

Bio-remediation of 6,000 m³ Solvent Impacted Soil

Raymond, Alberta

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Project Description

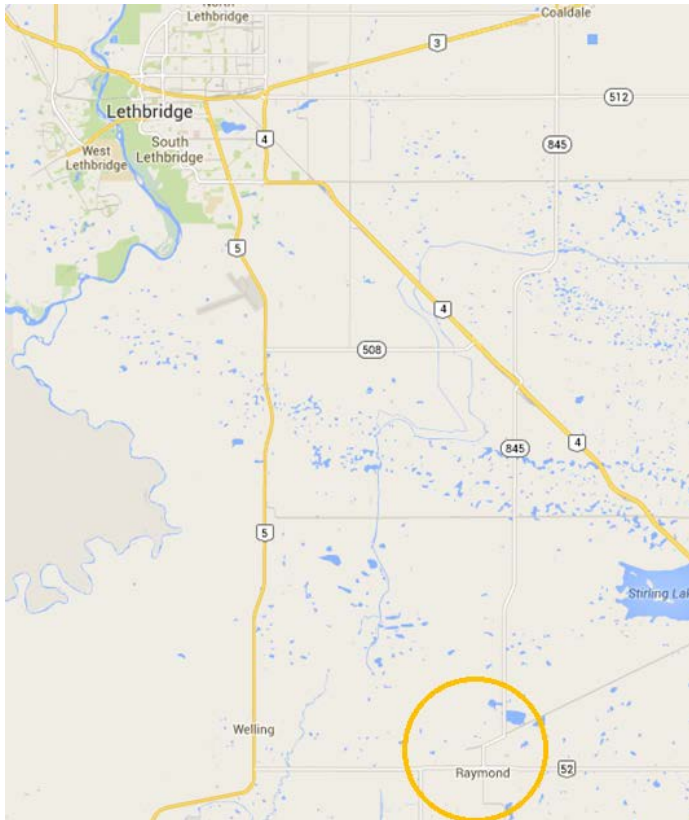
- Former Solvent Recycling Plant
- Extensive soil and groundwater quality impact
- Decommissioning initiated in 2010
- Remedial Action Plan (RAP) based on ex-situ bio-remediation on site
- Issues: high VOC concentrations, limited space, potential odour issues

Presentation Outline

- Chronology of events
- What we knew from compliance monitoring
- Pilot testing
- Remedial action

<1980

- Vacant land along CPR railway
- East of downtown Raymond, Alberta



1980s

- Technisol, Inc. (TriWaste) initiated operations as a solvent recycling facility in 1986
- Predominantly dealing with distillable paint wastes



1990s

- Plant expanded in 1992
- Ownership transferred to Newalta Corporation in 1996
- Ongoing compliance soil and groundwater monitoring



2009/2010

- Discontinued operations
- Initiated decommissioning process in accordance with EPEA Approval
- Discussions with ESRD
- Further assessed soil and groundwater quality
- Closure plan was accepted
- RAP based on excavating impacted soil and landfilling

Assessment on-site and off-site



- Changed conceptual RAP to treatment on-site in covered bio-piles
- Rationale: anticipated lower costs; a more sustainable option; and no need to transport low-flashpoint soil
- Initiated removal of above and underground infrastructure, railway spur
- Submitted plan for pilot testing
- Crushed and stockpiled concrete/rebar (floors, foundation elements, berms)

- Landfilled the crushed concrete
- Initiated pilot test in vacant building



- Tier 2 assessment (DUA and FAL exclusion)
- Decommissioned monitoring wells in work area
- Prepared site for remediation
- July – December: excavate, treat, test, backfill



- Finished treatment of remaining bio-piles
- Removed piping, blower, liners, grading
- Reporting



What did we know in 2009?

- Compliance monitoring data since early 1990s
- Groundwater table has fluctuated considerably
- Significant impact on-site and not much improvement
- Only trace concentrations VOCs off-site; mainly chlorinated compounds
- Soils are tight clay till
- Evidence of biodegradation

Attenuation–Simplified Redox Ladder

Redox Sensitive Parameter in Groundwater	Comments
Dissolved Oxygen (DO)	Questionable value; hard to measure the low levels that matter
Nitrate	>0.5 mg/L often indicates oxic conditions
Dissolved manganese	Becomes mobile after nitrate and oxygen are consumed >0.1 mg/L indicates suboxic conditions
Dissolved iron	Next in line to mobilize >0.1 mg/L indicates anoxic conditions
Sulphate	Sulphate reduction (relative to background) indicates anoxic conditions
Methane	If present, deep anoxic conditions exist

2011 Groundwater Quality Data

All in mg/L	Background (MW23)	Plume (MW09)
TDS	8,800	2,090
Nitrate-N	3.25	<0.01
Dissolved Mn	<0.02	1.66
Dissolved Fe	<0.05	10.4
Sulphate	5,820	146
VOCs (max.)	n.d.	47.6 (toluene)
Inferred redox	Oxic	Anoxic

Redox/attenuation conclusions:

- Anoxic conditions within plume
- Sulphate is abundant and plays an important role
- Attenuation is likely slow when sulphate is depleted
- System is deprived of oxygen; bio-remediation by aeration?

VOC breakdown

Impacts were predominantly due to spills and releases of glycols and “Gunwash”; a mixture of toluene, methanol, various ketones, etc. with minor benzene and chlorinated VOCs.

Compound	Estimated Half-lives (days)*	
	Aerobic	Anaerobic
Acetone	1 – 7 days	4 – 28 days
Toluene	4 – 22 days	56 – 210 days
Methanol	1 – 7 days	1 – 5 days
Ethylene glycol	2 – 12 days	8 – 48 days
Methylene chloride	7 – 28 days	28 – 112 days
1,1-DCA	32 – 154 days	128 – 616 days

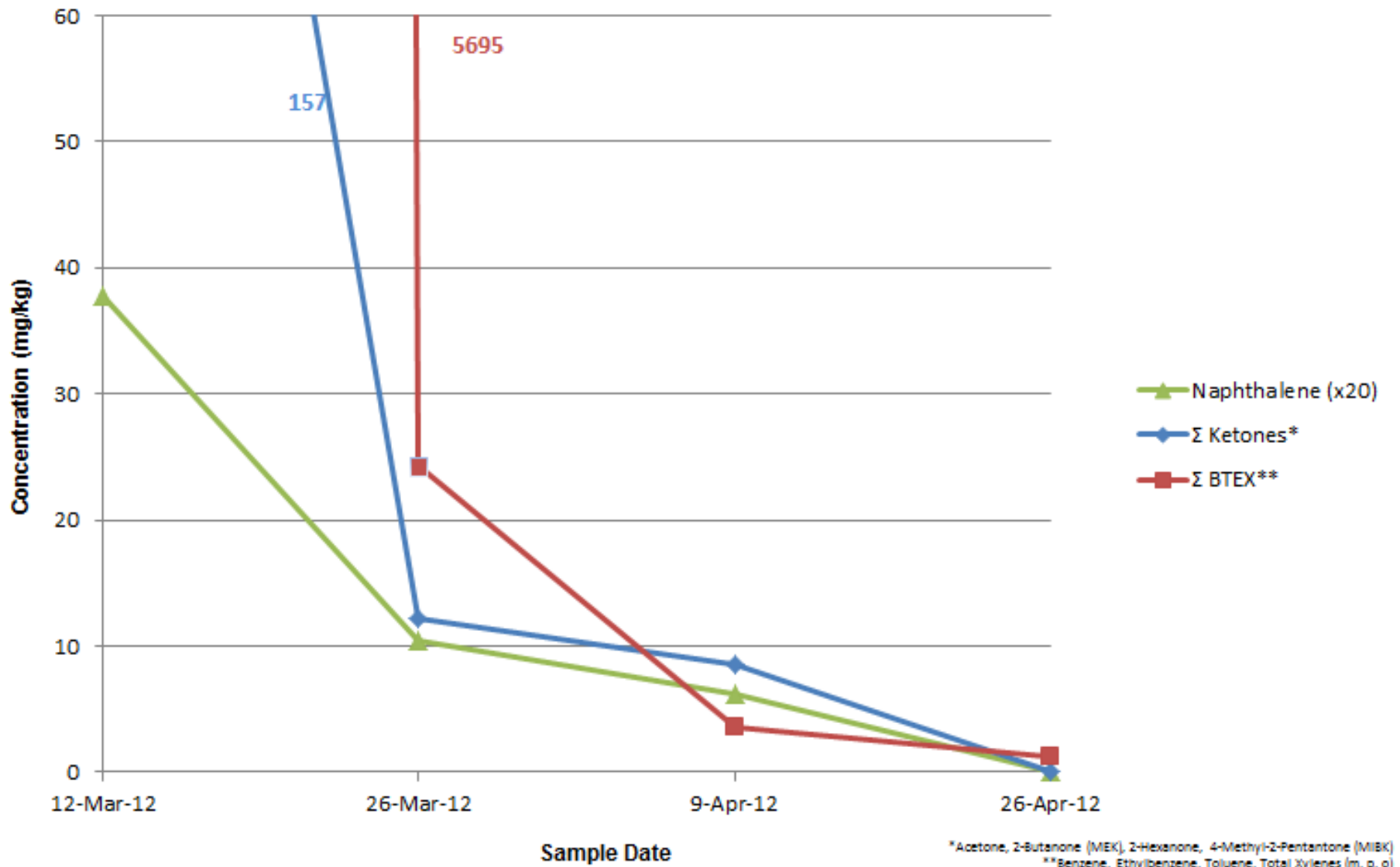
* Howard et al. (1991). Environmental Degradation Rates.

Pilot Testing

- Excavated 20 m³ impacted soil
- Placed in covered piles in controlled environment
- Three piles:
 - a. Nutrients
 - b. Oxygen release compound
 - c. No amendments
- Vapour recovery/ treatment
- Periodic mixing and sampling



Graph 1 : Bio-pile Treatment Pilot Test - Treatment Cell #1 (Nutrients)



*Acetone, 2-Butanone (MEK), 2-Hexanone, 4-Methyl-2-Pentanone (MIBK)
 **Benzene, Ethylbenzene, Toluene, Total Xylenes (m, p, o)

Pilot Test Results

- VOCs decreased in all three piles
- Sharpest decrease with nutrients
- Recalcitrant VOCs were naphthalene (expected) but also methanol and glycols (not expected)
- Vapour treatment was effective

Plan to Upscale the System

- Use ARVE (Active Release Vapour Extraction) unit to mix and break up soil
- Place in covered bio-piles (windrows) east of impacted area
- Add nutrients
- Periodically aerate with Micro-enfractionator
- Backfill when soil meets guidelines
- Start over with a new batch
- Meteo station, air quality monitoring

July 2013 Start

- Site preparation complete
- Rough/wet start – Needed to remove 130 m³ water first; ARVE unit clogged due to wet clay
- Plan B – place directly in windrows



Four batches treated; ~6,000 m³



Water Management



In Conclusion

- Pilot testing was good indicator of real situation
- 6,000 m³ successfully excavated, treated and backfilled
- Water disposal needed at the start but not during treatment
- Only concrete, liners and GAC landfilled
- No odour complaints
- Zero safety incidents

Issues/unforeseen

- Boulders, rocks and foundation elements caused extra work
- Glycols and methanol at high concentrations are recalcitrant
- Change in soil conditions on east side; greater volume impacted and less room for windrows
- Ran out of time/season; overwintering of windrows, but may have helped treatment

Lessons Learned

- Covering windrows is labour intensive
- Wet clay clogs equipment
- Micro-enfractionator leaves thin layer untouched; required additional treatment and confirmatory testing
- Creative water management pays off



Regular \$59.99

Overall Rating



5 out of 5

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Questions?



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