City of Yellowknife

PAG Rock Use at the SWF

Workshop – Nov. 8, 2024

Agenda

- Indigenous acknowledgement
- Introductions
- Tetra Tech to discuss current PAG rock use plans
- Core Geoscience to discuss PAG rock analytics
- Questions

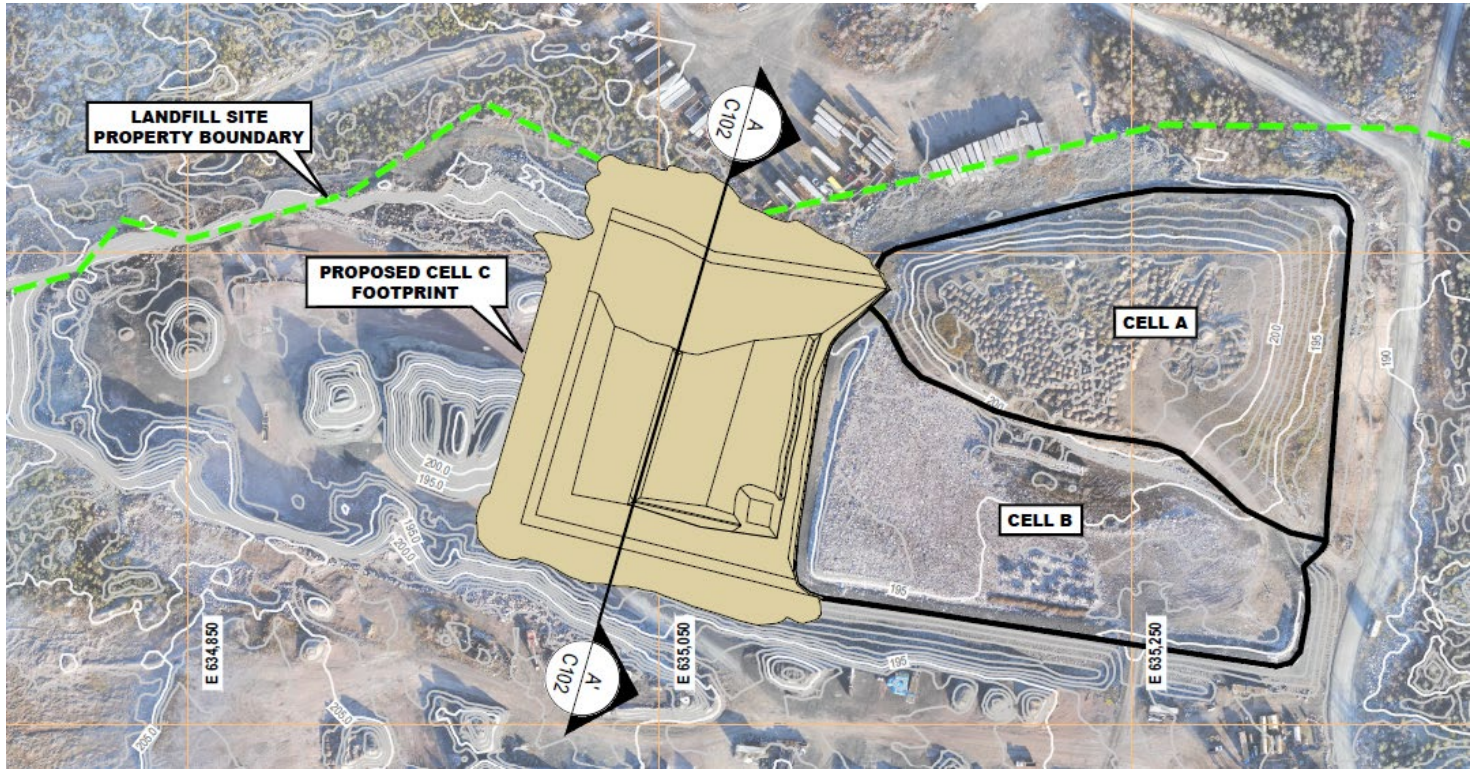
City of Yellowknife
Landfill Cell C (3)
Proposed Design and Potential for Use of PAG Material

TETRA TECH

November 2024

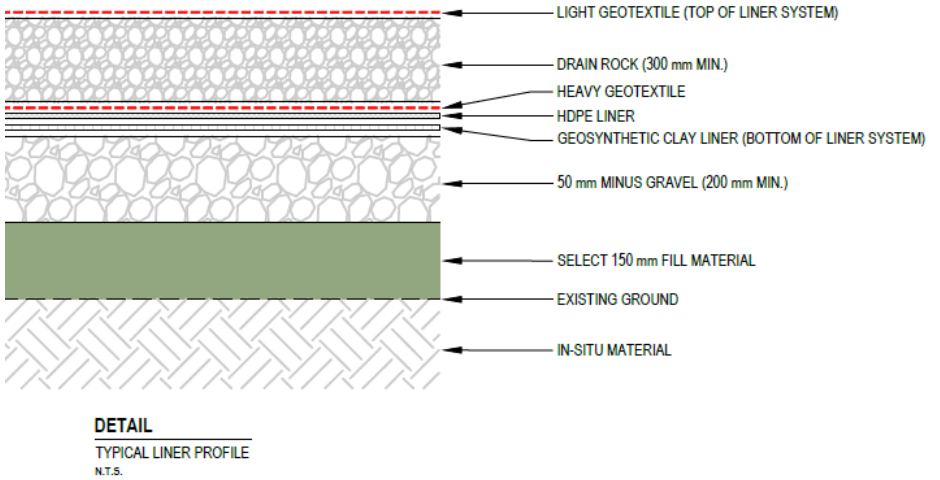
Project Overview

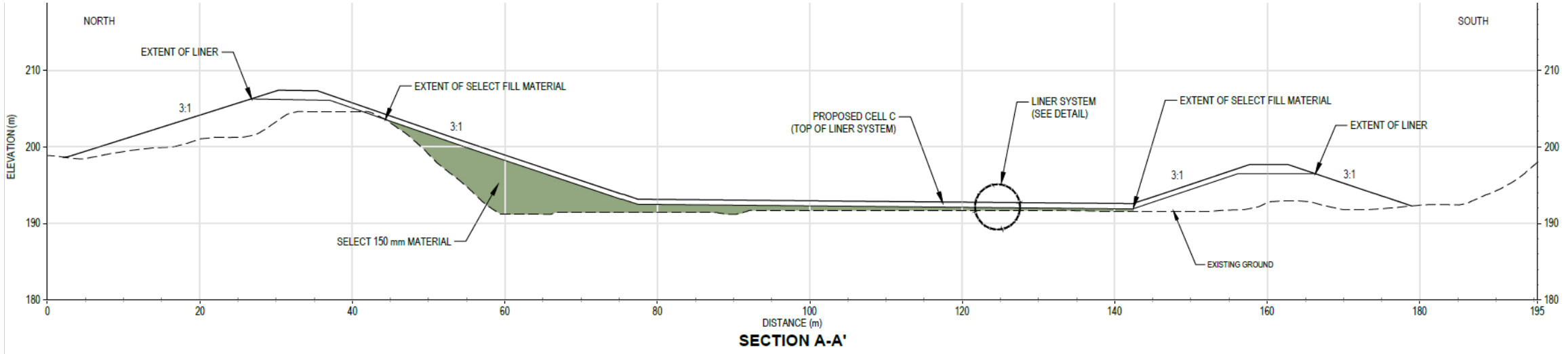
- Proposed Cell C (3) is west of existing landfill Cells A and B.
- Located in former quarry area, where PAG materials are currently stockpiled.
- Detailed design underway. Tender over winter 2025. Construction planned for 2025.



Proposed Landfill Cell Design

- Composite liner system
  - Geosynthetic clay liner (GCL) and HDPE (60 mil geomembrane) liner
- A significant volume of ‘Select Fill Material’ (shown in green) is required.
- Option for PAG material to be used as Select Fill Material?
- Material to be fully encapsulated beneath the liner but not in direct contact with the liner
  - Below a buffer layer of gravel.





HELP Modelling

- Hydrologic Evaluation of Landfill Performance (HELP)* modelling to anticipate liner performance.
- Modelled two scenarios:
  - Scenario 1 - Initial conditions with minimal waste and cover material over the liner.
  - Scenario 2 - Final conditions with waste and final cover/cap in place.
  - Both scenarios incorporate the proposed liner design.
  - Conservative assumptions include:
    - 2 pinholes/hectare and ‘poor’ installation of the geomembrane liner.
    - Maximum leachate elevation on liner modelled to be 4 m, is greater than the operational maximum head of 0.3 m
    - Average head on top of the LDPE cover is modelled to be 48 mm in depth, which is an order of magnitude higher than that which will be used as a performance standard for the design of the final cover system.
- Anticipated average annual percolation (or leakage) through the liner associated with the conservative assumptions outlined above:
  - Scenario 1 = 0.0070 m3 (7 Litres per year)
  - Scenario 2 = 0.0055 m3 (5.5 Litres per year)

Landfill Design, Construction, Operations, and Closure Considerations

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- Design
  - Composite liner system.
  - Leachate collection and removal system.
  - Buffer layer of gravel.
- Construction
  - Qualified contractor selection process.
  - Construction Quality Assurance (CQA) plans and field inspections.
  - Dipole leak detection to identify defects or damages in the installation process.
- Operations
  - First lift of waste (e.g. 2 to 3 metres) to include ‘soft’ waste only (no sharp or heavy items that could potentially puncture the liner).
  - No compaction equipment on the first lift .
  - Maximum leachate elevation (head) on liner of 0.3 m.
  - Typically landfills are considered an anaerobic environment (e.g. no oxygen).
- Closure & Post-Closure
  - Once final contours are reached, the landfill will require a final cover (cap) system to be designed and constructed.
  - Minimizes infiltration into the landfill, thus reducing the potential for further leachate generation.
  - Post-closure inspections and maintenance required.
- Limitations
  - If the liner system is damaged, there is no feasible way to repair it once landfill operations have commenced.

City of Yellowknife Solid Waste Facility
Proposed Expansion & PAG Investigation

- The City seeks to expand the SWF to the NWT Quarry pit for Cell C
  - Stockpiled material located in the NWT Quarry pit and adjacent undeveloped area have previously been identified as potentially acid generating (PAG)
- CoreGeo collected samples in June and August of 2024 for metal leaching (ML) and acid rock drainage (ARD) characterization of both stockpiled and in situ materials
- Two rock types were visually identified on site:
  - Local, mafic volcanics (in situ & stockpiled)
  - Imported, felsic intrusive rock (stockpiled)
- Representative samples were collected based on the mine environmental neutral drainage (MEND) program guidance (Price, 2009)
- 18 samples were sent for laboratory analysis:
  - Inductively coupled plasma mass spectrometry (ICP-MS) trace elements
  - Acid-base accounting (ABA)
  - 24-hour shake flask extraction (SFE)
  - Mineralogy by x-ray diffraction (XRD)
  - Toxicity characteristic leaching procedure (TCLP)

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Proposed Expansion & PAG Investigation

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Sampling Results

Acid Rock Drainage Potential

- In situ and stockpiled mafic rock are determined to be PAG or uncertain material
- Imported stockpiled felsic rock determined to be non-acid generating (NAG)

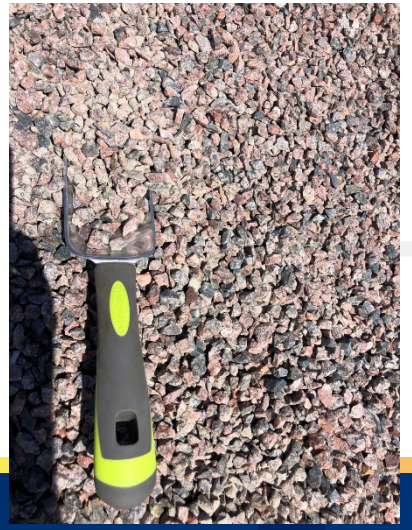
Summary of ABA Results		felsic rock	mafic rock	mafic rock
Parameter	**Unit**	stockpiled	stockpiled	in-situ
Paste pH	pH units	9.20	8.95	9.58
Total Sulfur	%	0.12	1.25	0.35
Total Carbon	%	0.13	0.10	0.13
Neutralization Potential (NP)	kg CaCO3/tonne	12	14	15
Net Neutralization Potential (NNP)	kgCaCO3/tonne	8.25	-24.36	4.06
Maximum Potential Acidity (MPA)	kgCaCO3/tonne	3.80	38.50	10.90
Neutralization Potential Ratio (NPR=NP/MPA)	-	3.20	0.38	1.37

NPR < 1 = PAG
1 < NPR < 3 = uncertain potential for ARD
NPR > 3 = NAG

Average Results

Local mafic bedrock & stockpiled material

Imported, felsic stockpiled material



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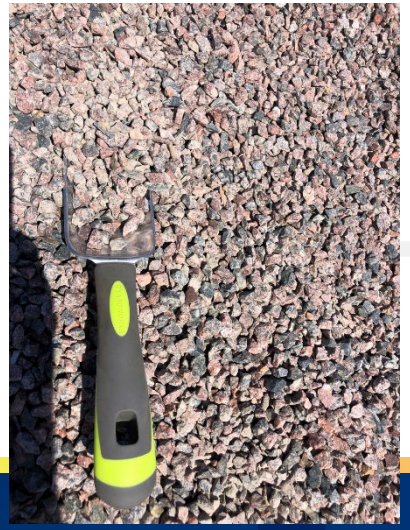

Metal Leaching Potential

- Shake flask extraction (SFE) results compared to CCME Water Quality Guidelines for the protection of freshwater aquatic life (long term)

  → Limited leachable metals found in stockpiled or in-situ materials

  1) YLF-12-2 (stockpile 12, mafic rock)
     - Ni (0.093 mg/L) exceeded CCME guideline (0.025 mg/L)
     - Cu (0.110 mg/L) exceeded CCME guideline (0.002 mg/L)

  2) YLF-11-1 (stockpile 11, mafic/felsic mix)
     - pH (4.58) outside of CCME pH range (6.5 - 9)
     - Fe (10.7 mg/L) exceeded CCME guideline (0.3 mg/L)
     - Function of weathering

- Samples passed toxicity characteristic leaching procedure (TCLP) tests

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Findings

- Based on ABA results, the local, mafic, Crestaurum Formation rock is anticipated to generate acidic conditions if it is in contact with water under normal atmospheric conditions

PAG Material Management

Current management

1) Surface water diversion from NWT Quarry area by surface grading and berms to minimize surface water ponding and runoff towards the area

Management options for facility expansion

2) Stockpiled materials used for construction of base layer in Cell C (Tetra Tech design)
3) Stockpiled materials removed from site

Reference

Price, William A., 2009. *Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials.* MEND Report 1.20.1.

Thank you!