Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

CMD 22-M7

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Presentation from the Canadian Nuclear Laboratories and Atomic Energy of Canada Limited

Présentation par les Laboratoires Nucléaires Canadiens et Énergie atomique du Canada limitée

Discussion on the Future of the Chalk River Laboratories

Discussion au sujet du futur des Laboratoires de Chalk River

Commission Meeting

Réunion de la Commission

January 27, 2022

Le 27 janvier 2022

Canada

Canadian Nuclear Laboratories | Laboratoires Nucléaires Canadiens

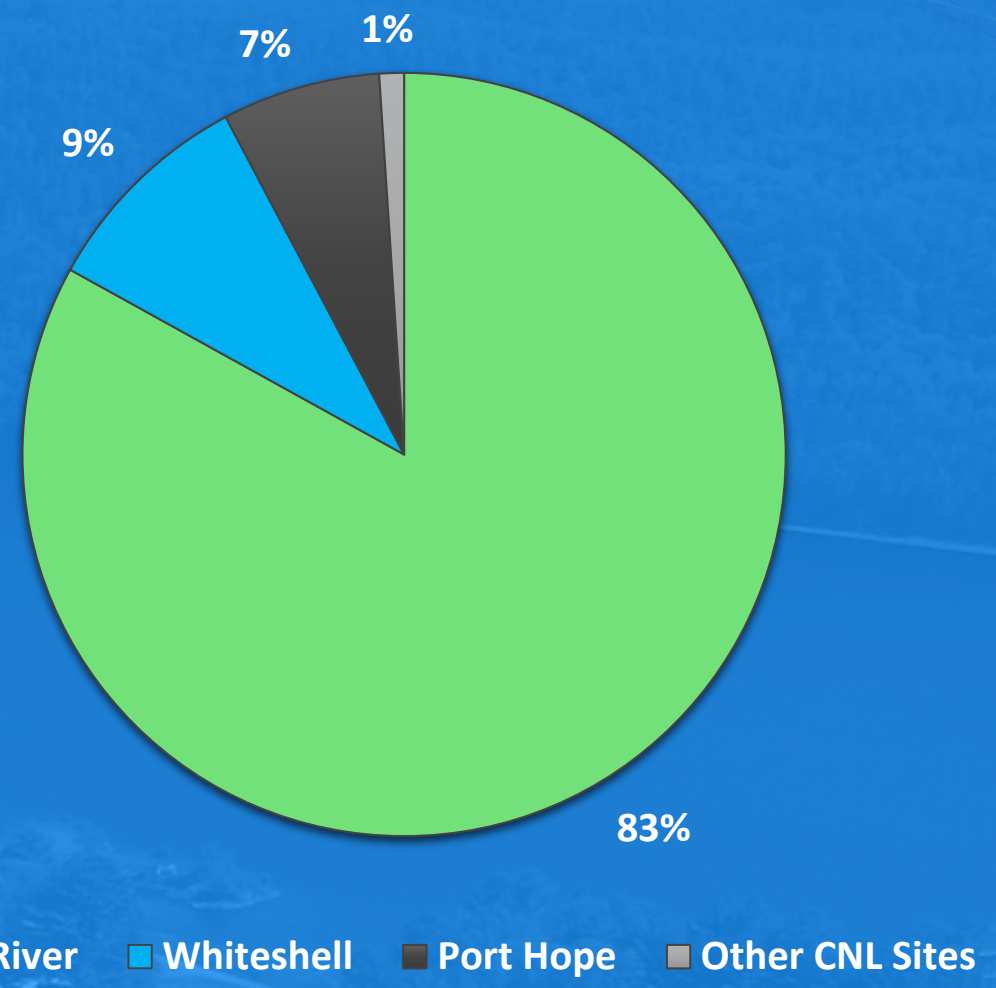
Strategic Priorities: Vision 2030

Restore and protect Canada's environment

Clean energy for today and tomorrow

Contributing to the health of Canadians

Employees at CNL



Indigenous Relations – Meaningful Engagement

Doing our part in reconciliation through Indigenous engagement and partnership is essential.

- REGDOC 3.2.2
- Impact Assessment Agency of Canada
- Truth and Reconciliation Commission of Canada: Calls to Action

Our objective is to:

- Ensure that opportunities are provided for meaningful engagement and participation to ensure Indigenous rights and interests are respected; this includes integration of Traditional / Indigenous knowledge.
- Communicate and engage on CNL operations and potential effects of project activities on the environment and on Traditional Uses.

Communications & Stakeholder Relations

- Internally, the Communications team works to ensure the communication of safety and/or operational performance improvement initiatives. Recognizing the importance of celebrating our successes, the Communications group shares lessons learned for continuous improvement, accomplishments and achievements of staff.
- External to the organization, we build working relationships and create opportunities for open dialogue between various stakeholder groups, local communities and CNL. Our objective is to increase understanding, grow our own appreciation of our communities' diverse perspectives, and enable members of the community to access first-hand knowledge about CNL activities.

Inform and Involve

We value the strong support - and trust - of our local communities

Public information Program - providing timely dissemination of accurate, reliable and understandable information.

- Environmental Stewardship Council and Community Advisory Panel
- Webinars
- www.CNL.ca
- CONTACT and Kids' CONTACT newsletter (bilingual) – 50k copies distributed
- Community events (participation, sponsorship and PSAs)
- Nuclear Education Outreach
- Tours, Open House, Digital Open House
- Media Relations
- Regular engagement with community leaders
- United Way
- Community board participation
- Alumni network

communications@cnl.ca

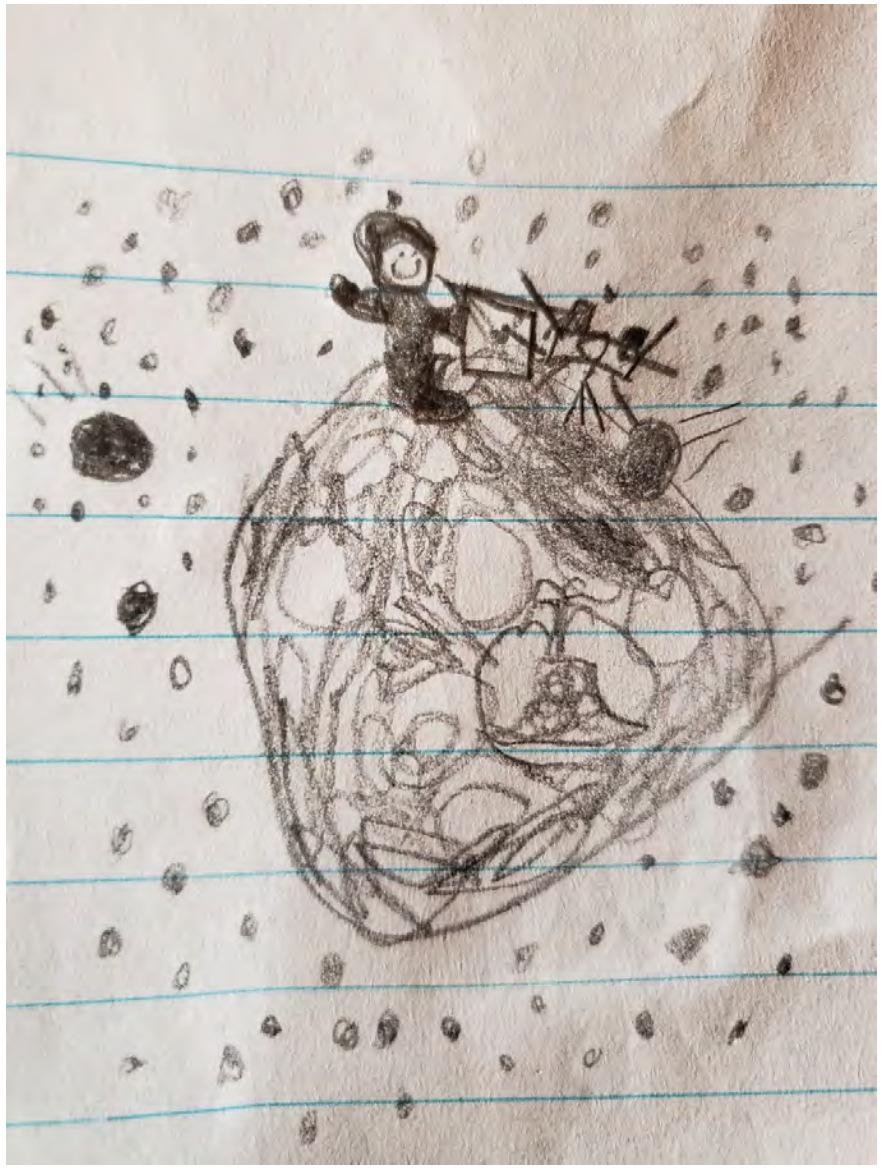
@CanadianNuclearLaboratories

@CNL_LNC

@Canadian Nuclear Laboratories

@canadiannuclearlaboratories

Youtube.com/cnlcanada



Strategic Priorities: Vision 2030

Restore and protect Canada's environment

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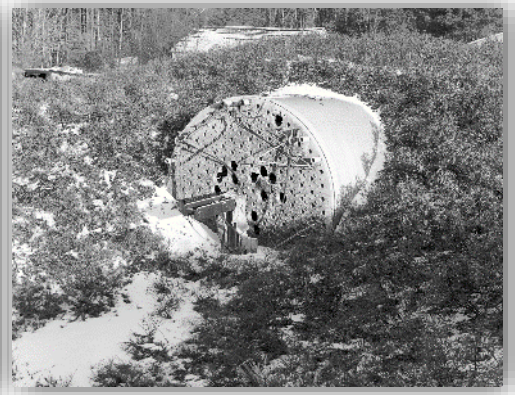
Contributing to the health of Canadians

Legacy Waste Management Areas at Chalk River Laboratories

CNL (and previously AECL) has been safely storing waste in the licensed Waste Management Areas for over 70 years. The Waste Management practices were consistent with the time and have not resulted in any unacceptable offsite impacts.



Waste Management Area A : 1946 - 1956

Liquid Dispersal of Low Level Liquid Waste: 1953 - 2000

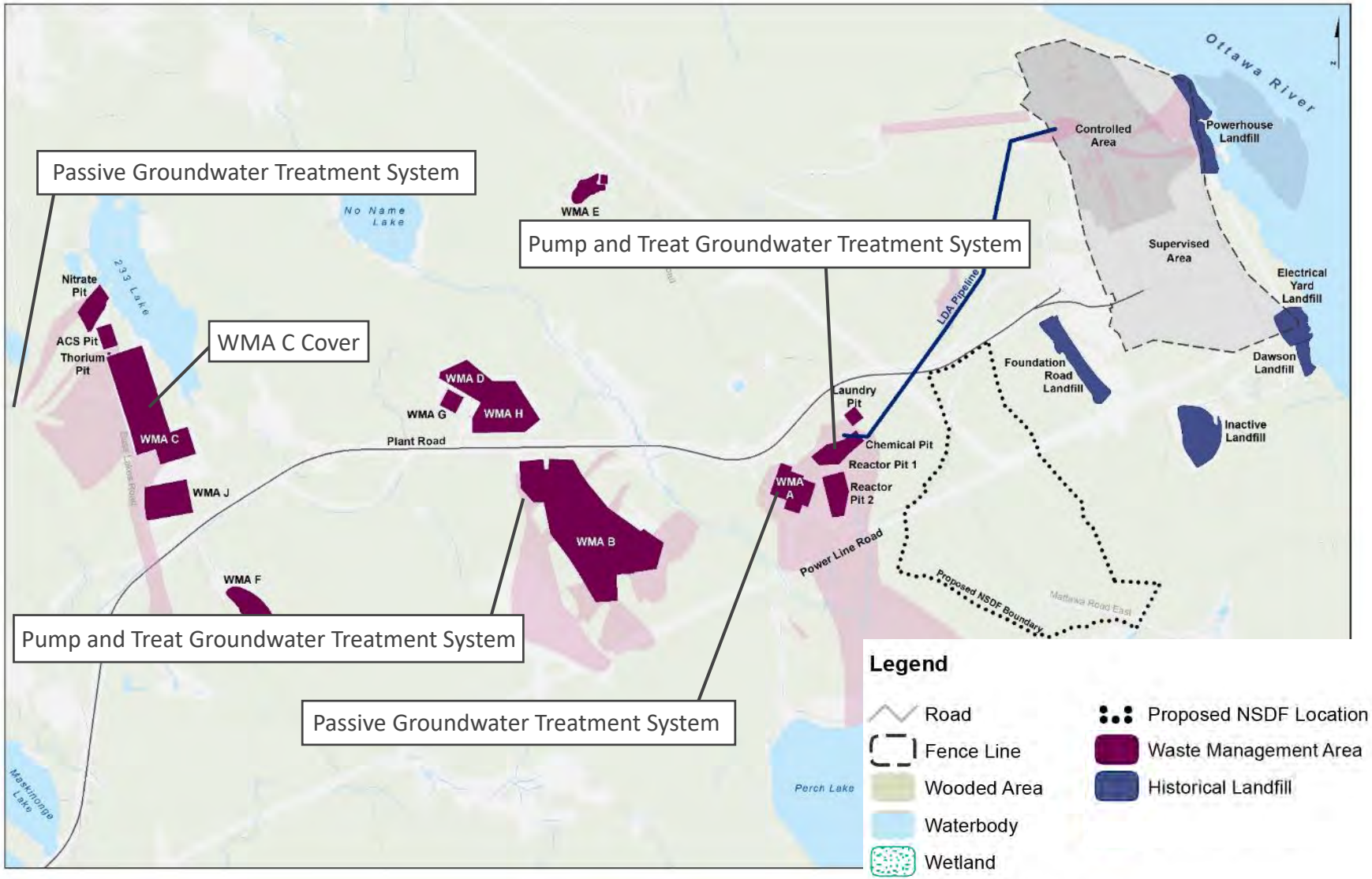
Waste Management Area F : 1976 - 1980

Waste Management Area C: 1963 - 2006

Waste Management Area A

Waste Management Area B

Legacy Waste Management Areas at Chalk River Laboratories

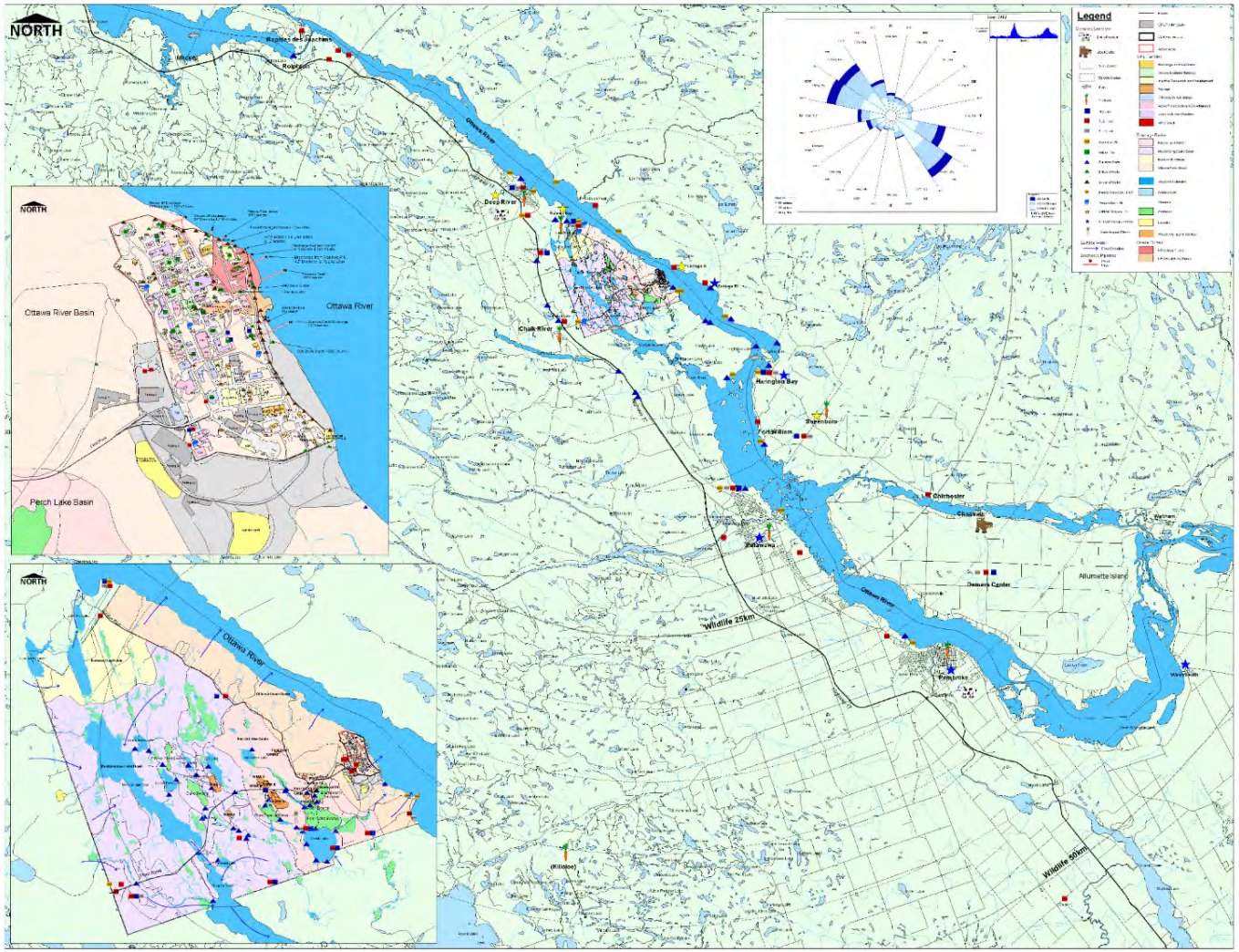


NOT TO SCALE

UNRESTRICTED / ILLIMITE

Effluent and Environmental Monitoring Program

- Monitoring program at Chalk River Laboratories is well established - more than 60 years of data and analysis
- Over 5,000 effluent samples collected and 20,000 analyses performed annually
  - Additionally, groundwater monitoring occurs on site with more than 20,000 analyses performed annually
- Similar amount of environmental sampling and analysis
- ISO 14001:2015 registered
- Follows CNSC regulatory requirements
- CNL publishes results annually
- Working together with Indigenous communities to incorporate Traditional Knowledge



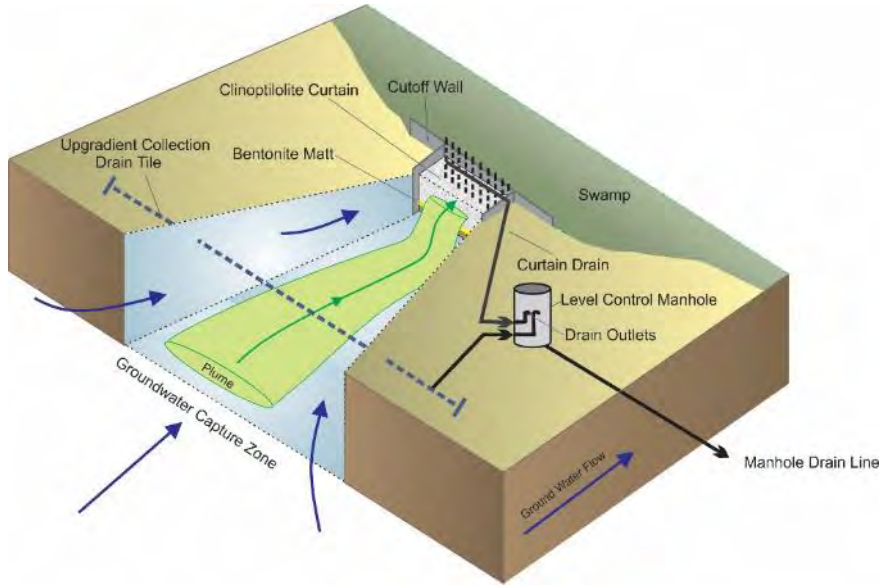
For detailed monitoring reports visit:
http://www.cnl.ca/en/home/environmental-stewardship/performance-report/default.aspx

Restore and Protect

Protecting the Environment with Mitigation Measures

Groundwater
Treatment Systems

Engineered Cover Systems



Groundwater
Treatment Systems

Restore and Protect

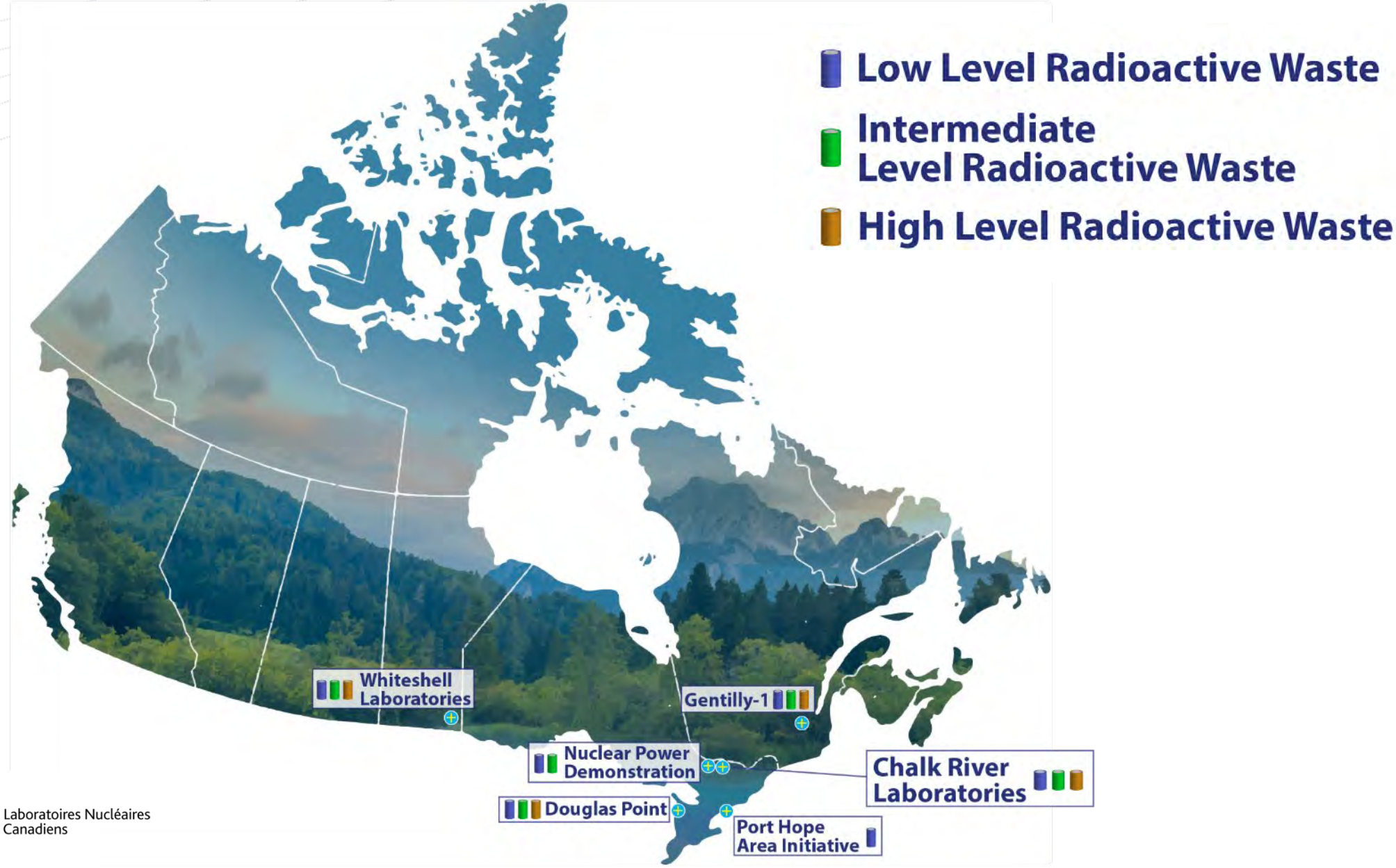
Monitoring the Environment



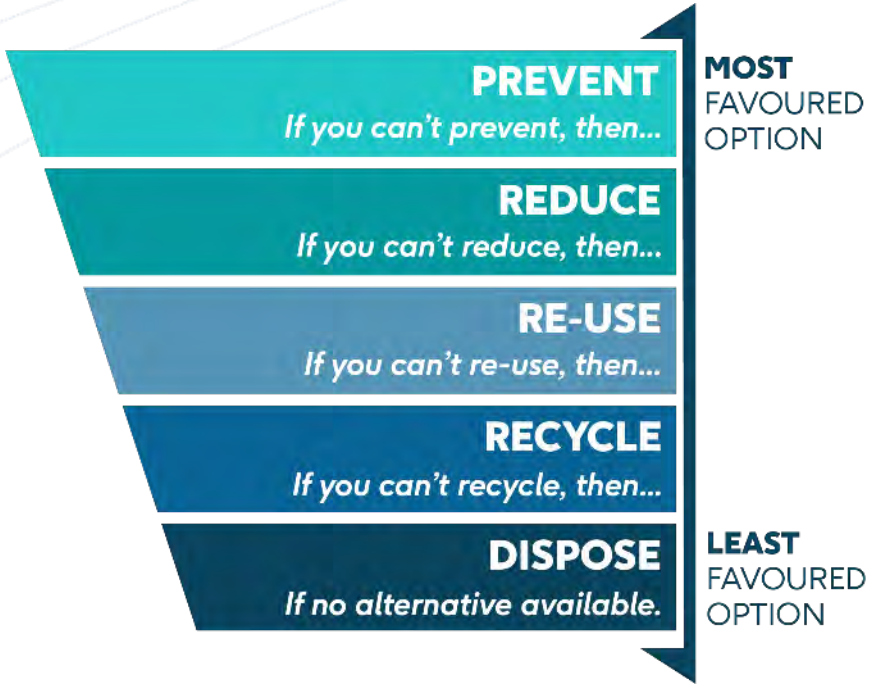





Restore and Protect – Radioactive Waste Storage



Restore and Protect – Integrated Waste Strategy



[Link: CNL Integrated Waste Strategy]

Planning & Preparation

- Waste Strategies
- Waste Inventory
- Waste Characterization
- Waste management plans

Generation

- Operational waste – typically small volumes.
- Decommissioning – bulk waste (e.g. soil, building debris)
- Legacy – retrievals from in ground or above ground storage

Transportation

Conducted according to CNL Transportation of Dangerous Goods requirements.

Processing

- Waste Sorting and segregation
- Waste Size Reduction
- Tool box of approved containers
- Decontamination
- Immobilization

Storage

- Storage of raw waste, Storage of conditioned waste.
- Interim storage, Long-term storage, Buffer storage.

Disposal

- On or off-site landfills
- Geological facilities
- Near Surface Disposal Facilities

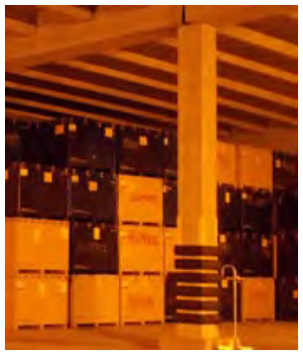
Evolution of Low Level Waste Management Practices

In Ground Sand Trenches 1946 - 1963

In Ground Asphalt Trenches 1955 - 1959

In ground Concrete Lined Storage 1955 - Present

Above Ground Container Storage 2007 – Present



Sort & Segregation 2020 - Present

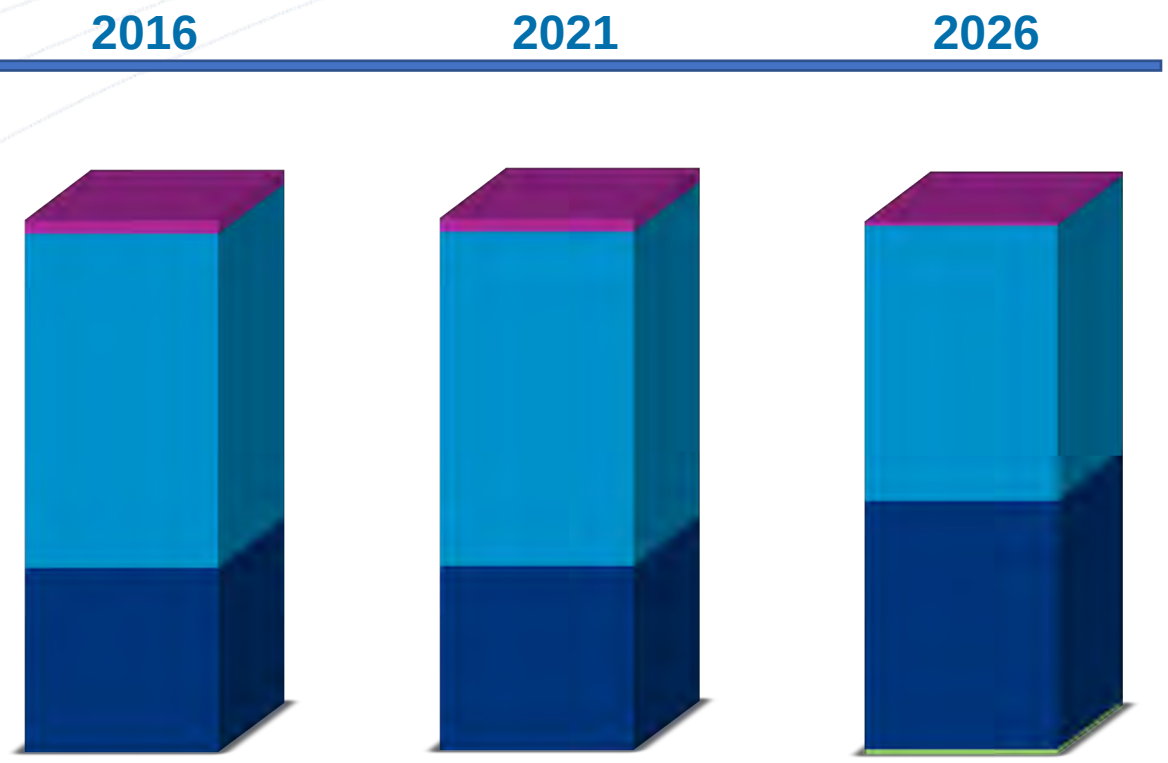
Recoverable Surface Storage 2017 - Present

NSDF Future

*Risk is decreased as technology improves

Low-Level Waste Destined for Chalk River

Generation, Consolidation, Storage and Disposal



Storage at Other CNL Sites

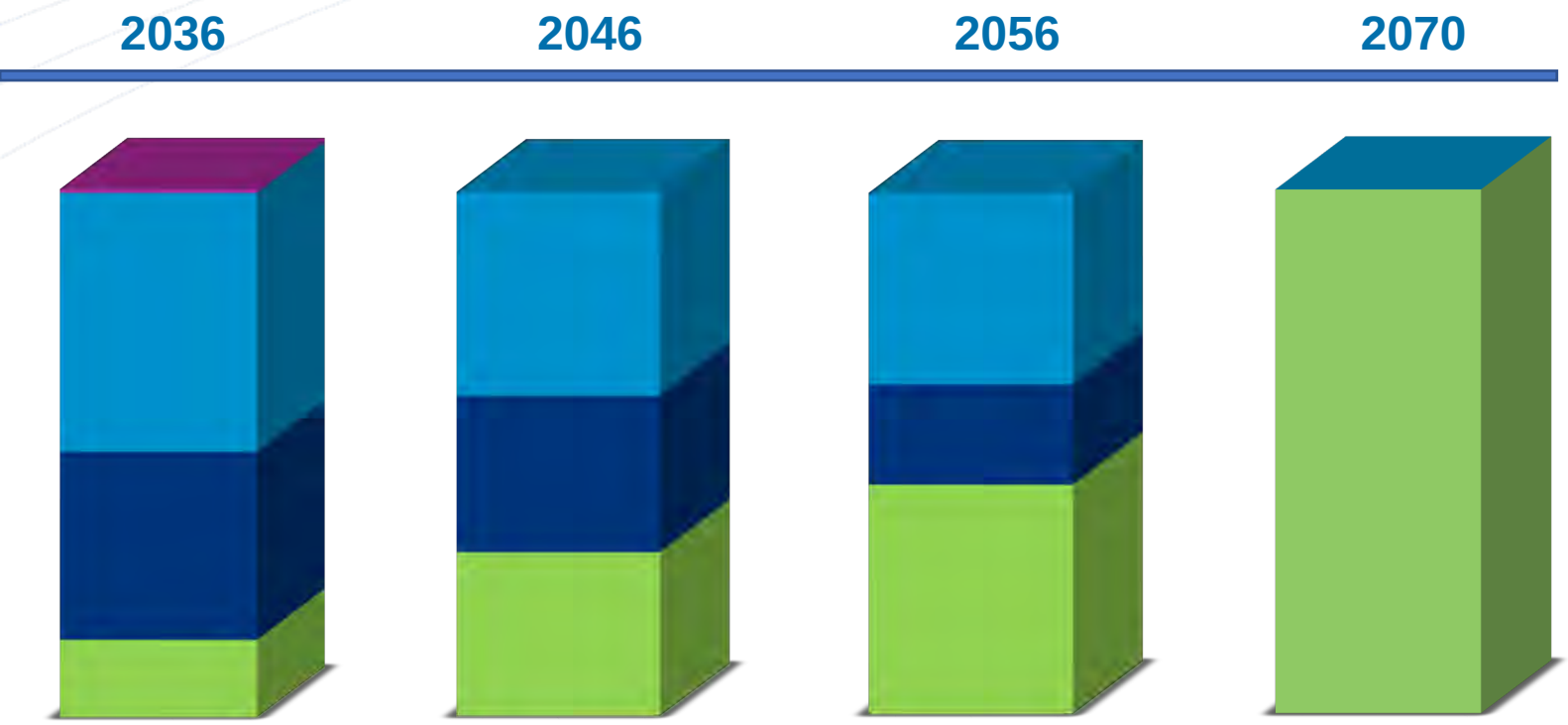
Future waste to be generated from decommissioning, remediation and future operations

Storage at CRL

Disposal

Low-Level Waste Destined for Chalk River

Generation, Consolidation, Storage and Disposal



Storage at Other CNL Sites

Future waste to be generated from decommissioning, remediation and future operations

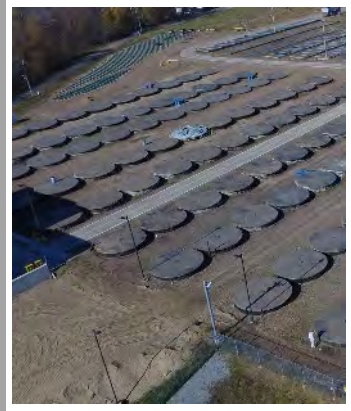
Storage at CRL

Disposal

Evolution of Intermediate Level Waste Management Practices

Rectangular Bunkers
1959 - 1979

Tile Holes 1956 - Present
Cylindrical Bunkers 1979 – Present



ILW Storage Facility
2026 -

Waste Processing
Estimated operations
2030 – 2070

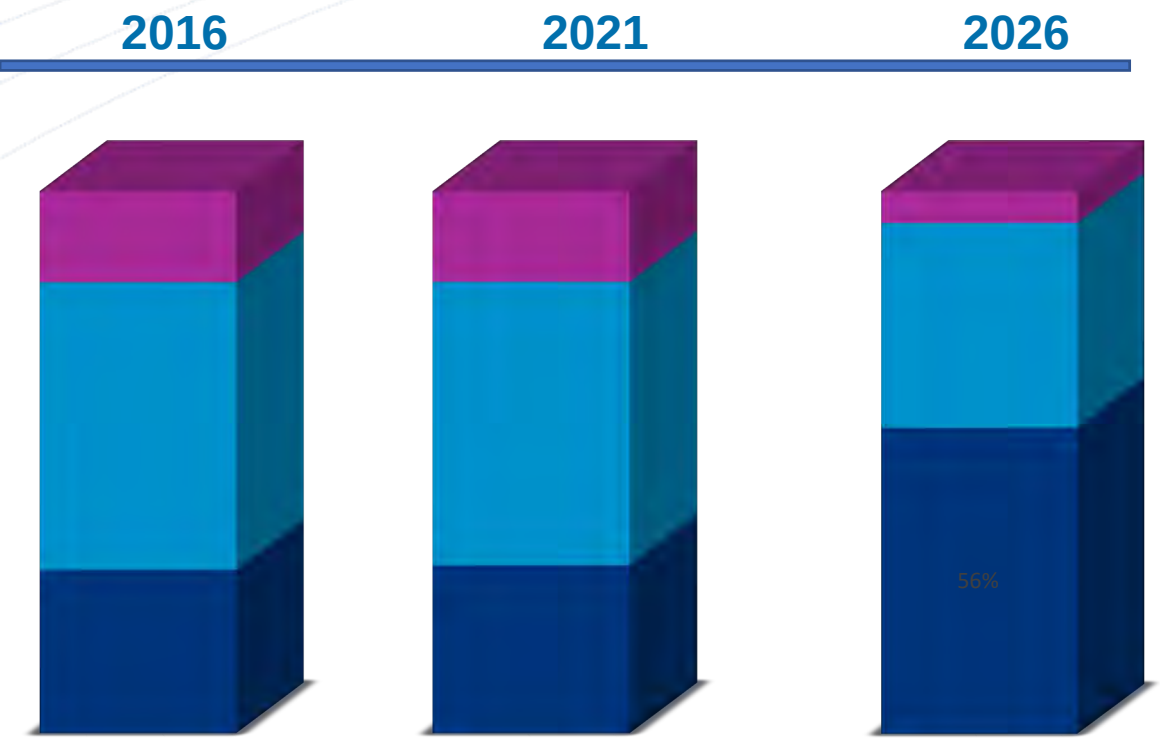
ILW Disposal
Future

Identifying Options

*Risk is decreased as technology improves

Intermediate-Level Waste Destined for Chalk River

Generation, Consolidation, Storage, Disposal Readiness



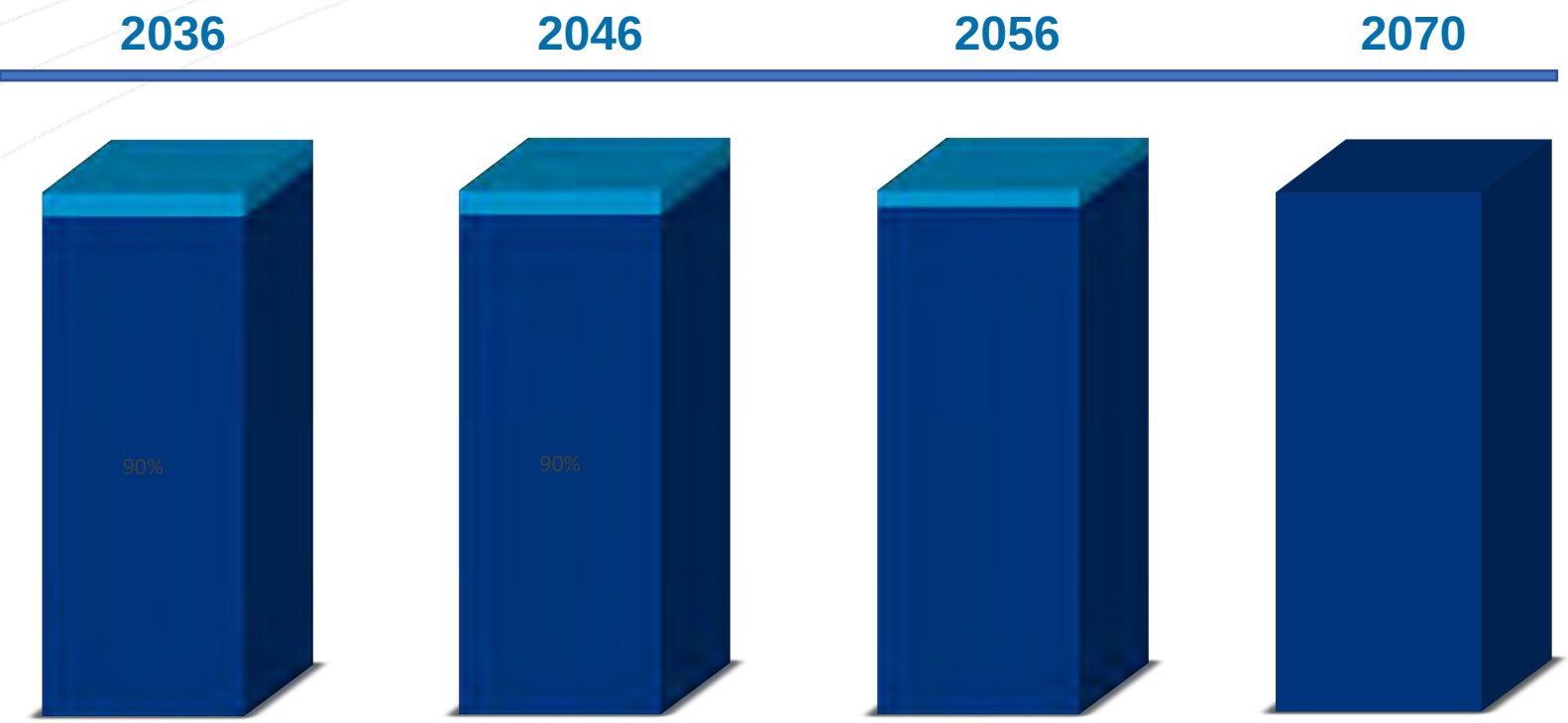
Storage at Other CNL Sites

Future waste to be generated from decommissioning, remediation and future operations

Storage at CRL

Intermediate-Level Waste Destined for Chalk River

Generation, Consolidation, Storage, Disposal Readiness



- Storage at Other CNL Sites
- Future waste to be generated from decommissioning, remediation and future operations
- Storage at CRL

*CNL is currently identifying possible disposal options for ILW and is preparing the waste for disposal while in storage.

High-Level Waste Management Practices

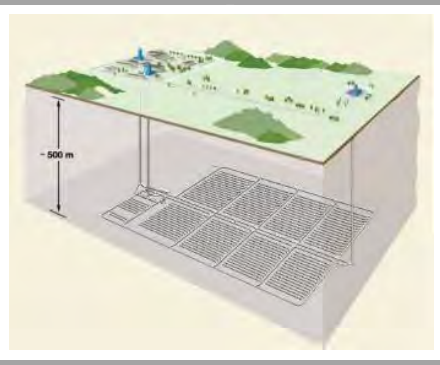
Tile Hole Storage
WMA-B
1963 - Present

Fuel Packaging and Storage WMA-B
2015 - Present

Concrete Canister Storage
WMA-G
1988 - Present

Waste Processing
Estimated Operations
2030 – 2070

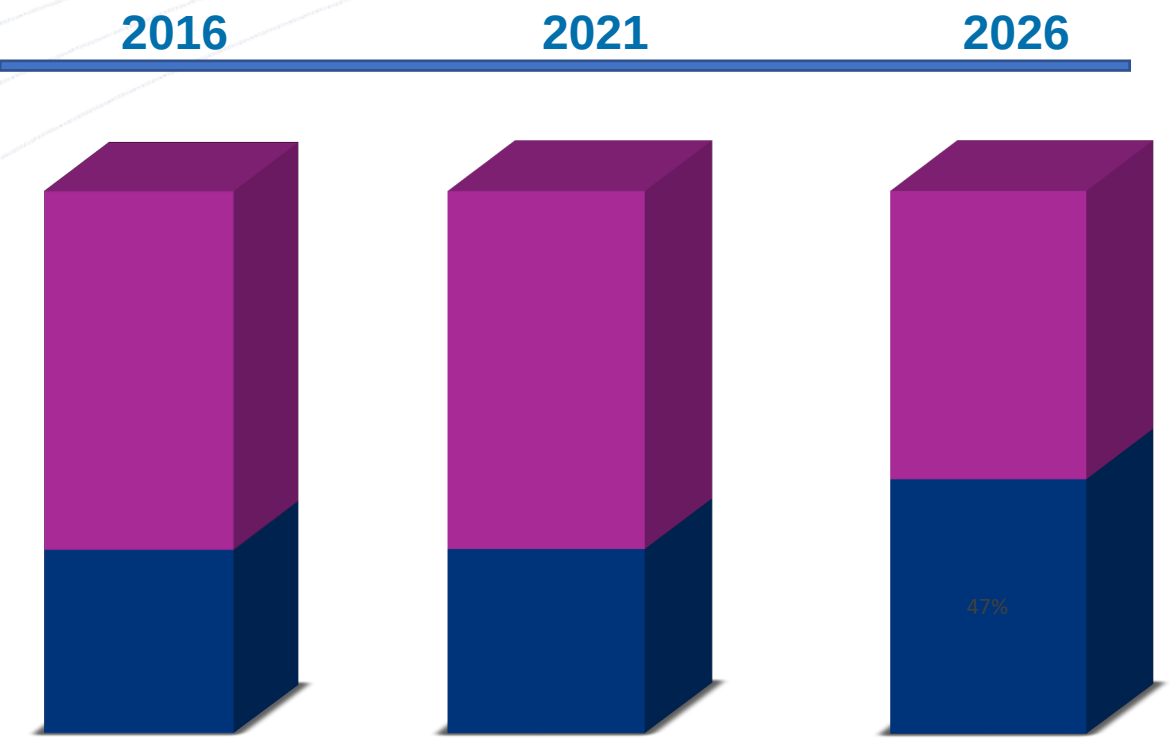
Proposed NWMO
Deep Geological Repository
Off-Site – 2050



*Risk is decreased as technology improves

High-Level Waste

Consolidation, Storage, Stabilization, Transportation & Disposal



High-Level Waste

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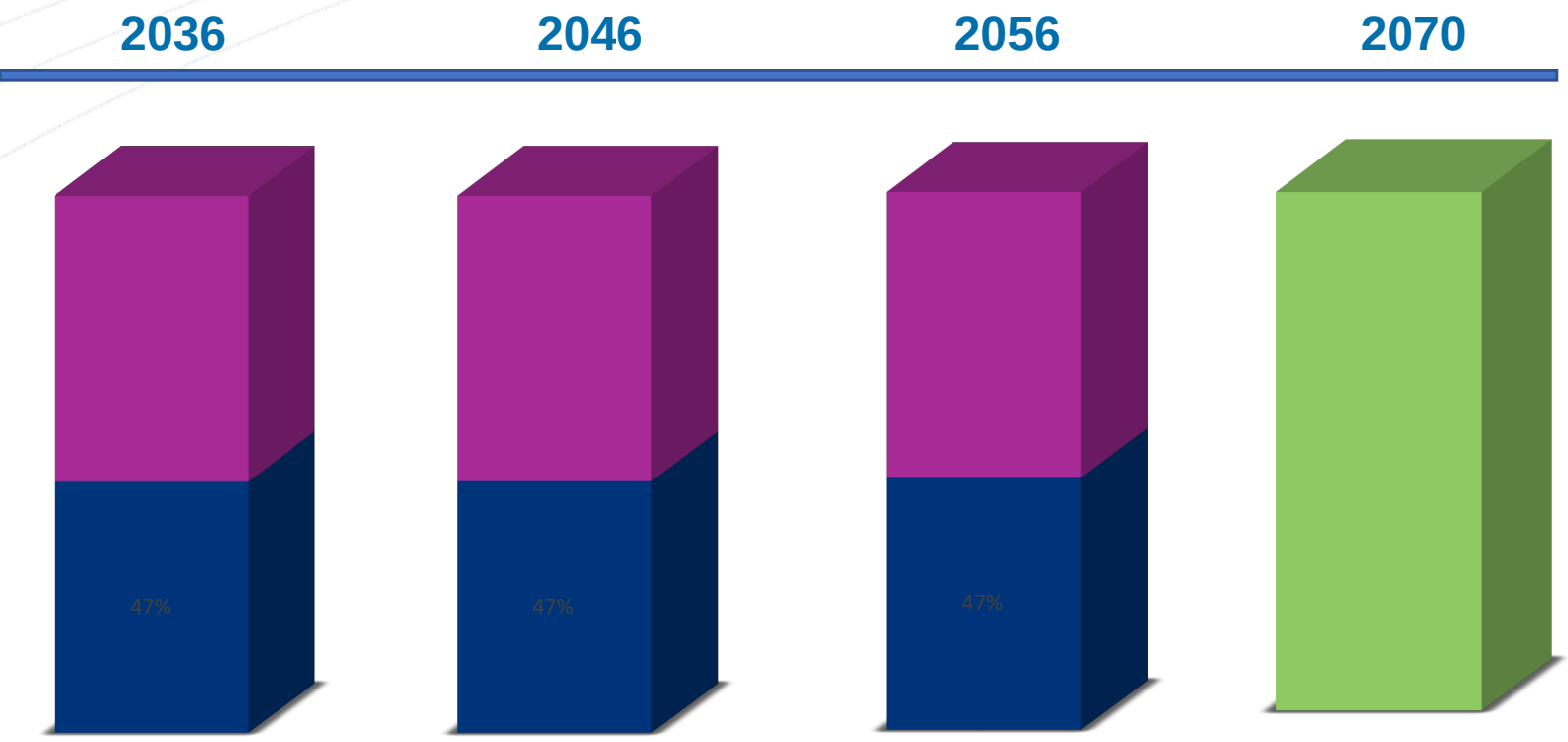


Storage at Other CNL Sites

Storage at CRL

NWMO Disposal

Highly Enriched Uranium (HEU) Repatriation Program

NRU/NRX HEU Repatriation Project

- CNL repatriated over 1000 irradiated HEU Fuel Assemblies from the NRU and NRX Reactors to the USA.
- This repatriation project reduced the CRL liability by over 120,000 TBq of activity.

Target Residue Material Repatriation Project

- CNL repatriated approximately thirty (30) tonnes of Highly-Enriched Uranyl Nitrate Liquid (HEUNL) from medical isotope (Mo-99) processing.
- This repatriation project reduced the CRL liability by over 4,000 TBq of activity.

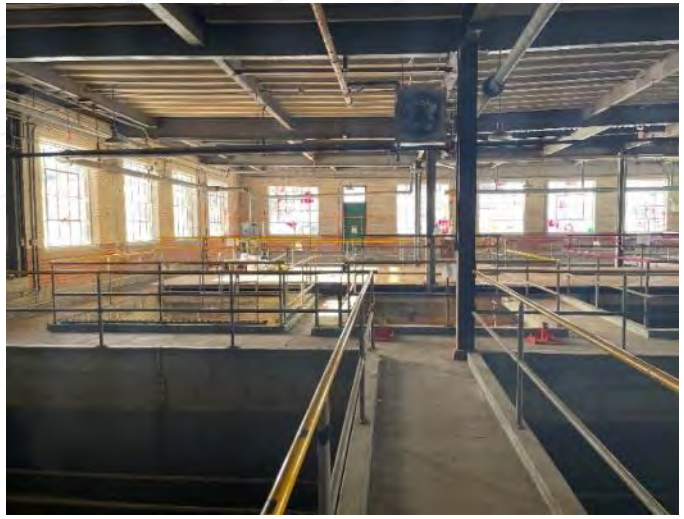
Future Repatriation Activities

- CNL continues to identify and evaluate repatriation opportunities.

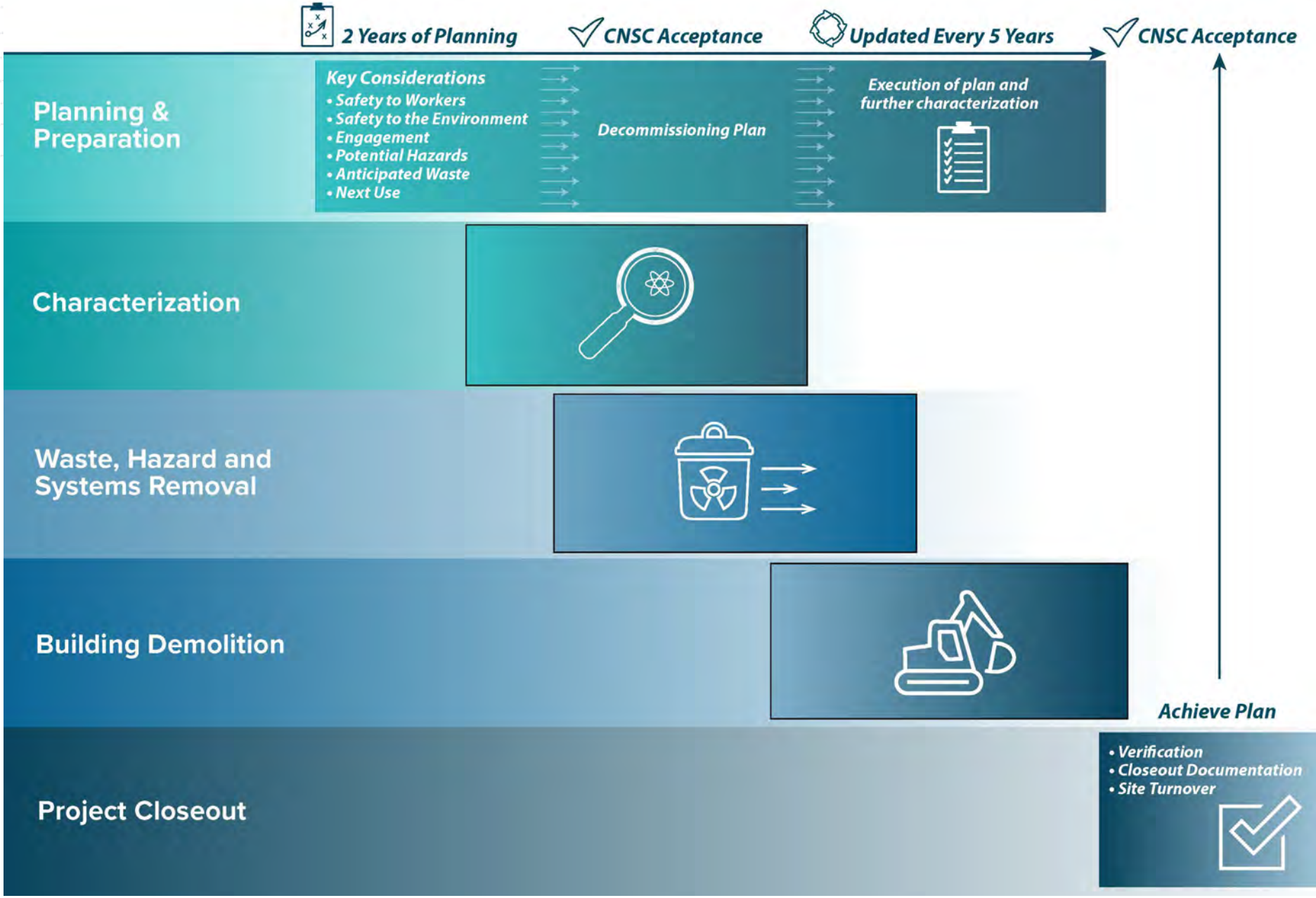
CNL Cleanup Function Support Area

Overview Decommissioning & Cleanup Plan

Decommissioning Lifecycle

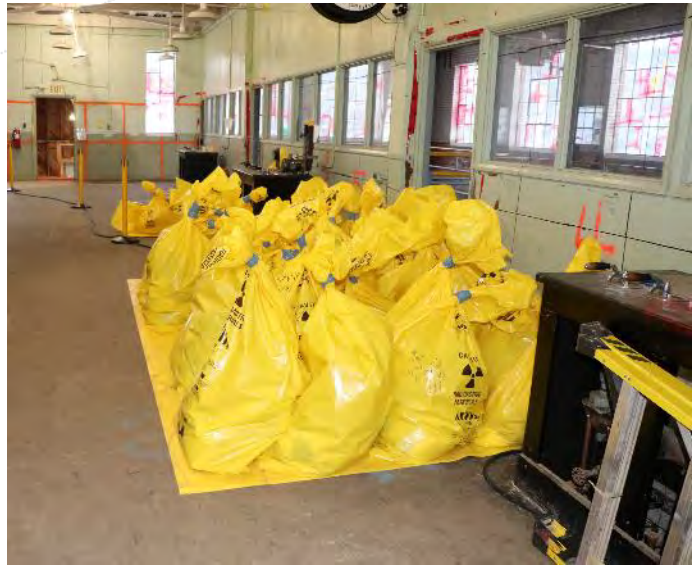


Decommissioning Process



Characterization

Waste, Hazard and Systems Removal



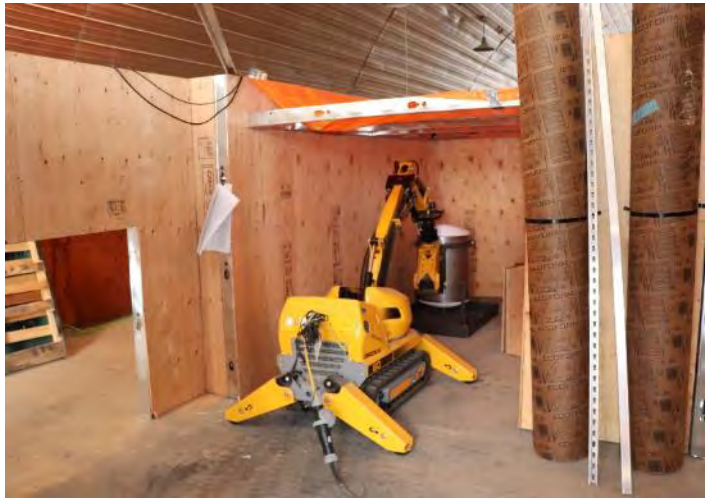
Building Demolition

Restore and Protect – Holistic Site Cleanup Plan

Executing the Comprehensive Preliminary Decommissioning Plan

Restore and Protect – Holistic Site Cleanup Plan

Utilizing technology to support decommissioning activities



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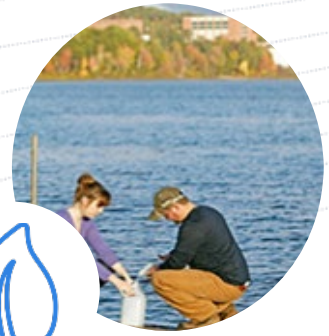


Science informs and supports our entire portfolio of work.

- Nuclear Surface Disposal Facility (NSDF)
- Port Hope/Historic Waste
- Waste Management
- Nuclear Power Demonstration (NPD)
- WR-1
- Facilities Decommissioning

And many more…

- Support for CANDU Owners Group/ existing fleet
- Post Irradiation Examination of Reactor Fuel
- Advanced Fuel Development
- Hydrogen technologies
- Cyber security
- Small Modular Reactor (SMR) technology

And many more…

- Actinium 225 production
- Targeted alpha therapies
- Radiobiology
- Low dose radiation research
- Dosimetry
- Emergency response

And many more…

CNL's S&T Organization

Hydrogen and Tritium Technologies

Reactor Fleet Sustainability

Isotopes, Radiobiology & Environment

Advanced Reactors

Safety & Security

PROJECT OFFICES

Small Modular Reactor Project Office

Isotopes Production Project Office

Federal Nuclear Science & Technology Work Plan

AECL oversees the Federal Nuclear Science and Technology Work Plan, which serves the collective interests of 14 federal departments and agencies in the areas of health, nuclear safety and security, energy and the environment.

- Helps inform government programs, policy and regulations
- Represents an annual investment of $76 million by AECL
- Agencies include:

Canadian Border Services Agency
Canadian Nuclear Safety Commission (CNSC)
Communications Security Establishment
Canadian Space Agency
Environment Canada
Global Affairs Canada
Health Canada (HC)
Industry Canada
Department of National Defence
Defence Research and Development Canada
National Research Council
Natural Resources Canada (NRCan)
Public Safety Canada
Royal Canadian Mounted Police

Federal Nuclear Science & Technology Work Plan

CNL's Strategic Initiatives map into 4 FNST Theme Areas and help CNL focus our capabilities and efforts in these areas

1. **Health**
   - *Health and Medical Radioisotopes*

2. **Environmental Stewardship**
   - *S&T for Environment Remediation Management*

3. **Safety & Security**
   - *Nuclear Detection, Forensics, and Response*
   - *Nuclear Cyber Security*

4. **Energy**
   - *Long Term Operations of Existing Reactor Fleet*
   - *Advanced Fuel Fabrication*
   - *A Global Hub for Small Modular Reactors*
   - *(Hydrogen) Decarbonizing the Transport Sector and Remote Communities in Canada*

Building to Support Future Needs:
Advanced Nuclear Materials Research Centre (ANMRC)

What is it: A modern nuclear facility, providing unique capabilities in Canada - 125,000 square feet and equipped with 12 hot cells and 23 laboratories and replacing current hot cell facilities dating back to the 1950s.

Status: Conceptual design complete; detailed design underway. Earthworks and pilings planned for 2022.

Planned completion date: 2027

Our Vision for Advanced Reactors & Small Modular Reactors

Support Canada's SMR efforts:

- *"demonstrate the commercial viability of the small modular reactor (SMR)"*
- *"recognized globally as a leader in SMR prototype testing and scientific support."*
- *"be a recognized hub for SMRs, where multiple vendor-supported prototypes are built and tested."*
- *Support science-informed regulation, decision-making and policy development*

How CNL is Enabling SMR / Advanced Reactors

Federal Science & Technology

FNST Work Plan helps build a framework for SMR development & deployment in Canada

Canadian Nuclear Research Initiative

Working with commercial companies to apply our nuclear capabilities to technical challenges

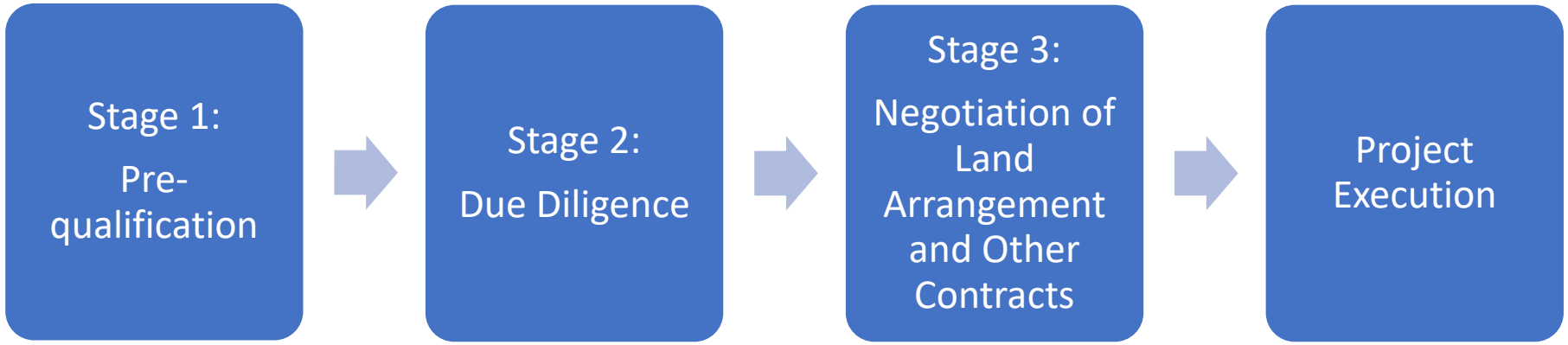
Clean Energy Demonstration & Innovation Research (CEDIR) Park

Advancing technology readiness via a demonstration platform for clean energy systems and adjacent technologies

SMR Demonstration Siting

Hosting a demonstration SMR on a CNL-managed site

SMR Siting Ongoing Invitation Process



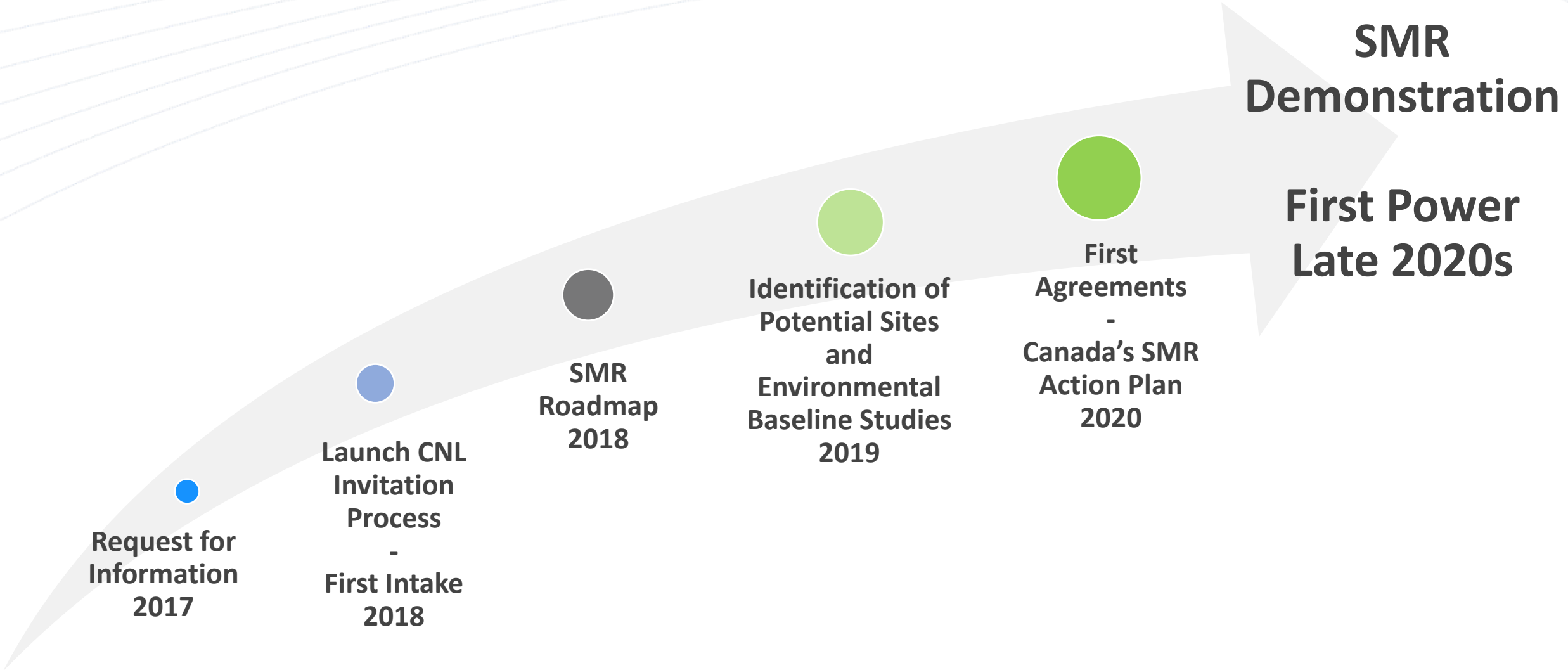
STARCORE NUCLEAR

TERRESTRIAL ENERGY

UBATTERY Local Modular Energy

GLOBAL FIRST POWER

CNL Demonstration Timeline



CEDIR Park: Clean Energy Demonstration & Innovation Research Park

CEDIR Park is a concept demonstration platform of low-carbon systems enabled by Small Modular Reactors for diverse applications.

- Offer a platform to showcase the implementation of low-carbon solutions to stakeholders
- Advance the technology readiness level of nuclear-renewable hybrid energy systems and associated technologies
- Demonstrate the operation of licensed, coexisting low-carbon technologies
- Potential of SMR offtakes – district heat, process heat, power to the grid
- Partnership opportunities

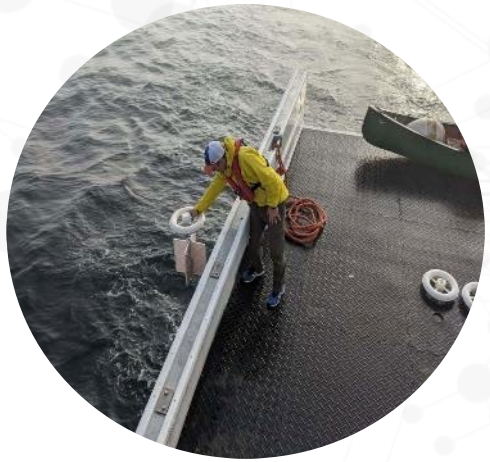
Focus Areas: Isotopes, Radiobiology and Environment

Radiobiology and Health

Studies to support understanding of Low Dose Radiation exposure health effects; radiation protection technologies

Isotopes and Medical Applications

R&D to support isotopes production; R&D for therapeutic and diagnostic drug evaluation



Environmental Stewardship

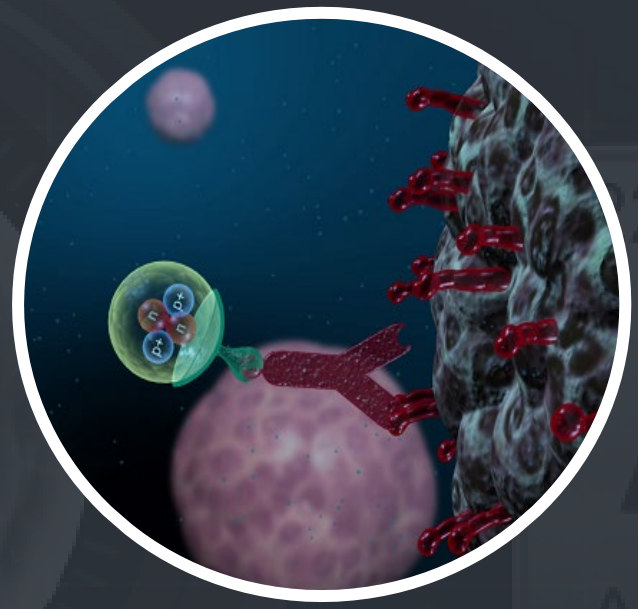
Addressing research gaps to inform Environmental Risk Assessments

Waste Management

Supporting Environmental Remediation Management and industry

Targeted Alpha Therapy
A New Weapon in the Fight Against Cancer

Actinium 225 is attached to a targeting molecule



When the isotope decays, it emits high-energy alpha particles

These particles kill the cancer cell, leaving nearby healthy cells unharmed

Targeted Alpha Therapy using Ac-225 is being considered as a potential treatment for a number of different cancers, including prostate, pancreatic and bladder cancer, as well as leukemia.

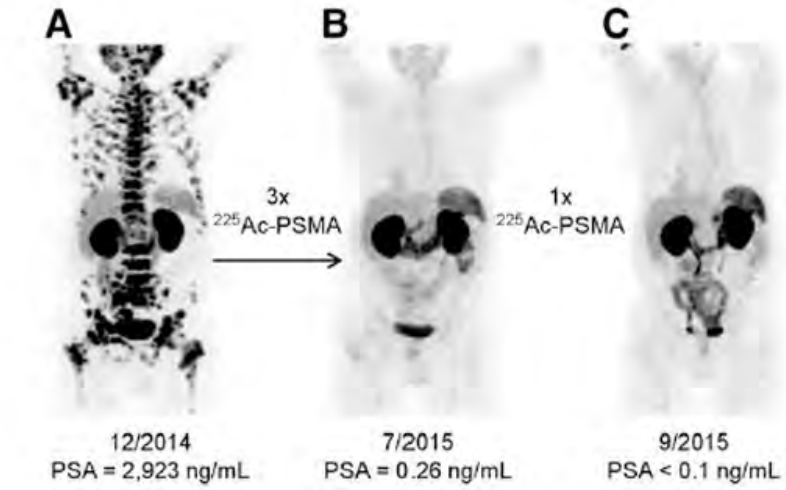
UNRESTRICTED / ILLIMITE

A Vision for the Future: Ac-225 Production

The Concept: A new facility housing a cyclotron particle accelerator co-located with a pharmaceutical grade isotope processing capability

With the scale envisioned, Ac-225 manufactured by CNL:

- Will provide life-saving benefits to cancer patients in Canada
- Puts Canada in the forefront as global provider of rare medical isotope
- Generates high tech employment opportunities
- Operating time frame estimated at 20 to 30 years



Focus Areas: Hydrogen Technologies

Integrated H_2 Infrastructure Design – Techno-economic assessments

Alternative fuels assessment for development for marine industry

Evaluation of Large-scale H_2 Based Clean Fuel Production and CO_2 utilization

Development and evaluation of syn gas approaches to support government and industry

H_2 Safety Solutions

Testing and technologies to support widespread Hydrogen utilization

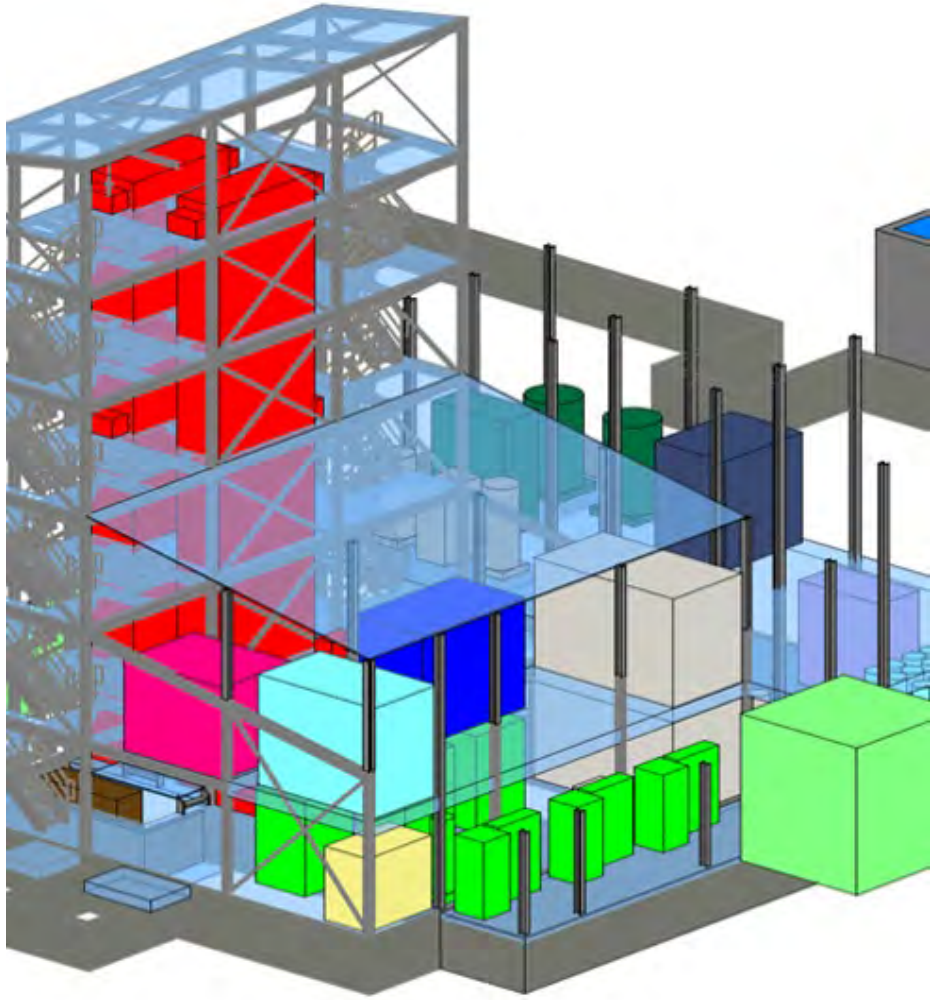
Hydrogen Storage

Evaluating storage technologies to support government and industry

Heavy Water Detritiation Facility (HWDF)

The Concept: The HWDF would house CNL-developed detritiation technologies to process approximately 600,000 litres of tritiated heavy water

The asset life of the facility will be 40 years with potential to support many industries.



Deuterium Applications

CNL has the opportunity to support many industries advancing greater benefits for society, including:

- Pharmaceuticals
- Scientific research and manufacturing
- Fibre optics

Focus Areas: Safety & Security

CNL is a centre of excellence in nuclear safety and security expertise and research.

Nuclear Emergency Response monitoring, training, exercises, consultancy/reach back and remediation services

Development and testing of nuclear detection and interrogation systems

Cyber Security testing, training, exercises

Procurement, development and deployment of safety- and security-critical instrumentation & control systems

70 Years & Counting: Enabling Canada's CANDU Fleet

- Fundamental research to extend safe and effective reactor life
- Tools and equipment development to reduce reactor outage periods
- Facilities and expertise to support rapid response for Canadian utilities and industry
- Support for future reactor technologies

Working better together: Collaborations

International

Domestic

Indigenous Communities

Industry

Academia

Future Vision: Enabling Innovation & Commercial Opportunities

As a national laboratory, CNL is uniquely positioned to enhance Canadian industry competitiveness to develop and deploy scientific and technological solutions.

This includes the creation of commercial vehicles on special projects and technologies. These could include:

- Actinium / Isotope production
- Small Modular Reactor/Advanced Reactor fuel manufacturing facilities
- Cyber & Security technologies
- Clean Energy Strategies: hydrogen, synthetic fuels
- Waste & Decommissioning Expertise

A clean future, together