RemTech 2011: BC Perspectives

Vapour Intrusion in High Density Development Mark Adamson, P.GEO, CSAP



Introduction

- Who is Mark?
 - Mark Adamson Geoscientist by training (C.Geol UK, P.Geo)
 - Environmental consultant working on contaminated Sites since 1996
 - Experience in Britain, Ireland, Canada

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 Coal gasification sites, mines, sawmills, pulp mills





Introduction

- Who is Golder Associates Ltd.?
 - Multidisciplinary consultancy with offices worldwide
 - Originally geotechnical engineering focus, but now almost all geoscience / environmental services are offered
 - Active member of SABCS BC



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Introduction

- Acknowledgements: This presentation draws on the work of
 - Science Advisory Board for Contaminated Sites in BC,
 - BC Ministry of Environment,





Overview

- Project Context South East False Creek Area and Anticipated Development Style
- Contamination Identified and Remediation Strategy Why complex?
- Residential Land Use assumptions, vs. High Density reality
- Project Specific examples of the Conflicts and Resolution
- Regulatory Instruments and Conditions
- Regulatory modifications being considered by BC MoE



Project Challenges

- Site Boundary Definition and Preferential Pathways
 - Complicates site investigation and clean up;
- Large volume of contaminated soil
 - Source removal cost prohibitive;
- Current owner was not the developer
 - What assumptions could be made about the future development?





Project Challenges Contd.

- Which vapour attenuation factors should apply?
 - Current residential attenuation seemed too conservative
- Requirements for new road adoption
 - City required soil meeting residential quality beneath new roads





- Area wide contamination
 - Typically heavy-end petroleum hydrocarbons and PAHs;
 - Can include volatile compounds "trapped" by saturated conditions.



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Proposed development:

- High Density Residential;
- Waterfront location
- Basement parking;

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Excavation of entire lot;







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SITE BOUNDARIES

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Site Boundaries

- Typical procedure for establishing Site boundary was complicated by area-wide poor quality fill;
- Clarification was provided by BC MoE Land Remediation Section;



Preferential Pathways

- Buried utilities surrounded by relatively high hydraulic conductivity zones;
- Influence on groundwater flow direction; and,
- Vapour migration.









RESIDENTIAL LAND USE

Low Density Compared to High Density

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Residential Land Use Assumptions

- Regulatory framework conceptual model single family home, differences with high density development, explain why assumptions are too conservative.
- 24 hour exposure and most sensitive human receptors (infants) assumed;





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Refresher on Vapour Investigation Design

- Measure vapour concentrations in the subsurface; then,
- Apply attenuation factors;
- Attenuation is a function of:
 - Land use;
 - Distance between the vapour source and the breathing zone;
 - Presence or absence of buildings;
- Recommended attenuation factor is 2.0x10⁻², where source is < 1.0 m from the breathing zone







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Vapour Intrusion Building Science

Canadian Mortgage and Housing Corporation, 2005

Saskatoon Research Apartment,





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Typical Dewatering – Construction Phase

This example relies on active pumping to depress the water table



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Examples of Constraints on High Density

- The Southeast False Creek Community Plan calls for a mix of high density residential and commercial development;
- Typical developments in the area comprised high rise condominiums with underground parking garages;
- Underground parking areas are typically below the water table and must either:
 - Use sumps and/or active pumping to locally reduce the water table elevation; or,
 - Use watertight construction to prevent groundwater ingress
- Specific constraints on development for subject site, cost of excavation, risk based approach,





Examples of Project Complexity

- Specific constraints on development for such sites include:
 - The cost of disposal of contaminated soils to facilitate parkade construction and/or to achieve regulatory compliance with numerical standards (\$20 million);
 - Implementing a risk based approach required agreement from the City who would ultimately adopt new roads:
 - The site was remediated by the current owner, but would be developed by others;
 - Current owner wanted to implement remediation and achieve regulatory compliance before completing the property transaction;





Regulatory Instruments

- Project objective was to obtain a Certificate of Compliance;
- All Certificates come with conditions;
- Vapour investigation must make assumptions regarding future development and these assumptions are highlighted in the Certificate;
- Example wording:
 - The site was not contaminated with respect to substances in vapour provided that the conditions at the site as described in the documents listed above are maintained <briefly describe site conditions, (e.g., slab on grade)>. Remediation of the vapour was therefore not required.>







A typical north to south cross section showing fill profile and location of soil contamination relative to BC commercial land use soil standards

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Scenario #1: Parking garage, 3 m deep with drain tile and sumps to depress the water table.

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Scenario #2: Double parking garage, 6 m deep with drain tile and sumps to depress the water table.

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Lateral Attenuation

- Vapour phase contamination may move laterally as well as vertically;
- Investigation must identify nearby sources (within 30 m recommended);
- Little formal guidance / agreement on applying attenuation factors laterally;
- MoE have indicated that sub-slab attenuation factor (0.02) may be used in some circumstances.





New Provincial Standards

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Potential Amendments to BC Regulation

- BC MoE is planning an omnibus updating of environmental quality standards;
- The implications for vapour assessment on high density residential developments are summarised here;





Potential Amendments to BC Regulation

- The draft "high density residential" land use definition is as follows:
- High density or commercial land use, depending on the scenarios and exposure pathways, would apply to
 - Lodges,
 - Hospitals,
 - Apartments and condominiums (greater than three-storey's),
 - Prisons and correctional centres, and
 - Community centres (when playgrounds, fields and parks are excluded),
- Providing there are appropriate exclusionary factors for certain site uses.





Vapour Intrusion Building Science

Canadian Mortgage and Housing Corporation, 2005

Saskatoon Research Apartment,





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High Density Residential Exposure Model



- There are differences depending on whether the apartment has an underground parking garage as part of the site development.
- For the scenario with a parking garage, the primary use of the garage is parking; however, garage use may include:
 - Storage units or laundry rooms.;
 - Maintenance activities (of elevators, ventilation systems, etc.)
 - A security attendant may also enter the garage on a regular basis.

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High Density Residential Exposure Model



- A parkade may or may not have an attendant,
- Attendant would spend the majority of a work shift in a booth or kiosk,
- Booth typically has an independent ventilation system.
- Potential exposure to volatiles from subsurface contamination is considered inconsequential.







SAB Recommendations

	Apartment without Parking Garage	Apartment with Underground Parking Garage or Above-grade Open Air Parkade	
	Dwelling Unit	Dwelling Unit	Garage
Vapour Attenuation Factor (AF)	Possible New Attenuation Factors ("AF1")	Possible New Attenuation Factors ("AF2")	Possible New Attenuation Factors ("AF3")
Vapour Standard Land Uses	Sch. 11 Residential Standard	Sch. 11 Residential Standard	Possible new Vapour Standard based on garage exposure



High Density Residential Attenuation

- A preliminary modeling study was completed using the Johnson and Ettinger model;
- For a parking garage scenario, the estimated median attenuation factor for the parking garage airspace is approximately **50 times less** than the current residential attenuation factor;
- SAB recommended that current attenuation factors be reduced by a factor of 50 when considering vapour exposure in the parking garage and dwelling units.





Summary





Summary and Conclusions

- Area wide determination provided clarification on owner's responsibilities for investigation and clean-up;
- Preferential pathways were key to understanding the groundwater regime;
- Applying single family home conceptual model to high density development with basement parking probably too conservative;
- Current vapour attenuation factors may be reduced by a factor of 50, for residential land use where basement parking garages are present;







Questions?

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