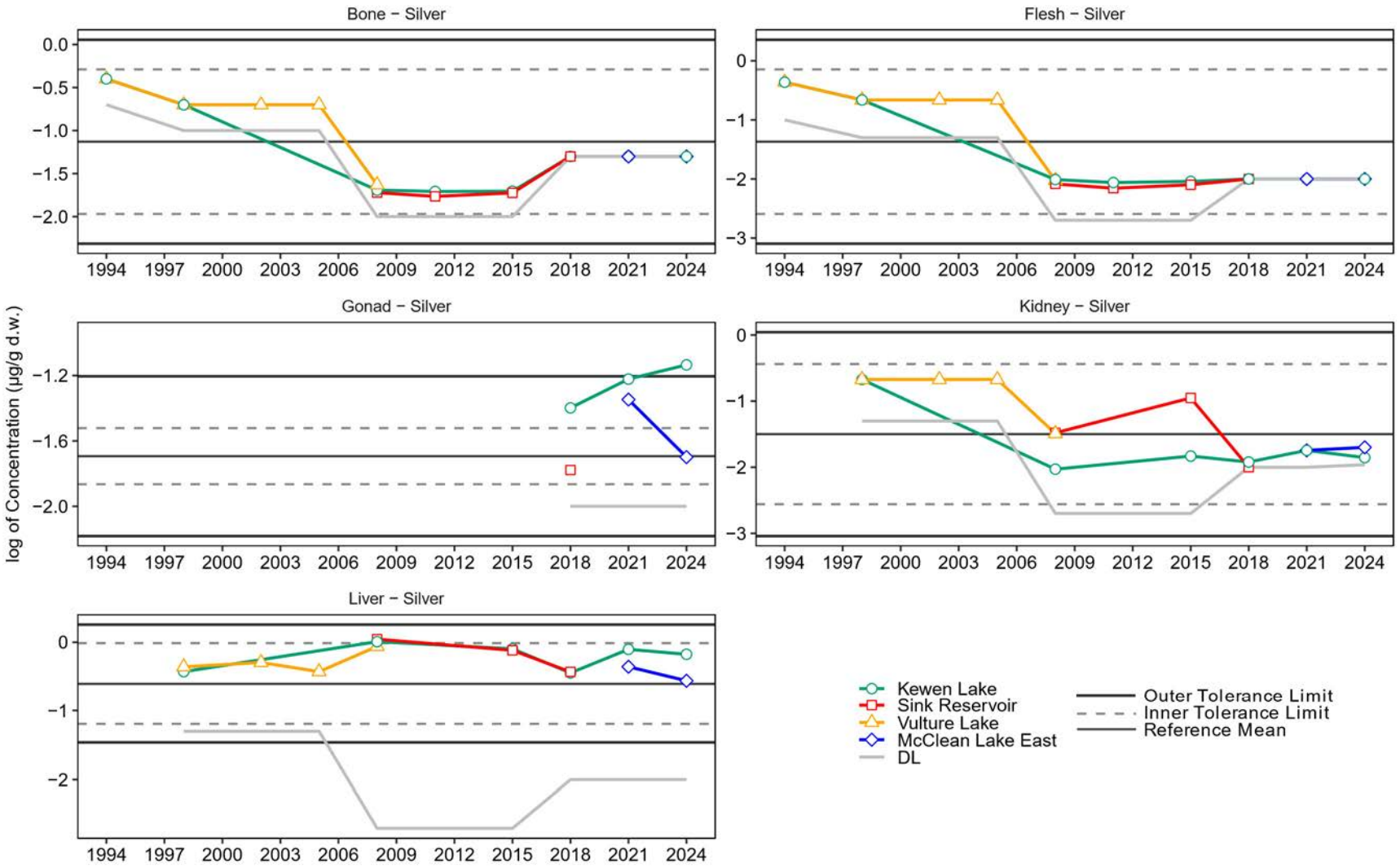


Figure 4.6-16 (16 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Silver concentrations in various fish tissue samples are shown.

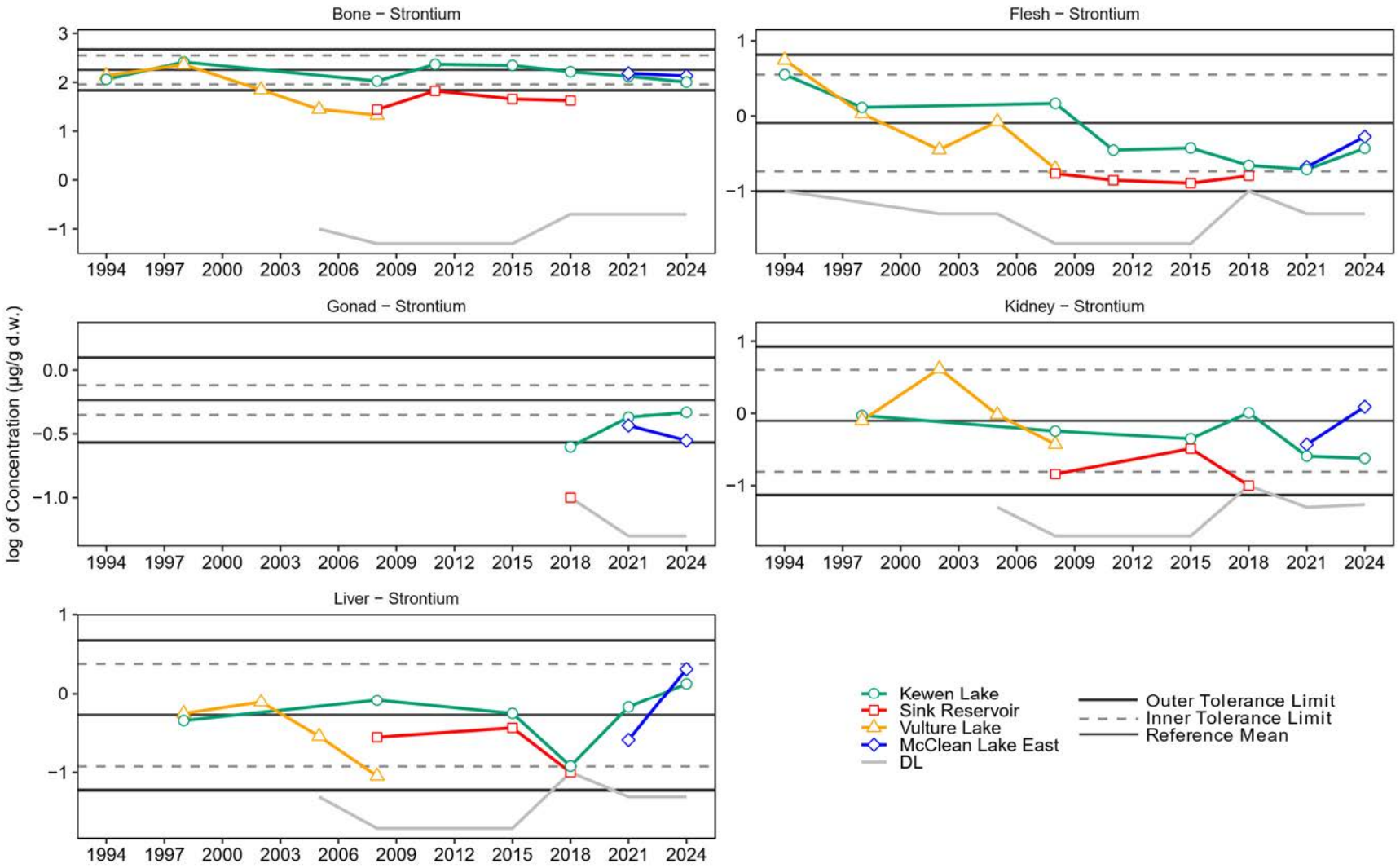


Figure 4.6-16 (17 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Strontium concentrations in various fish tissue samples are shown.

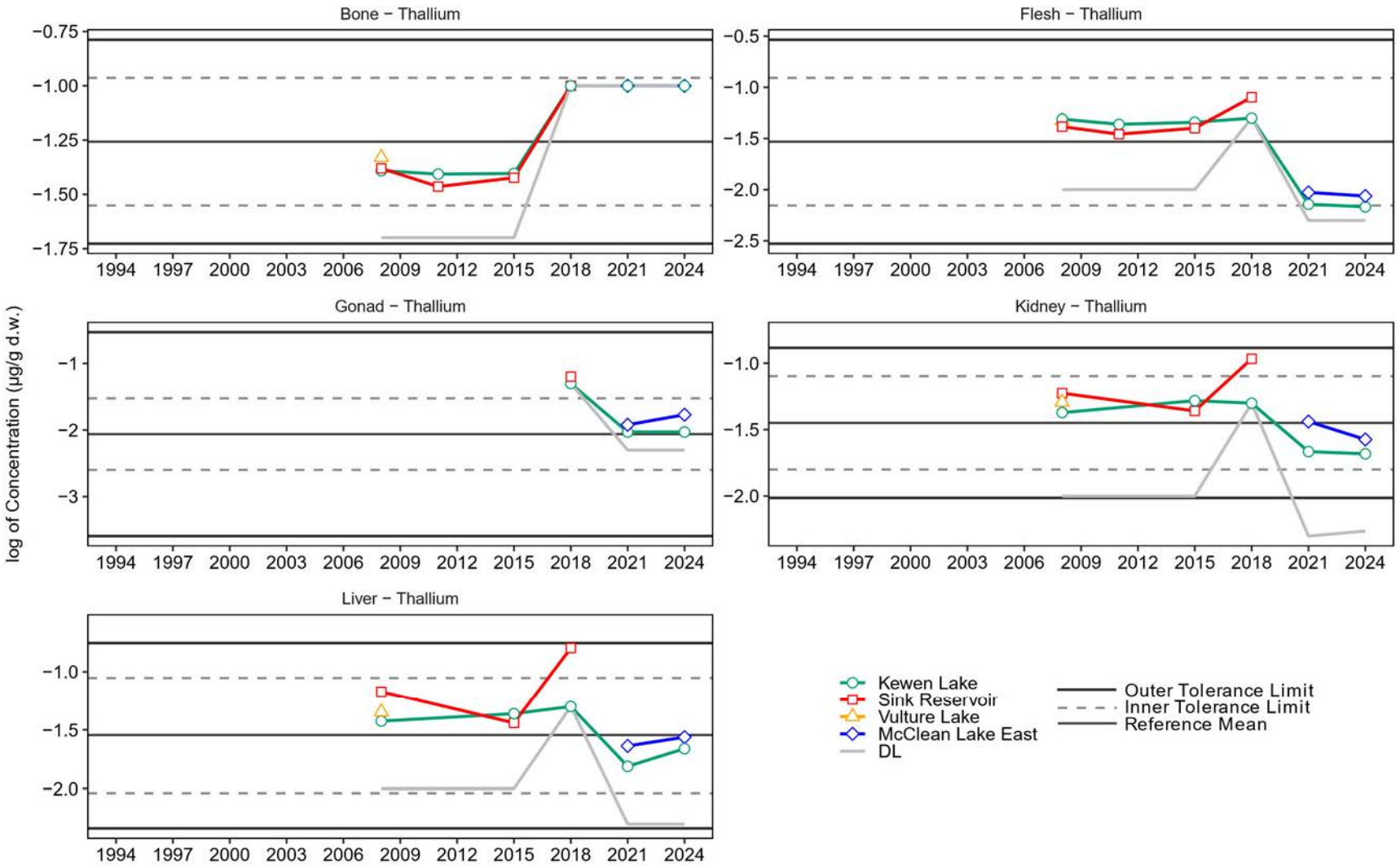


Figure 4.6-16 (18 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Thallium concentrations in various fish tissue samples are shown.

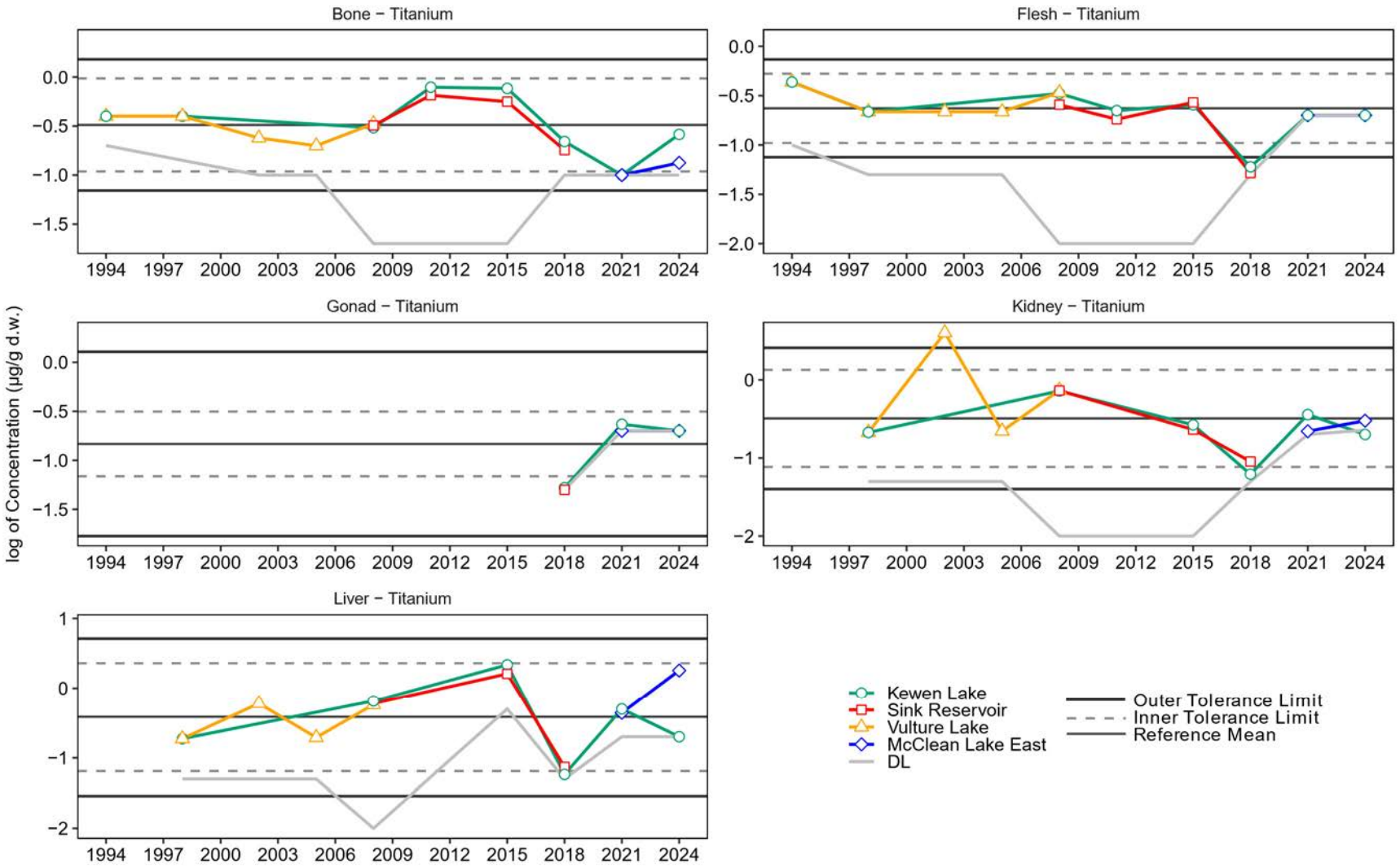


Figure 4.6-16 (19 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Titanium concentrations in various fish tissue samples are shown.



Figure 4.6-16 (20 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Uranium concentrations in various fish tissue samples are shown.

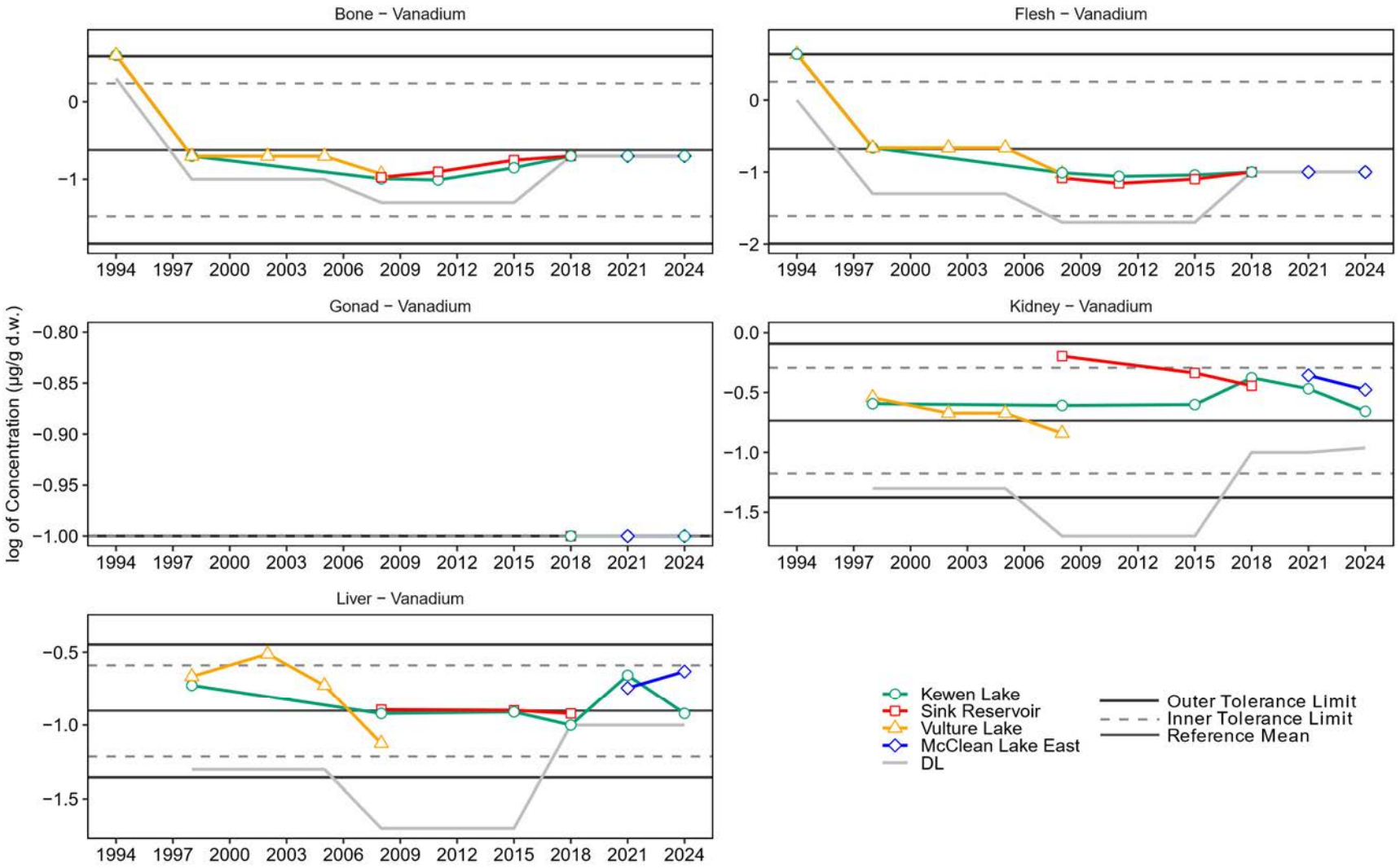
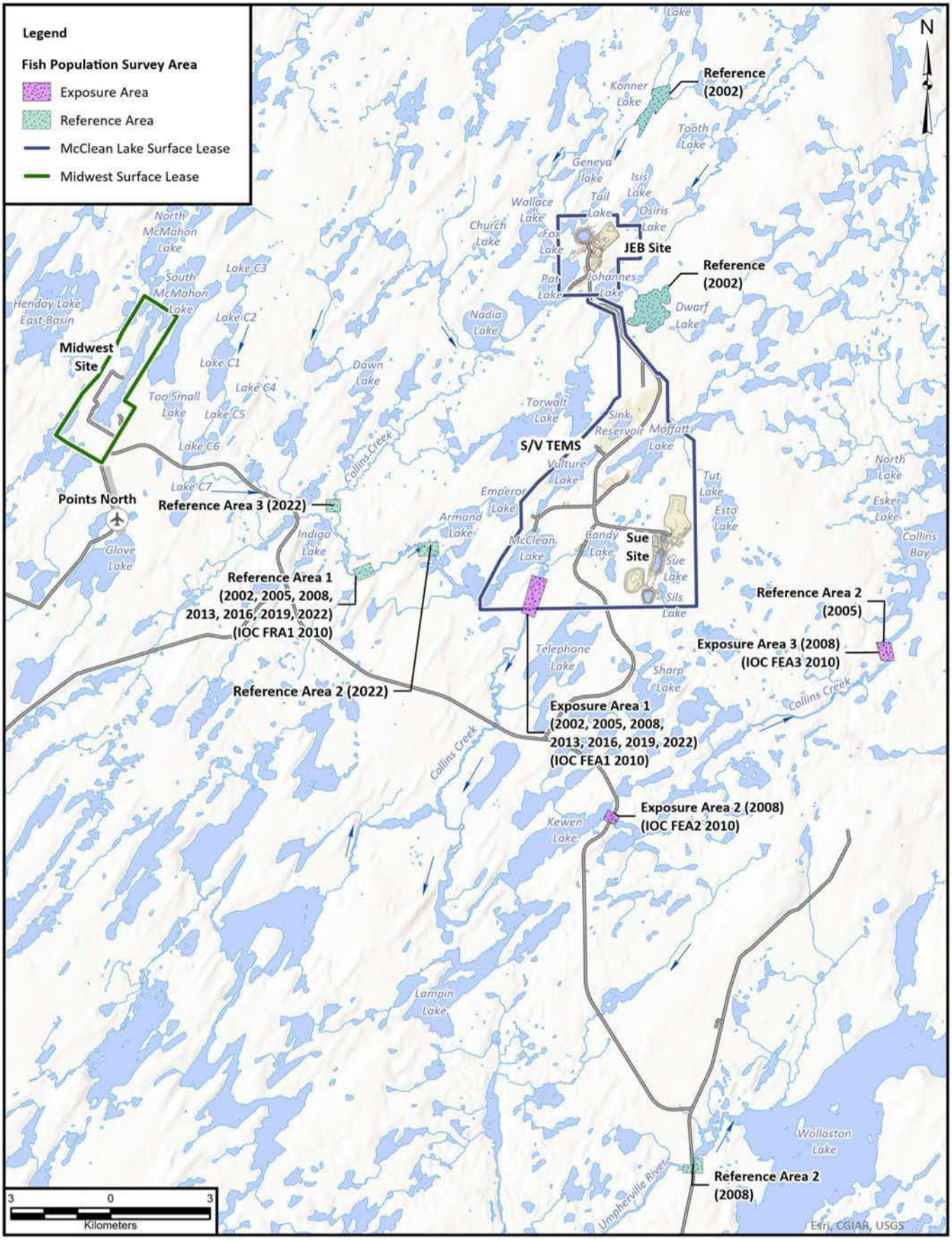


Figure 4.6-16 (21 of 21) Variations in COPCs in White Sucker collected from Exposure Lakes between 1994 and 2024

Figure Note: Vanadium concentrations in various fish tissue samples are shown.



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-10-22 2:14 PM Scale: 1:160,000
Data Sources: Natural Resources Canada, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 4.6-17
SAMPLING LOCATIONS FOR THE FISH POPULATION PROGRAM

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 4\EPTID Section 4.aprx

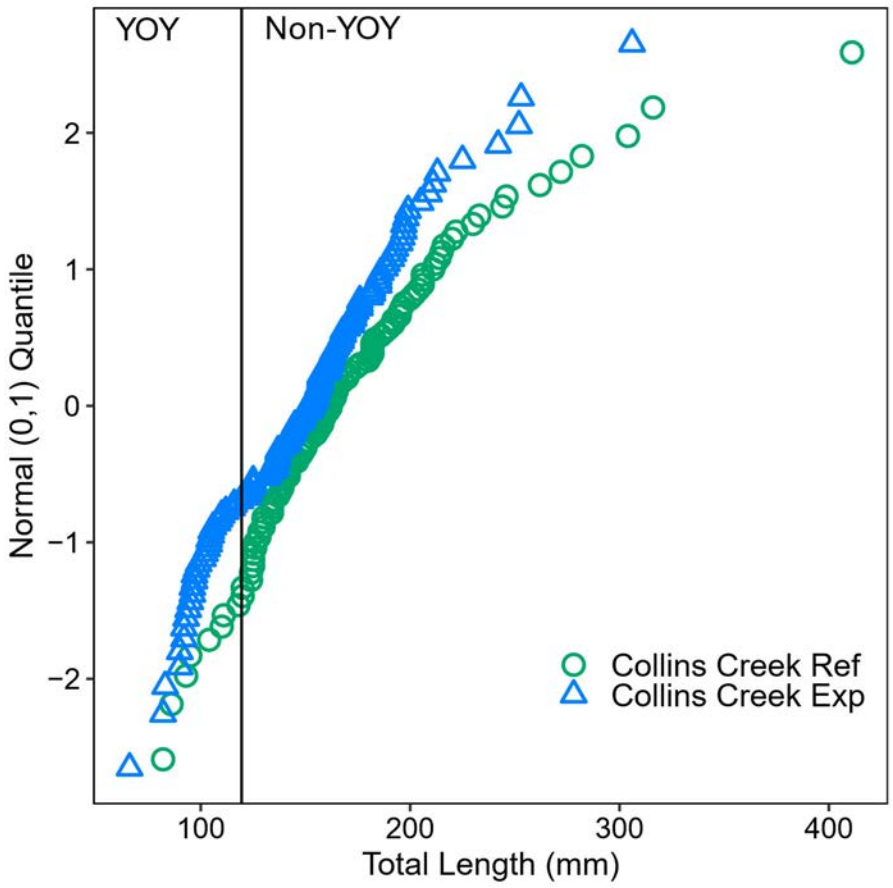


Figure 4.6-18 Probability Plots of Burbot in the Reference and Exposure Areas of Collins Creek, October 2022.

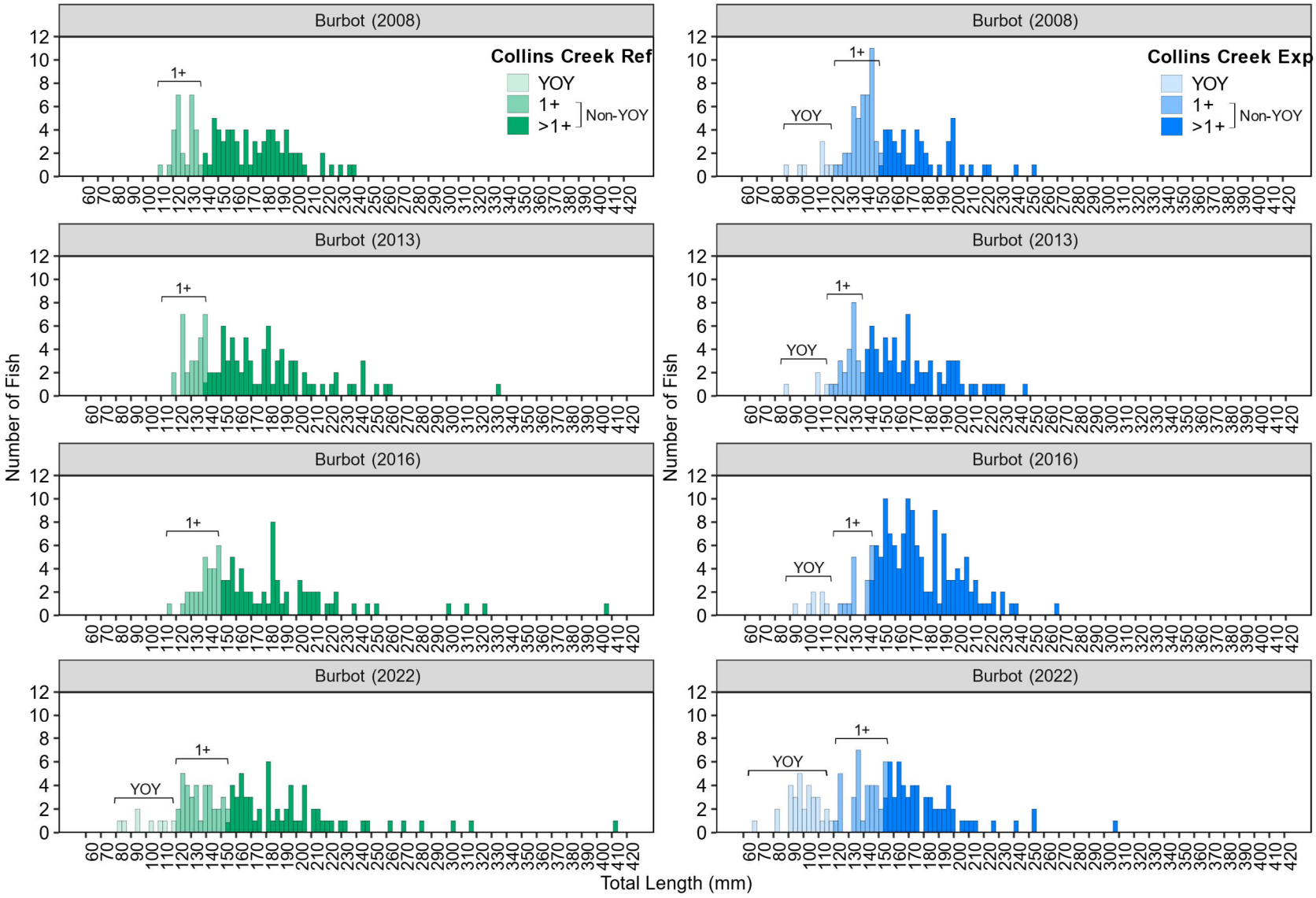


Figure 4.6-19 Comparison of Burbot Length-Frequency Histograms Among Years (2008, 2013, 2016, and 2022) in the Reference (left panels) and Exposure (right panels) Areas of Collins Creek with Age Classes Estimated.

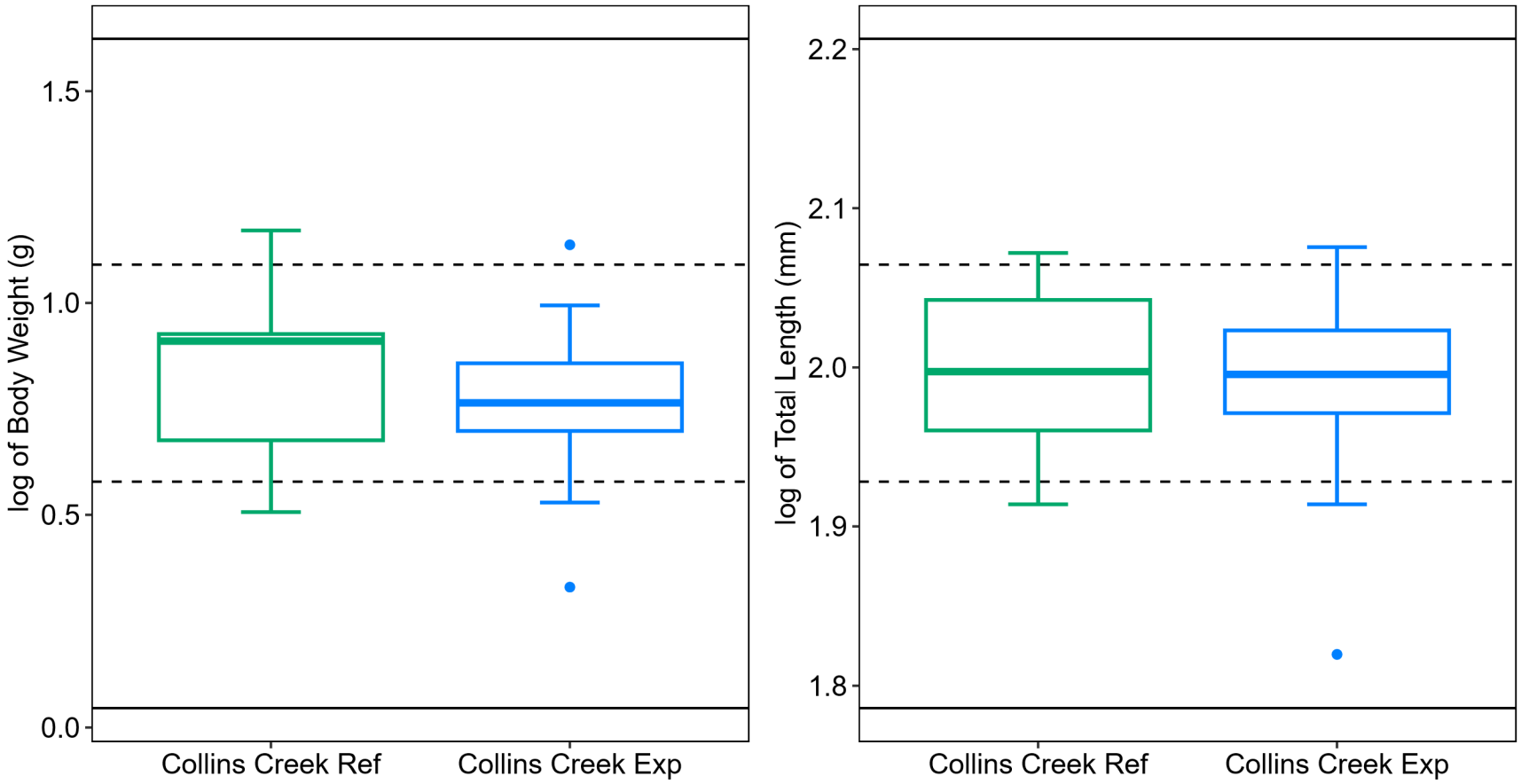


Figure 4.6-20 Box Plot of Weight and Length for YOY Burbot Collected from the Reference and Exposure Areas of Collins Creek, October 2022.

Note: Horizontal lines represent inner and outer tolerance limits based on reference site data. Limits are calculated using the non-central t-distribution to define the expected range of normal values, accounting for sample size and variability.

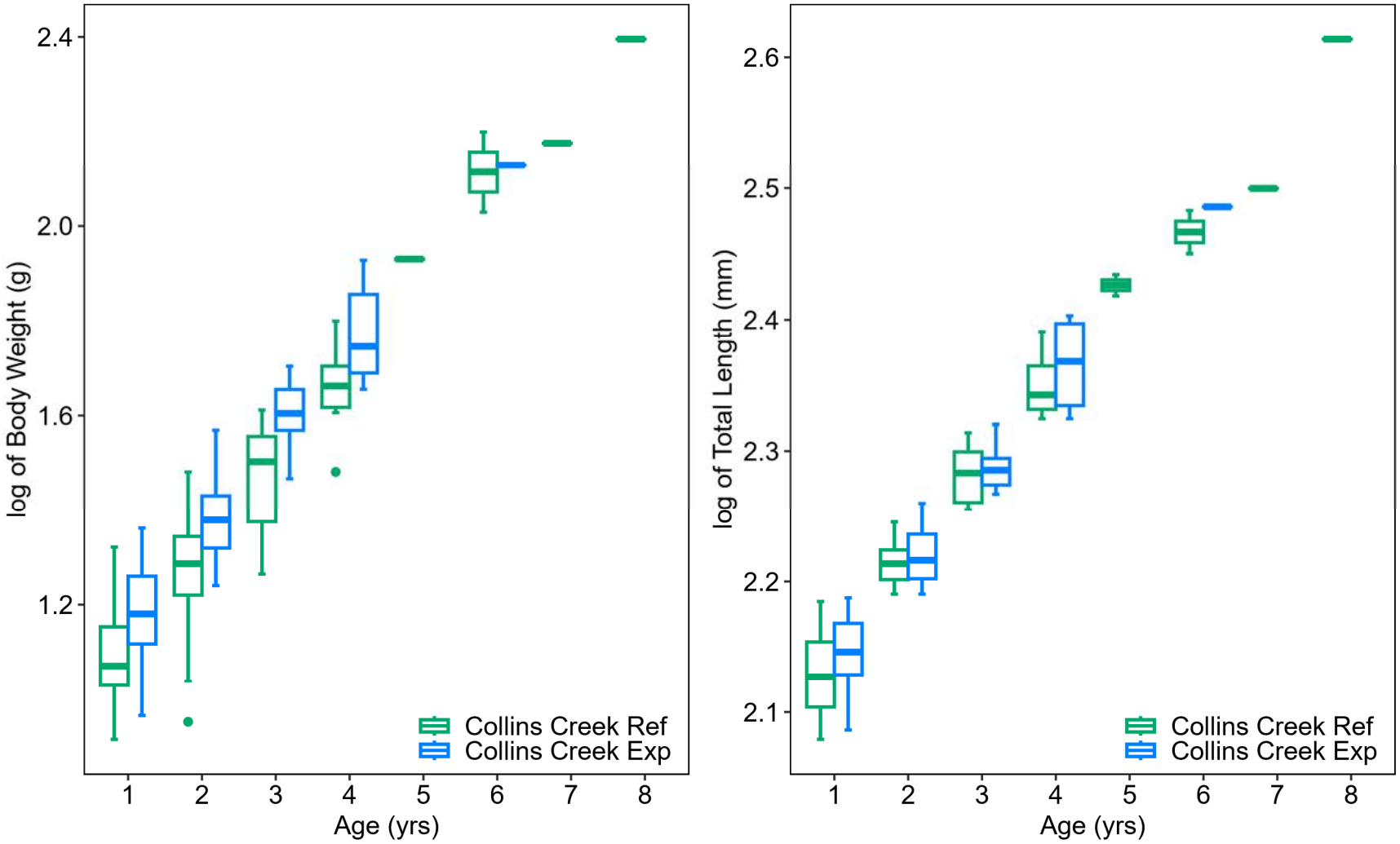


Figure 4.6-21 Box Plot of Weight and Length at age for Non-YOY Burbot Collected from the Reference and Exposure Areas of Collins Creek, October 2022.

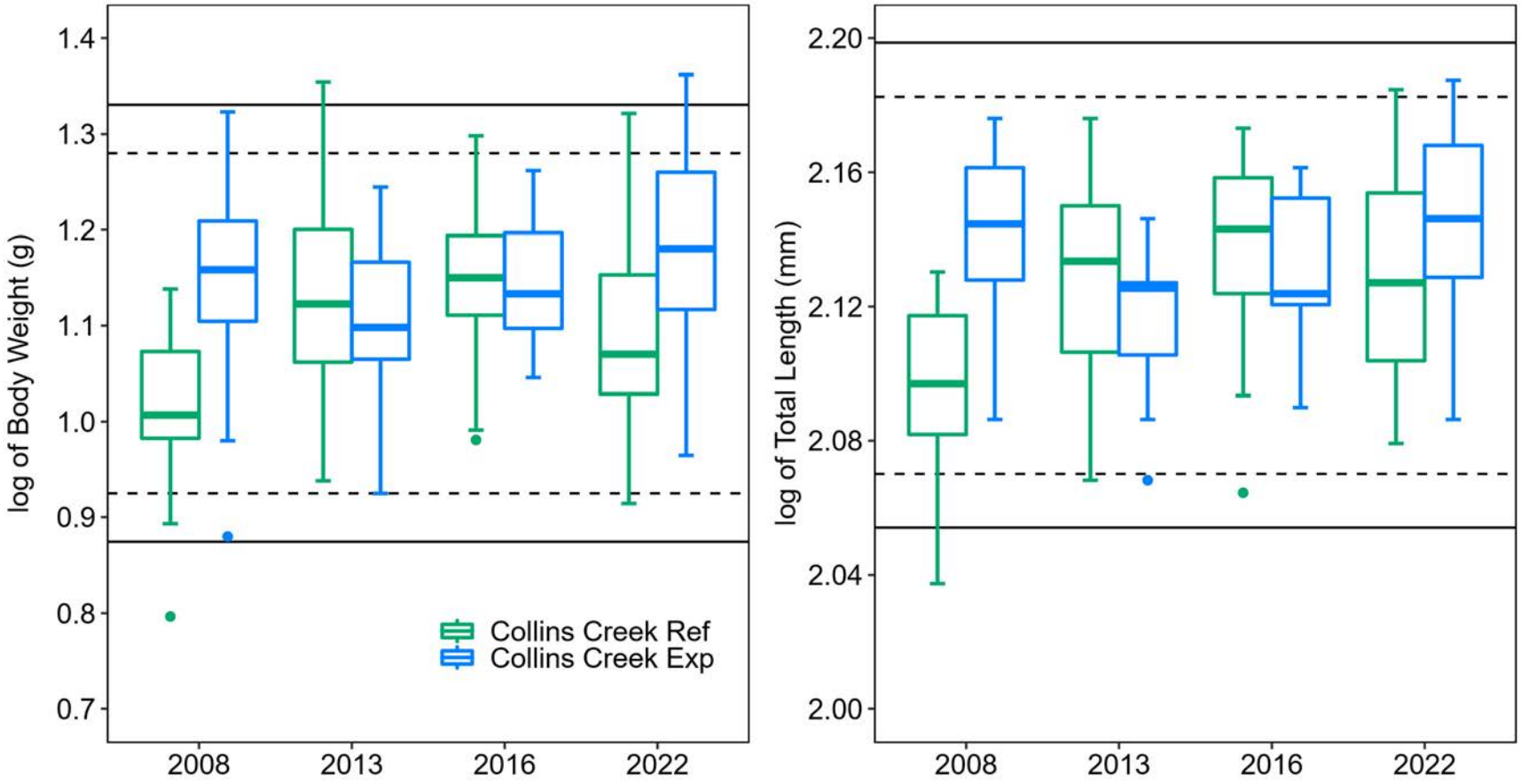


Figure 4.6-22 Box Plot of Weight and Length for 1+ Burbot Collected from the Reference and Exposure Areas of Collins Creek (October 2008, 2013, 2016, and 2022).

Note: Horizontal lines represent inner and outer tolerance limits based on reference site data. Limits are calculated using the non-central t-distribution to define the expected range of normal values, accounting for sample size and variability.

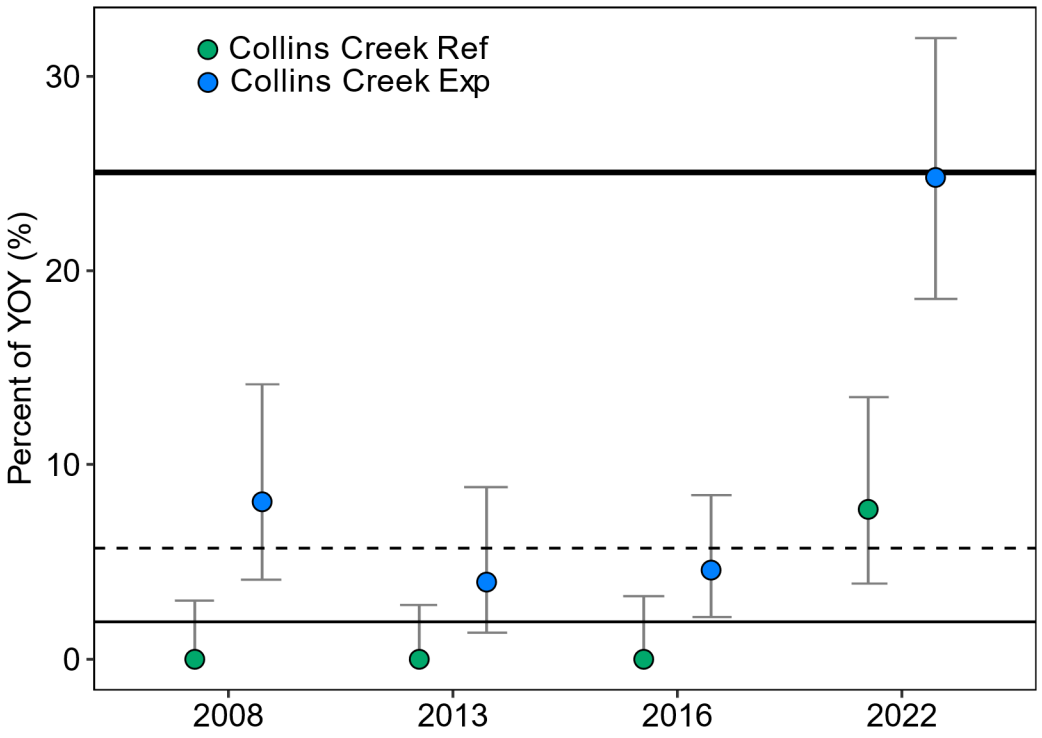


Figure 4.6-23 Variation in Percent Composition of YOY Burbot Collected from the Reference and Exposure Areas of Collins Creek (October 2008, 2013, 2016, and 2022).

Note: error bars are 95% confidence limits for estimated % YOY. Horizontal lines represent inner and outer tolerance limits based on reference site data. Limits are calculated using the non-central t-distribution to define the expected range of normal values, accounting for sample size and variability.

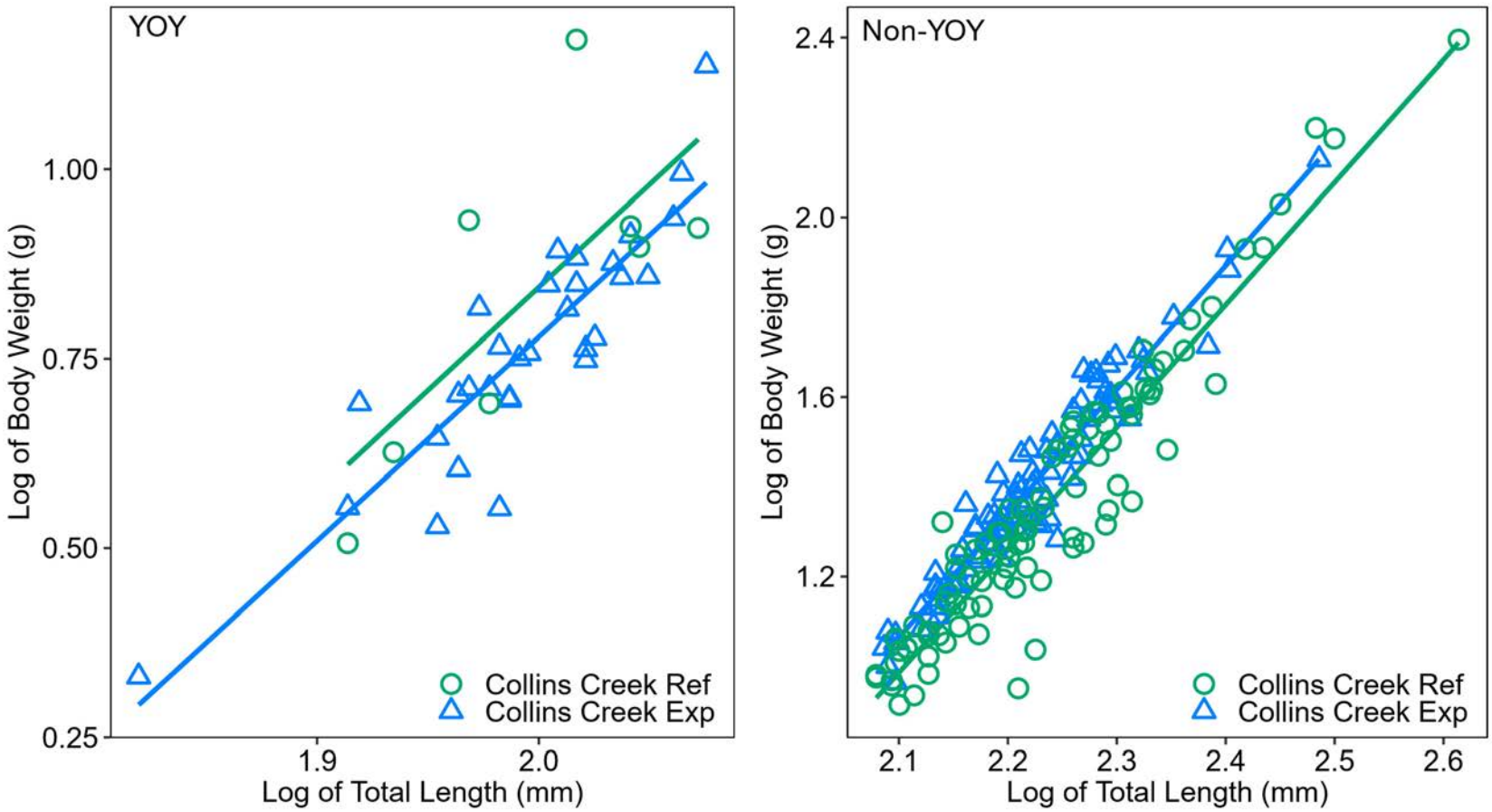


Figure 4.6-24 Relationship Between Weight (g) and Length (mm) of YOY and non-YOY Burbot in the Reference and Exposure Areas of Collins Creek, 2022.

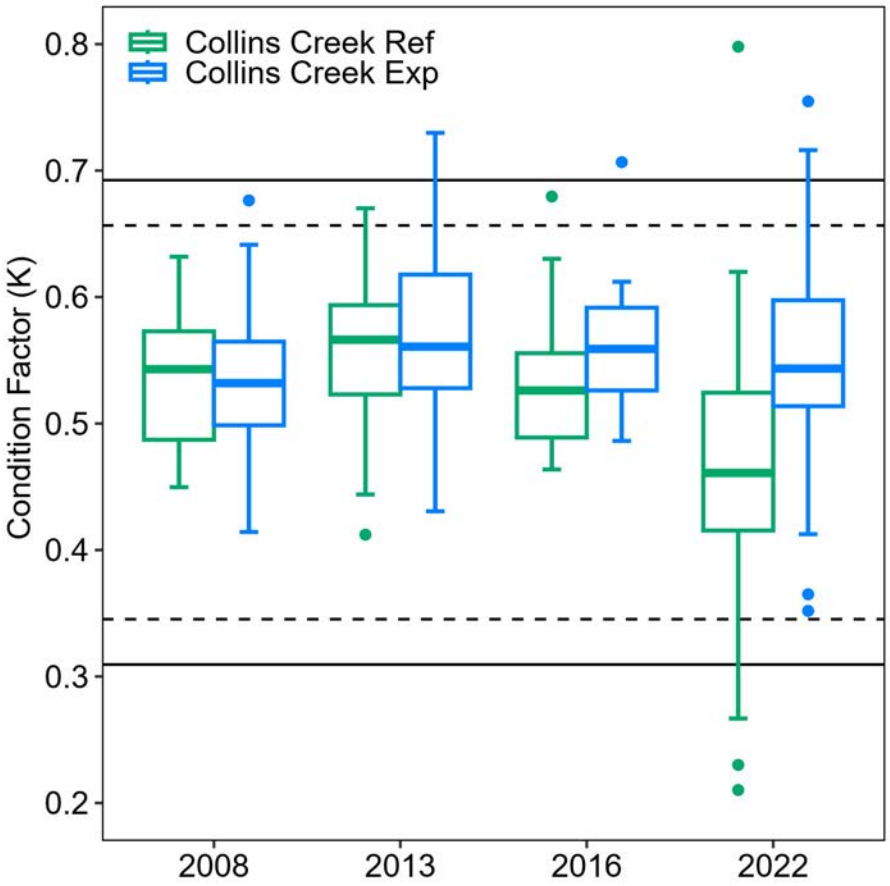


Figure 4.6-25 Box Plot of Condition Factor for non-YOY Burbot collected from the Reference and Exposure Areas of Collins Creek, 2022.

Note: Horizontal lines represent inner and outer tolerance limits based on reference site data. Limits are calculated using the non-central t-distribution to define the expected range of normal values, accounting for sample size and variability.

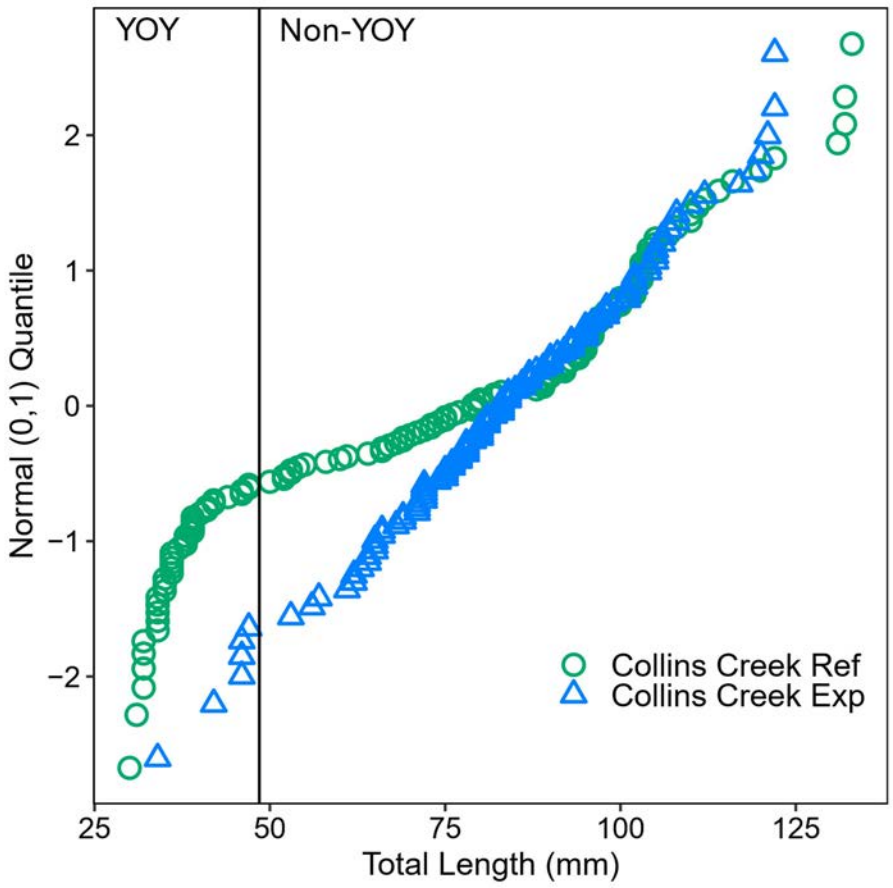


Figure 4.6-26 Probability Plots of Slimy Sculpin in the Reference and Exposure Areas of Collins Creek, October 2022.

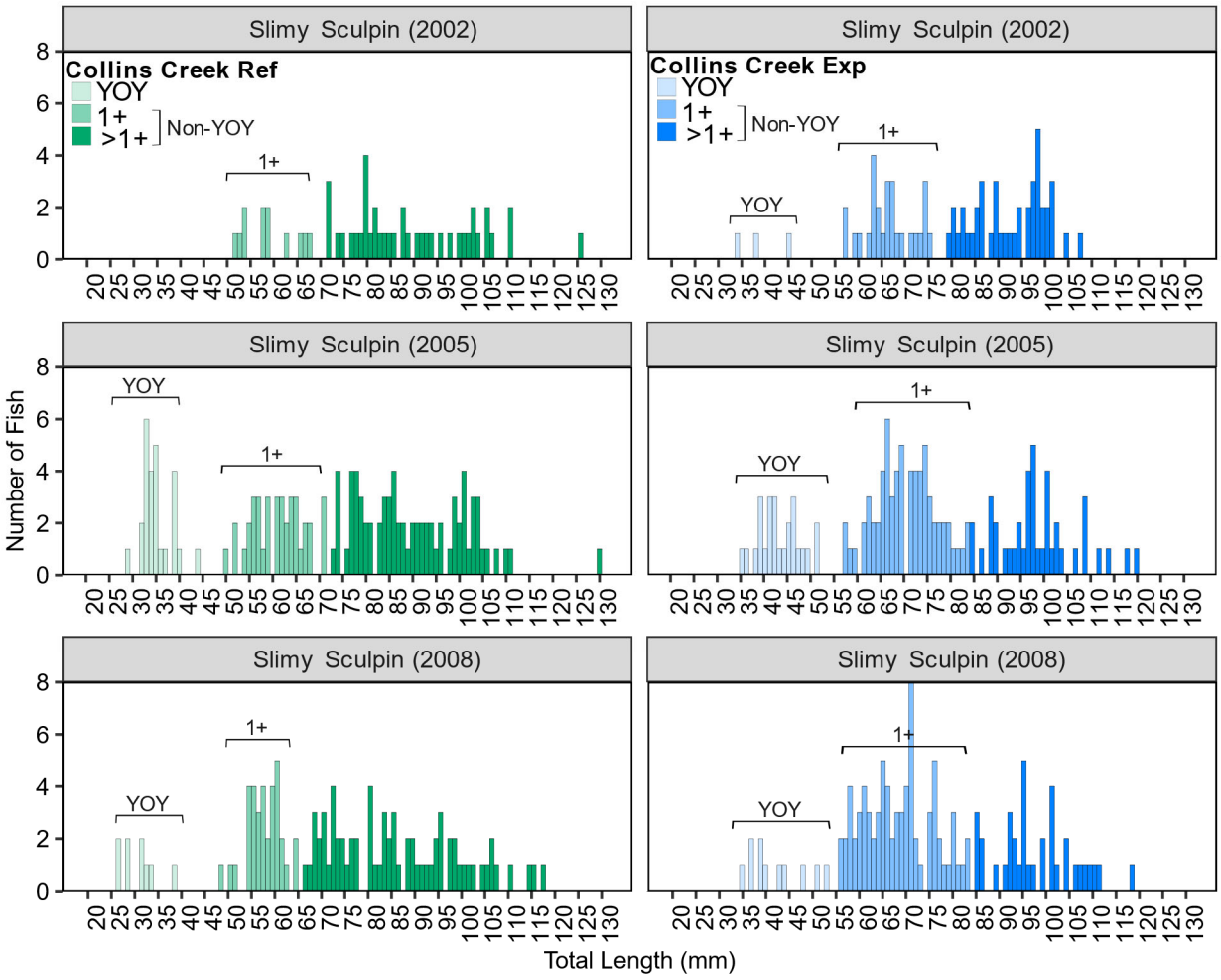


Figure 4.6-27 (1 of 2) Histogram of Slimy Sculpin Length (mm) in the Reference and Exposure Areas of Collins Creek, 2022.

Note: age classes are based on visual inspection of the length frequency histograms and correspond to “breaks” in the data.

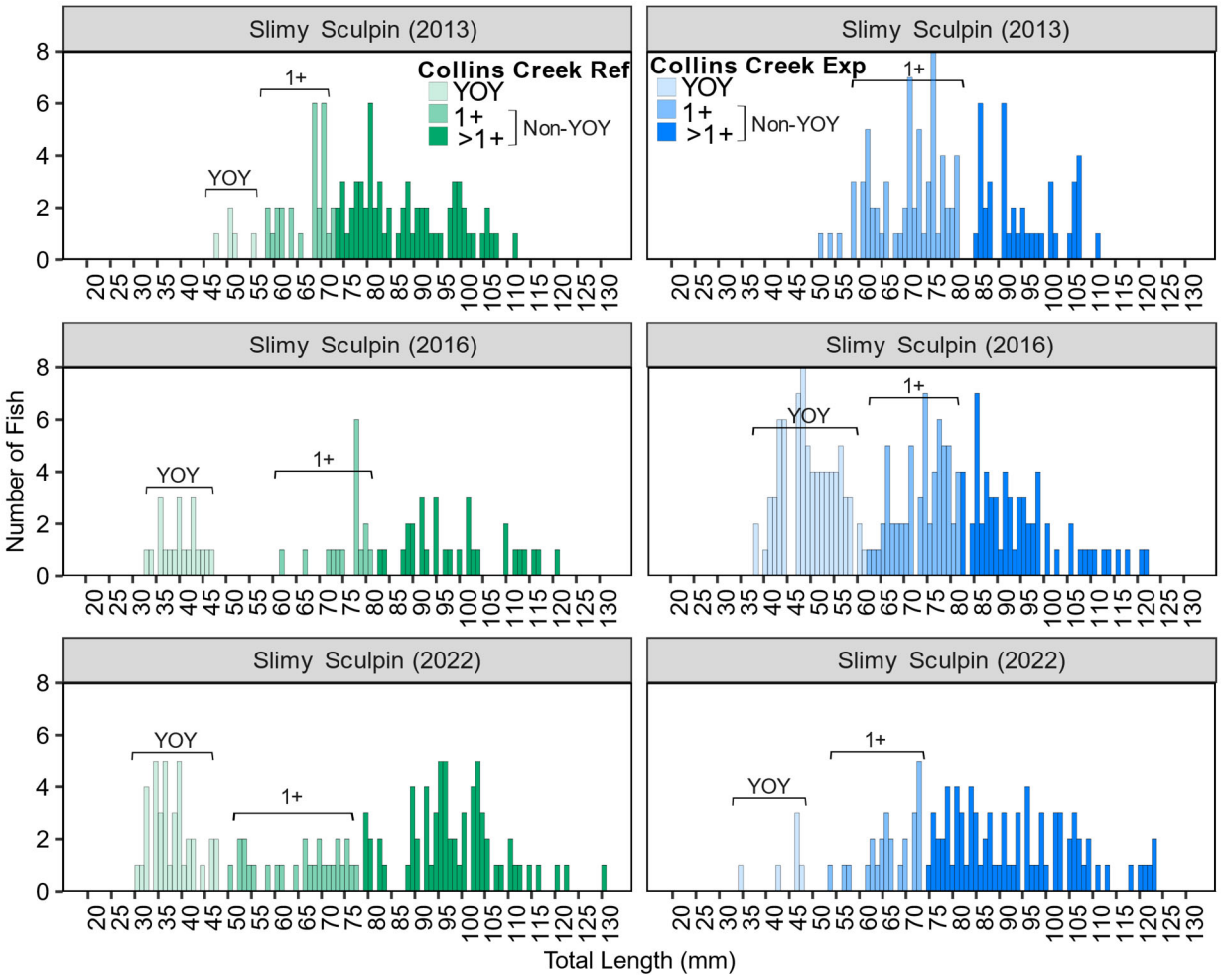


Figure 4.6-27 (2 of 2) Histogram of Slimy Sculpin Length (mm) in the Reference and Exposure Areas of Collins Creek, 2022.

Note: age classes are based on visual inspection of the length frequency histograms and correspond to “breaks” in the data.

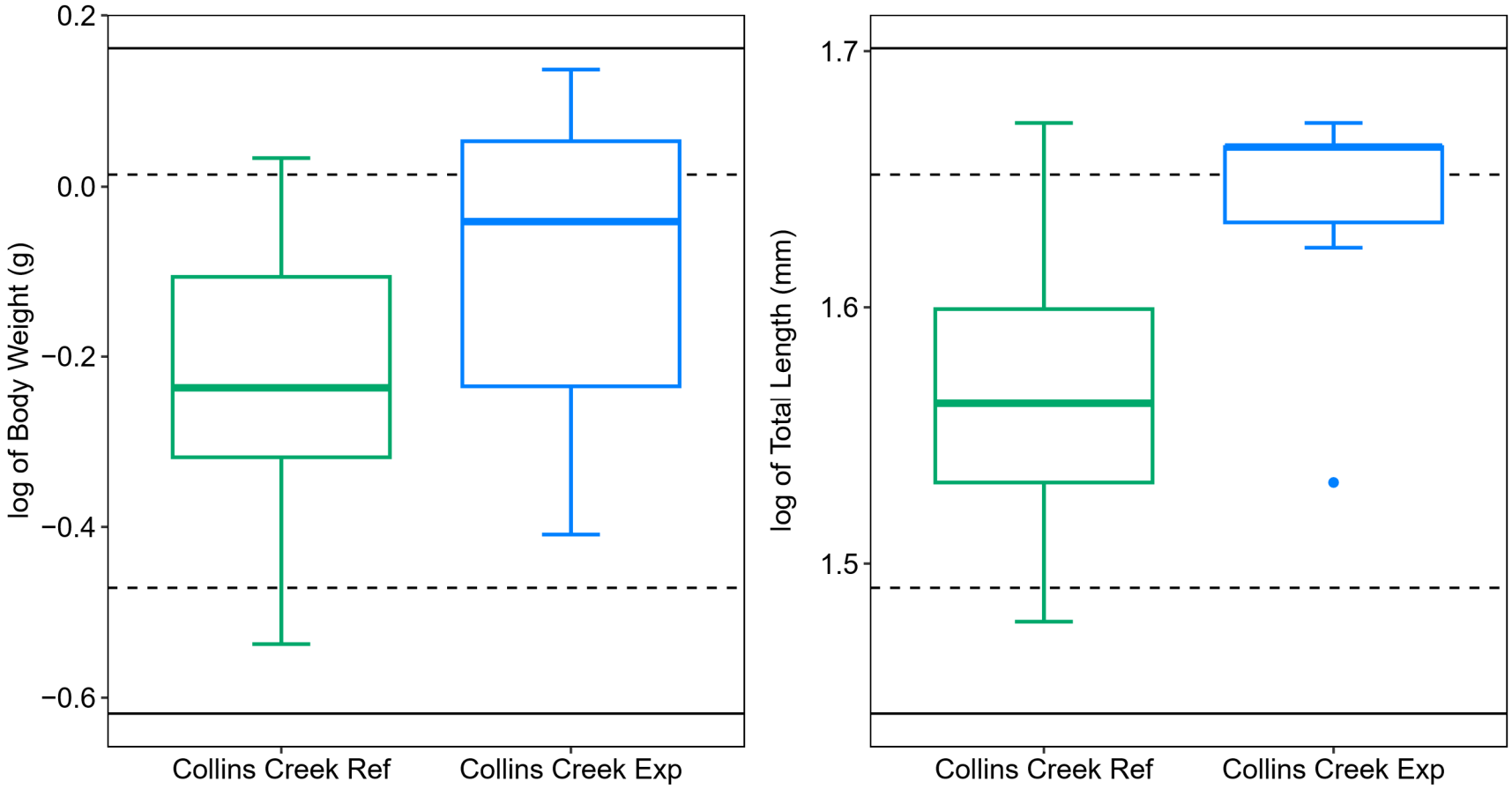


Figure 4.6-28 Box Plot of Weight and Length for YOY Slimy Sculpin Collected from the Reference and Exposure Areas of Collins Creek, October 2022.

Note: Horizontal lines represent inner and outer tolerance limits based on reference site data. Limits are calculated using the non-central t-distribution to define the expected range of normal values, accounting for sample size and variability.

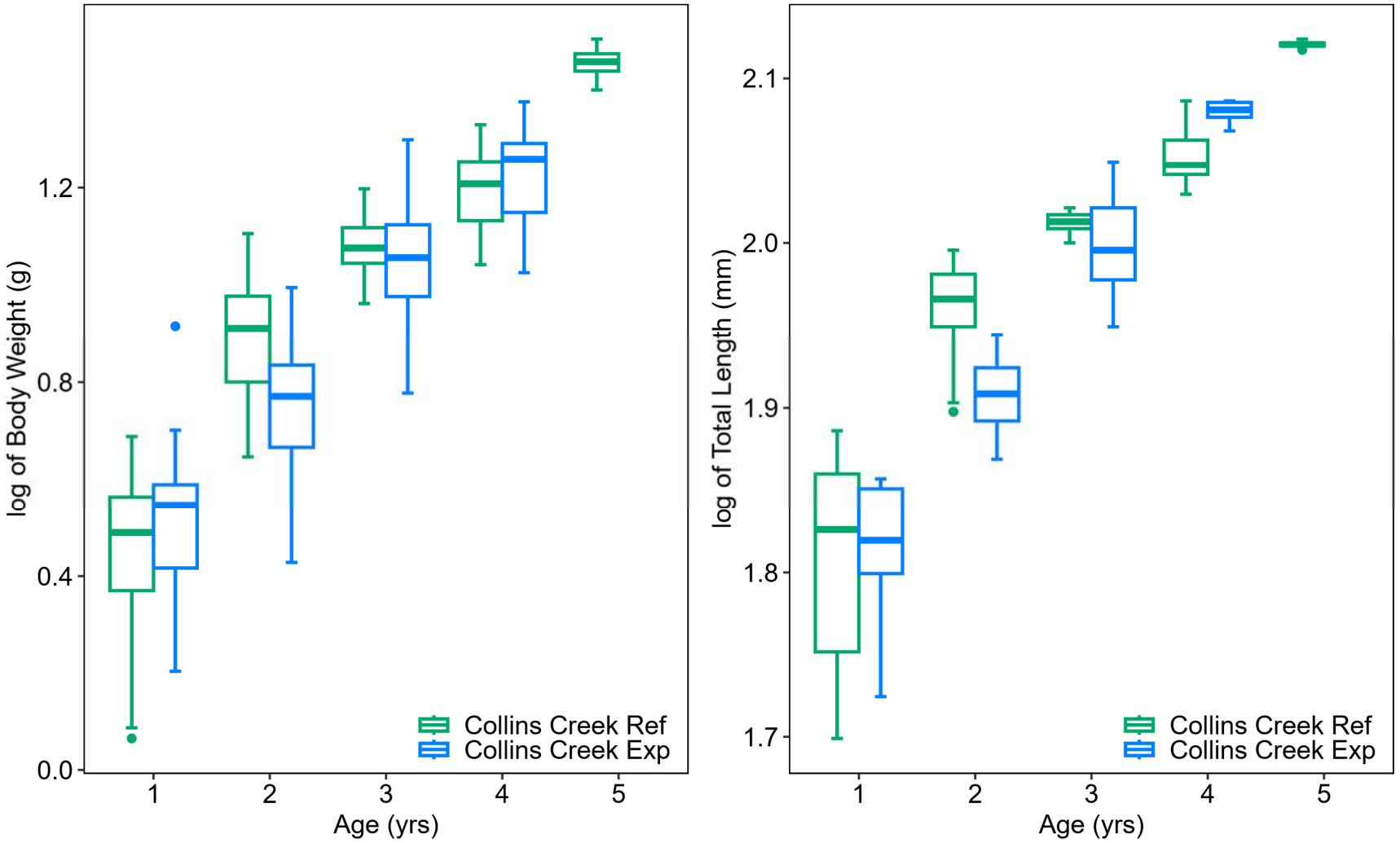


Figure 4.6-29 Box Plot of Weight and Length at age for Non-YOY Slimy Sculpin Collected from the Reference and Exposure Areas of Collins Creek, October 2022.

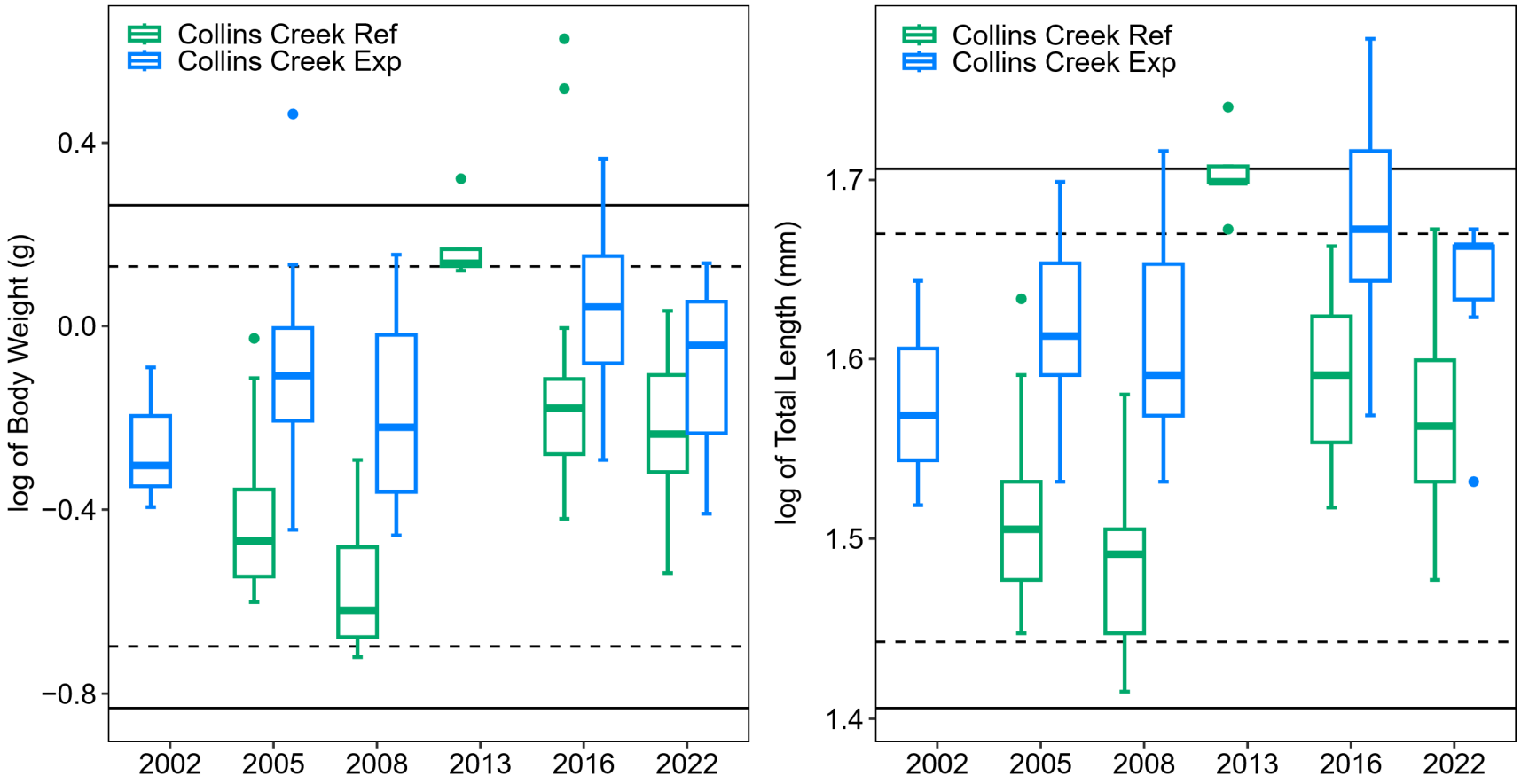


Figure 4.6-30 Box Plot of Body Weight and Total Length Among Years for YOY Slimy Sculpin Collected from the Reference and Exposure Areas of Collins Creek.

Note: Horizontal lines represent inner and outer tolerance limits based on reference site data. Limits are calculated using the non-central t-distribution to define the expected range of normal values, accounting for sample size and variability.

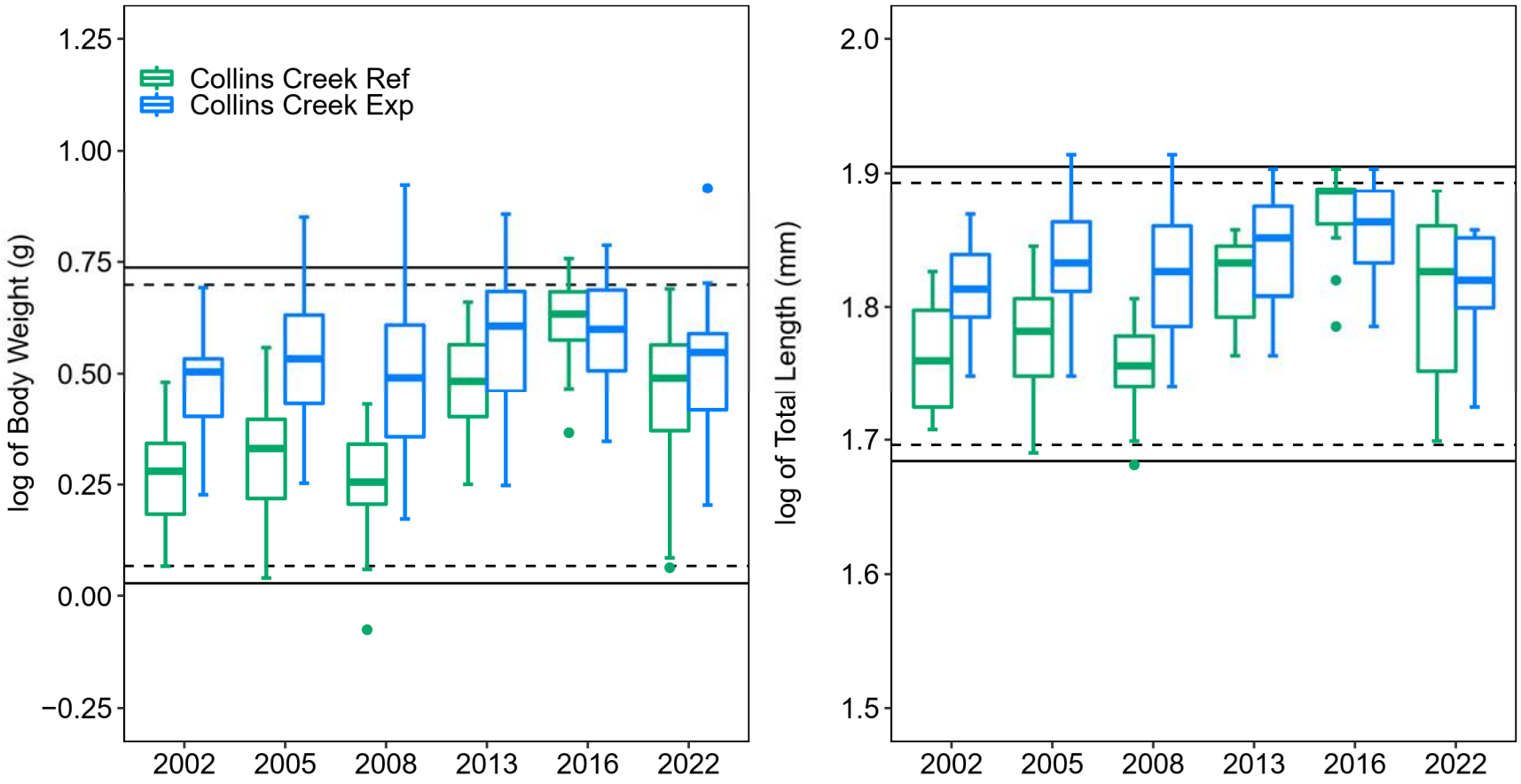


Figure 4.6-31 Box Plot of Body Weight and Total Length Among Years for 1+ Slimy Sculpin Collected from the Reference and Exposure Areas of Collins Creek.

Note: Horizontal lines represent inner and outer tolerance limits based on reference site data. Limits are calculated using the non-central t-distribution to define the expected range of normal values, accounting for sample size and variability.

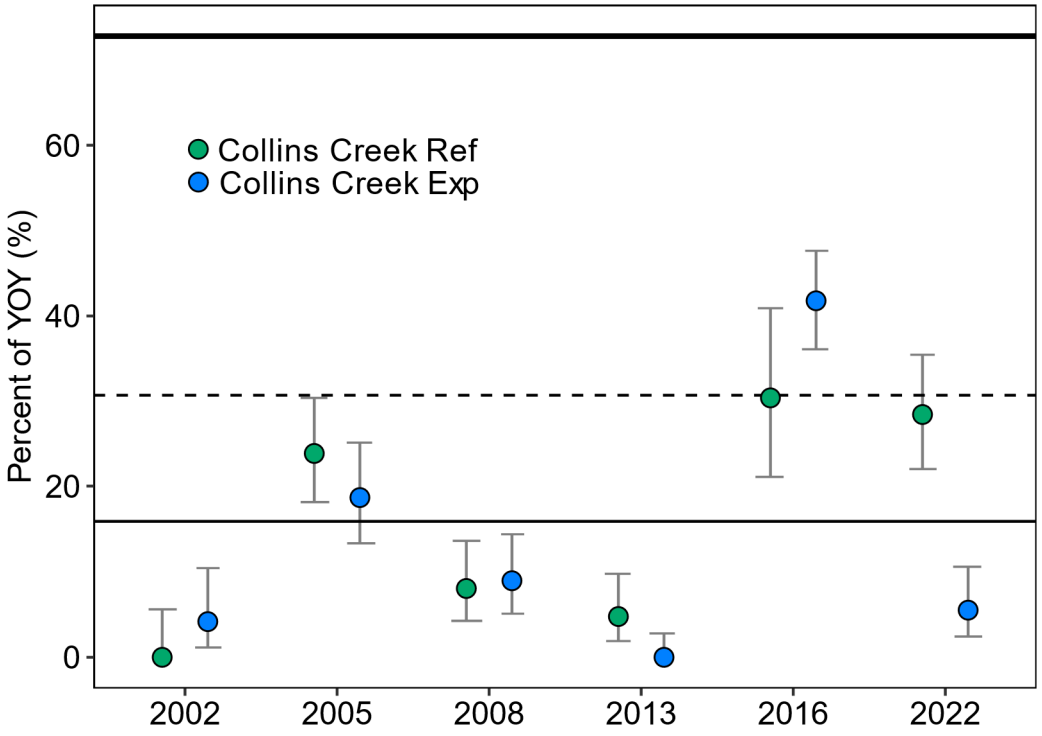


Figure 4.6-32 Variation in Percent Composition of YOY Slimy Sculpin Collected from the Reference and Exposure Areas of Collins Creek (October 2008, 2013, 2016, and 2022).

Note: error bars are 95% confidence limits for estimated % YOY. Horizontal lines represent inner and outer tolerance limits based on reference site data. Limits are calculated using the non-central t-distribution to define the expected range of normal values, accounting for sample size and variability.

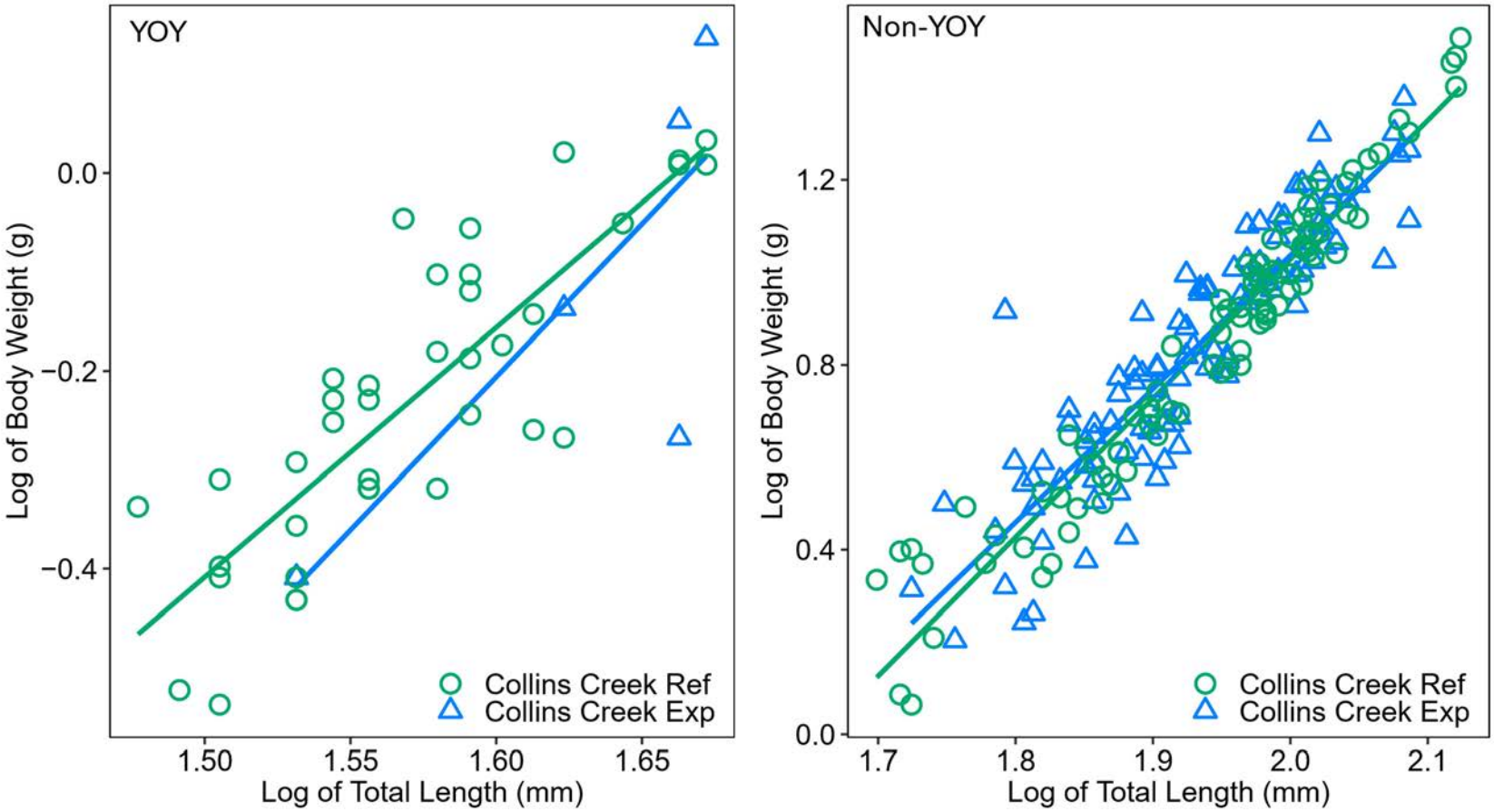


Figure 4.6-33 Relationship Between Weight (g) and Length (mm) of YOY and non-YOY Slimy Sculpin in the Reference and Exposure Areas of Collins Creek, 2022.

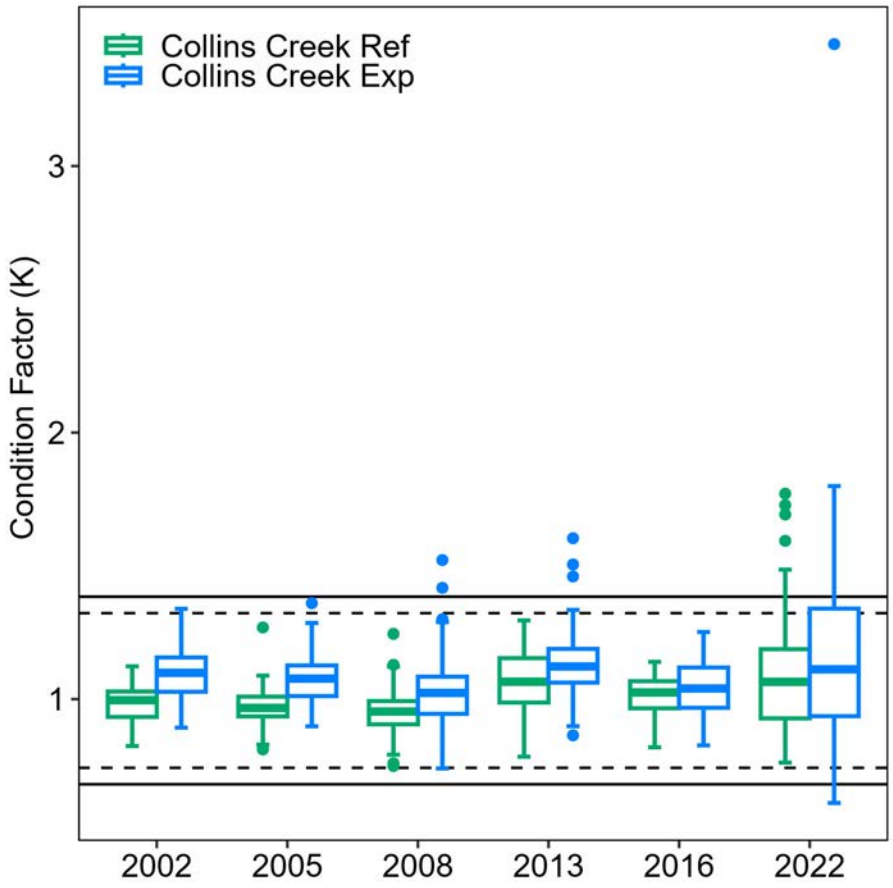
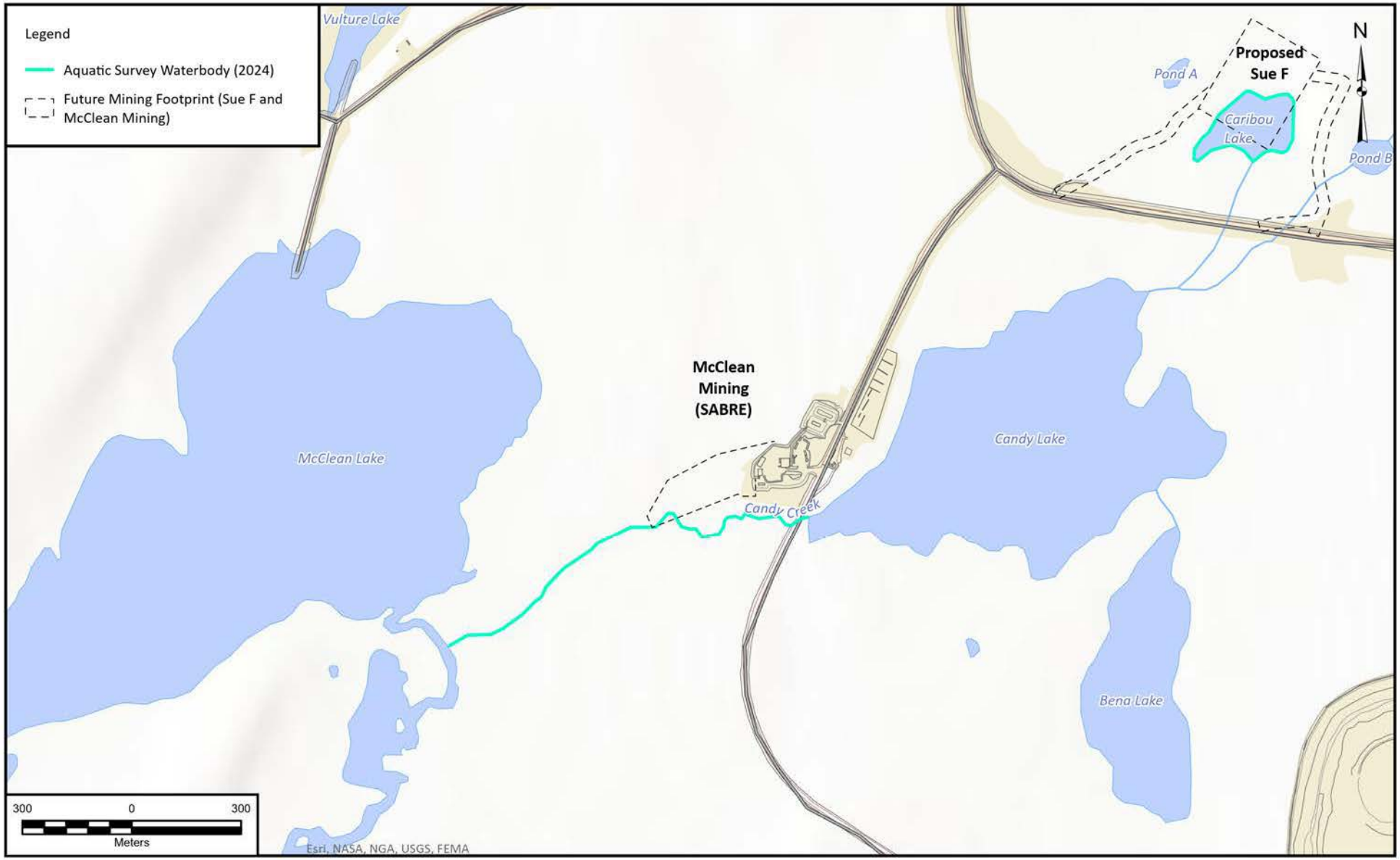


Figure 4.6-34 Box Plot of Condition Factor for non-YOY Slimy Sculpin collected from the Reference and Exposure Areas of Collins Creek, 2022.

Note: Horizontal lines represent inner and outer tolerance limits based on reference site data. Limits are calculated using the non-central t-distribution to define the expected range of normal values, accounting for sample size and variability



Projection: NAD 1983 UTM Zone 13N
Drawn: TL
Date: 2025-12-16 4:25 PM Scale: 1:15,000
Data Sources: *Natural Resources Canada, Geobase®, Saskatchewan Mining and Petroleum GeoAtlas, ORANO Canada Inc.*

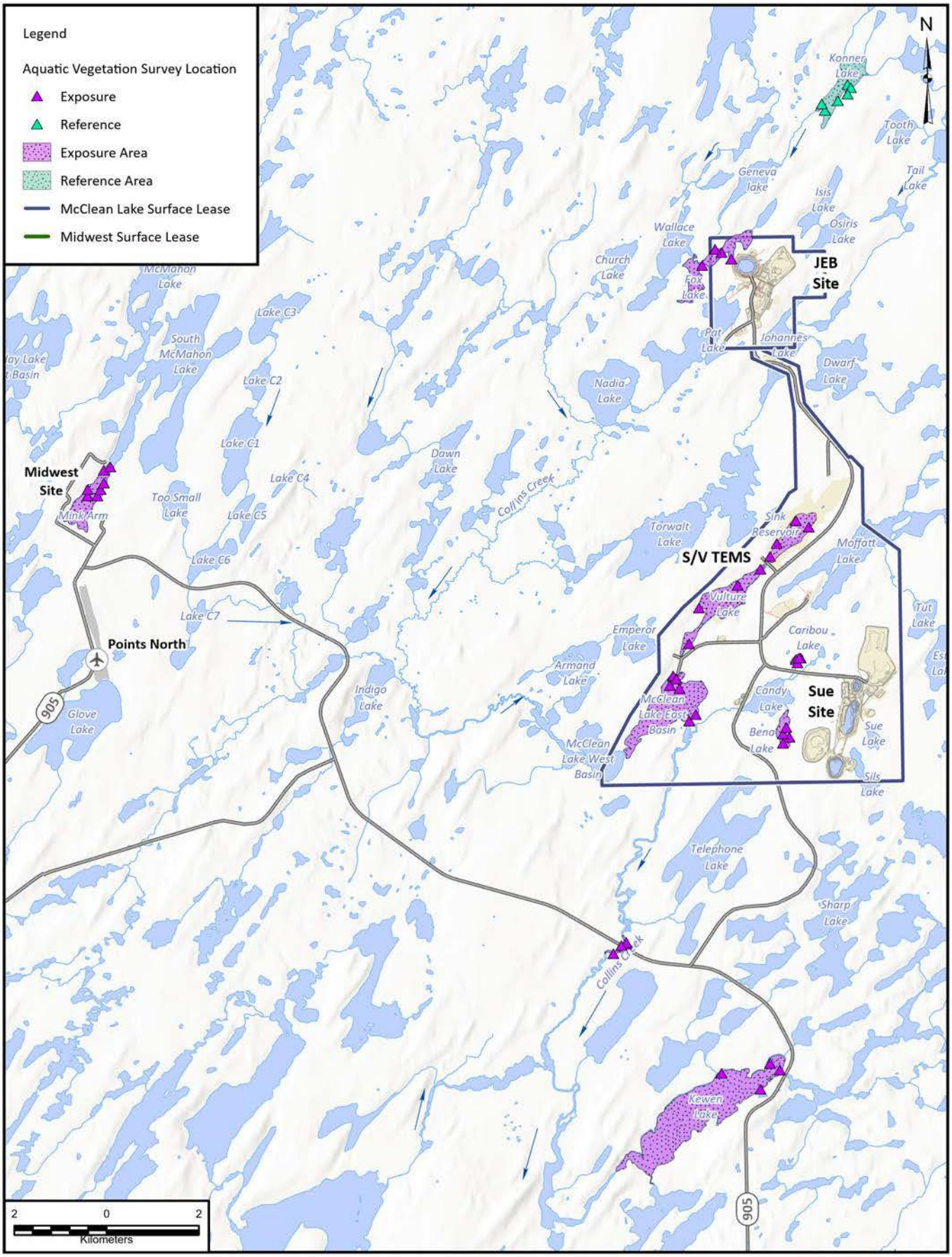
McCLEAN LAKE OPERATION

FIGURE 4.7-1
2024 AQUATIC SURVEY WATERBODIES

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 4\EPTID Section 4.aprx



Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-16 4:19 PM Scale: 1:115,000
Data Sources: Natural Resources Canada, ORANO Canada Inc.

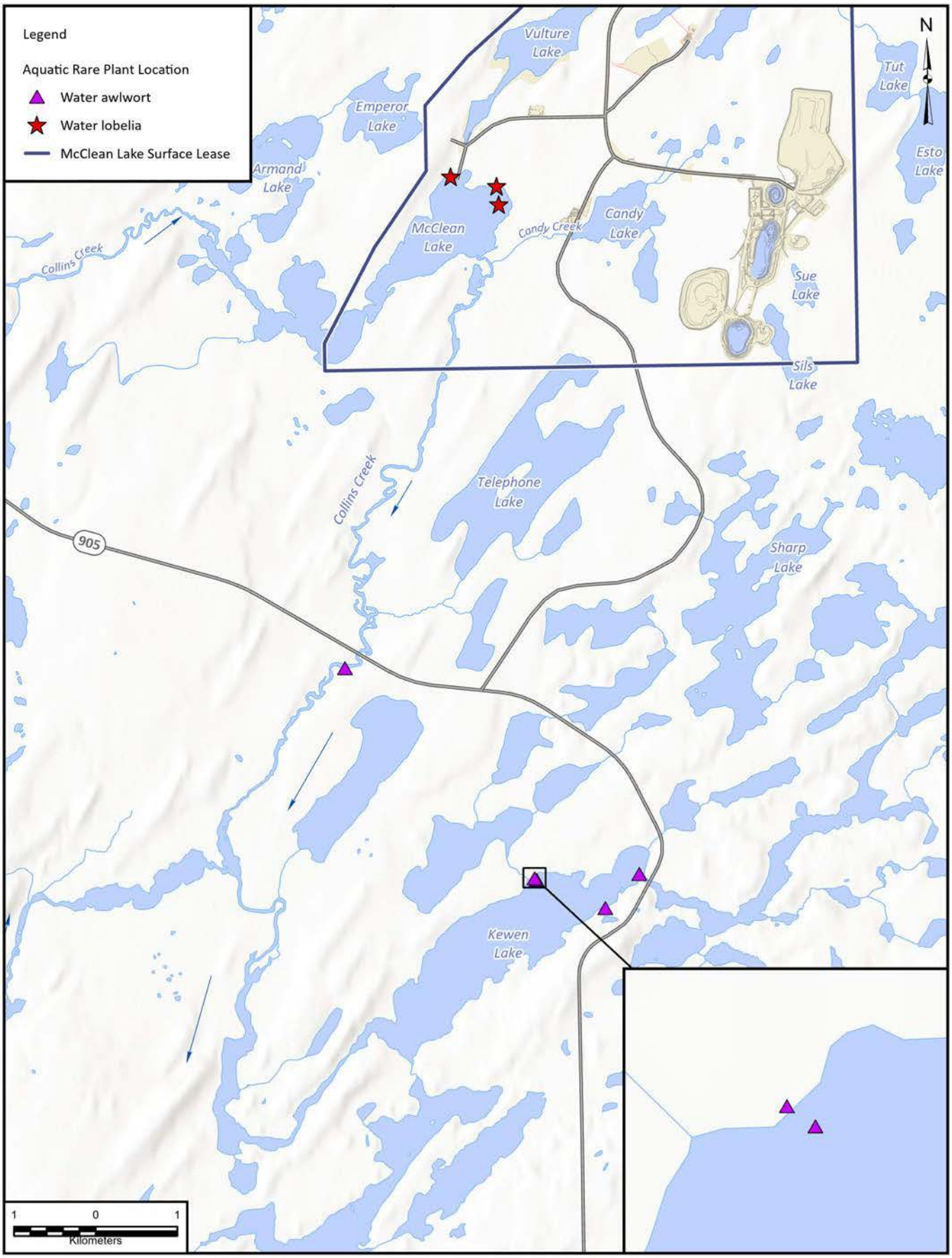
McCLEAN LAKE OPERATION

FIGURE 4.7-2
2024 AQUATIC VEGETATION SURVEY LOCATIONS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 4\EPTID Section 4.aprx



Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-16 4:25 PM Scale: 1:65,000
Data Sources: Natural Resources Canada, ORANO Canada Inc.

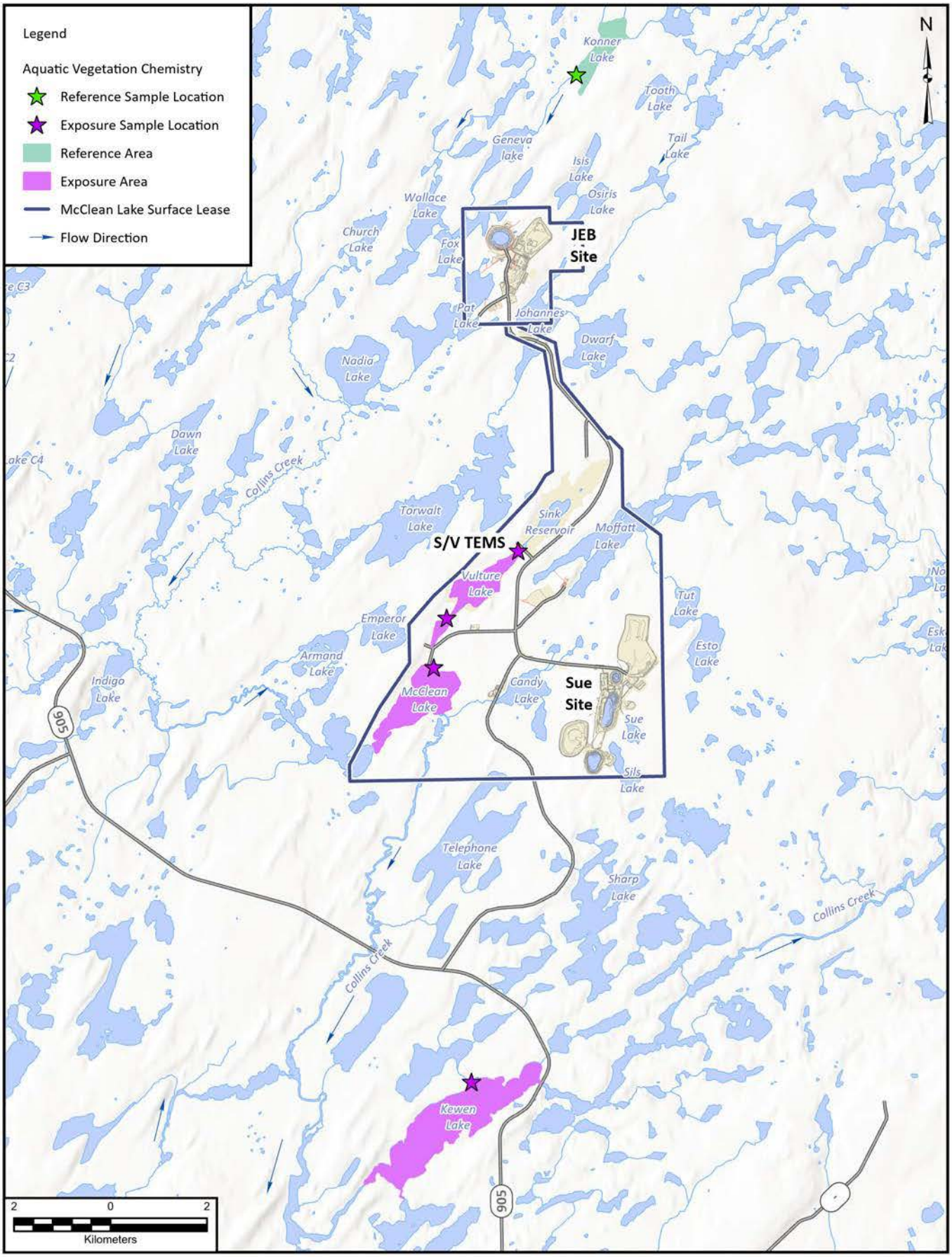
McCLEAN LAKE OPERATION

FIGURE 4.7-3
LOCATIONS OF 2024 AQUATIC RARE PLANTS OCCURRENCES AT THE McCLEAN LAKE OPERATION AREA

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 4\EPTID Section 4.aprx



Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-11 12:48 PM Scale: 1:110,000
Data Sources: Natural Resources Canada, ORANO Canada Inc.

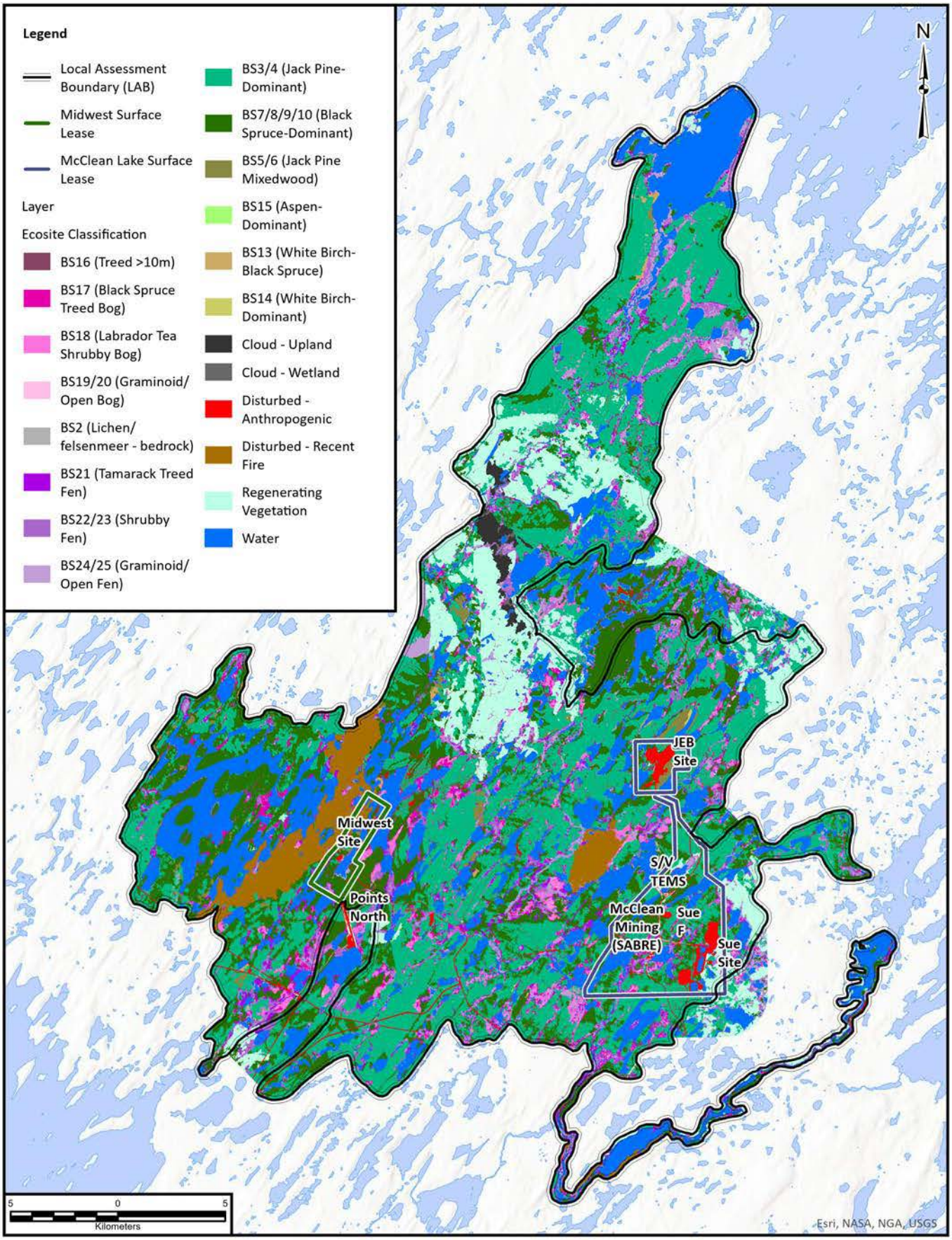
McCLEAN LAKE OPERATION

FIGURE 4.7-4
2024 AQUATIC VEGETATION & SEDIMENT CHEMISTRY LOCATIONS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 4\EPTID Section 4.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-05 12:00 PM Scale: 1:247,321
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 5.2-1
ECOSITE PATTERN WITHIN THE LOCAL ASSESSMENT BOUNDARY

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-11-07 4:14 PM Scale: 1:7,500
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

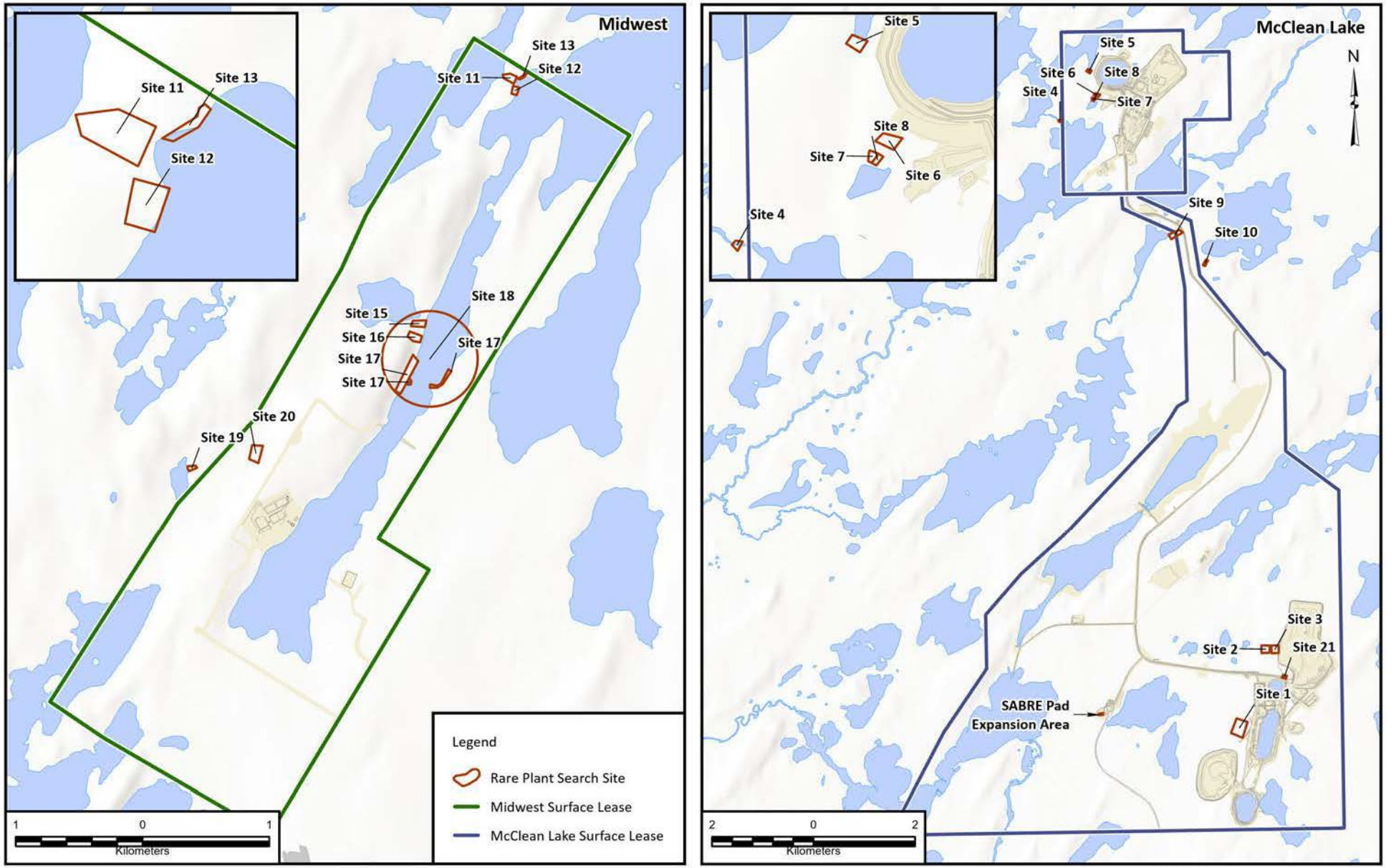
McCLEAN LAKE OPERATION

FIGURE 5.2-2
REVEGETATED AREA OF SUE C CWRP

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Compiled: T.Lohman
Drawn: T.Lohman
Date: 2025-12-17 8:42 AM
Scale: 1:34,170
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

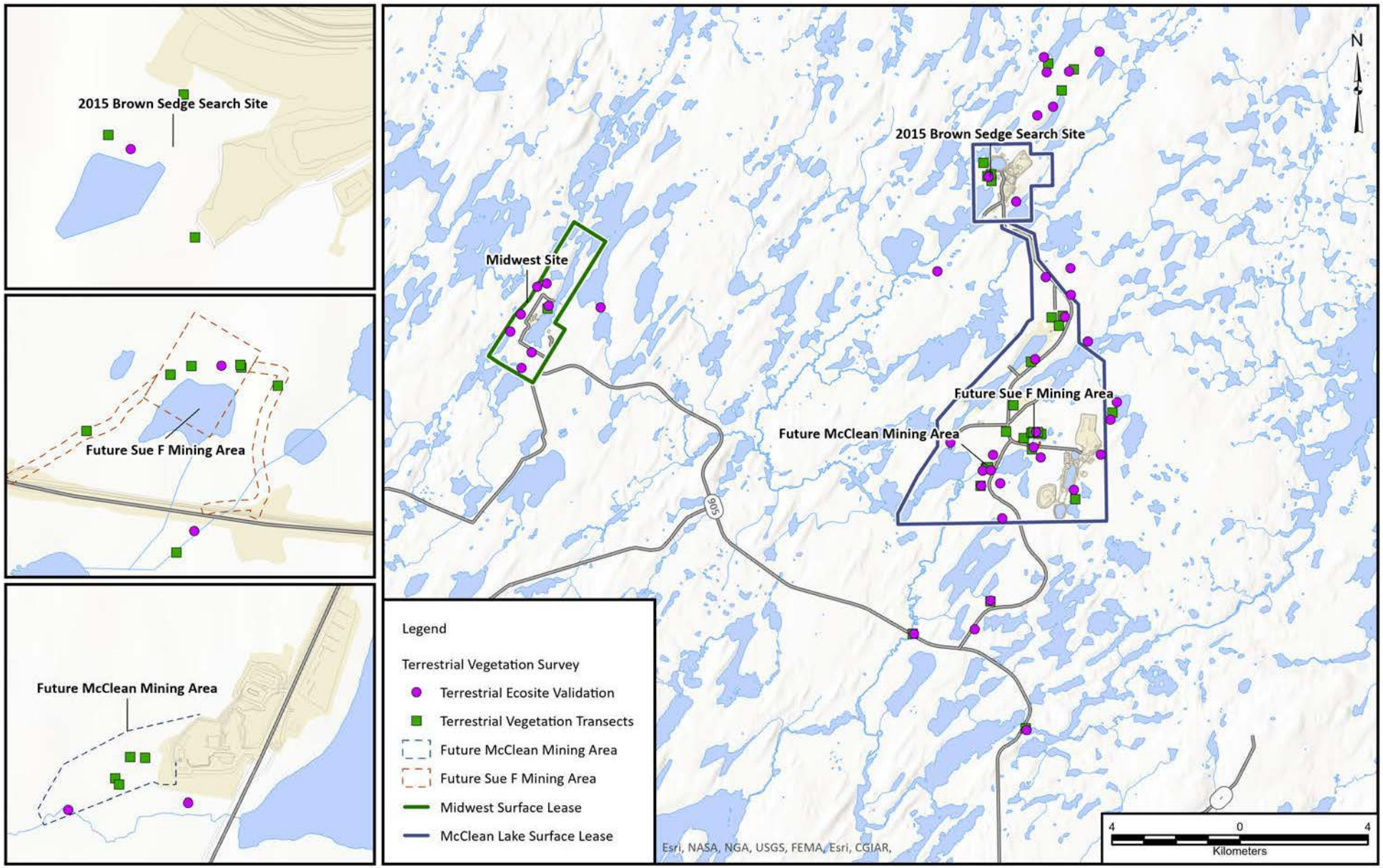
McCLEAN LAKE OPERATION

FIGURE 5.2-3
2023 RARE PLANT CHECKS SURVEYED LOCATIONS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-16 11:50 AM Scale: 1:168,861
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

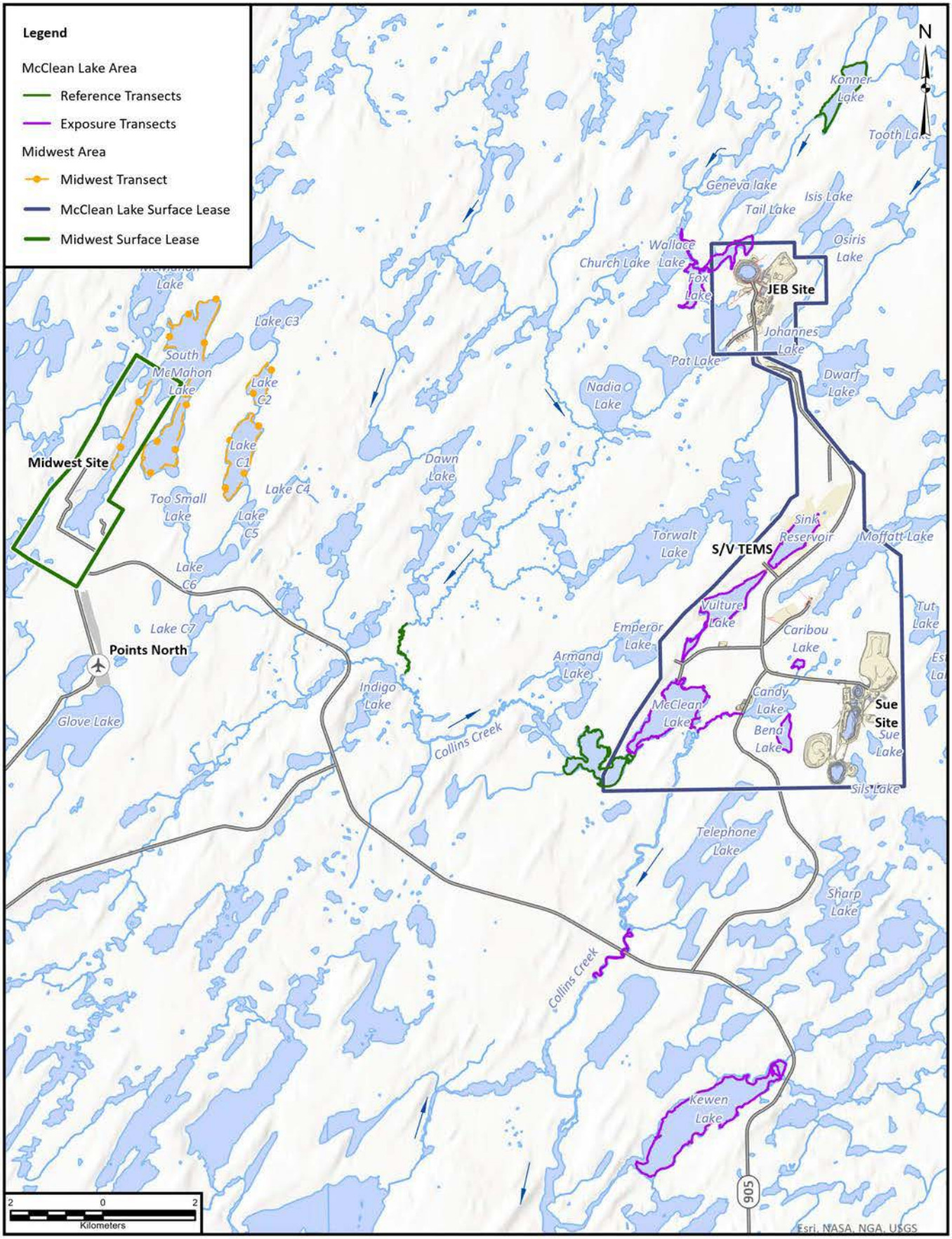
McCLEAN LAKE OPERATION

FIGURE 5.2-4
2024 TERRESTRIAL VEGETATION SURVEY LOCATIONS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-16 4:52 PM Scale: 1:115,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

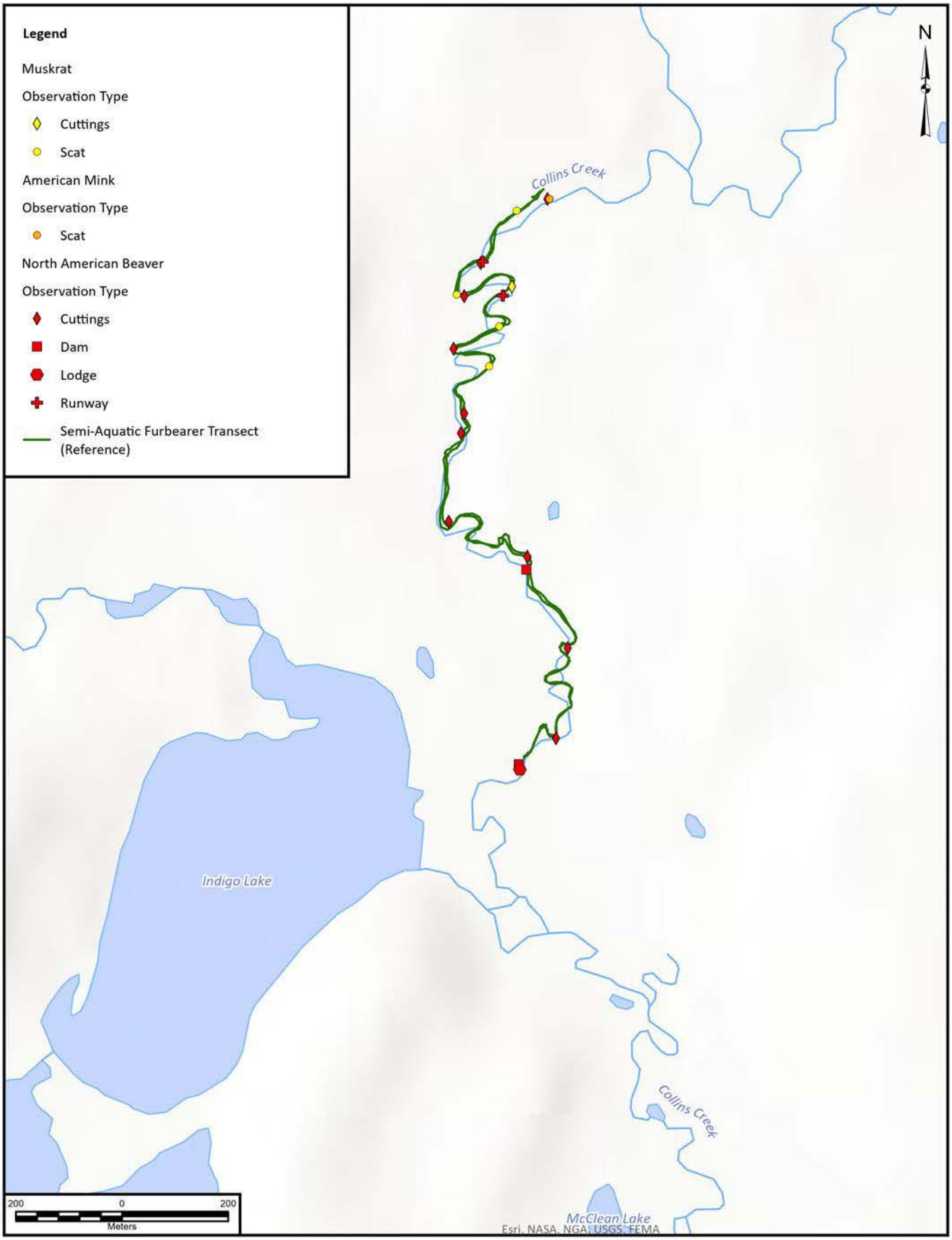
McCLEAN LAKE OPERATION

FIGURE 5.2-5
2024 SEMI-AQUATIC FURBEARER SURVEY TRANSECTS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-16 11:59 AM Scale: 1:10,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

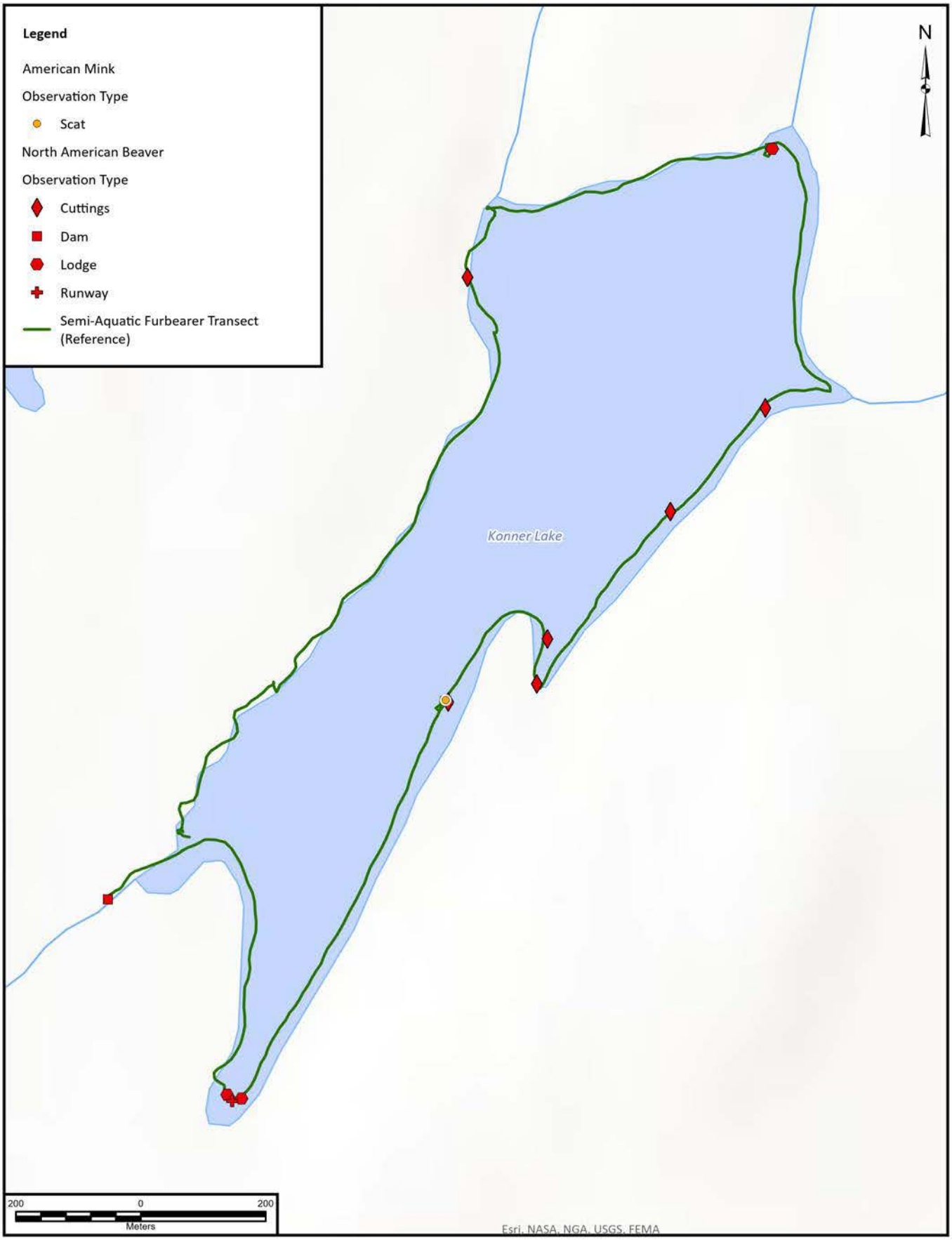
McCLEAN LAKE OPERATION

FIGURE 5.2-6
2024 SEMI-AQUATIC FURBEARER OBSERVATIONS:
COLLINS CREEK UPSTREAM

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-16 4:52 PM Scale: 1:8,500
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

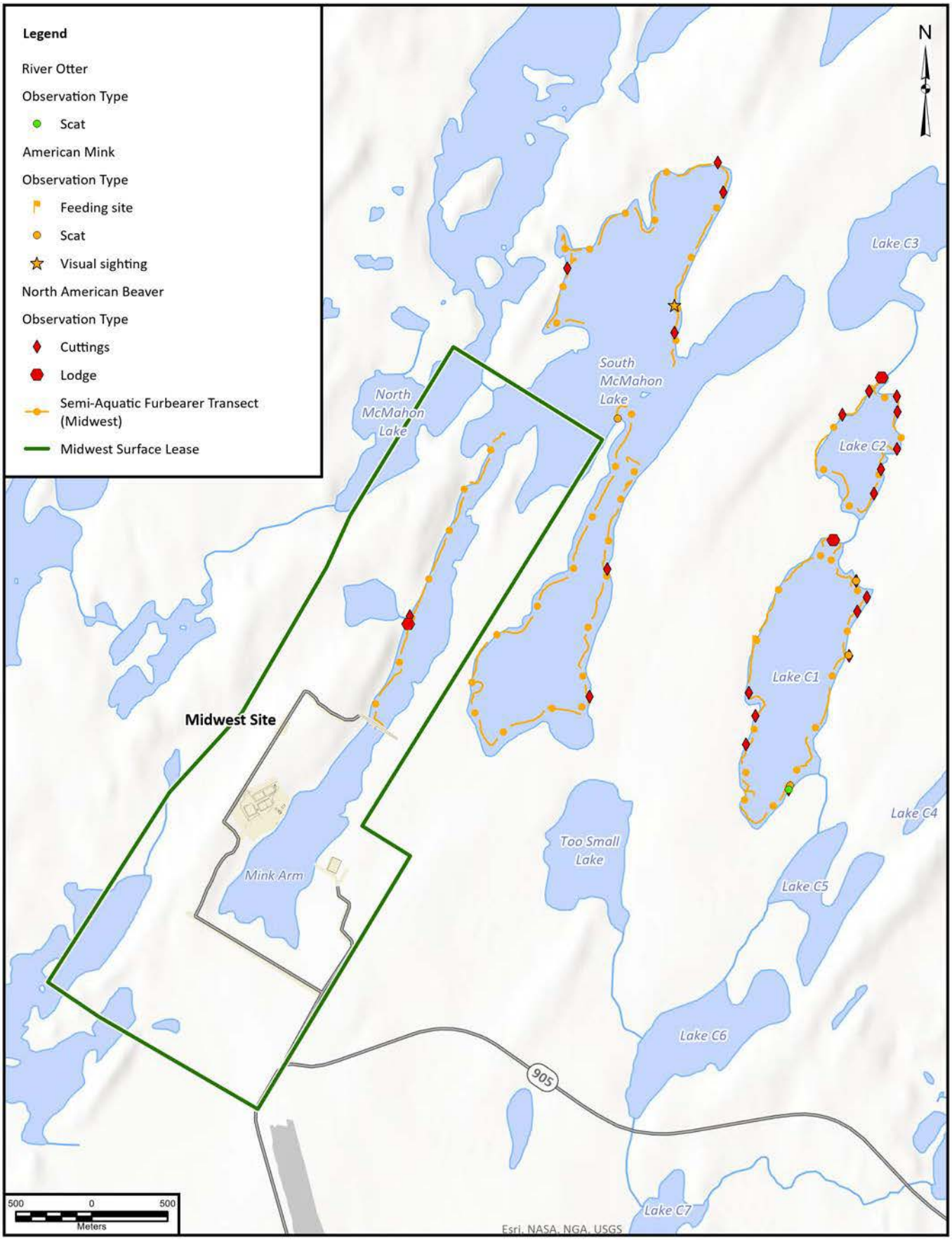
McCLEAN LAKE OPERATION

FIGURE 5.2-7
2024 SEMI-AQUATIC FURBEARER OBSERVATIONS: KONNER LAKE

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-16 11:59 AM Scale: 1:35,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

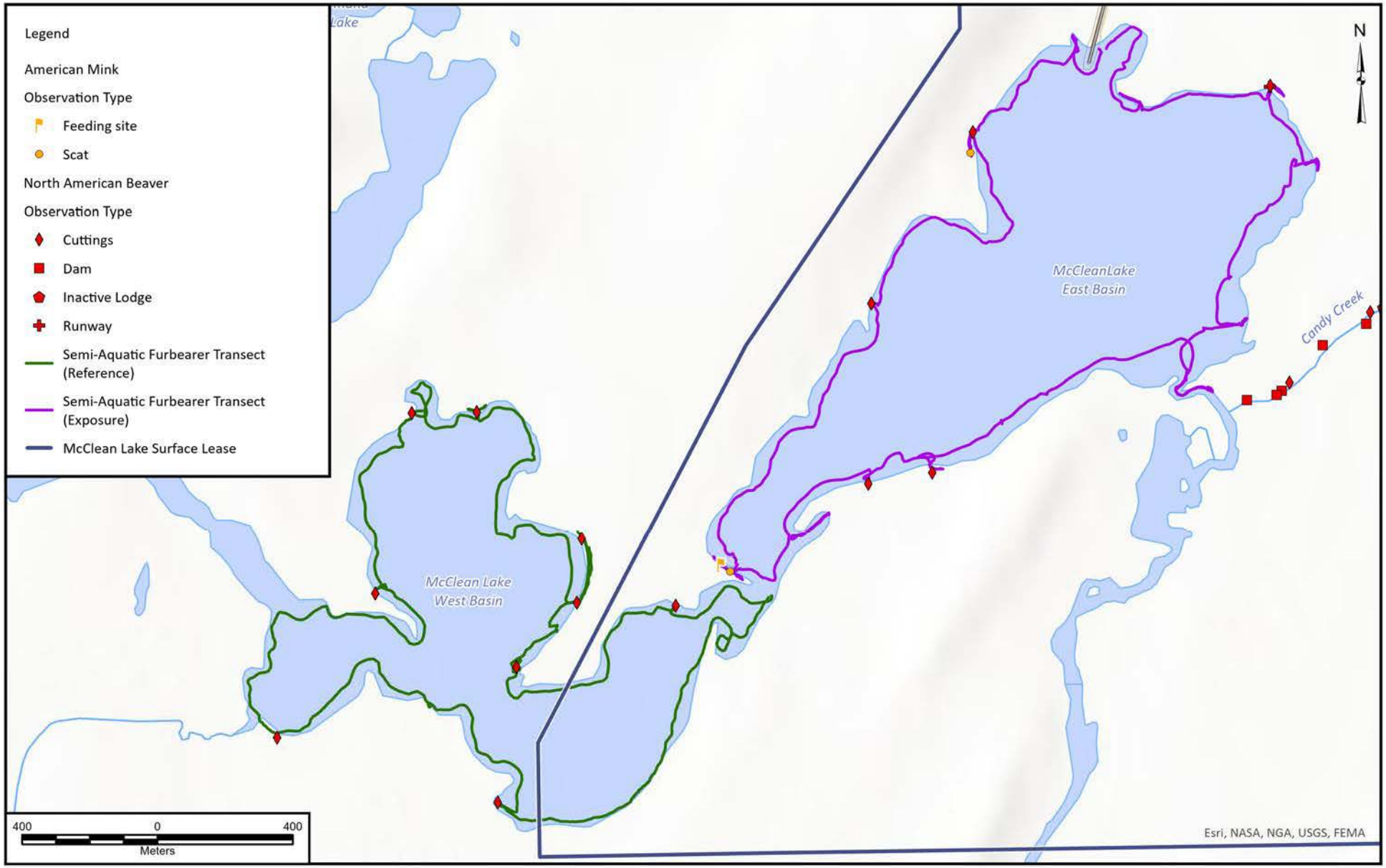
McCLEAN LAKE OPERATION

FIGURE 5.2-8
2024 SEMI-AQUATIC FURBEARER OBSERVATIONS: SOUTH McMAHON LAKE, LAKE C1 AND LAKE C2

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-16 11:59 AM Scale: 1:16,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

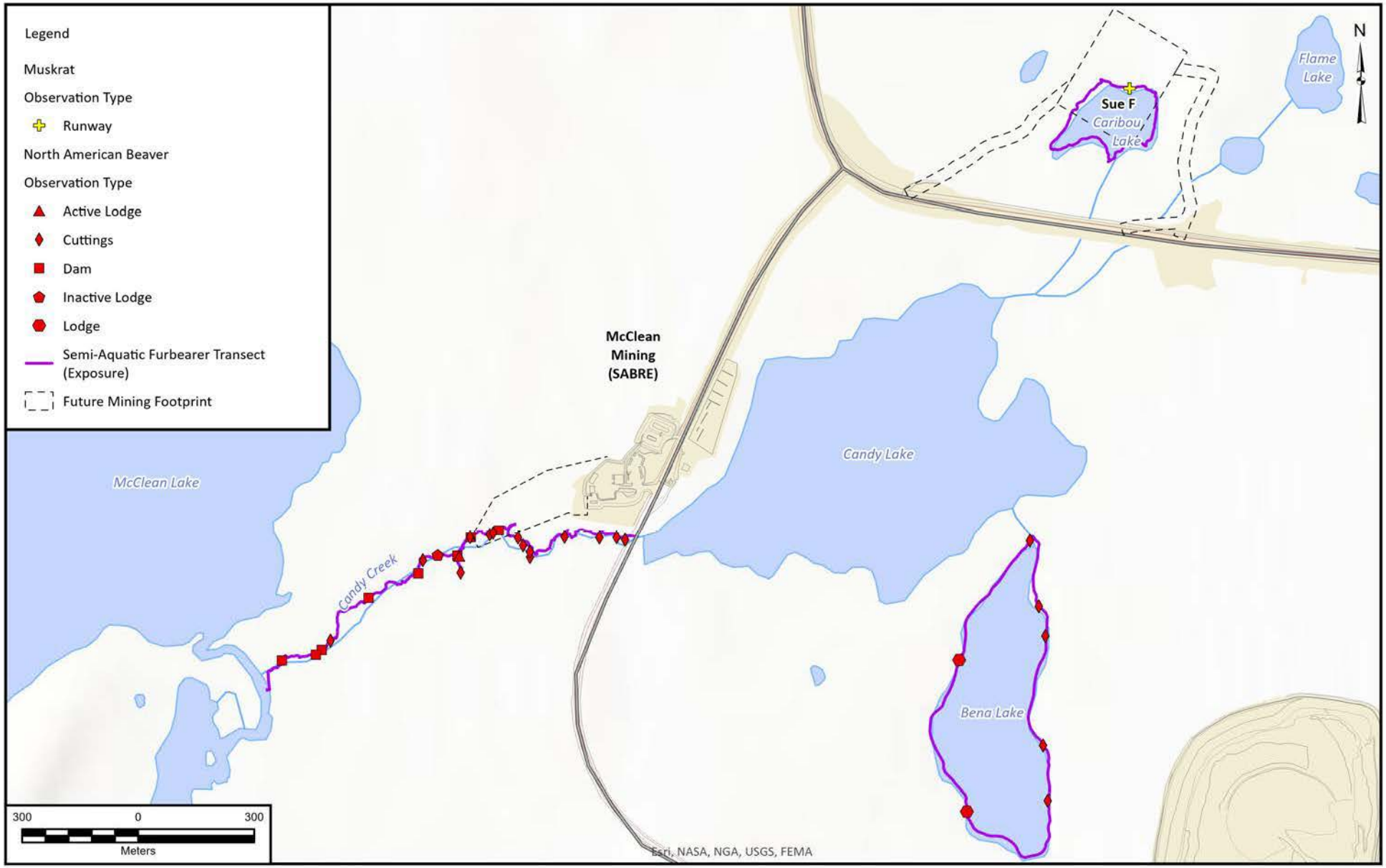
McCLEAN LAKE OPERATION

FIGURE 5.2-9
2024 SEMI-AQUATIC FURBEARER OBSERVATIONS:
McCLEAN LAKE EAST AND WEST BASINS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Compiled: T.Lohman
Drawn: T.Lohman
Date: 2025-12-16 11:59 AM
Scale: 1:14,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

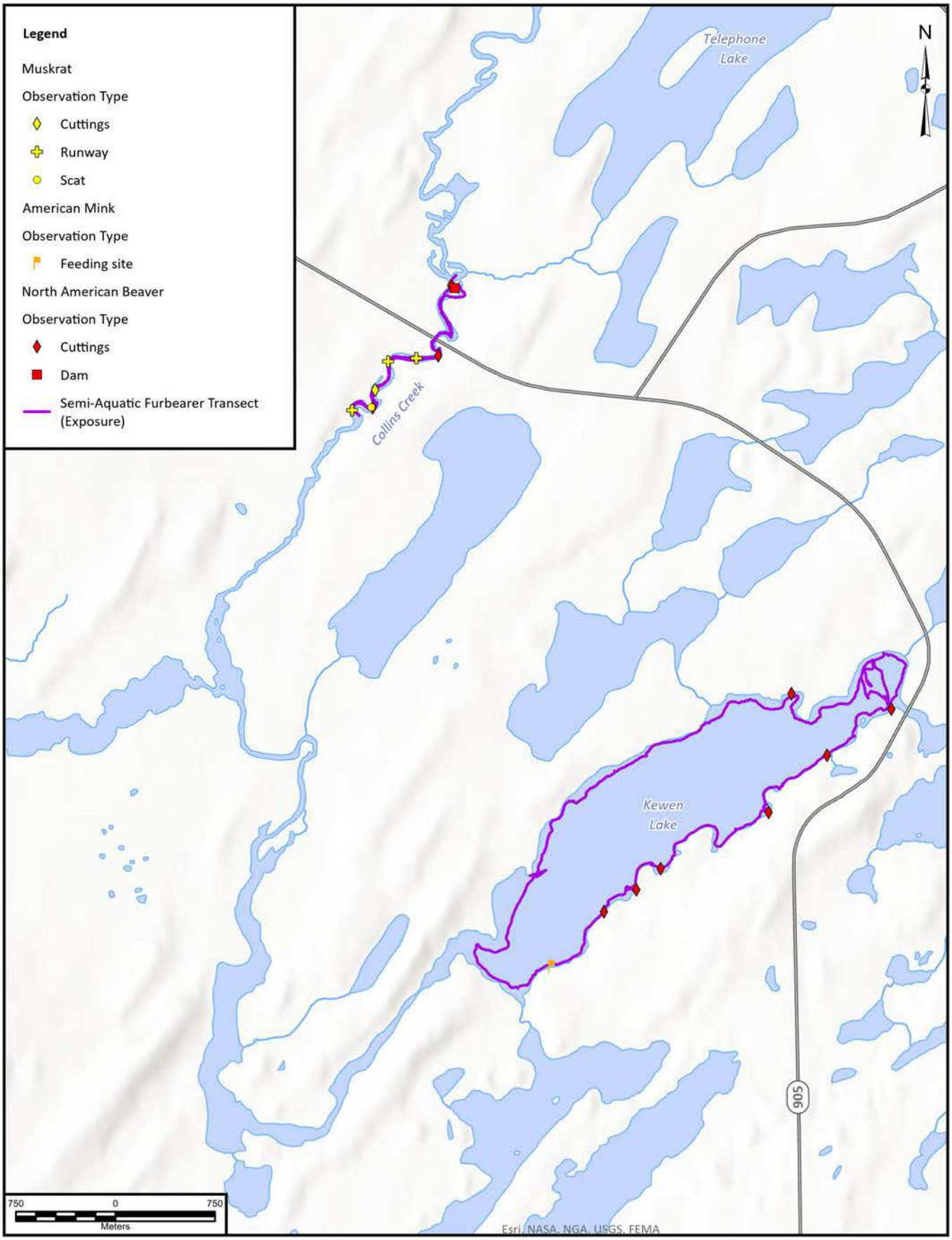
McCLEAN LAKE OPERATION

FIGURE 5.2-10
2024 SEMI-AQUATIC FURBEARER OBSERVATIONS:
CANDY CREEK, BENA LAKE AND CARIBOU LAKE

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



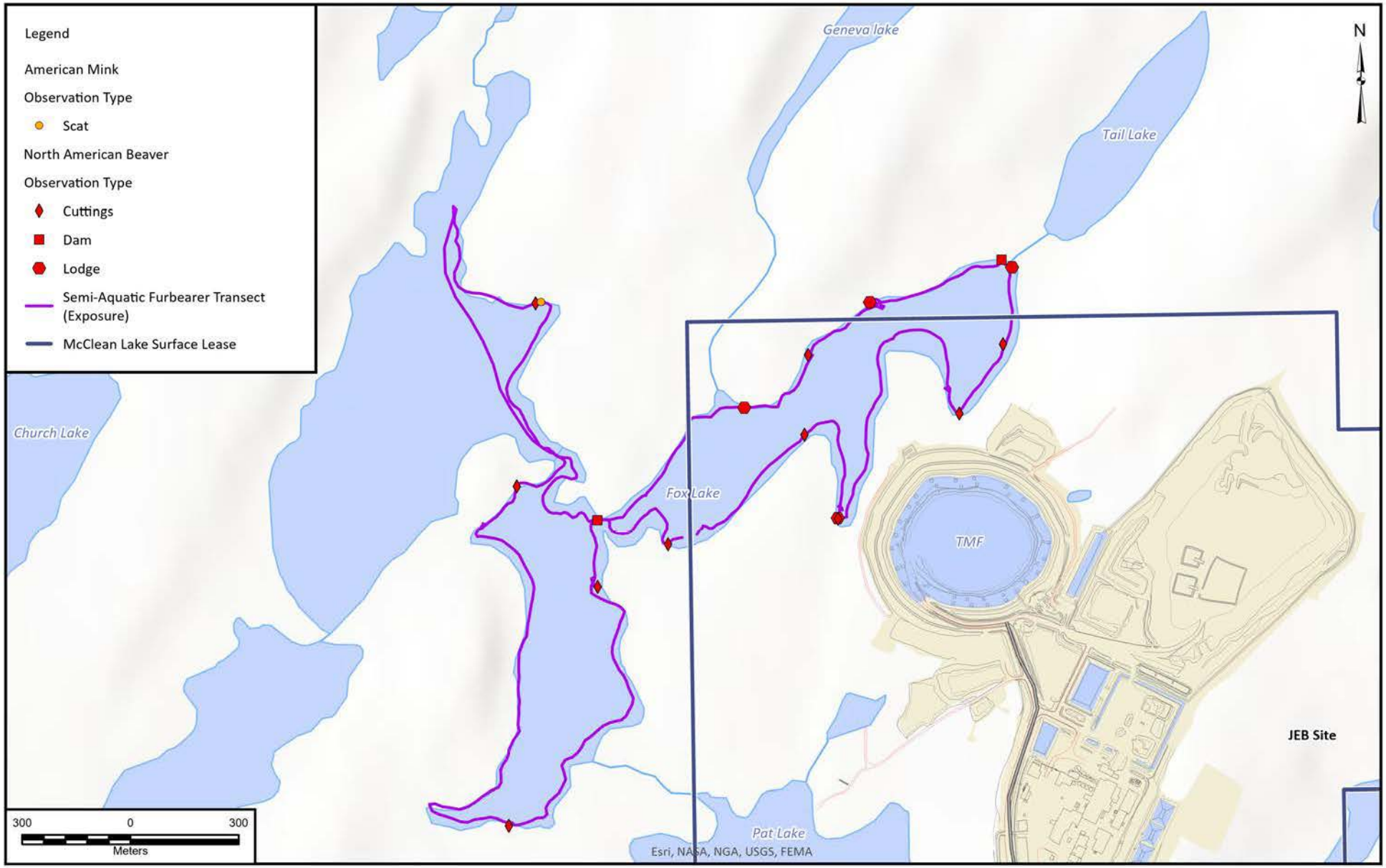
Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-16 11:59 AM Scale: 1:40,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 5.2-11
2024 SEMI-AQUATIC FURBEARER OBSERVATIONS: COLLINS CREEK DOWNSTREAM AND KEWEN LAKE

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-16 11:59 AM Scale: 1:15,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

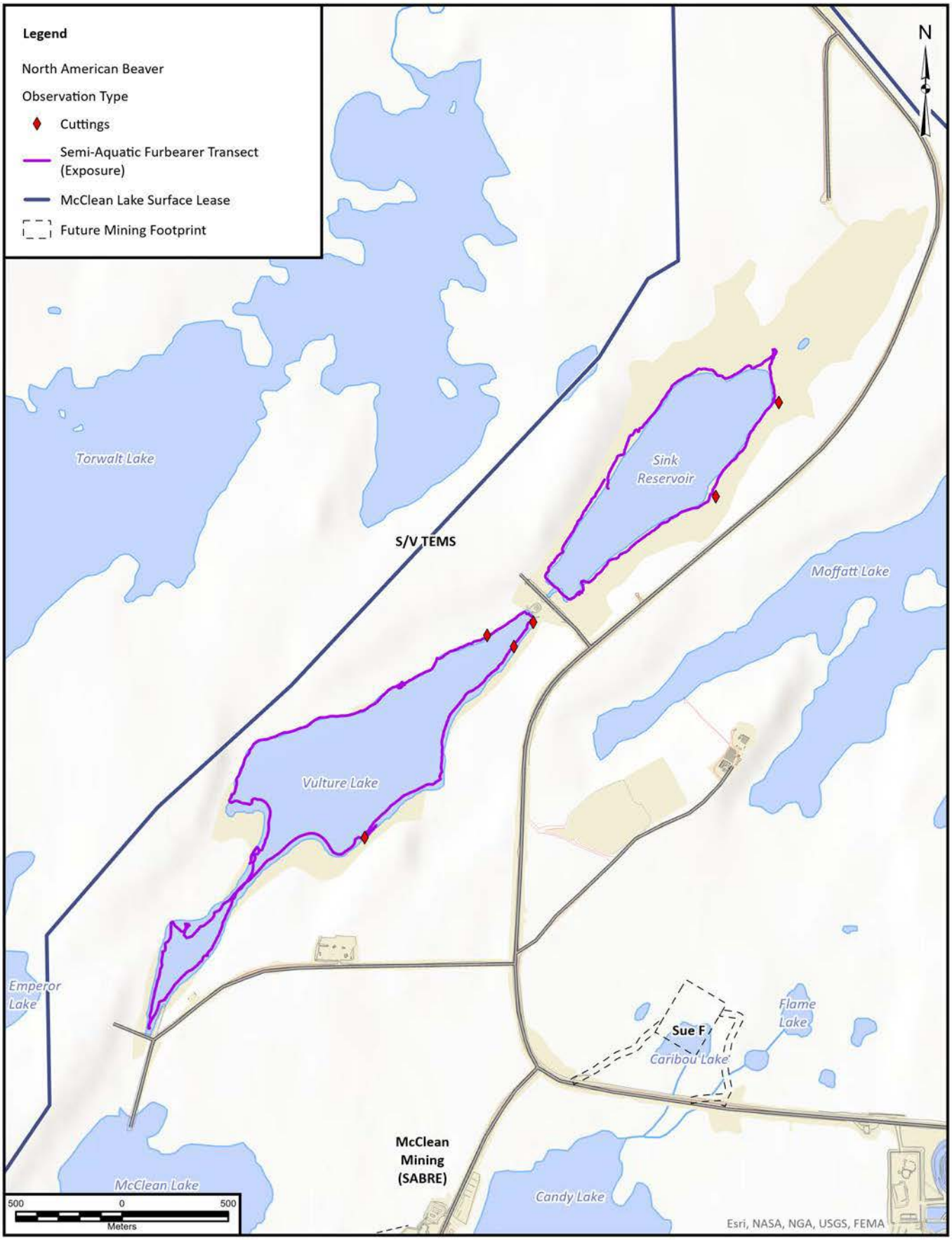
McCLEAN LAKE OPERATION

FIGURE 5.2-12
2024 SEMI-AQUATIC FURBEARER OBSERVATIONS:
FOX LAKE

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-16 4:52 PM Scale: 1:25,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

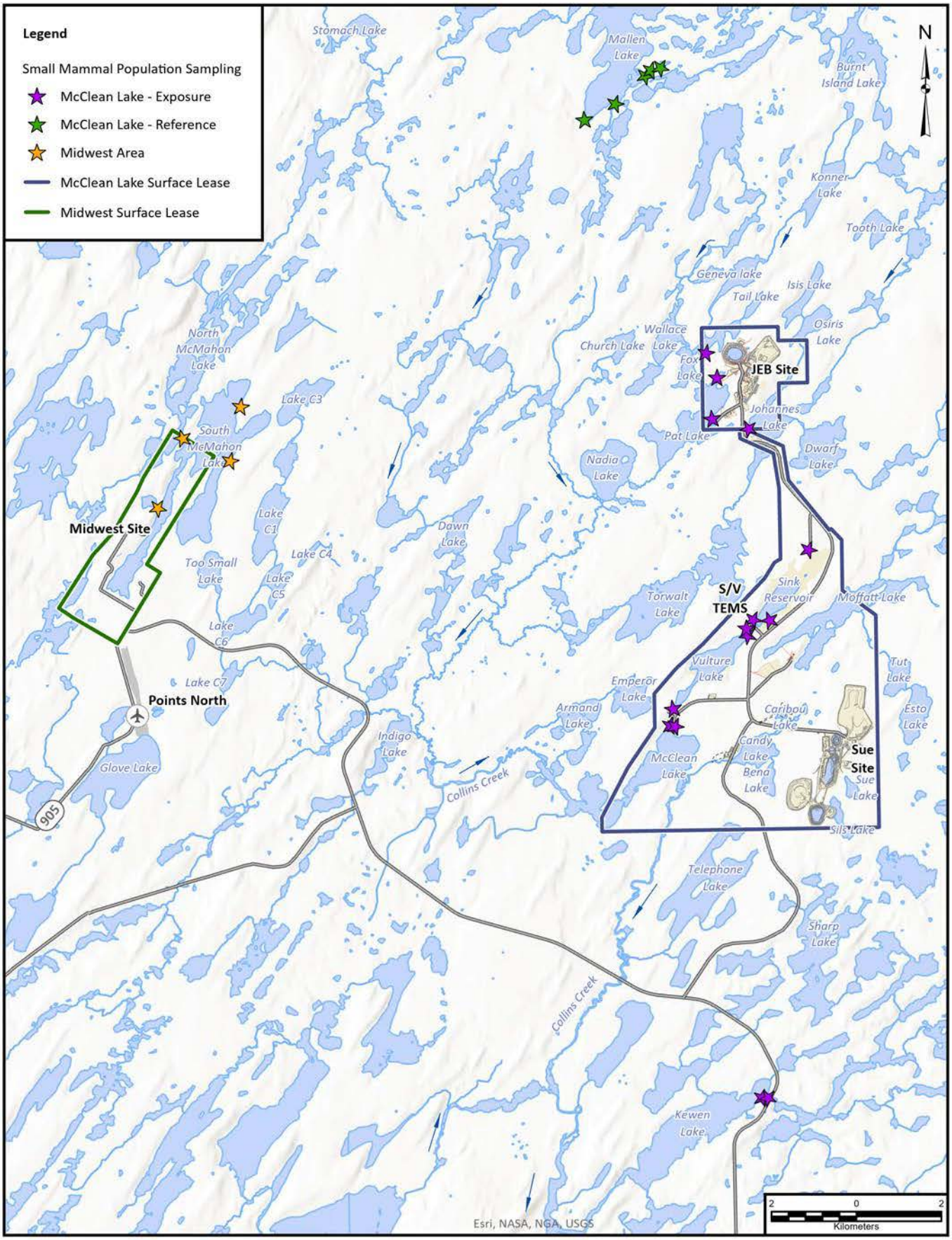
McCLEAN LAKE OPERATION

FIGURE 5.2-13
2024 SEMI-AQUATIC FURBEARER OBSERVATIONS: SINK RESERVOIR AND VULTURE LAKE

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-03 3:08 PM Scale: 1:125,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

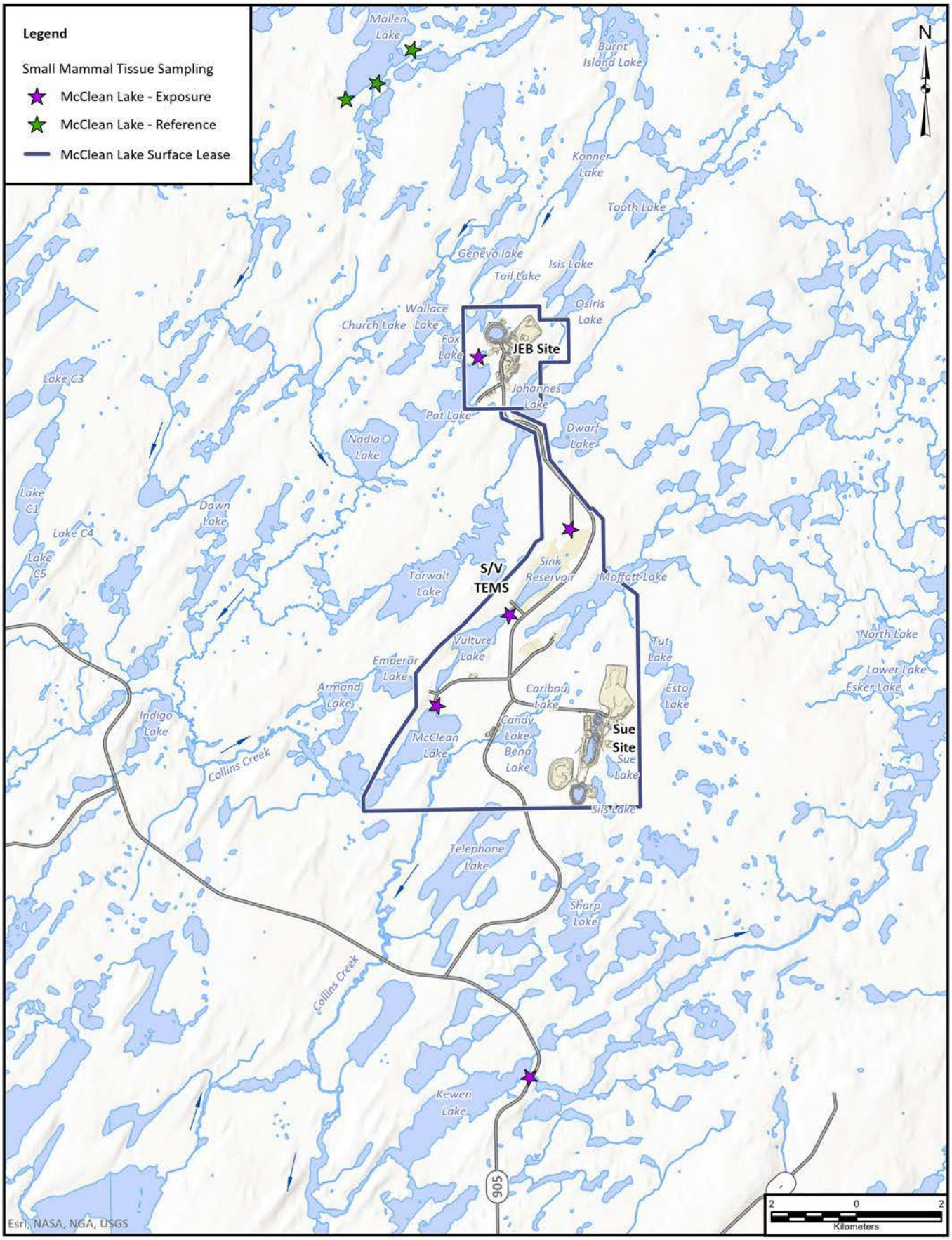
McCLEAN LAKE OPERATION

FIGURE 5.2-14
2024 SMALL MAMMAL POPULATION SURVEY LOCATIONS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-17 8:42 AM Scale: 1:125,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

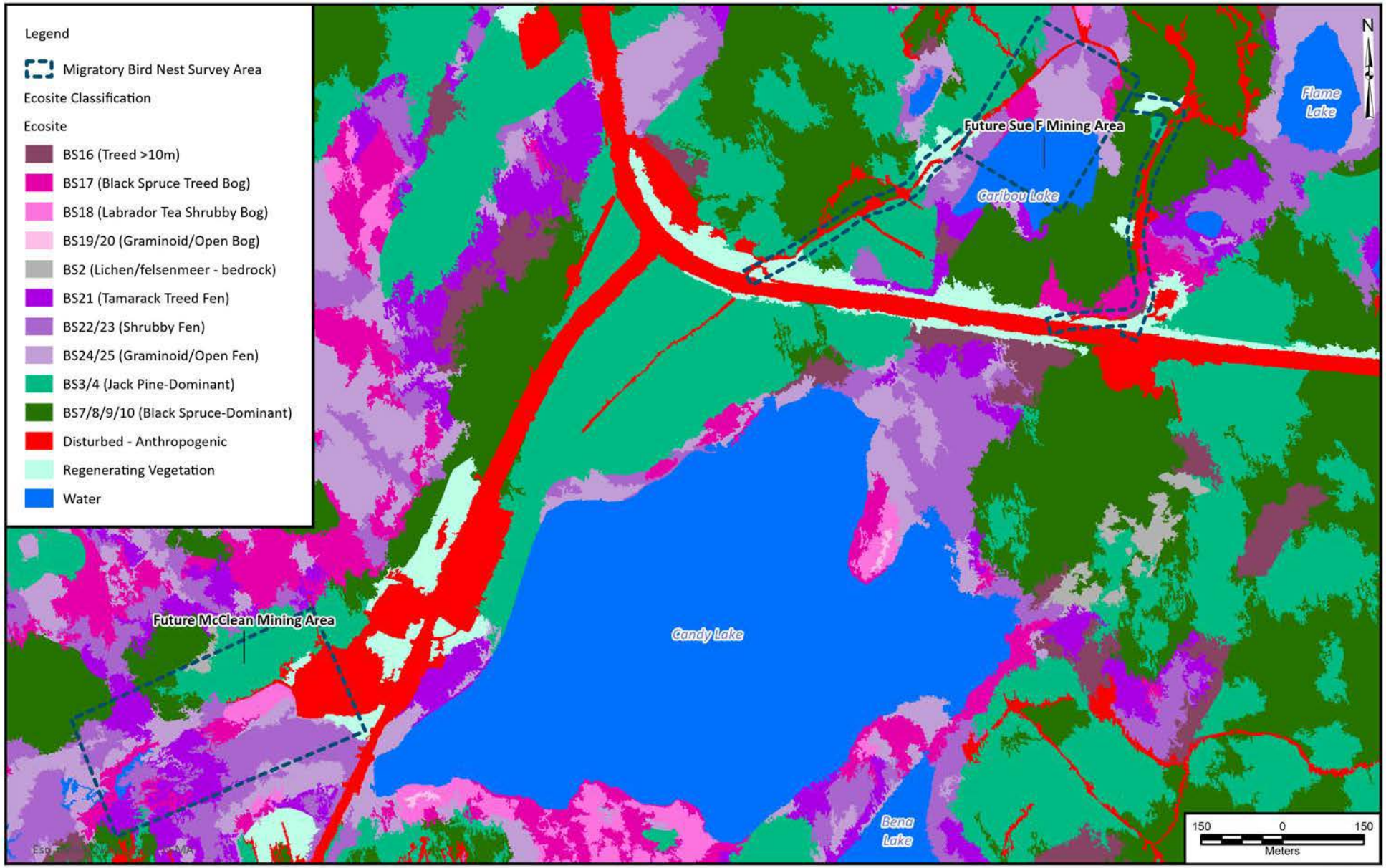
McCLEAN LAKE OPERATION

FIGURE 5.2-15
2024 SMALL MAMMAL TISSUE COLLECTION LOCATIONS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-16 5:09 PM Scale: 1:10,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

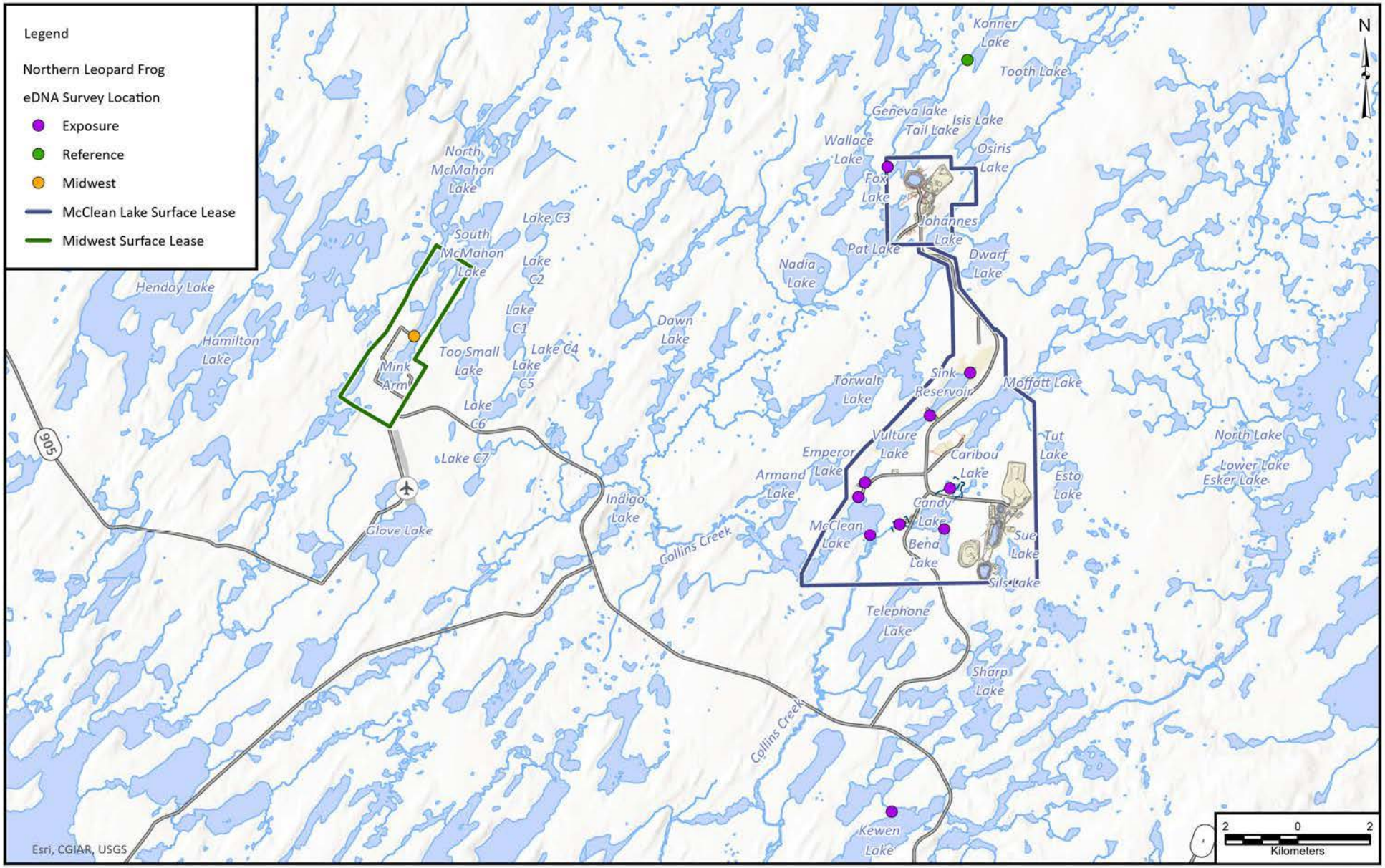
McCLEAN LAKE OPERATION

FIGURE 5.2-16
2024 MIGRATORY BIRD NESTS SURVEY AREA

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Compiled: T.Lohman
Drawn: T.Lohman
Date: 2025-12-17 11:09 AM
Scale: 1:150,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

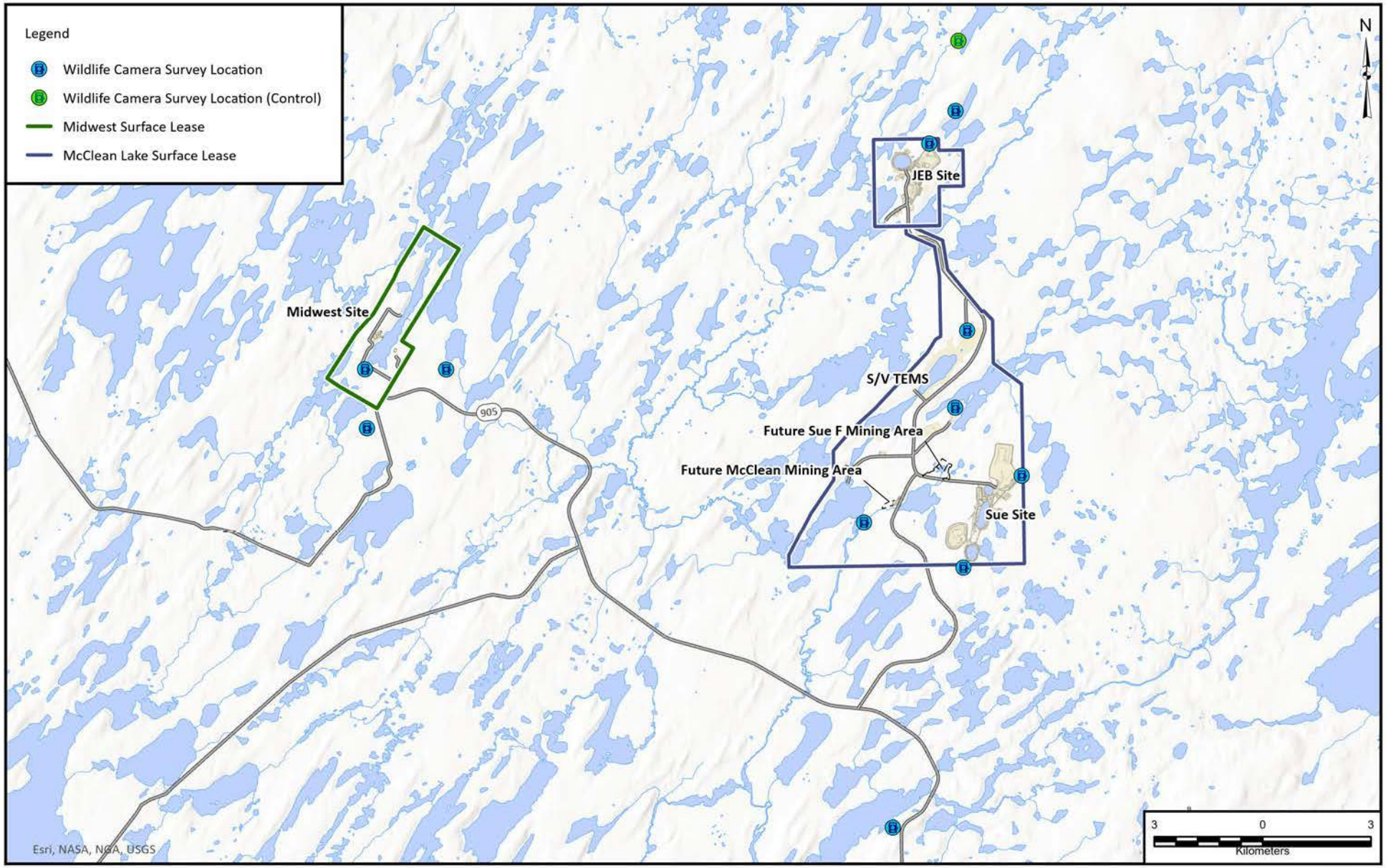
McCLEAN LAKE OPERATION

FIGURE 5.2-17
2024 eDNA SURVEY LOCATIONS FOR NORTHERN LEOPARD FROG

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-08 3:56 PM Scale: 1:150,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

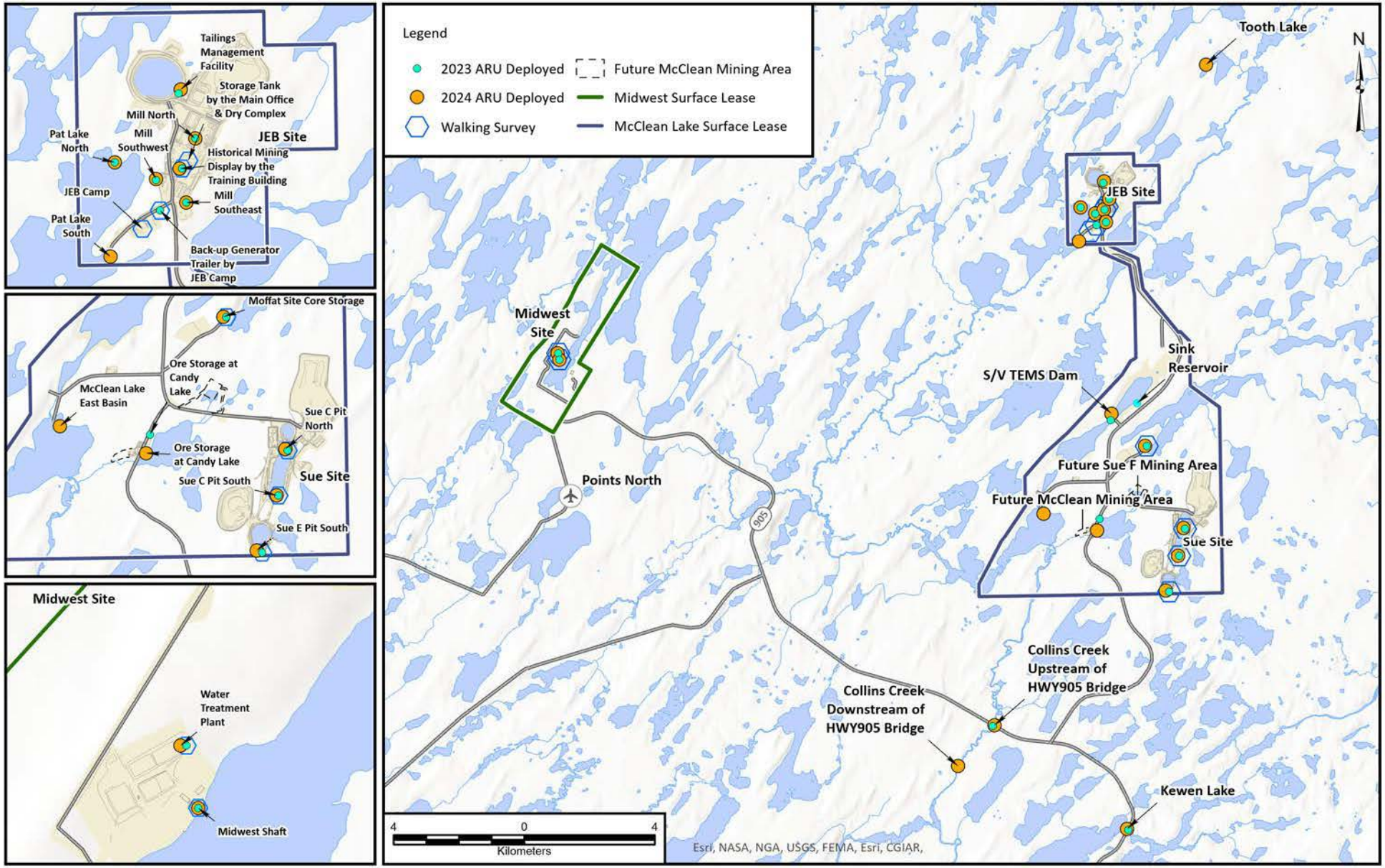
McCLEAN LAKE OPERATION

FIGURE 5.2-18
2024 WILDLIFE CAMERA SURVEY LOCATIONS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Compiled: T.Lohman
Drawn: T.Lohman
Date: 2025-12-12 3:02 PM
Scale: 1:145,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

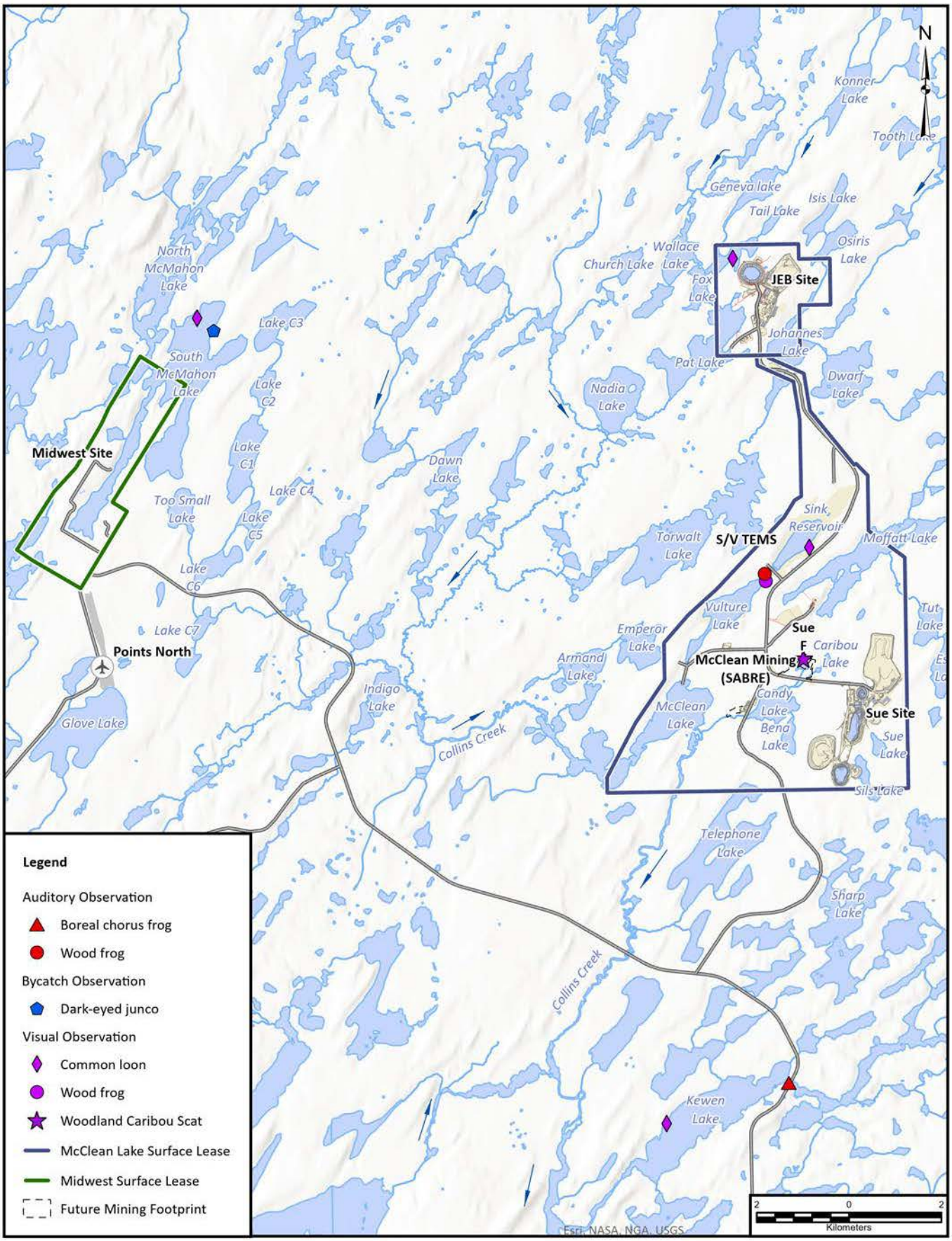
McCLEAN LAKE OPERATION

FIGURE 5.2-19
2023-2024 BAT ACTIVITY SURVEY LOCATIONS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-08 8:20 AM Scale: 1:115,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 5.2-20
2024 SUPPLEMENTARY WILDLIFE OBSERVATIONS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx

Legend

Identified Vascular Rare Plants

- Alaskan clubmoss
- Alpine azalea
- Bog adder's-mouth orchid
- Common butterwort
- English sundew
- Grey-leaf willow
- Hairy butterwort
- Hickey's clubmoss
- Labrador lousewort
- Lake quillwort
- Large-leaved sandwort
- Little yellow-rattle
- Long beech-fern
- Michaux' sedge
- Moor rush
- Mountain club-moss
- Northern bog clubmoss
- Northern lady-fern
- Purple lousewort
- Ribbon-leaf pondweed
- Smooth white violet
- Soft-stem spike-rush
- Water awlwort
- Water lobelia
- Western mountain-ash

Vascular Plant Habitat Suitability Rank

- High
- Moderate
- Low

N

Midwest Site

JEB Site

Points North

Future Sue F Mining Area

Future McClean Mining Area

Sue Site

- Midwest Surface Lease
- McClean Lake Surface Lease
- Local Assessment Boundary (LAB)
- Future McClean Mining Area
- Cloud
- Lake

Esri, NASA, NGA, USGS, Esri, CGIAR, USGS

3 0 3
Kilometers

Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-12 4:15 PM Scale: 1:150,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

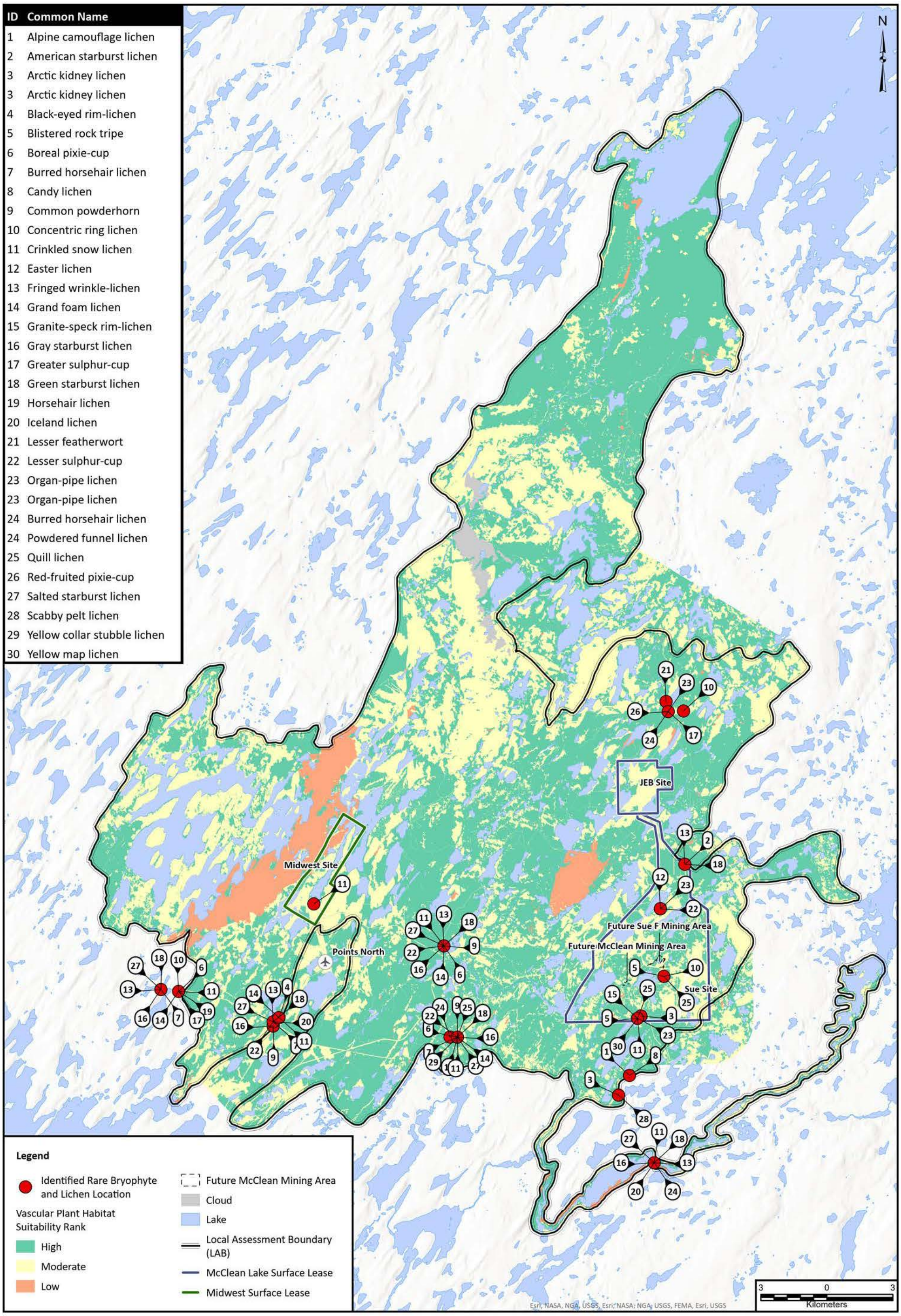
FIGURE 5.3-1
LOCATIONS OF PROVINCIALLY TRACKED
RARE VASCULAR PLANT SPECIES

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx

ID	Common Name
1	Alpine camouflage lichen
2	American starburst lichen
3	Arctic kidney lichen
3	Arctic kidney lichen
4	Black-eyed rim-lichen
5	Blistered rock tripe
6	Boreal pixie-cup
7	Burred horsehair lichen
8	Candy lichen
9	Common powderhorn
10	Concentric ring lichen
11	Crinkled snow lichen
12	Easter lichen
13	Fringed wrinkle-lichen
14	Grand foam lichen
15	Granite-speck rim-lichen
16	Gray starburst lichen
17	Greater sulphur-cup
18	Green starburst lichen
19	Horsehair lichen
20	Iceland lichen
21	Lesser featherwort
22	Lesser sulphur-cup
23	Organ-pipe lichen
23	Organ-pipe lichen
24	Burred horsehair lichen
24	Powdered funnel lichen
25	Quill lichen
26	Red-fruited pixie-cup
27	Salted starburst lichen
28	Scabby pelt lichen
29	Yellow collar stubble lichen
30	Yellow map lichen



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-12-12 4:15 PM Scale: 1:160,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

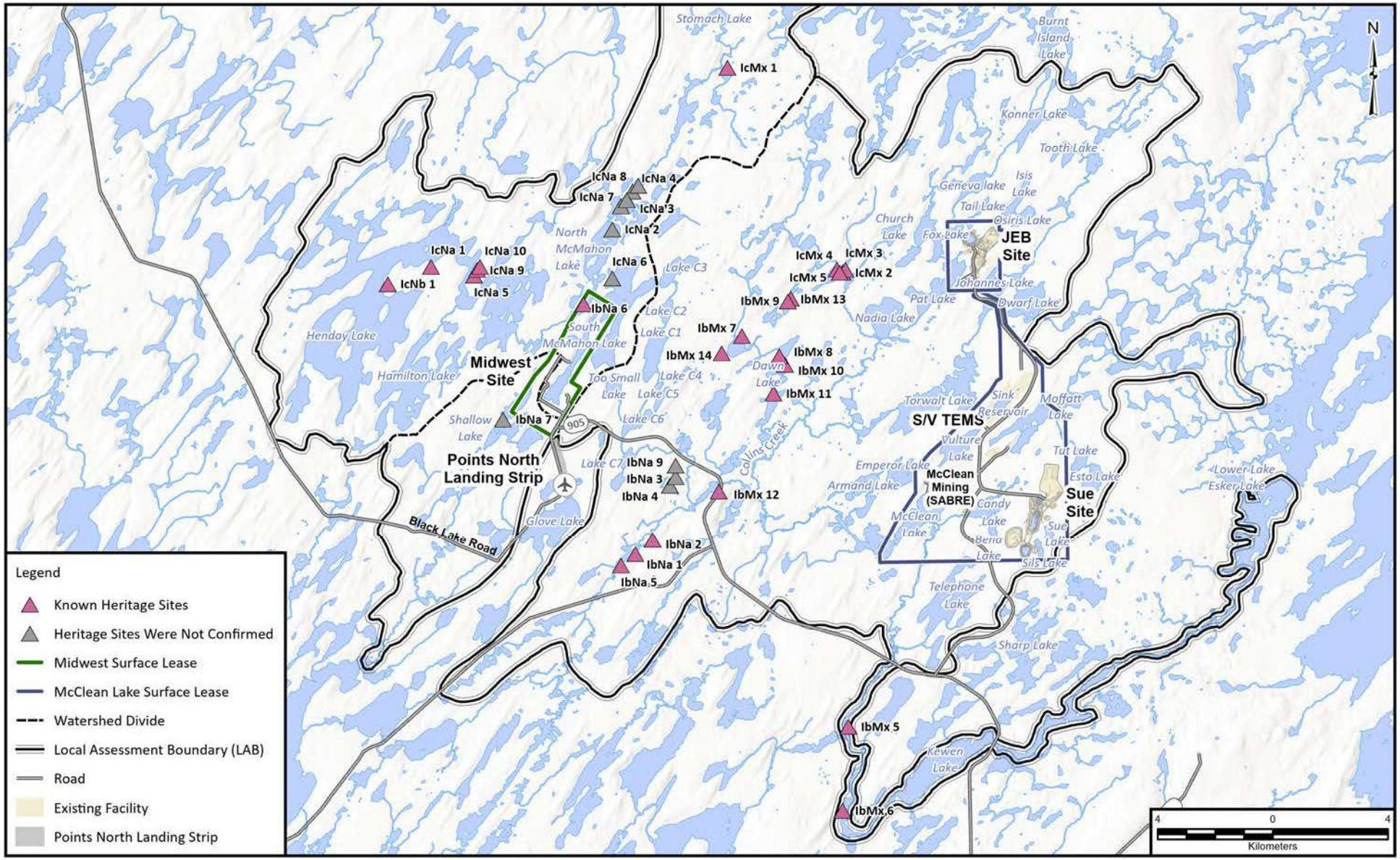
McCLEAN LAKE OPERATION

FIGURE 5.3-2
LOCATIONS OF PROVICIALLY TRACKED
RARE BRYOPHYTES AND LICHEN SPECIES

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 5.aprx



Projection: NAD 1983 UTM Zone 13N
Drawn: TL
Date:2025-11-12 Scale: 1:190,000
Data Sources: *Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.*

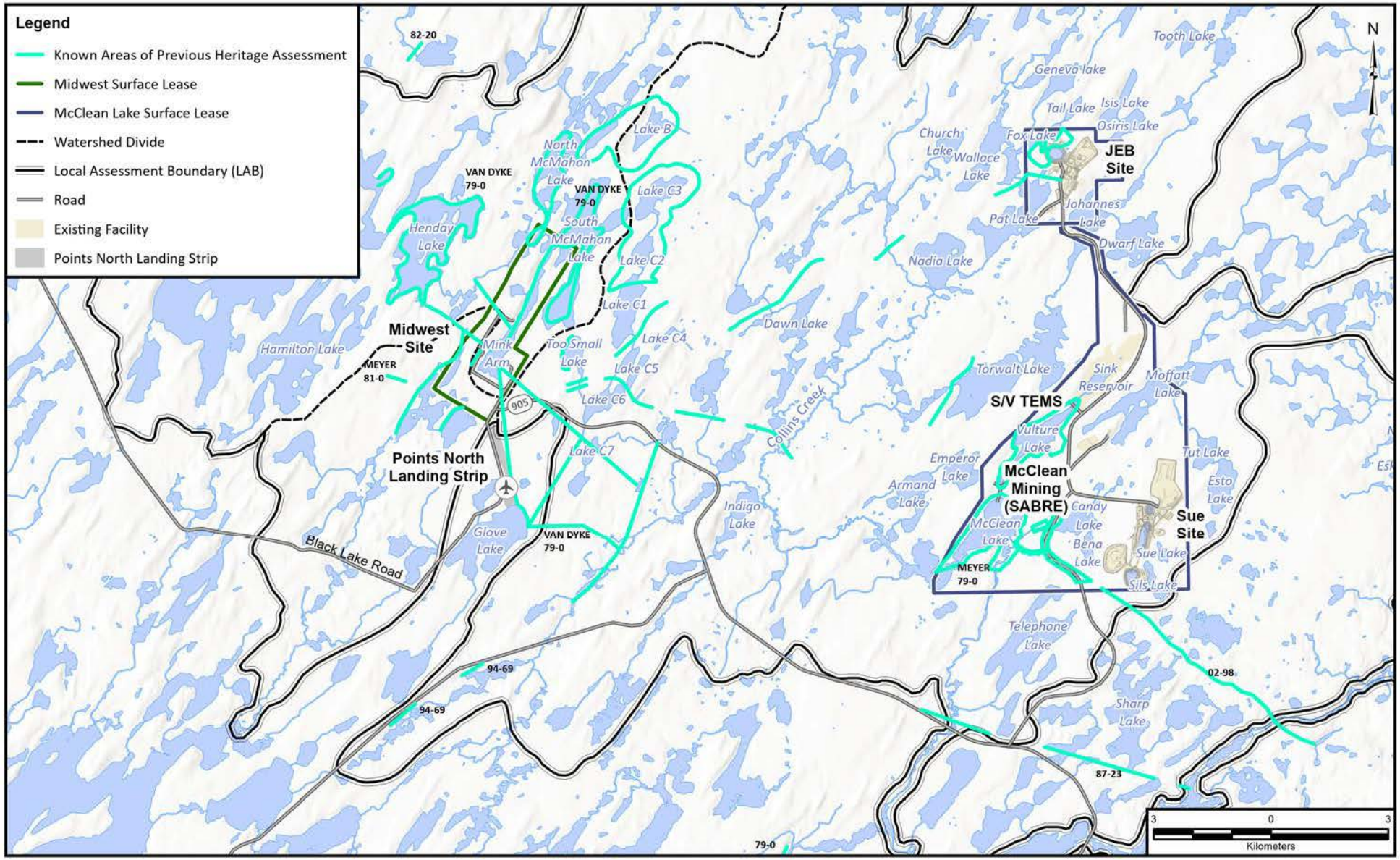
McCLEAN LAKE OPERATION

FIGURE 6.3-1
KNOWN HERITAGE SITES WITHIN THE LOCAL ASSESSMENT BOUNDARY

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 6\EPTID Section 6.aprx



Projection: NAD 1983 UTM Zone 13N
Drawn: TL
Date:2025-11-12 Scale: 1:140,000
Data Sources: *Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.*

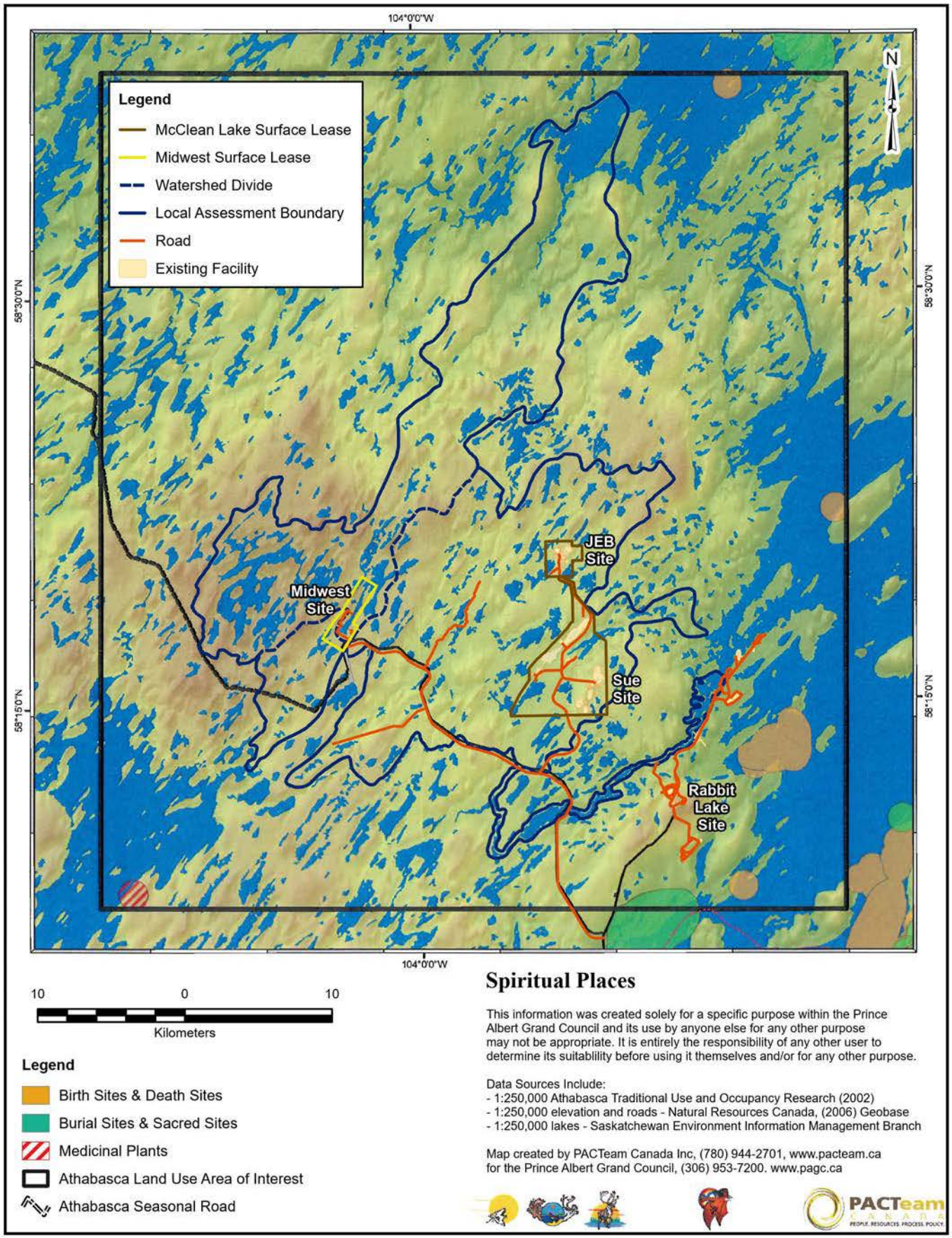
McCLEAN LAKE OPERATION

FIGURE 6.3-2
KNOWN AREAS OF PREVIOUS HERITAGE ASSESSMENTS
IN THE VICINITY OF THE McCLEAN LAKE OPERATION
AND MIDWEST SURFACE LEASE AREAS

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 6\EPTID Section 6.aprx



Spiritual Places

This information was created solely for a specific purpose within the Prince Albert Grand Council and its use by anyone else for any other purpose may not be appropriate. It is entirely the responsibility of any other user to determine its suitablility before using it themselves and/or for any other purpose.

Data Sources Include:
- 1:250,000 Athabasca Traditional Use and Occupancy Research (2002)
- 1:250,000 elevation and roads - Natural Resources Canada, (2006) Geobase
- 1:250,000 lakes - Saskatchewan Environment Information Management Branch

Map created by PACTeam Canada Inc, (780) 944-2701, www.pacteam.ca
for the Prince Albert Grand Council, (306) 953-7200. www.pagc.ca

Legend

- Birth Sites & Death Sites
- Burial Sites & Sacred Sites
- Medicinal Plants
- Athabasca Land Use Area of Interest
- Athabasca Seasonal Road

Projection: NAD 1983 UTM Zone 13N
Drawn: TL
Date: 2025-07-31 Scale: 1:360,000
Data Sources: *See Map*

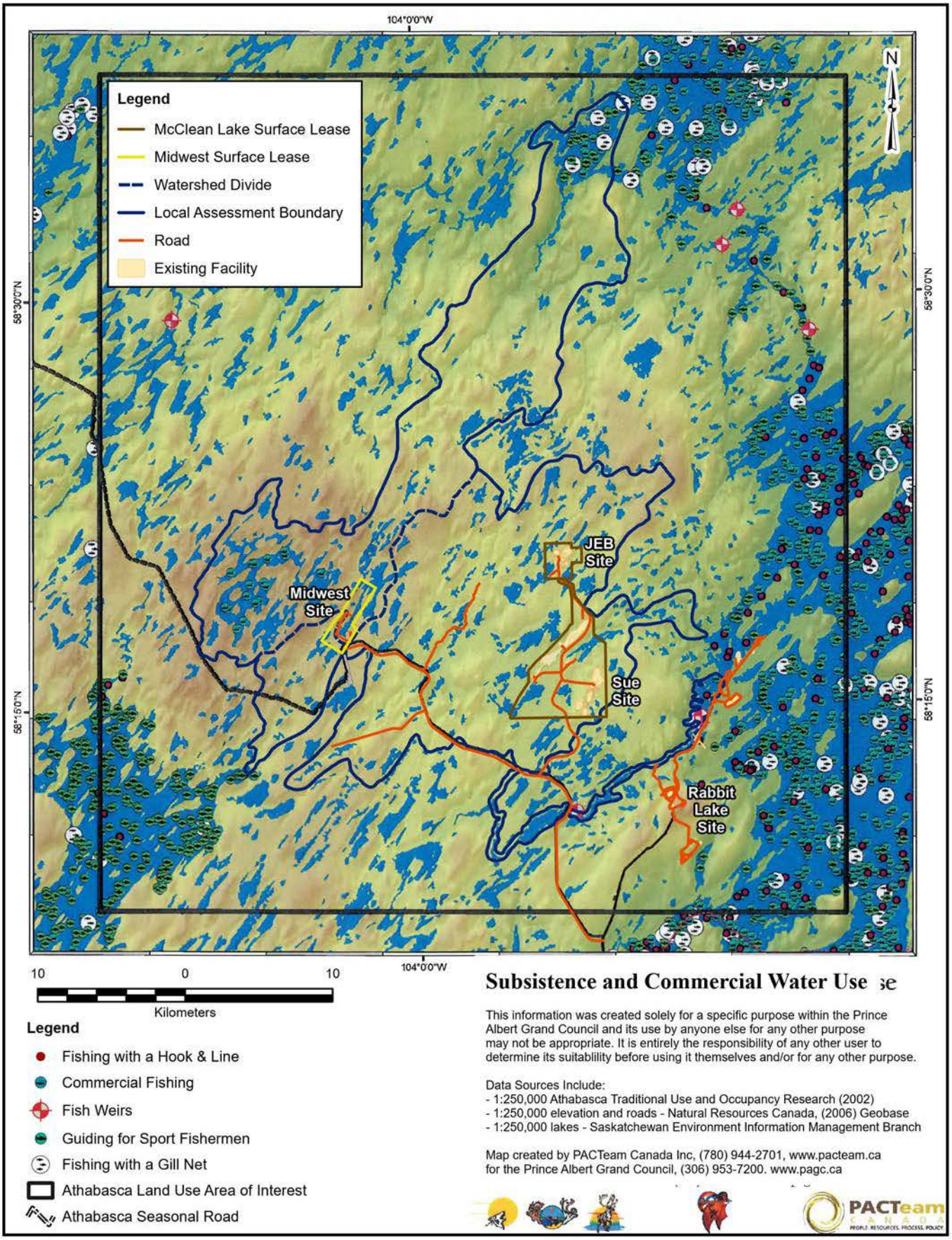
McCLEAN LAKE OPERATION

FIGURE 6.4-1
LOCATION OF SPIRITUAL PLACES
WITHIN THE AREA OF INTEREST

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 6\EPTID Section 6_temp.aprx



Legend

- Fishing with a Hook & Line
- Commercial Fishing
- Fish Weirs
- Guiding for Sport Fishermen
- Fishing with a Gill Net
- Athabasca Land Use Area of Interest
- Athabasca Seasonal Road

Subsistence and Commercial Water Use se

This information was created solely for a specific purpose within the Prince Albert Grand Council and its use by anyone else for any other purpose may not be appropriate. It is entirely the responsibility of any other user to determine its suitablility before using it themselves and/or for any other purpose.

Data Sources Include:
- 1:250,000 Athabasca Traditional Use and Occupancy Research (2002)
- 1:250,000 elevation and roads - Natural Resources Canada, (2006) Geobase
- 1:250,000 lakes - Saskatchewan Environment Information Management Branch

Map created by PACTeam Canada Inc, (780) 944-2701, www.pacteam.ca
for the Prince Albert Grand Council, (306) 953-7200. www.pagc.ca

PACTeam CANADA
PEOPLE. RESOURCES. PROCESS. POLICY

Projection: NAD 1983 UTM Zone 13N
Drawn: TL
Date: 2025-07-31 Scale: 1:360,000
Data Sources: *See Map*

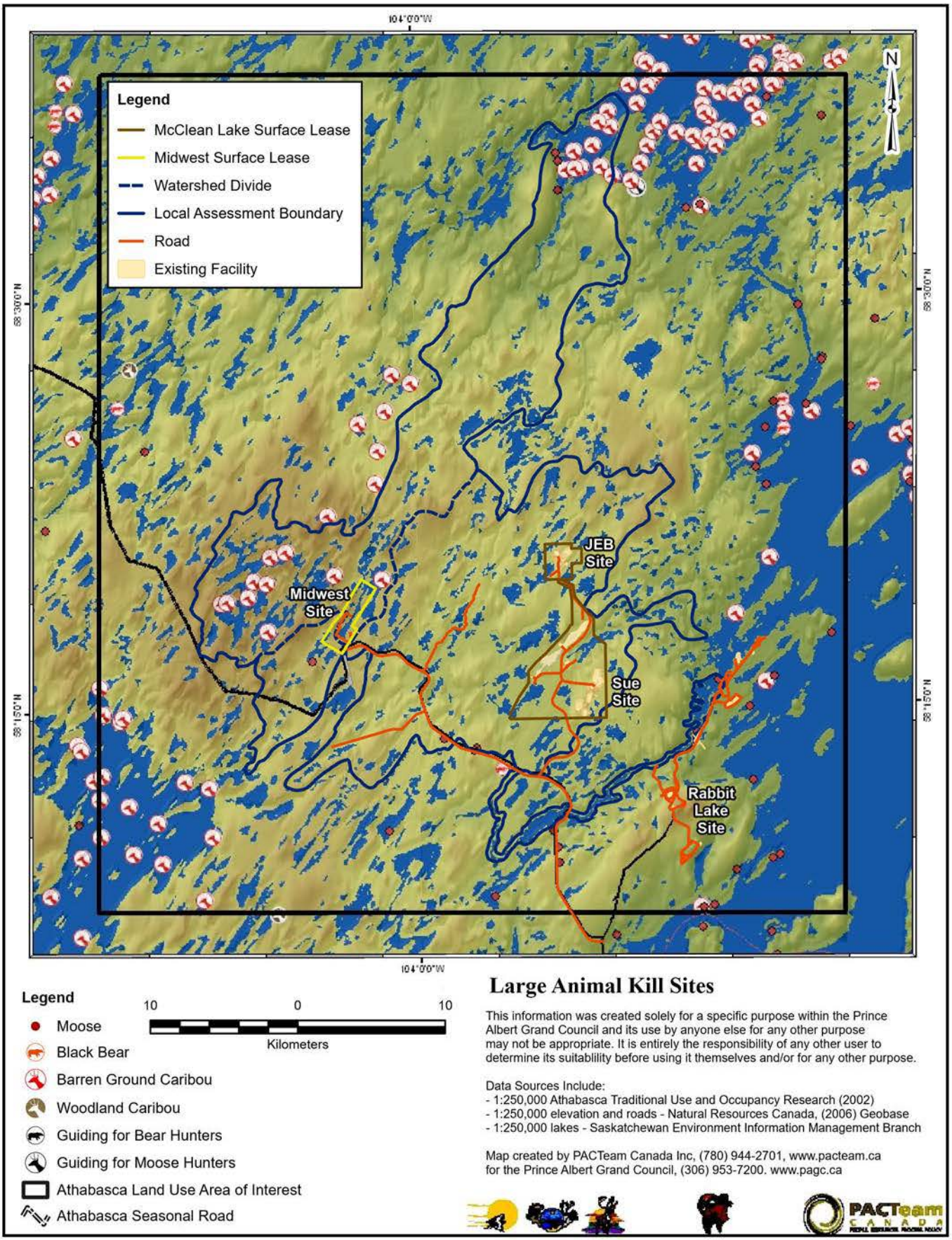
McCLEAN LAKE OPERATION

FIGURE 6.4-2
LOCATION OF SUBSISTENCE AND COMMERCIAL WATER USE WITHIN THE AREA OF INTEREST

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 6\EPTID Section 6_temp.aprx



Legend

- Moose
- Black Bear
- Barren Ground Caribou
- Woodland Caribou
- Guiding for Bear Hunters
- Guiding for Moose Hunters
- Athabasca Land Use Area of Interest
- Athabasca Seasonal Road

10 0 10

Kilometers

Large Animal Kill Sites

This information was created solely for a specific purpose within the Prince Albert Grand Council and its use by anyone else for any other purpose may not be appropriate. It is entirely the responsibility of any other user to determine its suitablility before using it themselves and/or for any other purpose.

Data Sources Include:
- 1:250,000 Athabasca Traditional Use and Occupancy Research (2002)
- 1:250,000 elevation and roads - Natural Resources Canada, (2006) Geobase
- 1:250,000 lakes - Saskatchewan Environment Information Management Branch

Map created by PACTeam Canada Inc, (780) 944-2701, www.pacteam.ca
for the Prince Albert Grand Council, (306) 953-7200. www.pagc.ca

Projection: NAD 1983 UTM Zone 13N
Drawn: TL
Date: 2025-07-31 Scale: 1:360,000
Data Sources: *See Map*

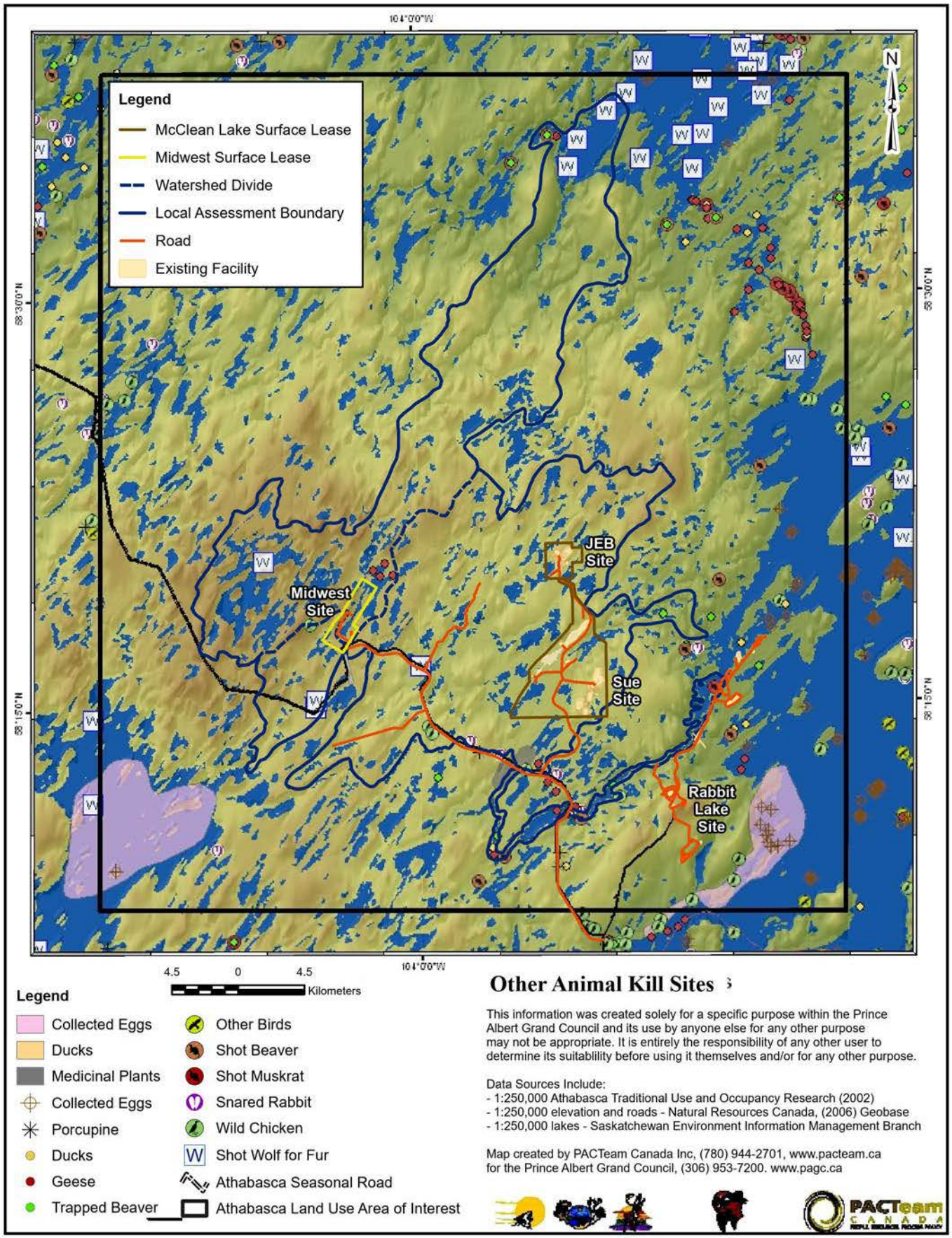
McCLEAN LAKE OPERATION

FIGURE 6.4-3
LOCATION OF LARGE ANIMAL KILL SITES
WITHIN THE AREA OF INTEREST

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 6\EPTID Section 6_temp.aprx



Other Animal Kill Sites

This information was created solely for a specific purpose within the Prince Albert Grand Council and its use by anyone else for any other purpose may not be appropriate. It is entirely the responsibility of any other user to determine its suitablility before using it themselves and/or for any other purpose.

Data Sources Include:
- 1:250,000 Athabasca Traditional Use and Occupancy Research (2002)
- 1:250,000 elevation and roads - Natural Resources Canada, (2006) Geobase
- 1:250,000 lakes - Saskatchewan Environment Information Management Branch

Map created by PACTeam Canada Inc, (780) 944-2701, www.pacteam.ca
for the Prince Albert Grand Council, (306) 953-7200. www.pagc.ca

Projection: NAD 1983 UTM Zone 13N
Drawn: TL
Date: 2025-11-10 Scale: 1:360,000
Data Sources: *See Map*

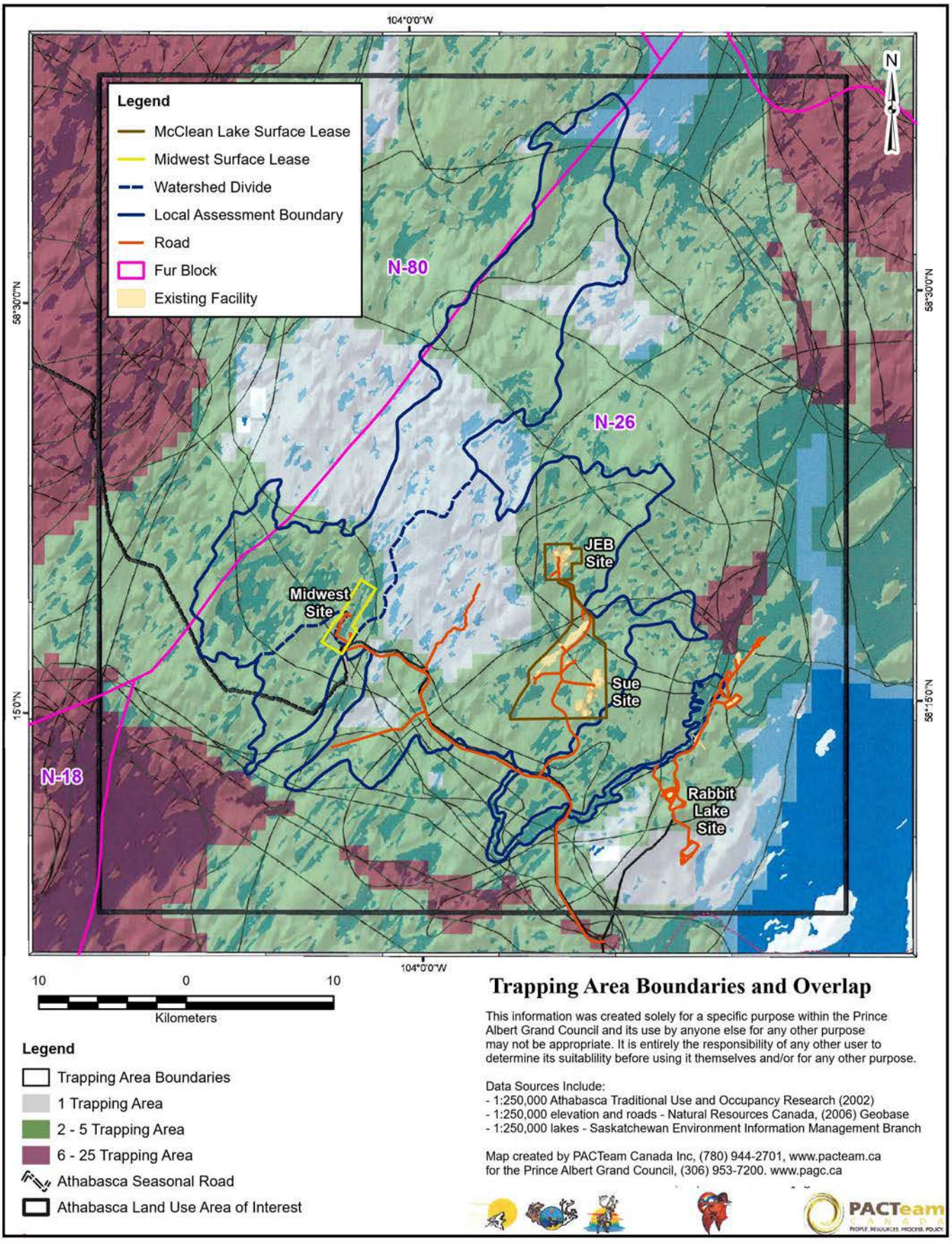
McCLEAN LAKE OPERATION

FIGURE 6.4-4
LOCATION OF OTHER ANIMAL HARVEST SITES WITHIN THE AREA OF INTEREST

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 6\EPTID Section 6.aprx



Trapping Area Boundaries and Overlap

Legend

- Trapping Area Boundaries
- 1 Trapping Area
- 2 - 5 Trapping Area
- 6 - 25 Trapping Area
- Athabasca Seasonal Road
- Athabasca Land Use Area of Interest

This information was created solely for a specific purpose within the Prince Albert Grand Council and its use by anyone else for any other purpose may not be appropriate. It is entirely the responsibility of any other user to determine its suitablility before using it themselves and/or for any other purpose.

Data Sources Include:
- 1:250,000 Athabasca Traditional Use and Occupancy Research (2002)
- 1:250,000 elevation and roads - Natural Resources Canada, (2006) Geobase
- 1:250,000 lakes - Saskatchewan Environment Information Management Branch

Map created by PACTeam Canada Inc, (780) 944-2701, www.pacteam.ca
for the Prince Albert Grand Council, (306) 953-7200. www.pagc.ca

Projection: NAD 1983 UTM Zone 13N
Drawn: TL
Date: 2025-07-31 Scale: 1:360,000
Data Sources: *See Map*

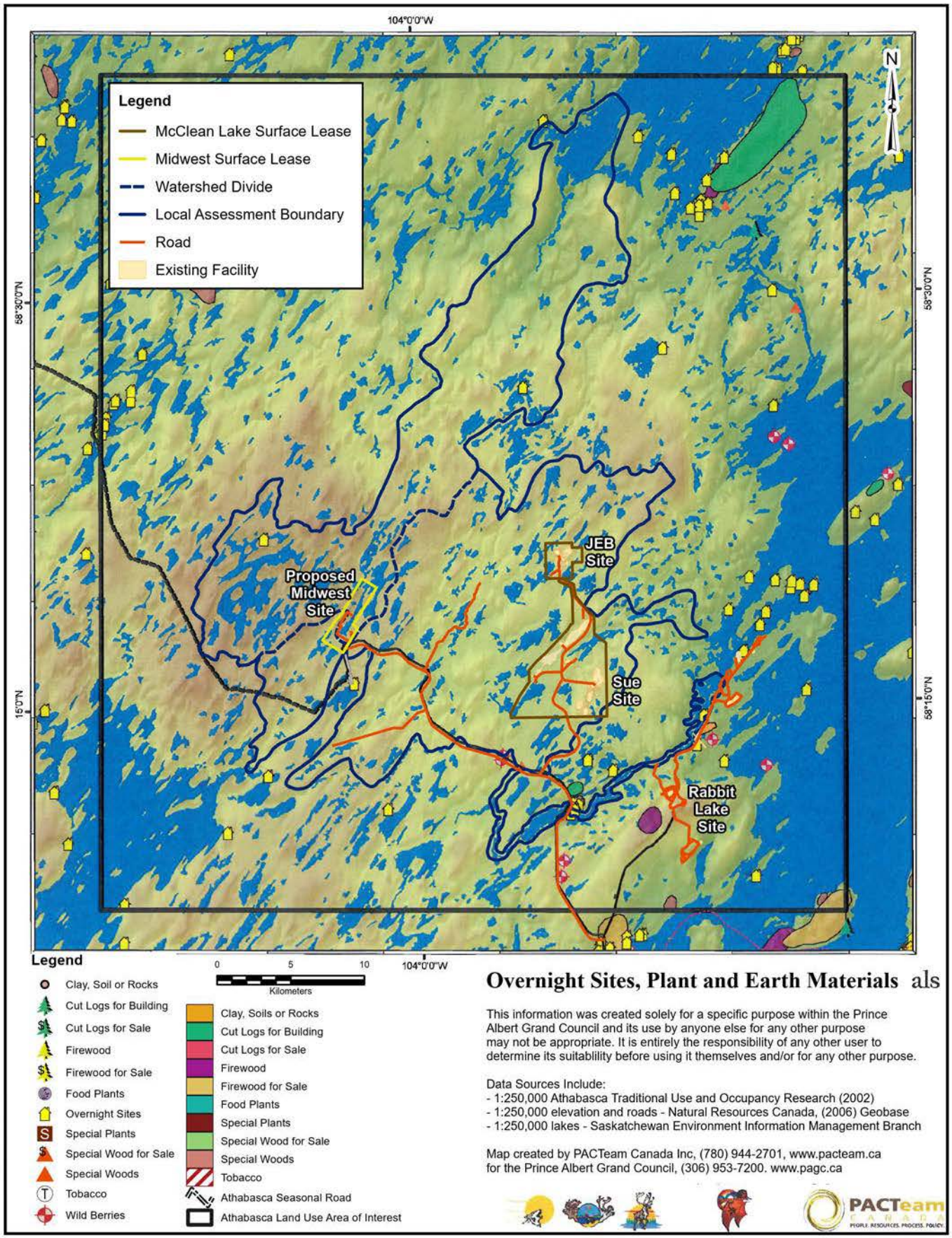
McCLEAN LAKE OPERATION

FIGURE 6.4-5
TRAPPING DENSITY WITHIN
THE AREA OF INTEREST

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 6\EPTID Section 6_temp.aprx



Overnight Sites, Plant and Earth Materials als

This information was created solely for a specific purpose within the Prince Albert Grand Council and its use by anyone else for any other purpose may not be appropriate. It is entirely the responsibility of any other user to determine its suitablility before using it themselves and/or for any other purpose.

Data Sources Include:
- 1:250,000 Athabasca Traditional Use and Occupancy Research (2002)
- 1:250,000 elevation and roads - Natural Resources Canada, (2006) Geobase
- 1:250,000 lakes - Saskatchewan Environment Information Management Branch

Map created by PACTeam Canada Inc, (780) 944-2701, www.pacteam.ca
for the Prince Albert Grand Council, (306) 953-7200. www.pagc.ca

PACTeam CANADA
PEOPLE. RESOURCES. PROCESS. POLICY.

Projection: NAD 1983 UTM Zone 13N
Drawn: TL
Date: 2025-11-10 Scale: 1:360,000
Data Sources: *See Map*

McCLEAN LAKE OPERATION

FIGURE 6.4-6
LOCATION OF OVERNIGHT SITES, PLANT, AND EARTH MATERIAL AREAS WITHIN THE AREA OF INTEREST

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 6\EPTID Section 6.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-04-29 2:10 PM Scale: 1:10,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

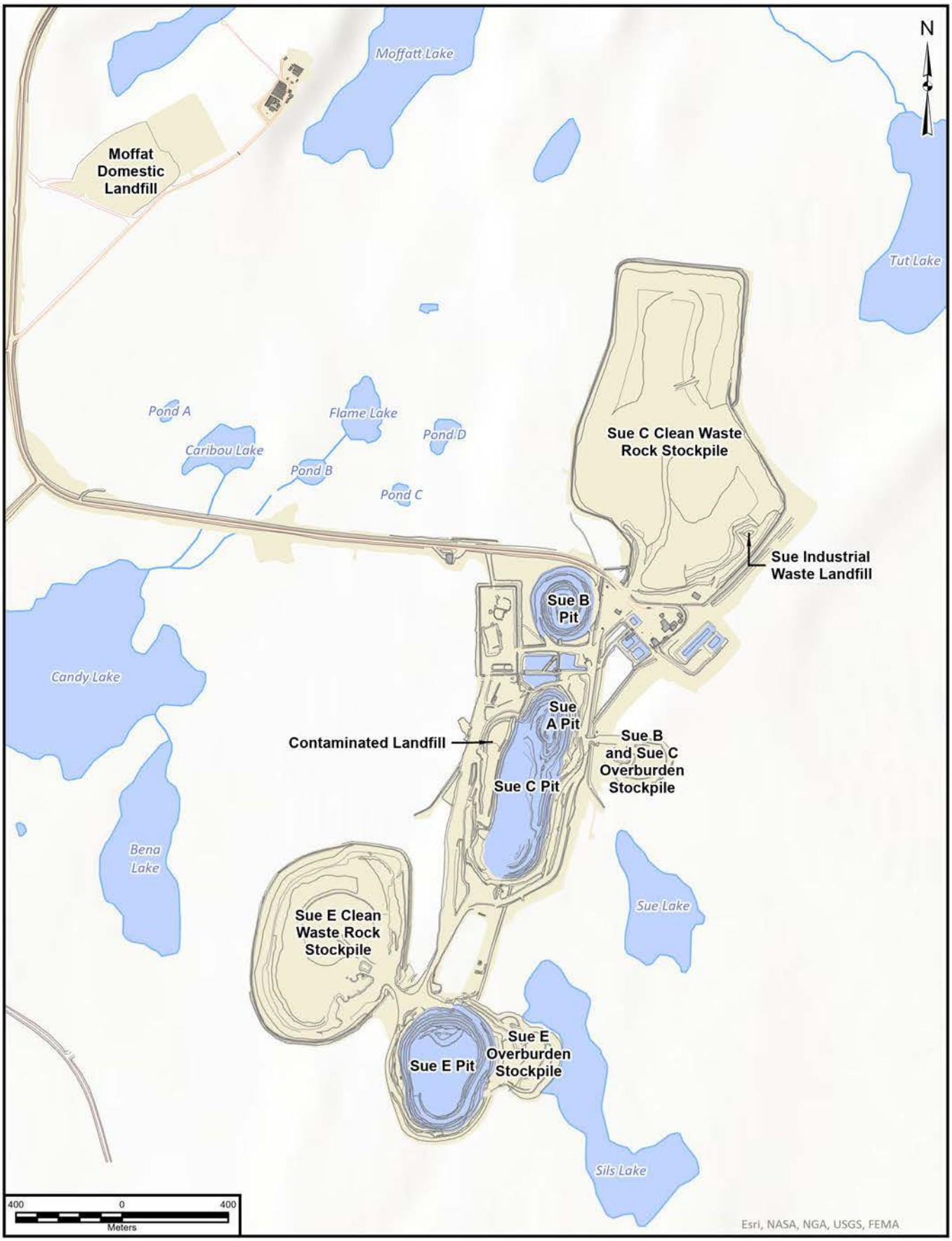
McCLEAN LAKE OPERATION

FIGURE 7.2-1
WASTE MANAGEMENT FACILITIES AT JEB SITE

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 7\EPTID Section 7.aprx



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2025-04-29 2:10 PM Scale: 1:20,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 7.2-2
WASTE MANAGEMENT FACILITIES AT SUE SITE

2025 ENVIRONMENTAL PERFORMANCE TID VOLUME 1

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2025\EP TID\EPTID Section 7\EPTID Section 7.aprx