An Expedited Risk-Based Remediation Strategy for Large-Scale Diesel Contamination in Northern Communities

Presented by:

Golder Associates Ltd.

Linda Kemp

Co-authored by:

Reidar Zapf-Gilje (GeoEnviroLogic)

Ian Hers and Trish Miller (Golder)

Robyn Weisner (FNESS)

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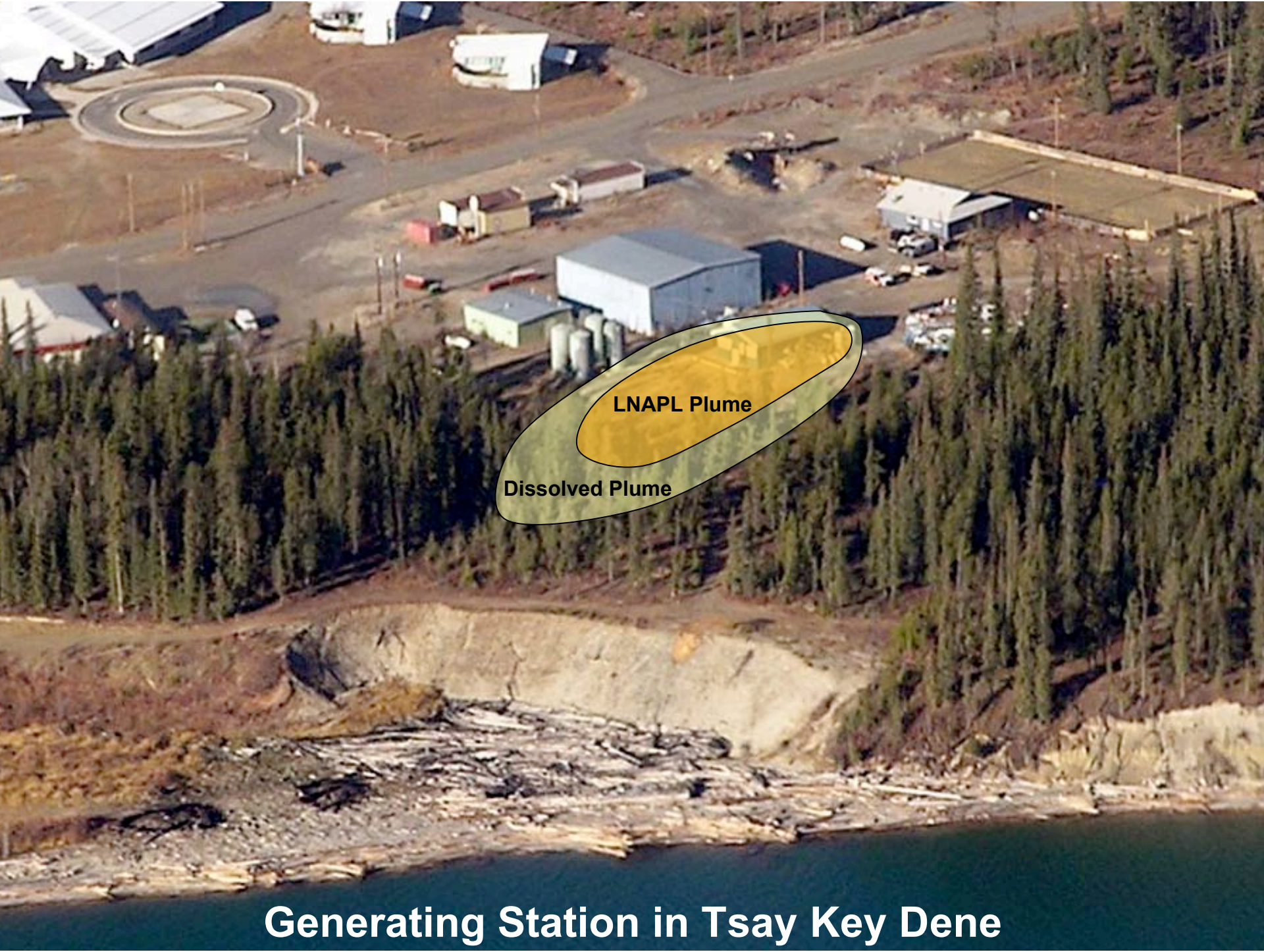
First Nations' Emergency Services

British Columbia, Canada


Fort Ware
Prince George
Fort Ware, BC

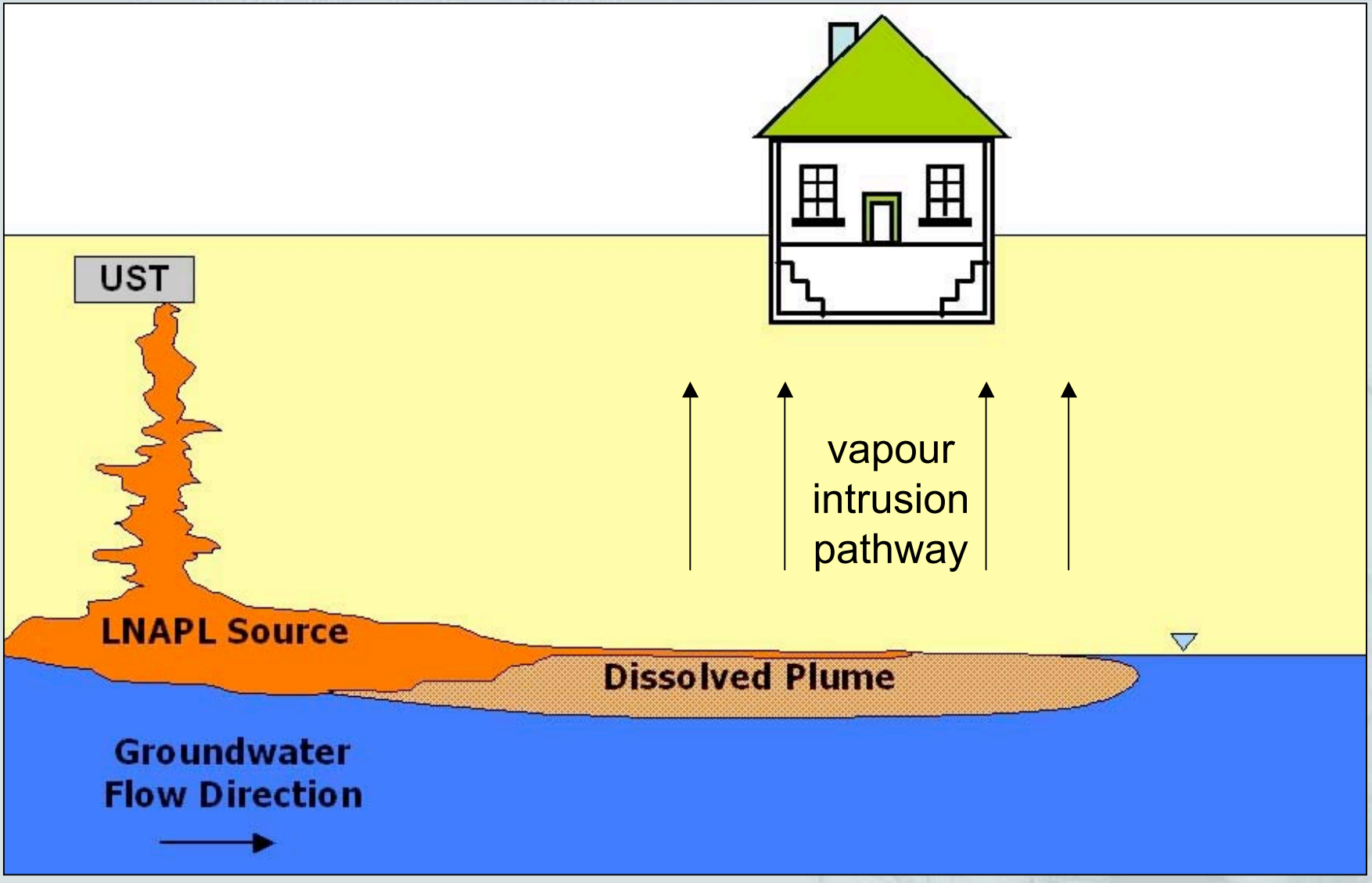
Generating Station in Tsay Key Dene

Generating Station in Tsay Key Dene



Generating Station in Tsay Key Dene

Conceptual Model of LNAPL Spill



Characteristics of a Diesel or Heating Oil Spill

Challenges

Challenges Working in Remote Northern Sites:

- Site investigation restrictions
- Remediation equipment failure
- Logistics
- Fiscal year work cycles

Strategic Approach - Rationale

Traditional approach

Objective:

- Clean-up of contaminated soil and groundwater for the protection of human health and the environment

Limitations

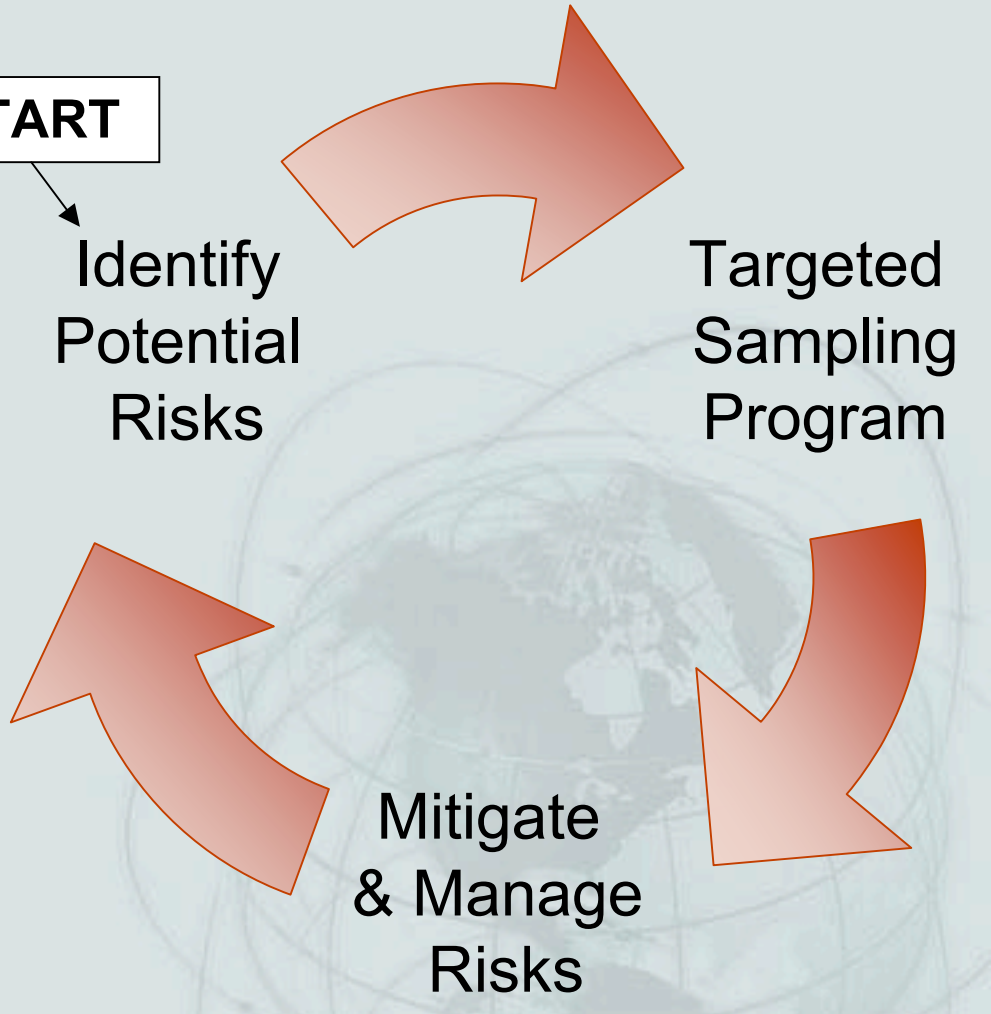
- Does not address immediate risks to human health and environment
- Can lead to expensive programs over many years
- Further delays under fiscal year budgetary cycles

Process and Objectives

Strategic Approach

Objectives:

- Identifying and Mitigating Immediate Risks Early On
- Assessing Long-term Risks and the Need for Remediation
- Remediation through source removal and Enhanced and/or Monitored Natural Attenuation



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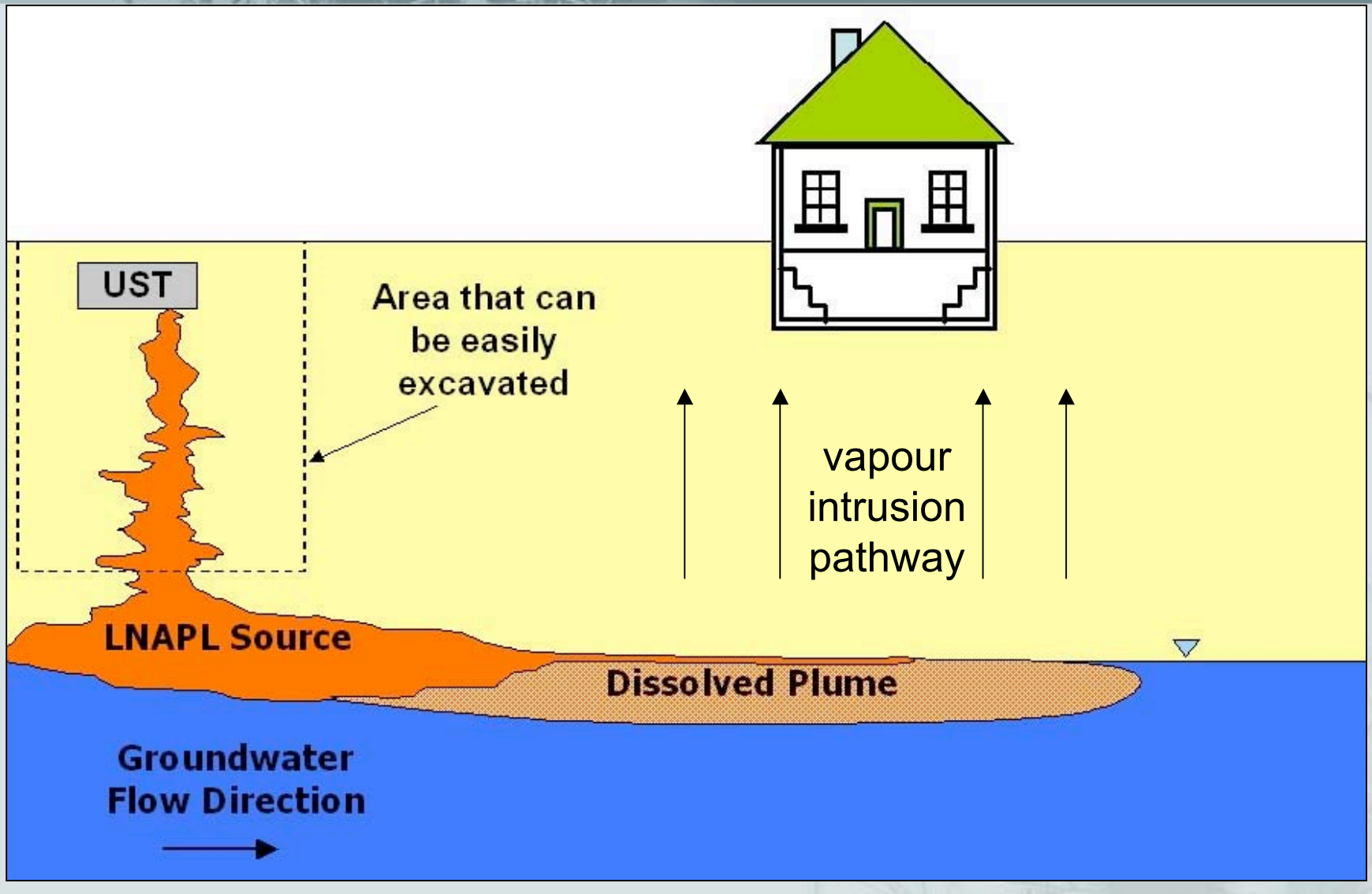
Typical Application



Conceptual Model for Typical Application

Implementation

Objective 1 - Identifying and Mitigating Immediate Risks Early On

- Conduct a detailed review of all available information (sources, pathways, and receptors)
- Develop and conduct sampling plan with primary focus on relevant exposure areas:
  - indoor air
  - sub-slab soil vapours
  - seepage water
  - drinking water wells
  - surficial soils
- Implement mitigation measures as necessary to reduce immediate risks:
  - Seal cracks and openings in floor slabs
  - Remove indoor air sources of contamination
  - Notify client of need for immediate mitigation measures

Implementation

Objective 2 - Assessing Long-term Risks and the Need for Remediation

- Develop and conduct further investigation with primary focus on contaminant extent and pathways:
  - Soil and groundwater sampling and delineation
  - Hydrogeology assessment
  - Soil vapour pathway assessment
- Conduct risk assessment to determine long term risks and the need for remediation

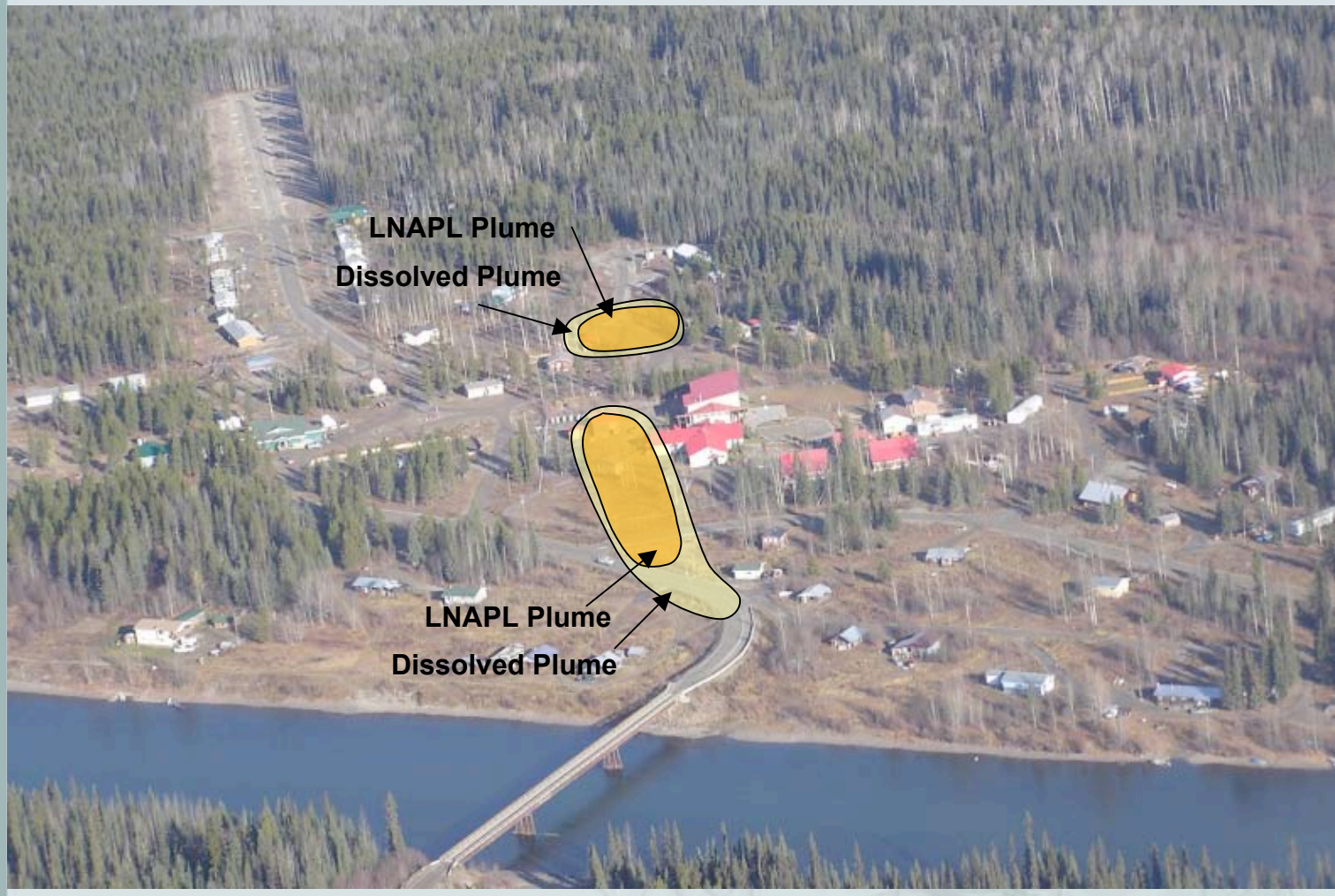
Implementation

Objective 3 - Remediation through Source Removal and Enhanced and/or Monitored Natural Attenuation

- Use risk assessment results to identify the need for remediation
- Conduct simple pilot testing program (same procurement cycle as investigation if feasible)
  - LNAPL recovery
  - Bioventing
  - Enhanced biodegradation
  - Monitored natural attenuation
- Use pilot test results to determine suitable remedial options

Case Study

- Two areas with large-scale LNAPL plumes
- Largest LNAPL plume 150 m long by 50 m wide
- LNAPL plume at 8 to 10 m bgs
- Shallow contamination excavated



Case Study: Kwadacha Nation - Fort Ware, BC

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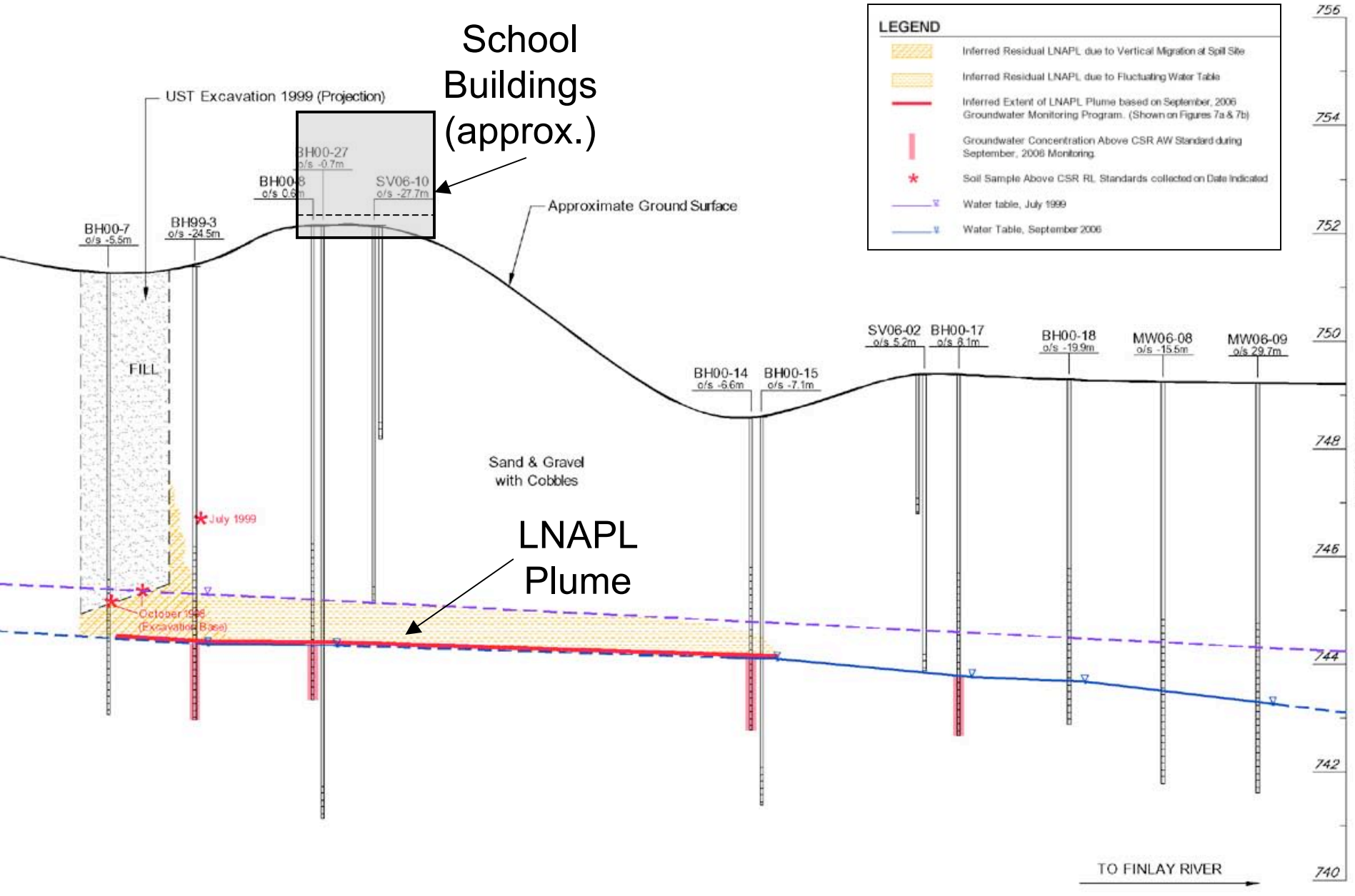
Case Study

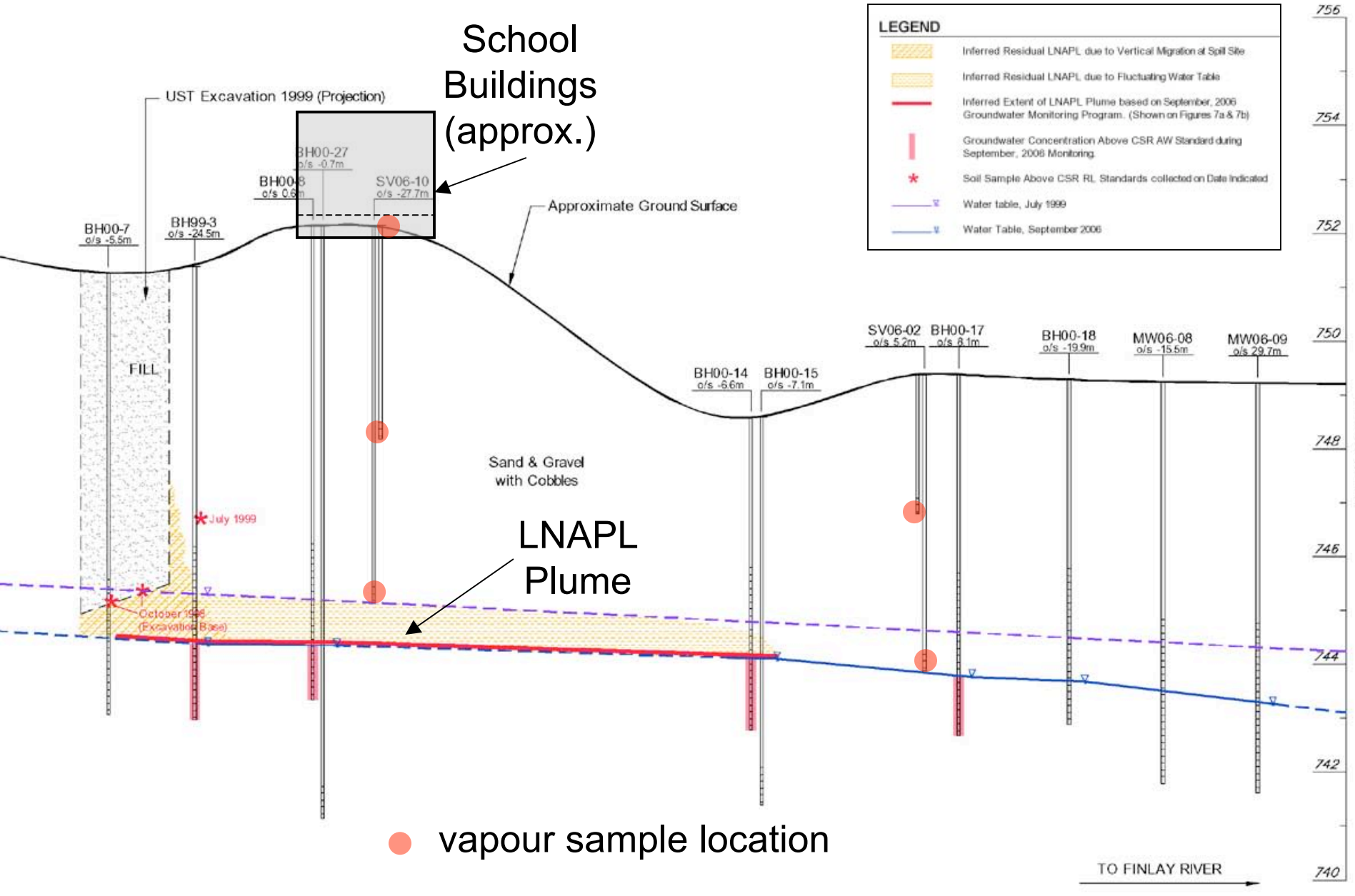

School Buildings (approx.)
UST Excavation 1999 (Projection)
Approximate Ground Surface
BH00-7 o/s -5.5m
BH99-3 o/s -24.5m
BH00-27 o/s -0.7m
BH00-8 o/s 0.6m
SV06-10 o/s -27.7m
FILL
July 1999
October 1999 (Excavation Base)
Sand & Gravel with Cobbles
LNAPL Plume
BH00-14 o/s -6.6m
BH00-15 o/s -7.1m
SV06-02 o/s 5.2m
BH00-17 o/s 8.1m
BH00-18 o/s -19.9m
MW06-08 o/s -15.5m
MW06-09 o/s 29.7m
LEGEND
Inferred Residual LNAPL due to Vertical Migration at Spill Site
Inferred Residual LNAPL due to Fluctuating Water Table
Inferred Extent of LNAPL Plume based on September, 2006 Groundwater Monitoring Program. (Shown on Figures 7a & 7b)
Groundwater Concentration Above CSR AW Standard during September, 2006 Monitoring.
Soil Sample Above CSR RL Standards collected on Date Indicated
Water table, July 1999
Water Table, September 2006
ELEVATION (m)
756
754
752
750
748
746
744
742
740
TO FINLAY RIVER

Case Study

Objective 1 - Identifying and Mitigating Immediate Risks Early On

- PQRA completed in 2005 – lead to FCSAP funding for 2006
- Developed and conduct sampling plan with primary focus on relevant exposure areas:
  - Indoor air in school building crawl spaces
  - Soil vapours along migration pathway
  - Shoreline reconnaissance
  - Indoor air where odours were reported
- Implement mitigation measures as necessary to reduce immediate risks:
  - Capped and sealed pipes to an old oil tank in building where odours were observed
  - Notified client of need for further investigation near building where odours were reported

Case Study



● vapour sample location

Case Study

Objective 2 - Assessing Long-term Risks and the Need for Remediation

- Additional investigation with primary focus on contaminant extent and pathways:
  - Plume delineation
  - Hydrogeology assessment
  - Soil vapour pathway assessment
- No long term risks were identified, but further monitoring was recommended to decrease uncertainty

Case Study

Objective 3 - Remediation through Source Removal and Enhanced and/or Monitored Natural Attenuation

- Remediation not required, but may still be desired to decrease remediation time-frames if cost effective
- Conduct simple pilot testing program (same procurement cycle as investigation)
  - LNAPL recovery
  - Bioventing
  - Enhanced biodegradation
  - Monitored natural attenuation
- Pilot test results indicated that monitored natural attenuation was most appropriate

Case Study

Simple Bioventing Pilot Test

Conclusions

Benefits of Strategy:

- Early action to protect human health and the environment
- Site investigation and remediation implemented in a timely manner
- Remediation is cost effective
- Addressed limitations of government procurement cycles
- Goes a step beyond source removal and risk assessment through the implementation of enhanced biodegradation or a MNA program
- **Puts human health and environmental protection first**

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Questions?

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