

# Case Studies in Risk Management Methods as a Component of the Remedial Process

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## Agenda

- Issues Summary
- Case Study # 1 –RA of DNAPL site (combined with remediation)
- Case Study # 2 – Chlorinated solvents and vapour intrusion RA (combined with remediation)
- Case Study # 3 – Due diligence RA using MGRA model (combined with remediation)
- Case Study # 4 – Streamlined Tier 3 RA
- Summary of opportunities for risk assessment



## Acronyms

BTEX – benzene, toluene,  
ethylbenzene & xylenes

DNAPL – dense non-aqueous  
phase liquid

DQRA – detailed quantitative  
risk assessment

HVAC – heating, ventilation  
and air conditioning

MGRA – modified generic risk  
assessment model (the  
“approved model”)

MOE – Ontario Ministry of the  
Environment

PCBs – polychlorinated  
biphenyls

PHCs – petroleum  
hydrocarbons

PQRA – preliminary  
quantitative risk  
assessment

PSF – pre-submission form

PSS – property specific  
standard

RA – risk assessment

RMP – risk management plan

RSC – Record of Site  
Condition



## Issues Summary

- General trend towards more stringent soil and groundwater standards
  - Some standards (Ontario) more difficult to achieve through remediation alone
  - Driving more risk assessments, often combined with remediation
- New guidance on vapour intrusion
- New modified generic risk assessment (MGRA) model in Ontario
  - MOE working on next (revised) version of model
- Ongoing efforts to streamline RA approvals



## Issues Summary

- The big questions asked:
  - Can I get approvals for risk assessment?
    - Answer: Any site can be approved with appropriate (proven) risk management
  - Can I get approvals in a timely manner?
    - Answer: There are ways of reducing number of reviews and overall time lines. In Ontario, approvals range from 4 to 18 months from first submission to MOE, excluding external delays



## Issues Summary

- Levels of assessment
  - Tier 1 – use of generic standards
  - Tier 2 – (limited scope risk assessment, PQRA)
    - In Ontario uses MGRA (the “approved model”) or based on community assessment report.
  - Tier 3 – full risk assessment submission (DQRA)
  - Streamlined Tier 3 (Tier 2 ½?)
    - Under development by Ontario MOE
    - Opportunities currently exist to achieve faster reviews and approvals



## Case Study #1 – DNAPL site

- Condominium development requiring RSC
- Near former coal gasification plant
- Coal tar DNAPL at bedrock interface
- Various metals and organics in soil and groundwater from historic industrial use
- Property surrounded by heritage buildings
  - Inability to remediate coal tar from off-site
  - Considerations for disturbance of adjacent heritage buildings
- Assessment goal: 3 levels of underground parking; leave coal tar in place



## Case Study #1 – RA Approach

- Coal tar challenges addressed in RA / RMP
  - Media of interest expanded to soil, groundwater and coal tar
  - Potential vapour intrusion from all media
  - Potential leakage of DNAPL into underground structures
  - Potential direct worker contact with coal tar or vapours in confined spaces
  - Potential migration of coal tar
  - Uncertainties in extent of coal tar
  - Upward movement of impacted groundwater



## Case Study #1 – Risk Management

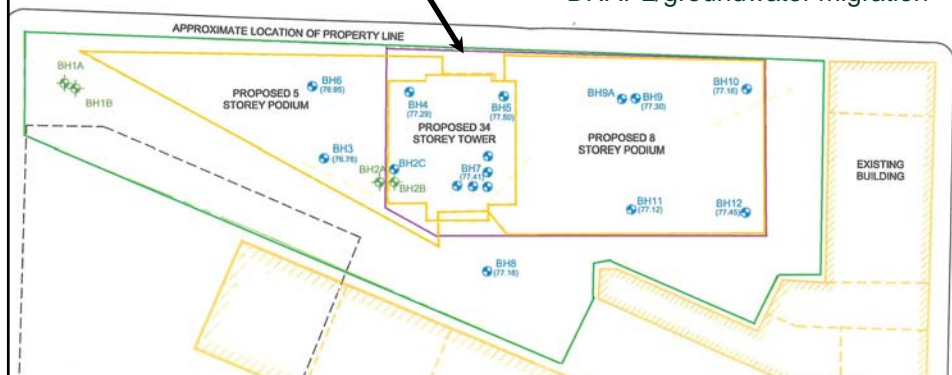
- Remediation
  - Limited to soils removed for foundation construction
- Barriers – constructed barriers to surface soils
  - Typical barriers expanded to allow for paving bricks consistent with historic character of neighborhood; above grade potted trees/shrubs
  - Utilized existing clay strata as partial barrier
    - Foundation design to inhibit creation of preferential groundwater/vapour pathway
  - Parking garage for increased ventilation

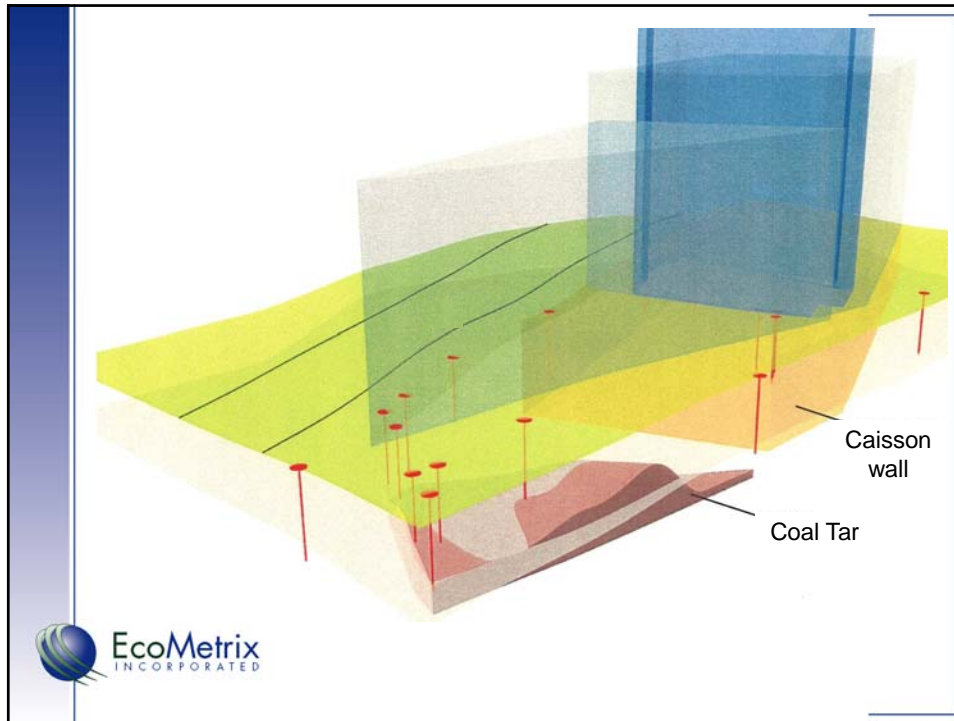


## Proposed development

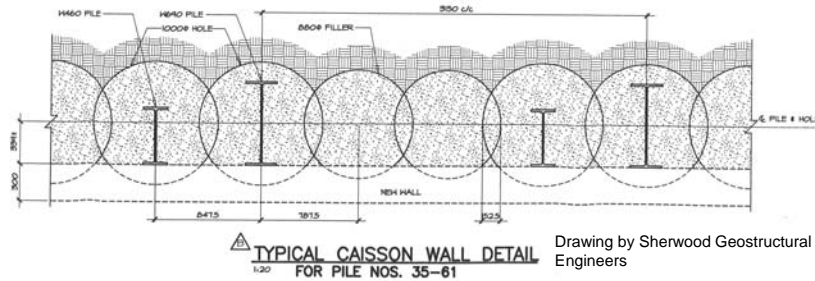
- Located underground parking to avoid DNAPL
- No subsurface structures above DNAPL (slab on grade)
  - minimize vapour intrusion & DNAPL/groundwater migration

Outline of proposed parking garage





## Parking garage design



- Continuous caissons wall extended into sound bedrock
- Interior wall designed for hydrostatic pressure with drainage and bentofix layer
- Goal to prevent groundwater seepage into structure and collect and discharge any seepage
- Monitoring program to sampling drainage



## Additional risk management for coal tar

- Worker chemical resistant PPE for potential direct contact with coal tar
- Self contained breathing apparatus and full body PPE within confined spaces in vicinity of coal tar
- No subsurface structures other than foundations in coal tar area; only parking garage or storage permitted below grade on property
- Inspections during construction by qualified professionals
  - Contingency for coal tar in base of excavation including cleaning out, grouting and sealing fractures, spray on vapour barrier applied.
  - Contingency measures were implemented due to coal tar in fractures extending to within caisson wall



## Case Study #1 – Long-term Monitoring and Maintenance

- Monitoring and maintenance of soil capping barriers
- Regular inspection of parking garage structure for leaks or structural compromise
- Regular inspection of dewatering system
- Sampling of seepage collected in parking garage drainage system
- Repair of any problems noted during inspection



## Case study # 2 – Chlorinated Solvents

- Commercial/industrial facility
- RSC required as component of sales agreement
- Full remediation of down-gradient property undertaken
- Impacts remaining beneath building
- Impacts co-mingled with (continuing?) off-site sources – full remediation impossible
- Previous indoor air sampling inadequate to draw conclusions
- Goal
  - obtain RSC on behalf of former owner



## Case Study # 2 – RA model

- Up-gradient tank farm – impacts evident
- Co-mingled plume providing carbon to fuel anaerobic degradation
- Building to remain, limiting remediation and risk management options
- Preliminary assessment conducted to scope risk management requirements
- Combine remediation with monitoring, plume migration controls and indoor air risk management





## Case Study # 2 – Remediation / Risk Management

- Adjacent property cleaned to meet Table 3 standards
- Barrier wall installed to prevent direct migration off-site
- Remediation on-site limited due to building foundation
- Intermittent pump and treat system to prevent groundwater movement around barrier
- Repair and sealing of floor slab and foundation joints



## Case Study #2 – Indoor air approach

- Roof mounted HVAC in most of unit, high ceiling space and raised construction suggest limited vapour intrusion potential
- Recommended soil vapour, indoor and ambient air sampling in accordance with MOE draft guidance – conducted in 2 seasons
- Soil vapour evaluated using MGRA based on subsurface conditions
- Indoor air compared to MOE indoor air standards
- Ambient compared to AAQC and indoor air standards



## Case Study # 2 – Monitoring & Maintenance

- Follow up indoor air monitoring
  - Results may indicate acceptable or additional air monitoring or actions required
- Groundwater monitoring of solvent degradation
- Ongoing groundwater capture and maintenance of barrier
- Contingency to vary indoor air ventilation to maintain positive pressure and retest
- Additional contingency for installation of passive venting



## Case Study #3 – Due Diligence RA

- Mixed use industrial/commercial site with PHC and BTEX compounds, PCBs, inorganics and impacts from salt storage in soil and groundwater
- Down-gradient industrial/commercial, residential, golf-course and creek
- Site to be redeveloped for industrial/commercial purposes
- Risk assessment conducted in stages and refined
- Goal:
  - Develop remediation target concentrations
  - Develop risk management options



## Case Study #3 – Preliminary findings

- Road salt caused chloride exceedances of ½ solubility in groundwater
- PHCs exceeded ½ solubility in groundwater
- Potential risks associated with vapour intrusion and soil contact
- Groundwater impacts localized; very tight till soil with low hydraulic conductivity (flow rate of ~ 0.7 m/yr)
- Hydrocarbon impacts primarily at depth
- No evidence of plume migration



## Case Study #3 – Preliminary recommendations

- Cap areas of site exceeding with potential soil direct contact risk
- Building design to manage potential vapour intrusion risks
- Supplementary site characterization
  - Fraction organic carbon in soil (for site specific modification of free product threshold)
  - Soil vapour monitoring
  - Refinement of risk management requirements based on supplemental site characterization
- More detailed evaluation of off-site migration potential



## Case Study #3 – Second Stage

- Modified Tier 2 risk assessment using MGRA (streamlined Tier 3?)
  - Additional risk management measures not in model employed by utilizing intermediate model output
  - Stratified approach employed
  - MGRA output refined based on
    - Alternate capping providing greater protection than allowed in MGRA
    - Removal of source areas and associated restrictions based on  $\frac{1}{2}$  solubility
    - Consideration for limited groundwater movement



## Case Study #3 – Third Stage

- Soil vapour monitoring conducted
- Risk assessment revisited based on results
- Soil vapour monitoring results well below criteria generated based on MGRA model



Photos courtesy of Conestoga Rovers



## Case Study #3 – Final Recommendations

- Remediation target concentrations proposed based on risk management:
  - Cap areas of the site with potential soil contact risk
  - Remediate areas of solid salt residue
  - Remediation to target concentrations including potential free phase PHCs
  - Meet target groundwater concentrations at property boundary (to protect off-site residential)



## Case Study #4 – Streamlined RA

- Agricultural site with some commercial use
  - planned commercial redevelopment
- RSC desired to support sale of land
- Uranium exceeds potable groundwater standard
- No known source; hypothesized to be mobilized from bedrock by historic farming practices



## Case Study #4 - Issues

- High water table; municipally identified wetland on-site
- Municipality responded that potable groundwater applies to site
- Municipal water available at site (currently on well water)



## Case Study #4 - Approach

- Biologist conducted site reconnaissance
  - No surface water or aquatic habitat on-site
- Municipal water supply system drawings obtained
  - Water supply available down-gradient
- MOE well records
  - Most wells deeper than site impacts
- Door to door survey
  - Eliminated potable groundwater concerns down-gradient





## Case Study #4 - Results

- Run MGRA for potable groundwater
  - Results yield target concentrations in direction of potable wells cross-gradient
- Run MGRA for non-potable groundwater
  - Generates PSSs
  - Risk management cross-gradient to monitor that groundwater at cross-gradient boundary meets potable targets; prohibition on on-site drinking water wells
- Findings presented in modified version of MGRA report template
  - Included biological survey, well water survey, discussion of potential for complete/incomplete drinking water pathway based on site hydrogeology
  - Reliance on MGRA qualifies assessment for potential streamlined review



## Summary of Opportunities for RA

- Any site can be risk assessed
  - Question is what risk management approaches are acceptable to owner versus extent of remediation desired/ practical
  - Establish PSSs as remedial targets or to address post-remediation contamination or manage in place
- Some options exist to address free product in RA where remediation is impractical
- If regulatory approval is not required, due diligence RA is best option
- New opportunities are emerging for streamlined or accelerated review by Ontario MOE with use of MGRA model
- Ontario MOE exploring process changes to improve acceptance time lines for Tier 3 RAs



## Questions?

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