

Managing an Historical Landfill

Frans Hettinga, Mandi Parker

complex world CLEAR SOLUTIONS™



Using a Holistic Approach to Assessment and Management of an Historical Landfill

1: Mandi Parker, Corporate Sustainability Manager, City of Lethbridge

- Introduction: City of Lethbridge
- Current set up of municipal waste management
- Former Landfills, including the Northside Closed Landfill
- Brief site history

2: Frans Hettinga, Principal Specialist, Tetra Tech Canada Inc.

- Site description, conceptual site model
- Typical closed landfill issues; leachate, landfill gas, groundwater quality impacts, runoff, erosion, breakouts, how to monitor
- Managing risks, options to move forward



Lethbridge

- Ft Whoop-up in 1869 (previously named Ft Hamilton)
- Founded in 1885
- Regional Centre in 1905
- Built around CPR, agriculture, coal mining
- Currently hosts: two federal research stations, a university, college, agrifood industry, retail, service and hospitality
- 101,482 people (2019)
- Waste management has evolved with the growth of the City



Current set up of municipal waste management



- 5 km north of the City
- Currently called City of Lethbridge Waste and Recycling Center
- Class 2 landfill; also industrial soils cell, closed Class 3 landfill, compost pad, material recovery facility, drop off facilities, waste transfer station, admin building and education center
- Last Coulee landfill for the City
- Future projects: landfill gas capture system, hydrovac disposal, Class 1 compost

Waste management was different in the past...



- Several (suspected) dumps/landfills
- Known: Northside Closed Landfill, Centre Site Closed Landfill
- Suspected: several others; locations to be confirmed
- In common: limited or no construction information or operational records

Focus on Northside Closed Landfill



- City owned from 1972-1985
- Was landfill prior but smaller footprint
- Estimated 550,000 tonnes of various wastes
- Approximately 12.5 ha
- Waste thickness up to 35 m in an existing coulee behind a soil berm
- No synthetic or clay liner
- No leachate management
- Cap placed in 1986 by Alberta Environment (0.6 – 1.0 m thick)

Current Status

- Vacant land except for adjacent AltaLink substation
- Publicly accessible but not formally a park
- Surrounding land mainly parkland
- Residential neigbourhoods approximately 300 m from waste footprint
- Groundwater, leachate and vapour monitoring network
- Waste is capped; cap and drainage improvements were made
- Landfill gas (LFG) collection trench in place with passive venting
- Ongoing monitoring and risk management

TE TETRA TECH

Listing of Projects over the Years

- 1977 Solid Waste Disposal Study
- 1982 Lethbridge Landfill Site, Gas and Leachate Assessments
- 1988 Landfill Delineation for a proposed North Lethbridge Development
- 2000 Landfill Characterization Study
- 2001 Leachate Monitoring Plan
- 2007 Methane Mitigation and Migration Plan

- 2008 Coulee Failure Report, EBA Engineering Consultants Ltd.
- 2010 Gas and Leachate Management Strategy
- 2012 Site Characterization and Remedial Approach
- 2014 Drainage installation and venting system
- Various Years 2001 to 2019 Annual Monitoring



Recent Activities



- Ongoing monitoring of liquid (groundwater and leachate) levels, groundwater and leachate quality and LFG
- Well installation within the waste footprint and leachate recovery trials
- Drilling to further assess groundwater flow patterns and groundwater quality proximate to the site
- Prepared a conceptual site model (CSM) and strategy to manage risks

(Closed) Landfills are Unique



- Not your "regular" contaminated site
- They don't go away; monitoring programs need to be pragmatic, simple and effective
- Consider how they are constructed, how they behave and how they are best managed

Building a CSM



- Several drilling programs over the years at the Northside Closed Landfill
- Clay present beneath waste but extent of it not always clear
- Complex geology with various glacial deposits, pre-glacial sands and gravels followed by bedrock
- Coulee setting with exceptional large vertical profile and deep groundwater table
- Top of the bedrock is above the Oldman River level

CSM basics

- Sources: landfill waste, leachate and LFG including non-methane organic compounds
- Leachate present in significant thickness and has variable composition across the site
- Various release mechanisms and pathways possible; erosion, runoff, leachate infiltration and groundwater migration to off site receptors, LFG emissions



Conceptual Site Model Summary

Release Mechanism	COPC	Migration Pathway	Potential Receptor	Exposure Pathway
Leachate infiltration into foundation or through cover	Nutrients and inorganics; metals; PHCs; VOCs.	Migration vertically to groundwater then carried with groundwater flow.	Human users of water (i.e., water well); aquatic life.	P1 - Migration to off-site groundwater user or receptor (i.e., well/waterbody).
		Direct seepage from landfill to runoff.	Aquatic life; human users of site.	P2 - Migration to surface waterbody (e.g., river) or direct exposure to human users of site.
LFG emissions	Methane, H ₂ S, NMOCs; climate change effects.	Migration upwards through cover.	Human users of site; terrestrial receptors.	P3 - On-site surface emissions.
		Migration laterally above water table, or volatilization from dissolved constituents in groundwater.	Human users of site; enclosed buildings.	P4 - Migration to on-site or off-site receptors.
Erosion	Nutrients and inorganics; metals; PHCs; VOCs.	Carried with runoff or via dust.	Human users of site; terrestrial receptors; aquatic receptors.	P5 - Direct exposure to waste or leaching to surface water.

Note:

PHC - petroleum hydrocarbons

NMOC - non-methane organic compounds

VOC - volatile organic compounds

Current Monitoring Program

- LFG monitoring
- Leachate monitoring and sampling
- Groundwater monitoring and sampling
- Seepage and erosion monitoring





Network of more than 60 soil vapour probes, groundwater monitoring wells and leachate wells

We are getting data, now what?

- Evaluate (change in) groundwater levels, flow patterns
- Review fluctuations in leachate quality and level
- Look for leachate impacts in groundwater, trends
- Compare LFG readings to trigger levels for methane

Are the results in line with previous post-closure information? Is the program still effective?

Do we need to consider corrective actions?

The source of all evil...



- Leachate is liquid that exist as part of waste in a landfill
- Composition varies depending on age of landfill and type of waste
- At the Northside Closed Landfill: highly saline, with organic contaminants (e.g. hydrocarbons, solvents) and deeply anoxic (methanogenic)
- Useful parameters to evaluate potential groundwater quality impact: chloride, boron, indicators or anoxic conditions (nitrate, manganese, iron, sulphate, ammonia), DOC, VOCs
- Less useful: water treatment related parameters (COD, BOD, TKN), most metals

TE TETRA TECH

Data evaluation considerations

- Comparing to generic guidelines is not necessarily useful as upgradient/background groundwater is highly saline (TDS ~5,000 mg/L), with nitrate >200 mg-N/L and exceedances for various metals (manganese, copper, selenium, uranium)
- Focus on parameters that are abundant in the leachate (DOC, ammonia) and mobile (chloride, boron)
- Understand which VOCs may be present in older landfills and why (e.g. chlorinated solvents and breakdown products like vinyl chloride)



Data evaluation considerations

 Consider redox conditions and effects on leachate and groundwater quality





Current Status

- To date no indication that the groundwater quality at existing downgradient monitoring wells is significantly impacted by leachate
- Methane gas migration is not of concern
- The CSM, additional assessments and ongoing monitoring results are helping to manage the site as efficiently and effectively as possible
- A risk management plan has been largely implemented
- A decision making process is underway related to further leachate management

Questions?



Mandi Parker, P.Ag. Corporate Sustainability Manager

P: 403-320-4798 E: <u>mandi.parker@lethbridge.ca</u>

www.lethbridge.ca

Frans Hettinga, BSc | Principal Specialist Direct +1 (403) 723-6860 | Mobile +1 (403) 899-1469 | Frans.Hettinga@tetratech.com

Tetra Tech | Leading with Science[®] | Solid Waste Management Practice Suite 110, 140 Quarry Park Blvd SE | Calgary, AB T2C 3G3 | tetratech.com

