RemTech 2006

The Application of In-Situ Chemical Oxidation to Remediate Chlorinated Ethenes at Former Dry Cleaning Facilities in Alberta

by

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XCG

Outline

Terms and Definitions

- Project 1 – History, Site Assessment, Remedial Approach, Remediation, Results
- Project 2 – History, Site Assessment, Remedial Approach, Risk Assessment, Results
- Summary and Conclusions

Terms and Definitions

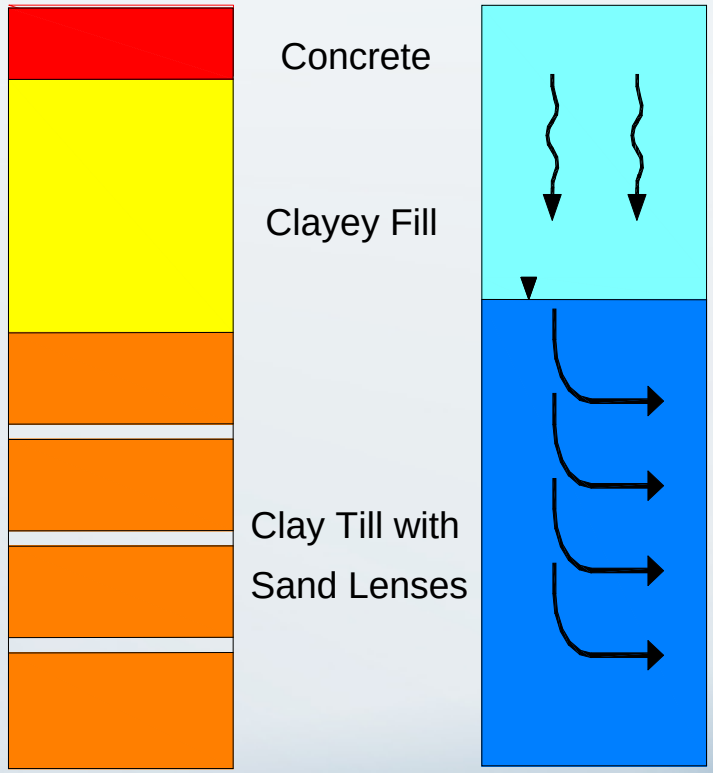
- PCE – perchloroethylene, tetrachloroethylene, tetrachloroethene
- ISCO – in-situ chemical oxidation
- CCME – Canadian Council of Ministers of the Environment. CCME commercial soil guidelines were used to assess the soil impacts

Project 1 - History

- Original tenant (dry cleaner) operated from 1978 – late 1990s.
- New retail grocery store was constructed on-site in 2002, in the area of the former dry cleaner.
- Grocery store and asphalt parking lot currently cover area of former dry cleaner.

Project 1 – Site Assessment

- Phase I ESA (2003) identified former dry cleaner as potential concern.
- Phase II ESA (2003) identified soil impacted with PCE in three boreholes at two depths.
- Additional Phase II ESA (2003) identified no groundwater impacted above standards.



Project 1 – Remedial Approach

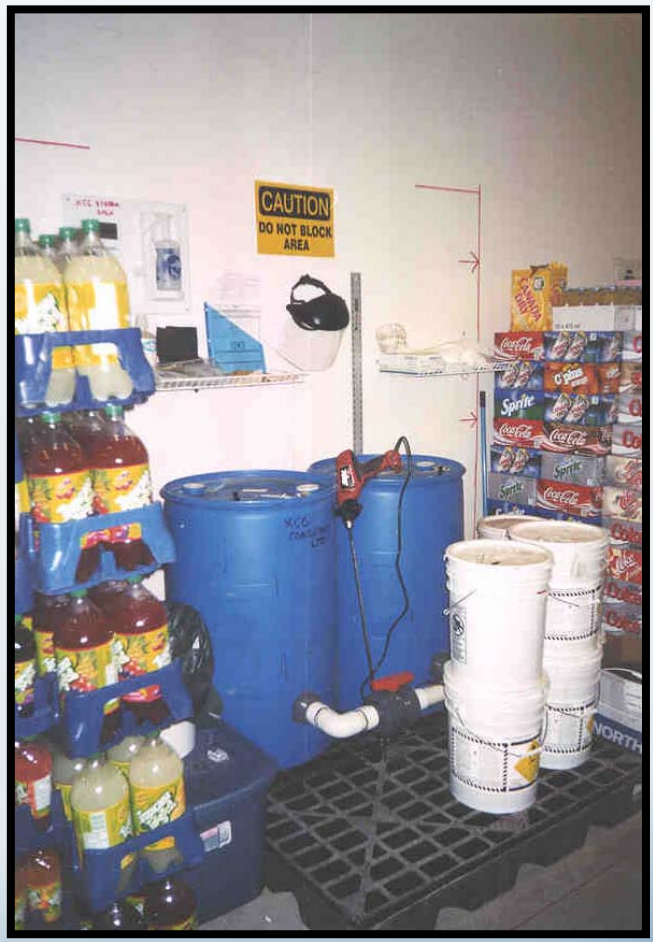
- ISCO – Potassium permanganate ($KMnO_4$)

$$4KMnO_4 + 3C_2Cl_4 + 4H_2O \rightarrow 6CO_2 + 4MnO_2 + 4K^+ + 8H^+ + 12Cl^-$$

- Solution of 2.5 g/L introduced to the infiltration tile system.
- Estimated two 14- to 17-day injections would be required over a two- to three-month period.
- Cost of conventional remediation approach (dig & haul) was 10 times that of in-situ remediation proposed by XCG.

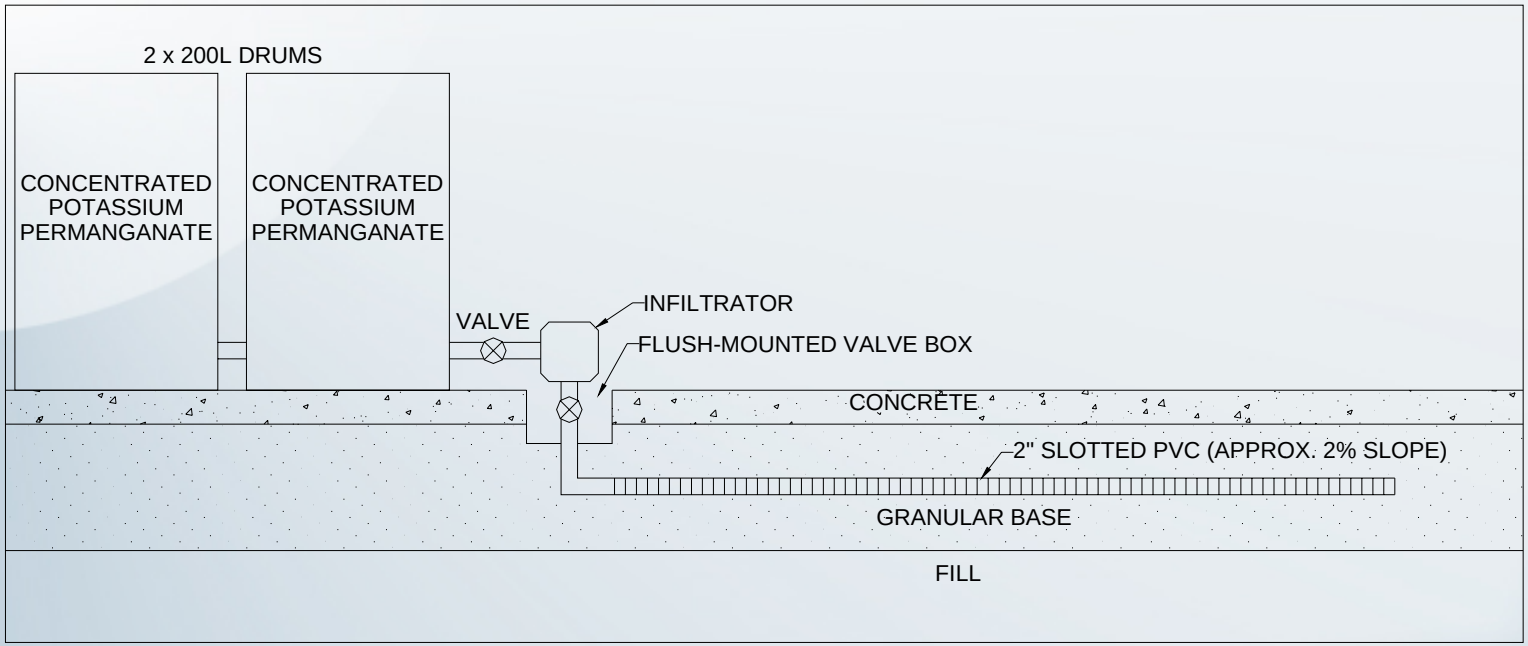
Project 1 - Remediation

- Developed health and safety plan
- Utility locates
- Design, installation, and operation of potassium mixing and injection system
- Installation of two infiltration tiles under building and one exterior
- Installation of four sampling points

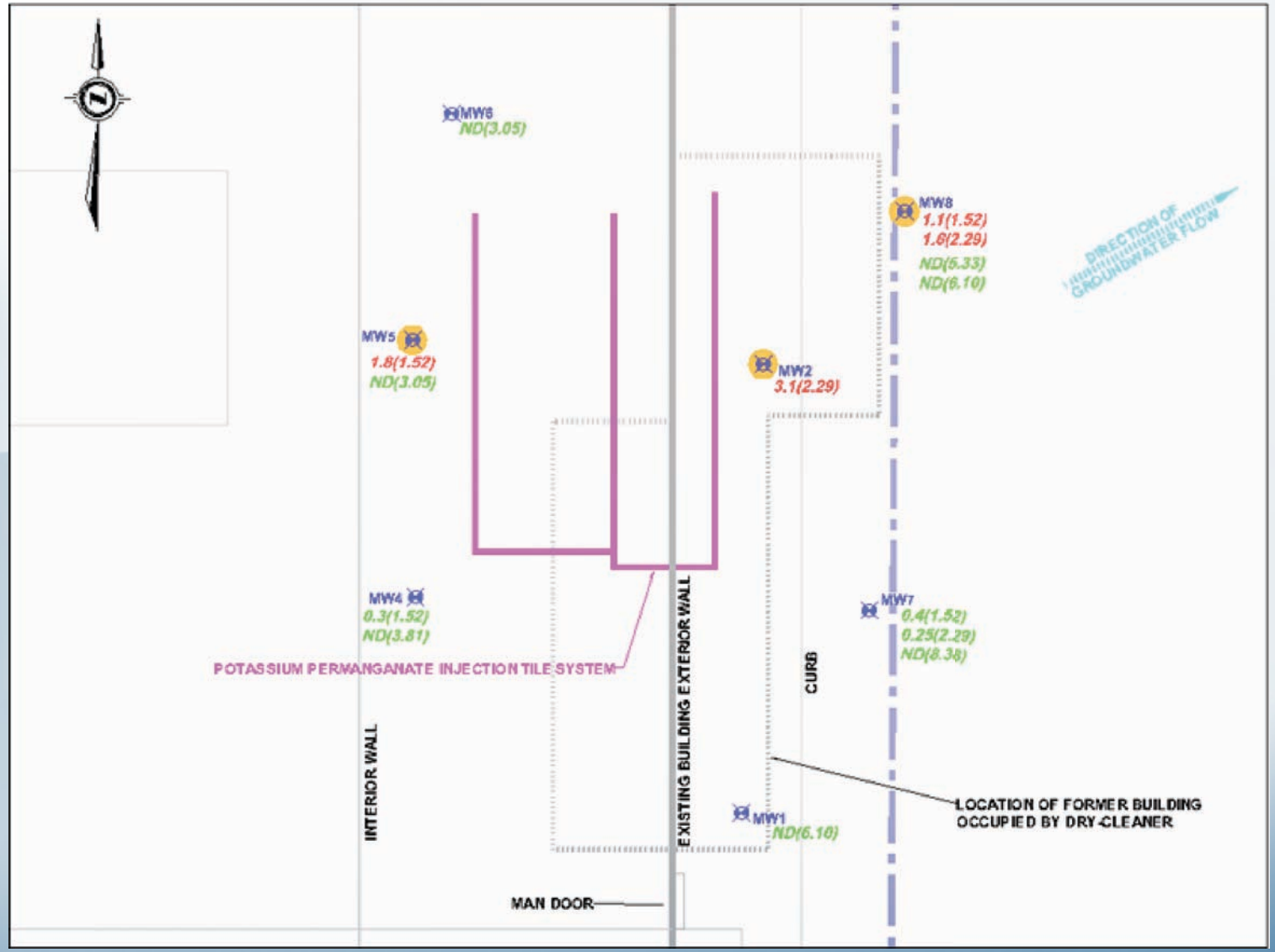


Project 1 – Injection System

Injection System to deliver $KMnO_4$



Project 1 - Results



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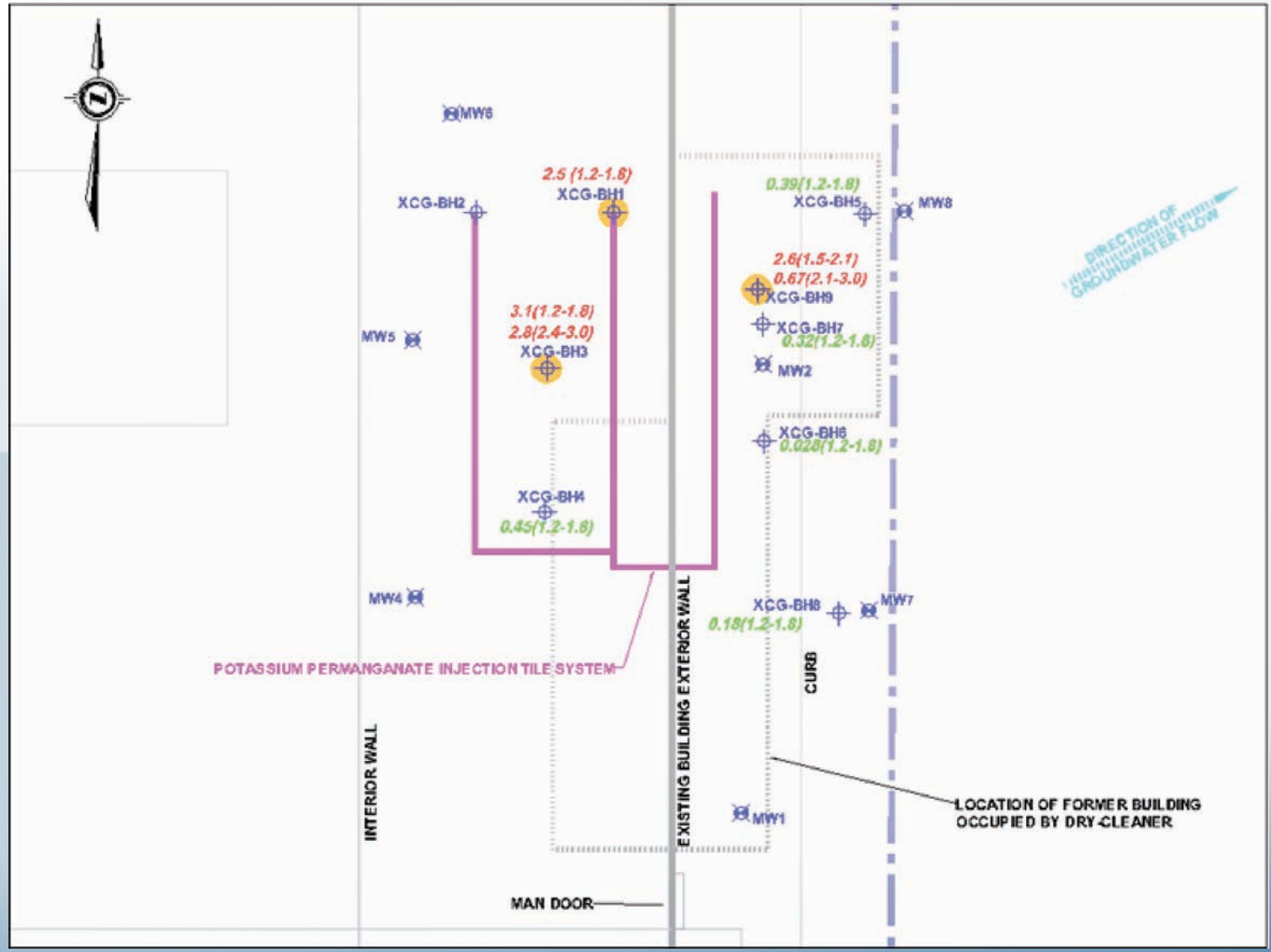

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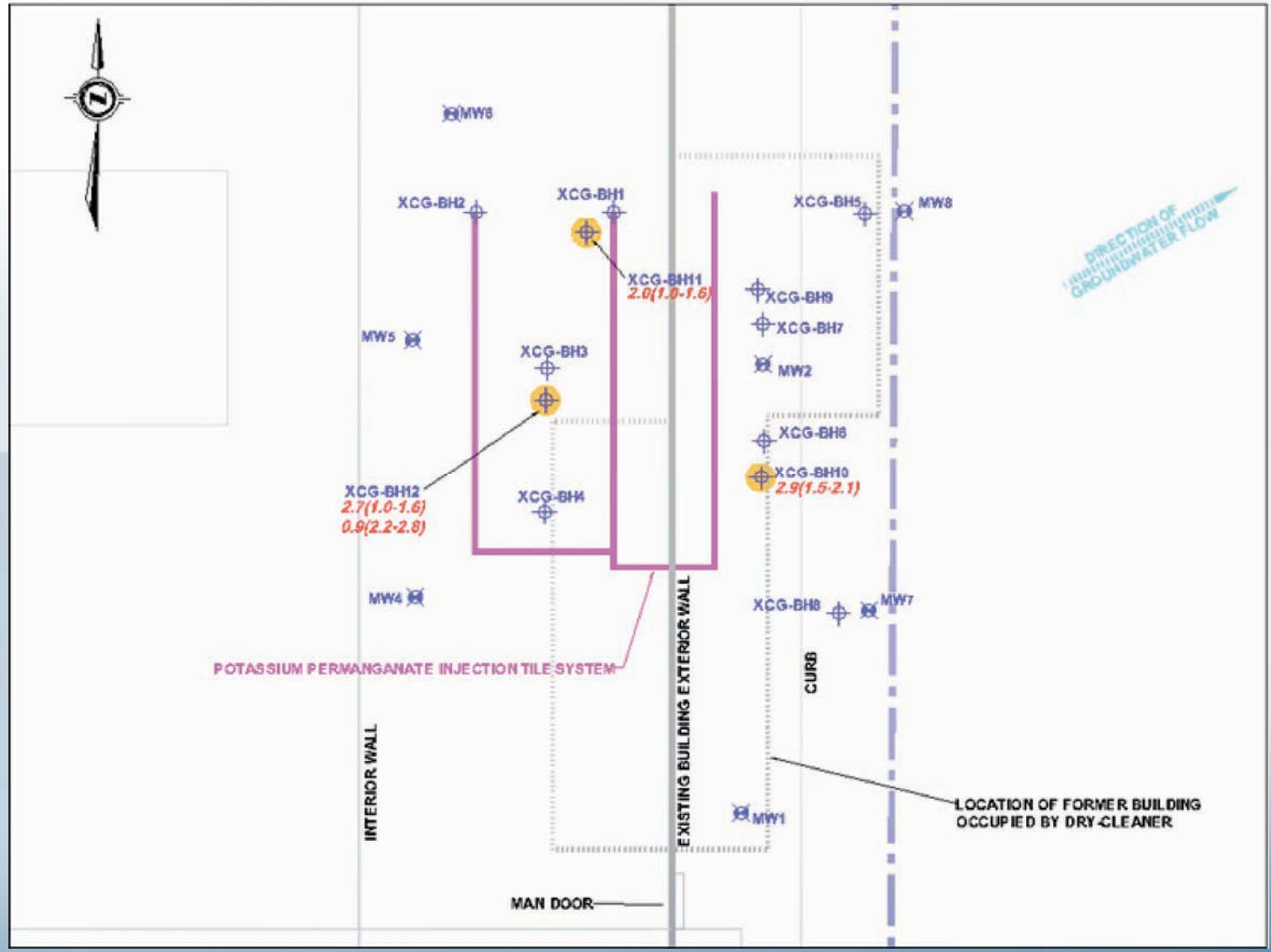

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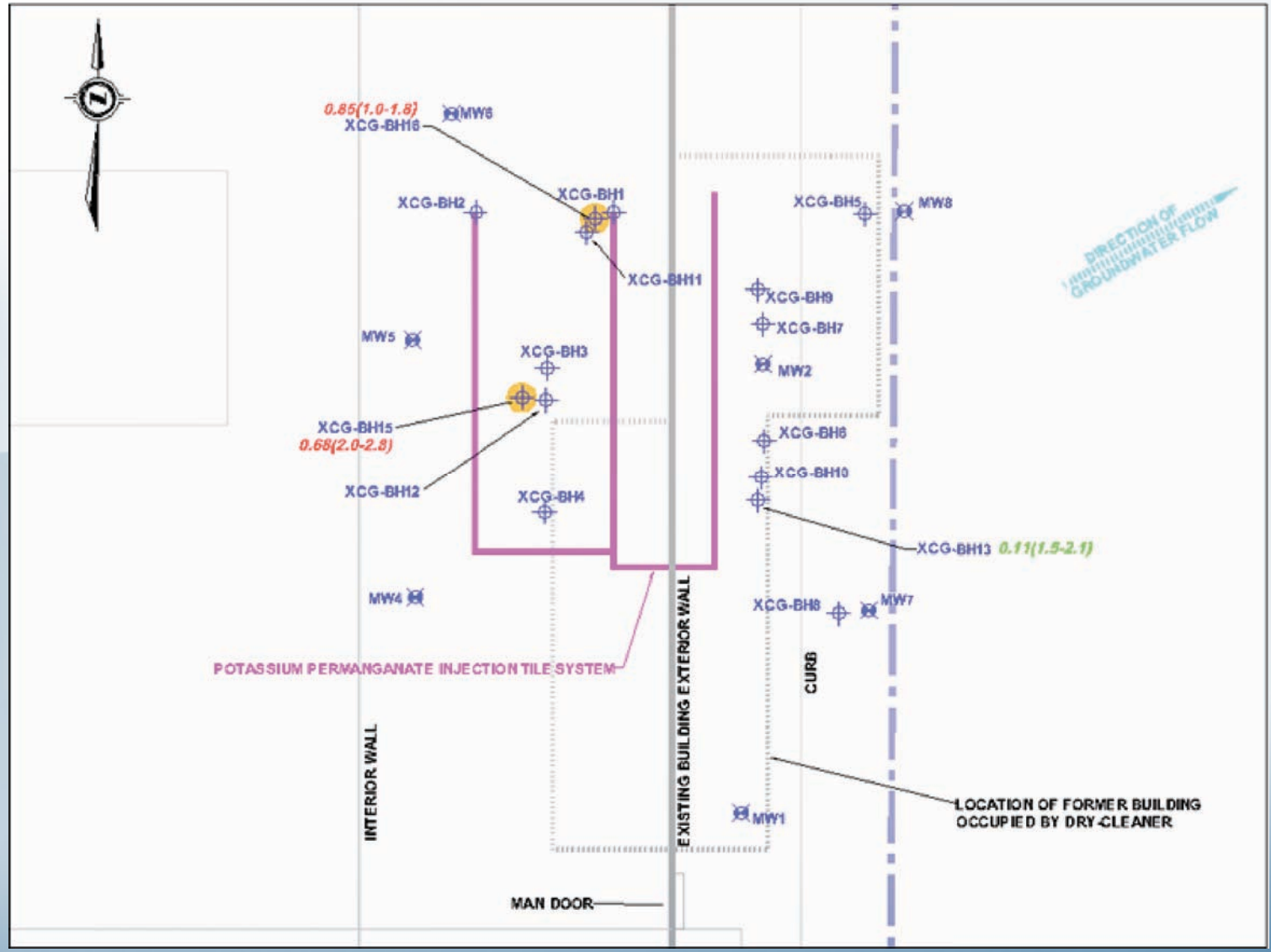

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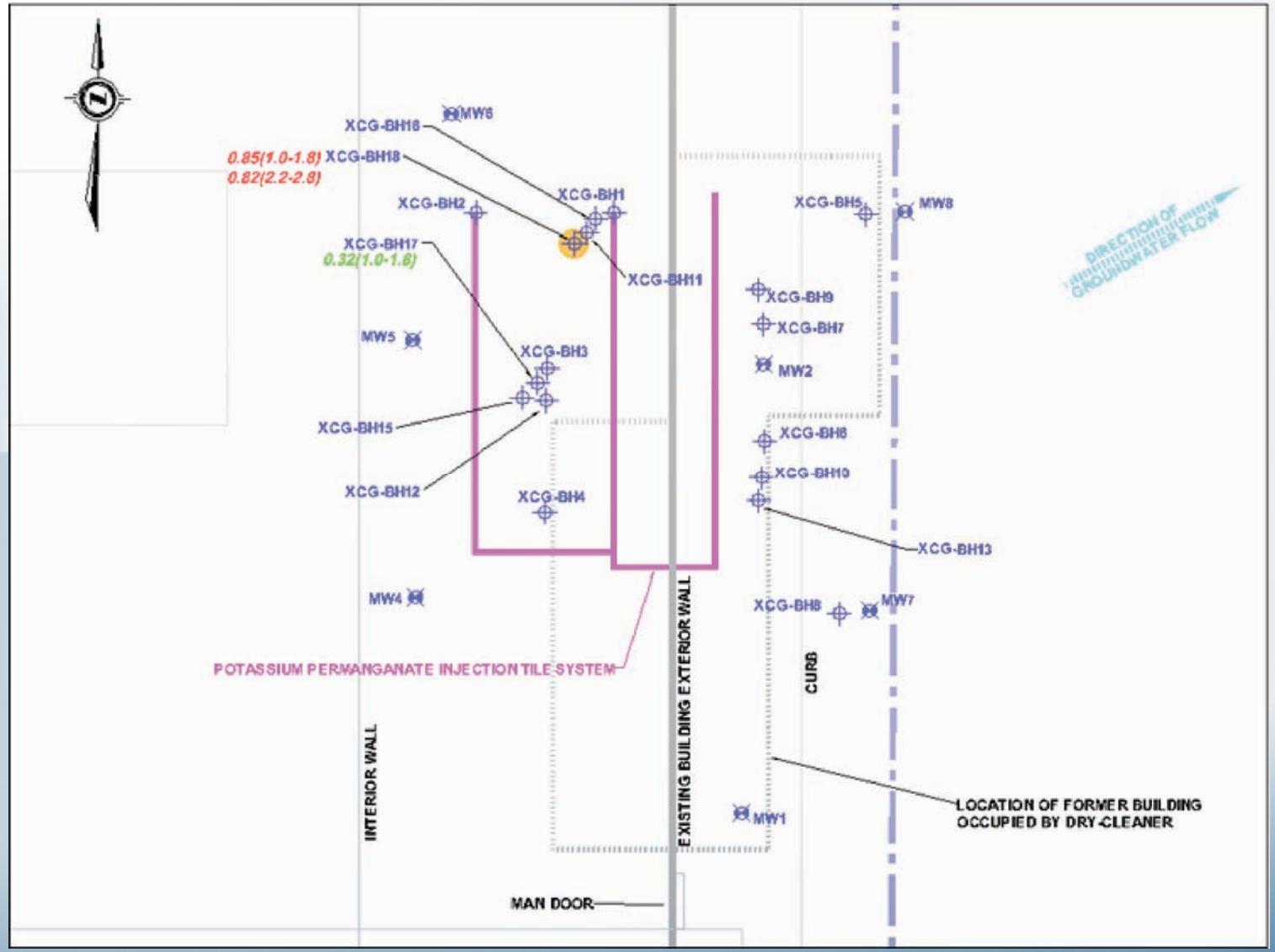


Project 1 - Results

- Removal of PCE in soil was achieved.
- Soil verification sampling was carried out one year later.
- The rate of removal was limited by the low permeability of the soil.
- No more investigations were recommended.
- Client received holdback from financial institution based on analytical results.

Project 1 - Results

- PCE has significantly decreased although three samples were still above CCME guidelines.

Compound	% Removed
PCE	88%
TCE	>99%
cis-DCE	>99%
Vinyl Chloride	>99%

Project 1 Results

- Injection process was slow.
- $KMnO_4$ did not reach all contaminated soil due to low hydraulic conductivity.
- Numerous verification boreholes were advanced on the property.

Project 2 - History

- Former tenant (dry cleaner) operated at the site until 1985.
- Two USTs containing PCE were discovered and removed in May 1993.
- Approximately 550 tonnes of impacted soil was excavated and removed from the site for landfill disposal.
- Remedial excavation was halted due to the risk of structural failure of an adjacent building.

Project 2 – Site Assessment

- Phase II ESA (September 2005) identified soil impacted with PCE in all ten boreholes advanced at the site. Groundwater PCE and TCE impacts were also found at the site.
- Phase II ESA (December 2005) used to delineate identified PCE impacts to soil and PCE and TCE impacts to groundwater.

Narrow 3-Channel CMT with Numbered Wellhead

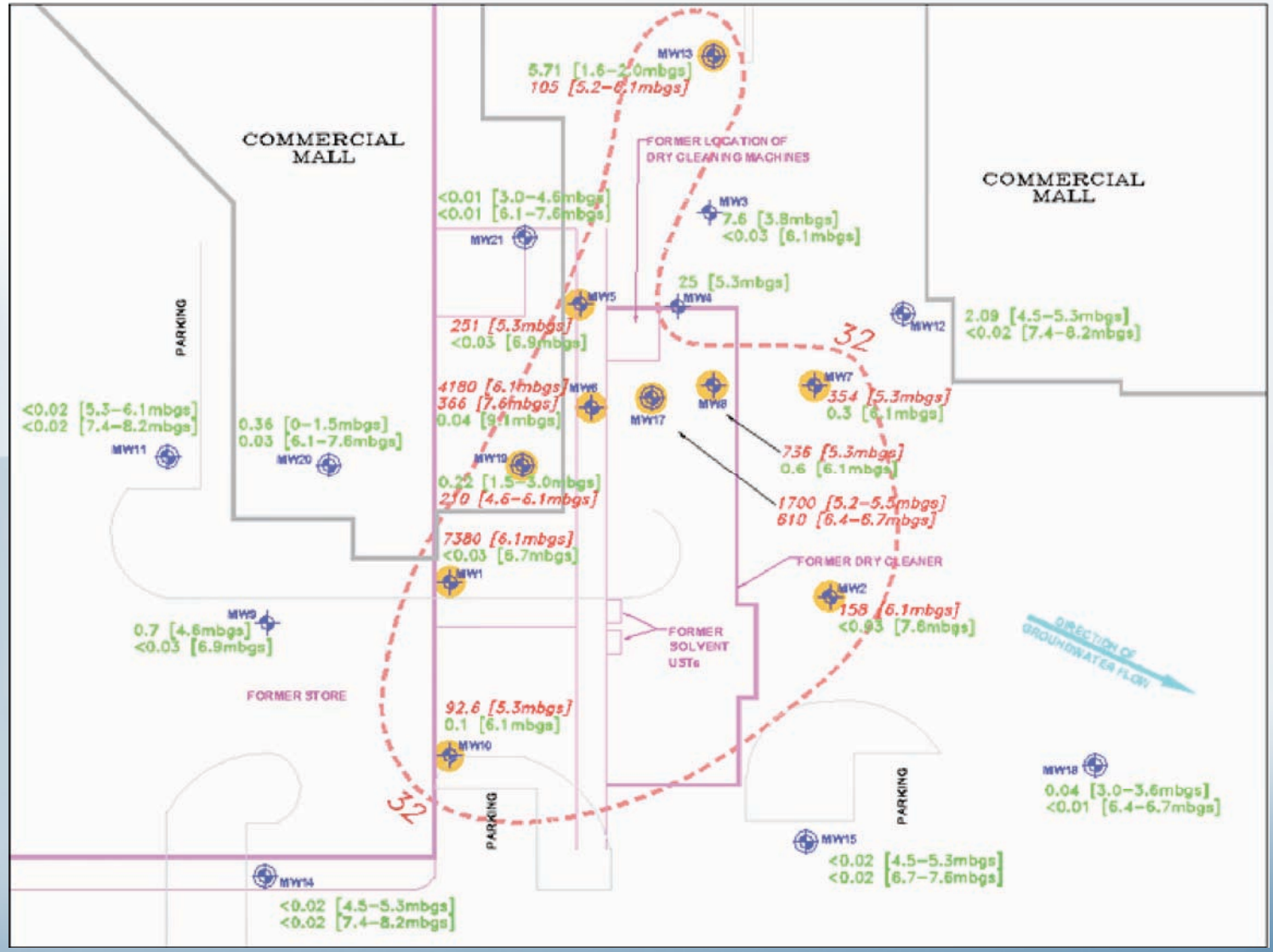
Project 2 – Risk Assessment

- Objective of Risk Assessment to develop Property-Specific Risk Assessment Standards for soil and groundwater.
- Both human health and ecological risk assessments were completed for the site based on conservation assumptions.
- Assuming no remediation effort at the site, calculated health risks to on-site indoor long-term workers, on-site visitors, and remediation/construction worker receptors are unacceptable.
- XCG recommended a Risk Management Plan.

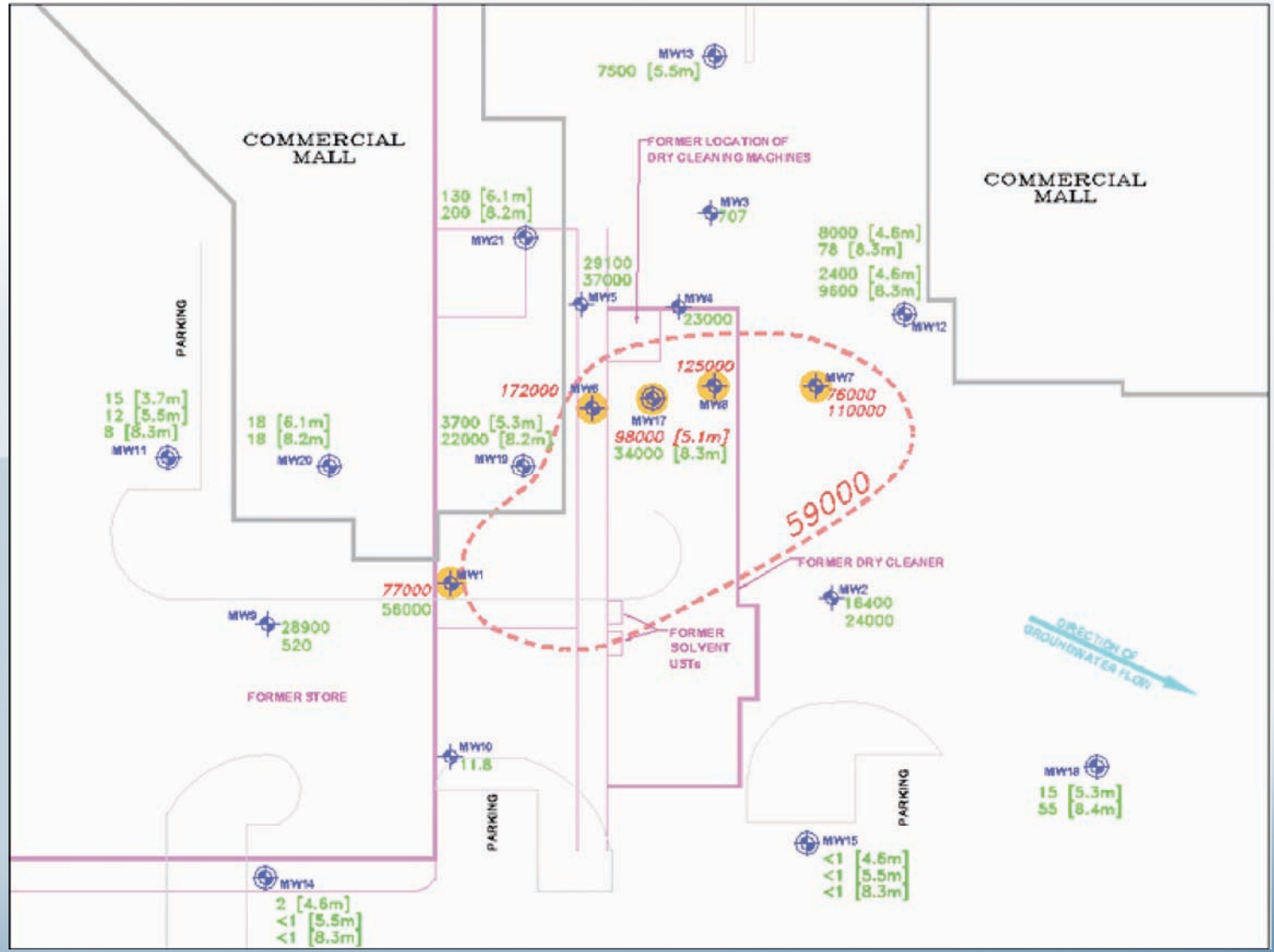
Project 2 – Additional Site Assessments

- Supplemental Phase II ESA (February 2006)
- Remedial Action Plan
- Supplemental Phase II ESA (July 2006)

Project 2 – Soil Impacts



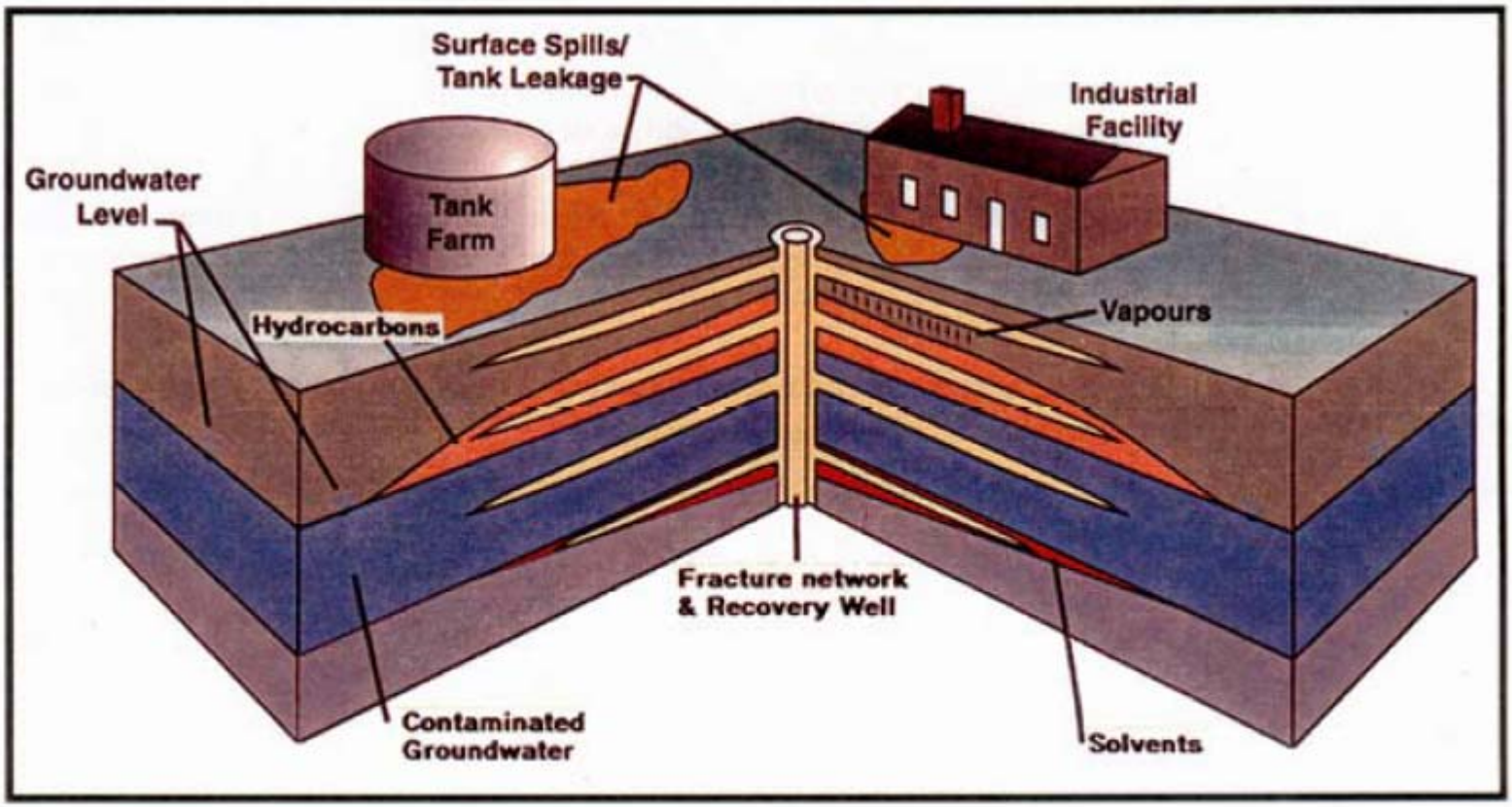
Project 2 – Groundwater Impacts



Project 2 – Remedial Action Plan

- Soil Fracturing to increase clay permeability
- Creation of Injection Wells through the specifically placed screens

Soil Fracturing



SCHEMATIC OF SITE CLEAN-UP USING THE *FRAC RITE* ™ PROCESS AT AN INDUSTRIAL FACILITY

Project 2 – Remedial Action Plan

- ISCO using Peroxidant

Benefits of Peroxidant	
■ Low treatment cost	■ Controlled oxidation reaction
■ Proven effectiveness	■ Fast remediation time
■ Not exothermic	■ Safe/controls for air emissions
■ No vinyl chloride is produced in Chlorinated compound reactions	■ No health or safety issues
■ Easy to apply by push injection	■ Regulator supported technology

Summary and Conclusions

- Conventional remedial technologies can be too expensive for many business transactions.
- Emerging in-situ technologies can be more a cost-effective remedial option for many property owners.

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Questions?