Protecting Lake Ontario

Port Granby
Treating Wastewater from the Low level Radioactive Waste Management Facility

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Outline

- History
- Project Scope
- Key Project Stages
- Existing Treatment Facility
- Design Challenges
- Wastewater Treatment Process
- Specific Contaminants
Port Granby WMF

- Waste was generated as result of radium and uranium ore refining (1930’s to 1980’s)
- Marginally contaminated soil (Radium 226, Uranium, Arsenic)
- Existing Waste Water Treatment Plant (WWTP) collects and treats leachate from in–ground waste storage areas since 1977

History - Port Granby Waste Management Facility (WMF)

Port Granby, Lake Ontario
History

2001- Port Hope Area Initiative (PHAI)

• Municipality of Clarington, Municipality of Port Hope, Government of Canada
• Agreement to build a new long term waste management facility to safely treat the marginally contaminated soil

PHAI Management Office Tripartite

• Atomic Energy of Canada Ltd – Lead agency/license holder
• Public Works and Government Services Canada – Contract administrator
• Natural Resources Canada – Project sponsor
**Project Scope**

- AECL: Assume management and operation of the Port Granby waste management facility
- Safely clean up 450,000 m³ of historic low-level radioactive waste
  - Contaminated waste and soil will be excavated, transported to an approved long term waste management facility and covered with an engineered cap.
  - Contaminated surface water, groundwater and leachate will be treated at a new Wastewater Treatment Plant – designed to treat the volume and characteristics of the modified waste water streams.
Project Scope - Overview
**Key Project Stages**

**STAGED PROJECT IMPLEMENTATION**

**Phase 1 - Regulatory Approval / Design - 2001**
- Stage 1: Environmental Assessment Process, bench scale testing
  - 2011 – Public Hearing; Canadian Nuclear Safety Commission will issue a Waste Nuclear Substance License to AECL for the Port Granby Long Term Low Level Radioactive Waste Management Project for 10 years
- Stage 2: Pilot program, development of detailed design – tender ready

**Phase 2 – Clean up and construction – started in 2012**
- Construction of long term WMF and WWTP
- Full remediation project will take 10 years including 5 years waste transfer, site remediation and decommissioning of existing facilities

**Phase 3 – Long term monitoring and maintenance – 2021 on**
- Continuous monitoring of the remediated site and the new facilities
Existing WMF Wastewater Treatment
Design - Challenges

- Challenging residuals management process
- Varying inputs – concentrations and flows will vary significantly over the life of the WWTP, due to weather and construction activities
- Relatively unknown water matrix
- Flexible process concept required due to varying flows during construction phase and post-construction

Contaminants of Potential Concern (COPC)

COPC list was developed during EA

Primary COPC:
- Arsenic,
- Radium -226,
- Uranium,
- Nitrate

<table>
<thead>
<tr>
<th>Parameters of Potential Concern</th>
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<tbody>
<tr>
<td>Ammonia-N</td>
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<tr>
<td>Nickel</td>
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<tr>
<td>Arsenic</td>
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<tr>
<td>Nitrate-N</td>
</tr>
<tr>
<td>Calcium</td>
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<tr>
<td>Nitrite - N</td>
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<tr>
<td>Cobalt</td>
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<td>Phosphorus</td>
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<td>Copper</td>
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<tr>
<td>Potassium</td>
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<tr>
<td>Fluoride</td>
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<tr>
<td>Radium-226</td>
</tr>
<tr>
<td>Iron</td>
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<tr>
<td>Selenium</td>
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<tr>
<td>Lead</td>
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<td>Uranium</td>
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<td>Magnesium</td>
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<td>Vanadium</td>
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<td>Molybdenum</td>
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Contaminants of Potential Concern (Source: Development of an Integrated Leachate Treatment Solution for the Port Granby Waste Management Facility)
Anticipated Flow Rates Future WWTP

Predicted Average and Maximum Combined Monthly Flows to LTWMF WWTP
(source: Design Rationale and Process Control Description - 2011)
Water Conveyance to and from Port Granby WWTP
Pilot Scale Test

• Pilot scale testing for water treatment completed under supervision of AECL in 2010 to confirm the performance of treatment systems and determine the design requirements.

• Pilot scale test included:
  – Membrane bio-reactor (MBR)
  – Reverse Osmosis (RO) treatment

• Overall removal rates for primary COPC’s Arsenic, Uranium, Radium-226 and Nitrate were 98-99%
Wastewater Treatment & Residuals Management Strategy

1. Contaminated water from all sources
2. Equalization
3. Biological Treatment (MBR)
   - Aeration Tank
   - Membrane Tank
   - Removal of metals & radionuclides
   - Nitrification/De-nitrification
4. Reverse Osmosis
   - Removal of metals & radionuclides
   - Removal of nitrate
5. pH adjustment
6. Thickening/Dewatering
7. Contaminated solids to long term WMF
8. Thickening/Dewatering
9. Evaporator
10. Dryer

Treated effluent
Wastewater Treatment System Design Criteria

• Average flow 10,000 to 14,000 m³/month (14 to 19 m³/hr)
• Average Peak flow 25,000 to 35,000 m³/month (35 to 48 m³/hr)
• Influent projections of selected primary contaminants¹
• Details of discharge criteria for WWTP will be included in the Waste Nuclear Substance license to be issued by CNSC

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<thead>
<tr>
<th>COPC</th>
<th>Lower</th>
<th>Upper</th>
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<tbody>
<tr>
<td>Arsenic (mg/l)</td>
<td>0.1</td>
<td>10</td>
</tr>
<tr>
<td>Uranium (mg/l)</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>Radium-226 (Bq/l)</td>
<td>4</td>
<td>75</td>
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<tr>
<td>Nitrate (mg/l)</td>
<td>100</td>
<td>2000</td>
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Design Features of the Future WWTP

Equalization
• Flow and Load fluctuations

Dual treatment train configuration for water treatment trains
• Ability to adapt Treatment plant to seasonal flow scenarios and maintenance requirements

Multiple barrier process (i.e. MBR followed by RO)
• Flexibility to adapt to fluctuations in influent quality
• Depending on flows and loads treatment concept can be altered to bypass treatment stages (e.g. brine treatment)
• Allocation of space for future processes (i.e. ion exchange)
Contaminants of potential concern: Uranium

**WWTP influent: Uranium:**
Average: 7 mg/l; Maximum: 16 mg/l

**WWTP solids dewatering: Uranium:**
Average: 900 - 8200 mg/l
Maximum: 1,800 – 17,000 mg/l
Contaminants of potential Concern: Radium-226

WWTP influent: Radium - 226:
Average: 21.6 Bq/l; Maximum: 55.4 Bq/l

WWTP solids dewatering: Radium - 226:
Average: 900 - 8200 mg/l
Maximum: 1,800 – 17,000 mg/l
Contaminants of potential Concern: Ra-226 and U

• Following simulations Ra-226 and U:
  
  – No permanent shielding is required around equipment
  
  – Operations: Minimize solids handling time
  
  – Wet handling methods to minimize generation of airborne particulate matter
Conclusions

- WWTP - Treatment concept will provide process flexibility
- WWTP will achieve a high effluent quality
- Minimization of waste
- Anticipated removal rates of COPC will significantly reduce loading to environment
Acknowledgements

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Thank you!