



# Remediation and Risk Management Strategies for Managing an LNAPL Impacted Site

**Kraut Point Small Craft Harbour,  
Riverport, NS**

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# Overview

- Background
- Previous Investigations and Findings
- R/RM Strategy Development and Implementation
- Operational Challenges
- R/RM Conclusions
- Climate Change Risk Assessment
- Next Steps





# Background

- Site located in Riverport, NS, along Nova Scotia's South Shore.
- Public commercial fishing wharf for over 100 years (remains active)
- Part of Small Craft Harbour Program (DFO).
- Home to over 25 vessels that fish for lobster, haddock, cod, tuna, herring, among others.



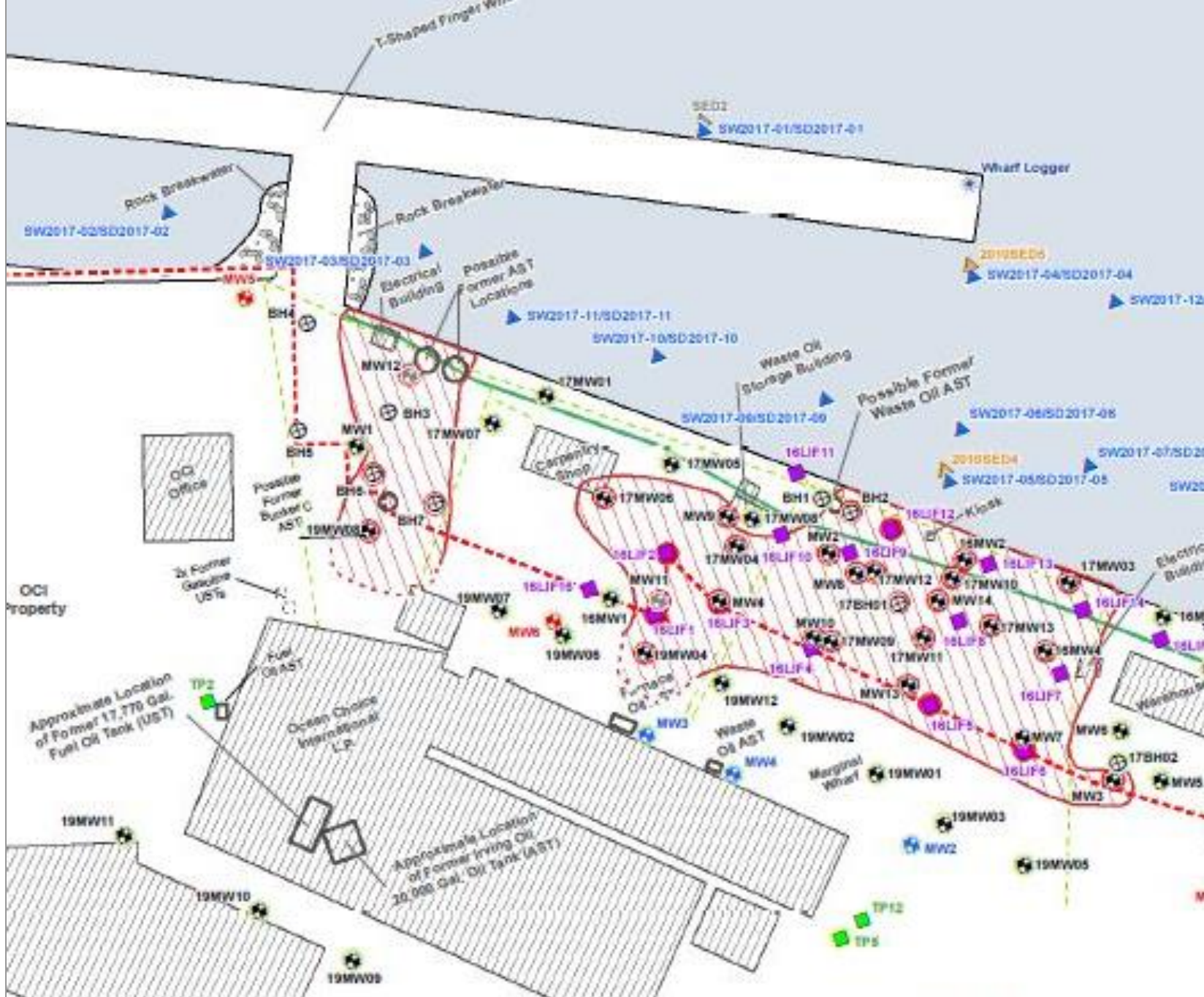
# Background

- Adjacent property contained a large fish processing plant (no longer active)
- Several small ASTs (<1200L) located on subject property over the years.
- Fuel pipeline located along the edge of the wharf (no longer active)
- Furnace oil and diesel fuel ASTs located on adjacent property.
- 20,000 gallon AST on adjacent property
- Former tank farm located to the southeast.

# Previous Investigations

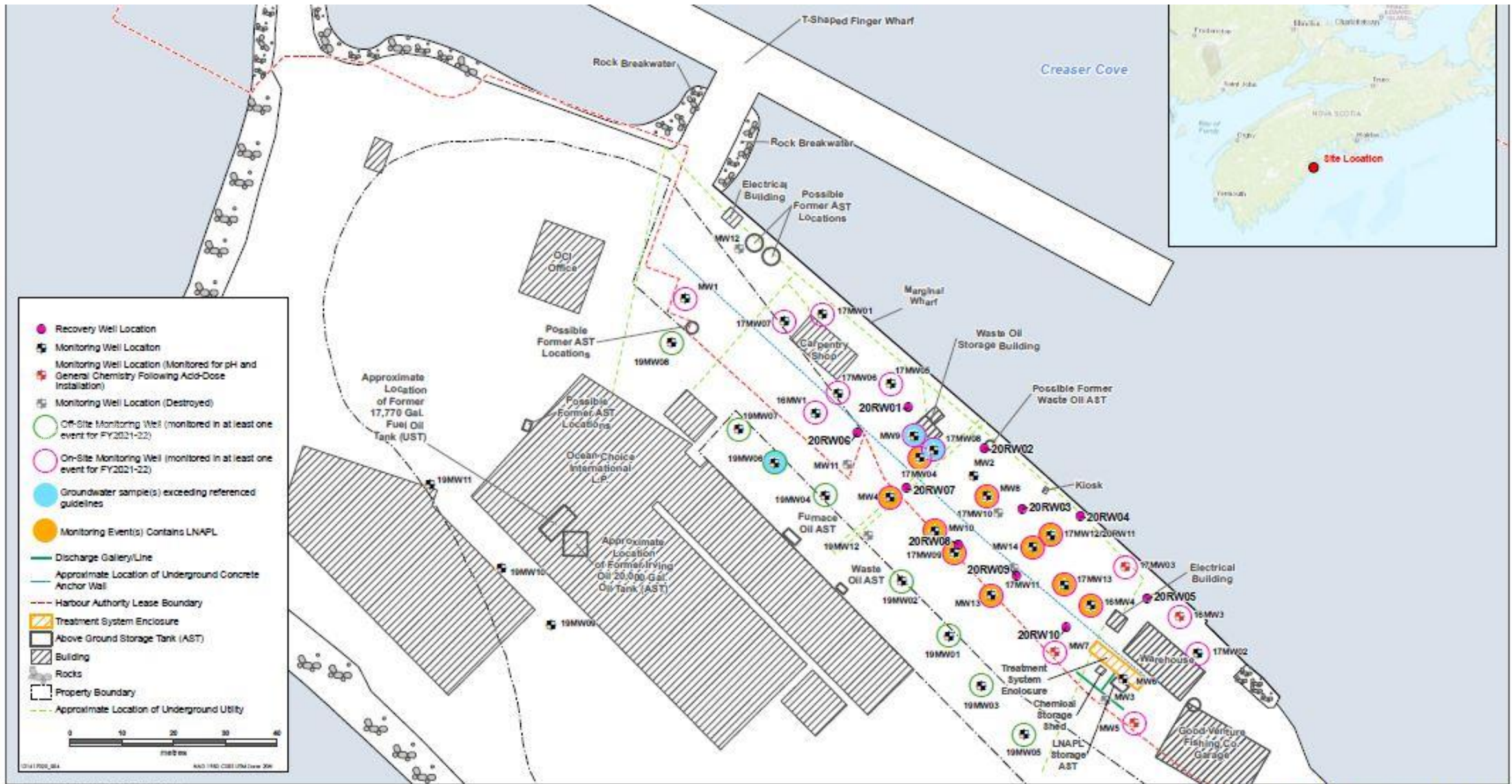
- Phased ESA's (I/II/III) completed between 2001 and 2018.
- Several rounds of quarterly GW monitoring (currently ongoing)
- Two rounds of LIF investigation.
- MPVE Pilot Study
- Hydrogeology Assessment
- LNAPL Mobility Assessment
- Surface Water/Sediment Sampling Program





# Findings

- Multiple areas of PHC-impacted soil identified.
- Naphthalene identified in soil (one location)
- PHC-impacted groundwater identified
- LNAPL body identified



Site Plan - Monitoring Well and Recovery Well Locations  
 Public Services and Procurement Canada  
 for Fisheries and Oceans Canada  
 Kraut Point Small Craft Harbour

SCH # 1145, DFRP # 02636, RPIS # MS 01145, FSCI # 00017804

Figure A1







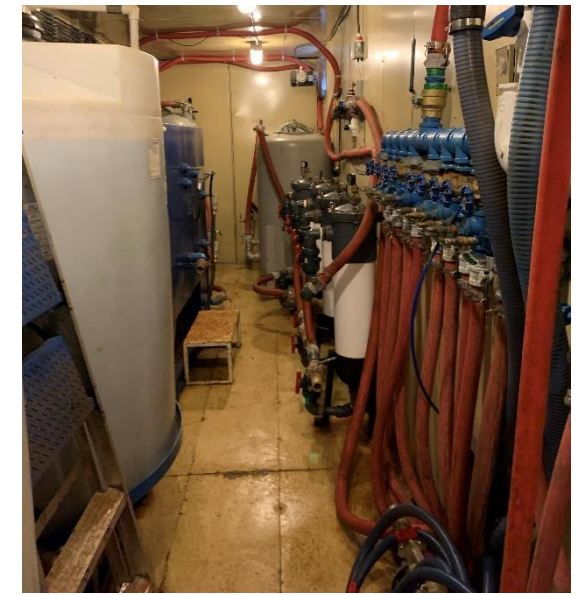
# R/RM Strategy Development

- R/RM strategy developed in 2019.
- Wharf sheet pile wall driving factor for R/RM approach.
- Multiple lines of evidence approach used:
  - LNAPL recovery to reduce LNAPL saturation
  - LNAPL footprint assessment (quarterly)
  - Dissolved Phase GW monitoring (quarterly).
  - Natural attenuation assessment (quarterly)



# R/RM Strategy Implementation

- R/RM strategy implemented in February 2021
- LNAPL Recovery System Installed by SCG Industries:
  - Dual phase extraction system - liquid (water/LNAPL) and soil vapour
  - 11 recovery wells equipped with submersible pumps
  - On-site treatment system for:
    - LNAPL separation
    - Water treatment
    - Soil vapour venting
  - Recovered LNAPL → on-site long-term storage
  - Treated water → discharge to subsurface





## R/RM Strategy Implementation

- Recovery system operated continuously for 2 years.
- Completed in March 2023.
- LNAPL Recovery System Operation:
  - Weekly Operational Checkups
  - Bi-weekly discharge compliance sampling
  - Monthly System Optimization
- Enhanced Recovery Program completed in 2023:
  - Injection of hot water into the subsurface through temporary injection wells.
  - Multi-phase recovery through an existing recovery well.





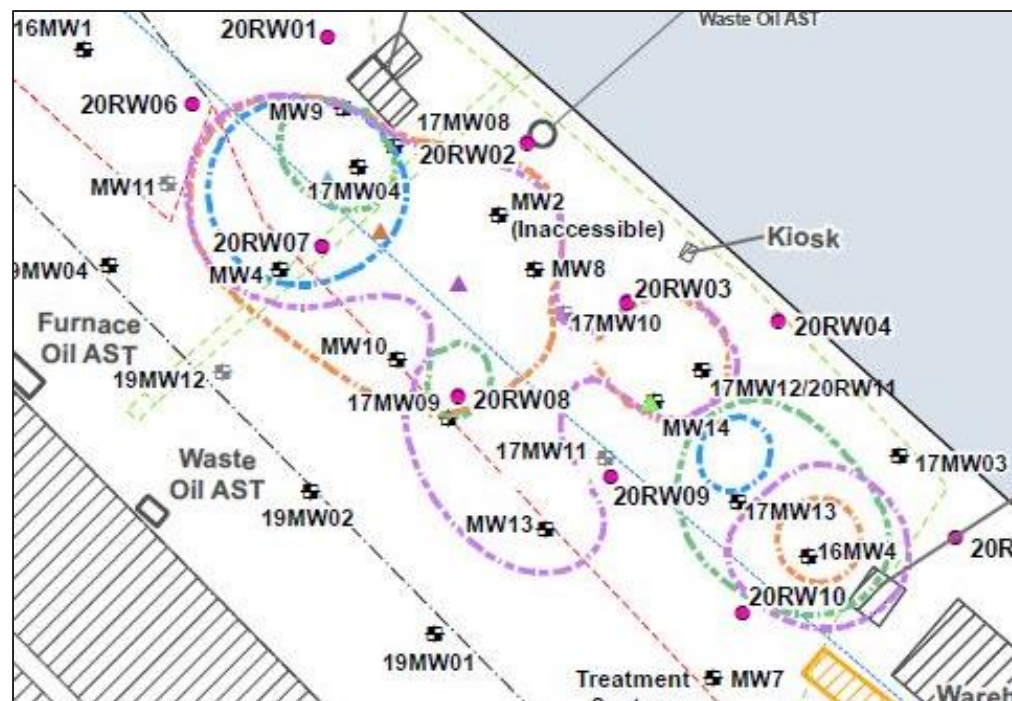
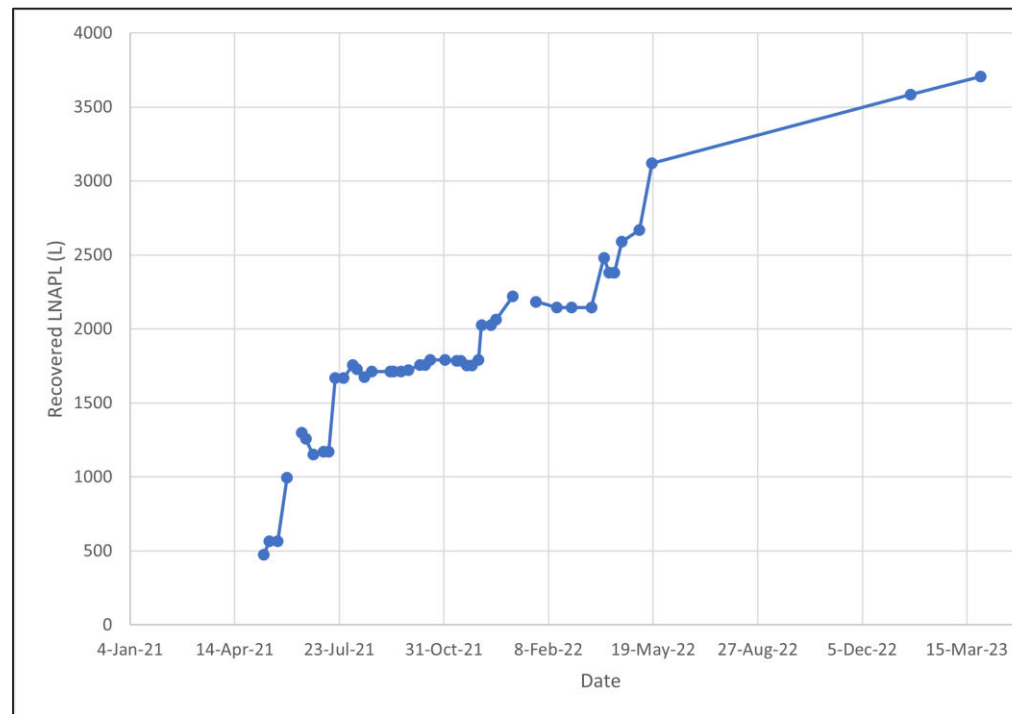
# Operational Challenges

- Fluctuating groundwater table with static submersible pumps
- High iron and manganese groundwater concentrations.
  - Precipitate accumulation throughout system infrastructure.
  - Increased frequency of maintenance required
  - Acid-dosing system installed to mitigate precipitate accumulation in discharge.



# LNAPL Recovery System Conclusions

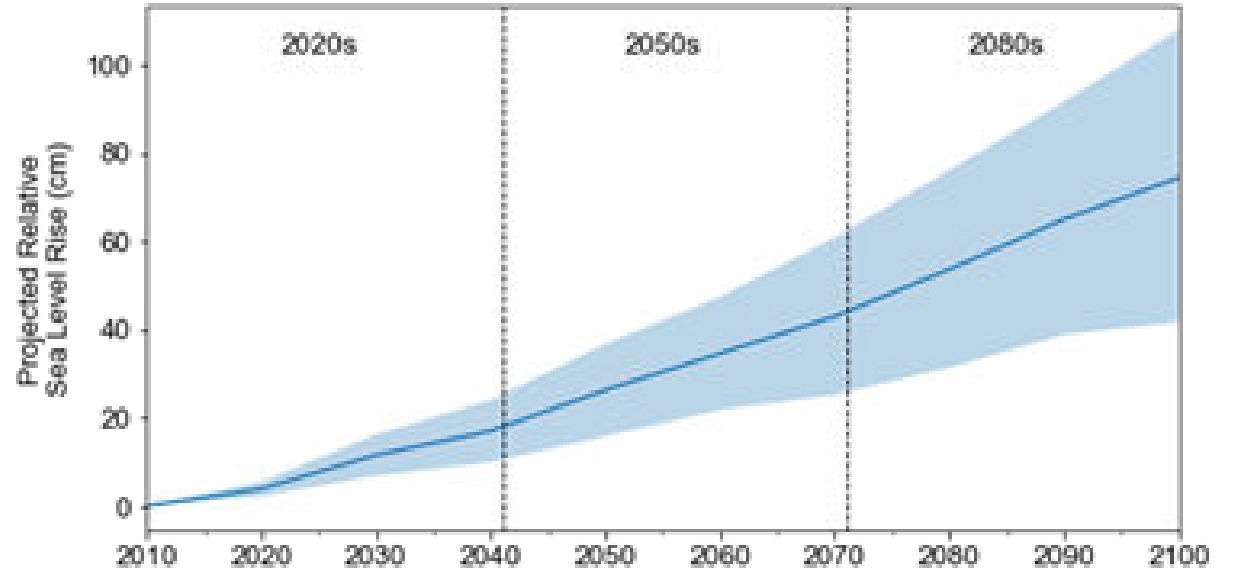
- LNAPL body appears stable.
- Potential for future mobility is low.
- LNAPL recovery rate decreased throughout duration of project.
- ~ 4200L of LNAPL recovered.
- LNAPL body more fragmented than before.
- Decreasing trends in LNAPL thickness in site MWs.
- Enhanced recovery program indicated minimal impact.





# Climate Change Risk Assessment

- Part of Risk Management Strategy for the site.
- One of the first of it's kind in Canada.
- Data collected to evaluate exposure to climate-related hazards:
  - Previous Environmental Investigations
  - Climate Projections
  - Conceptual Site Model (CSM) Components
- Risk scores estimated for critical site infrastructure and CSM components
  - Based on Relative Concentration Pathway (RCP) 8.5 climate projections.
- Risk score = Exposure x Likelihood x Consequence

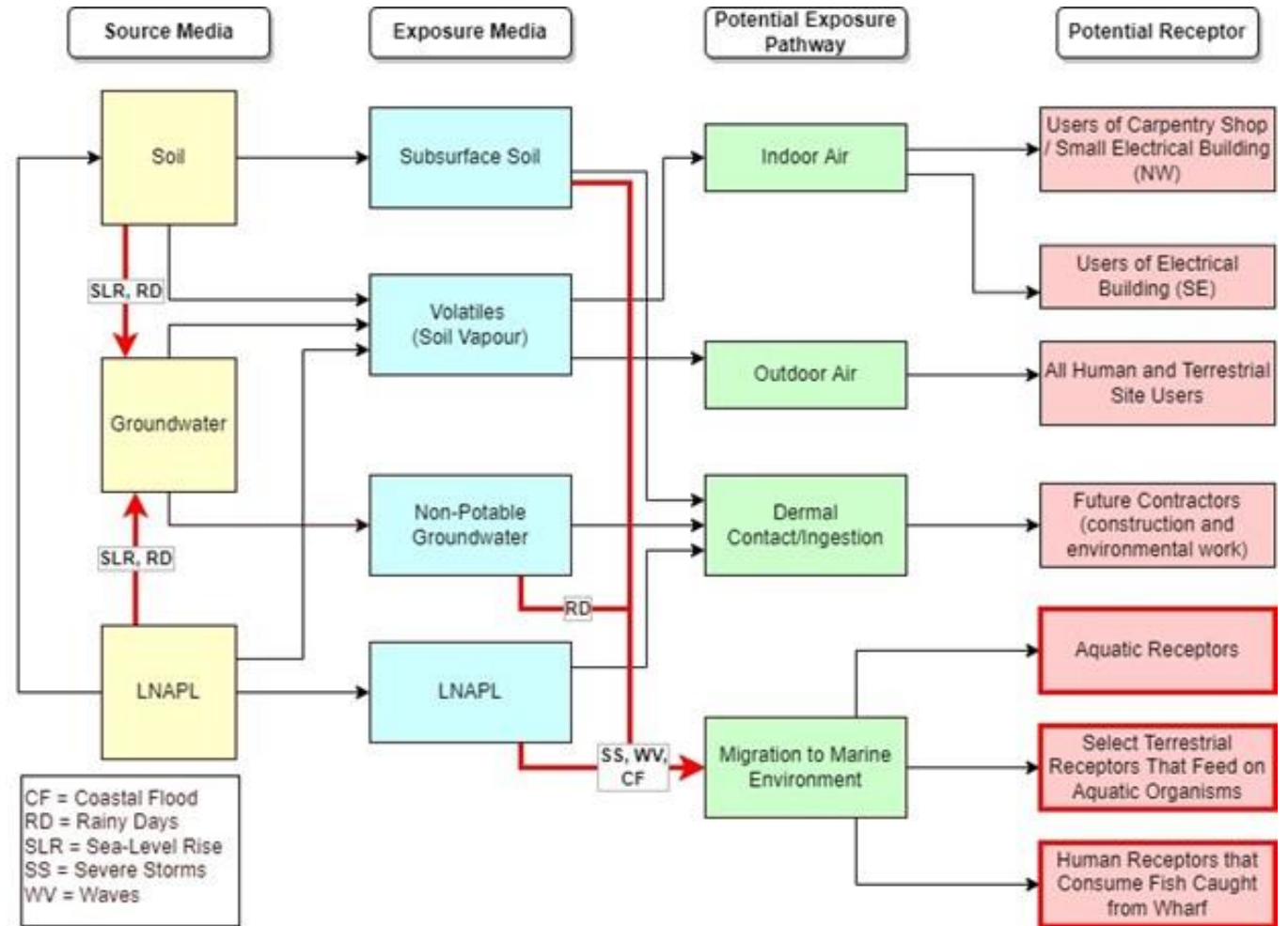


| Asset                       | Hazard(s)      | 2020s       | 2050s       | 2080s       | Trend      | Confidence |
|-----------------------------|----------------|-------------|-------------|-------------|------------|------------|
| Sheet-Pile Wall             | Waves          | Medium (12) | Medium (12) | Medium (12) | Steady     | Low        |
|                             | Severe Storms  | Low (8)     | Medium (12) | Medium (16) | Increasing | Low        |
|                             | Coastal Flood  | Low (6)     | Low (9)     | Medium (15) | Increasing | Very Low   |
| Tie Backs                   | Coastal Flood  | Low (0)     | Low (9)     | Medium (15) | Increasing | Very Low   |
| LNAPL Body                  | Coastal Flood  | Low (4)     | Low (6)     | Medium (10) | Increasing | Very Low   |
| Dissolved-Phase Groundwater | Rainy Days     | Low (9)     | Medium (12) | Medium (12) | Increasing | Medium     |
| Contaminated Soil           | Sea-Level Rise | Low (6)     | Low (8)     | Medium (10) | Increasing | Low        |
| Asphalt Cap                 | Coastal Flood  | Low (4)     | Low (6)     | Medium (10) | Increasing | Very Low   |



# Climate Change Risk Assessment

- Severe storms, waves, and coastal flood impacts found to pose **highest risk to on-site infrastructure**.
- Increased precipitation and sea-level rise posed **highest risk to subsurface impacts**.
- Results of Climate RA inform adaptation strategies:
  - Maintenance of sheet pile wall
  - Maintenance of asphalt cap
  - Hydrogeological studies
  - Increased monitoring





# Next Steps

- Confirm objectives of R/RM continue to be met
- Two years of quarterly confirmatory sampling:
  - GW Monitoring
  - LNAPL Body Footprint Assessment
  - Natural Attenuation Assessment
- Possible site closure
- Possible long-term monitoring followed by site closure

**Step 1:** identify suspect site

**Step 2:** historical review

**Step 3:** initial testing program

**Step 4:** classify site (optional)

**Step 5:** detailed testing program

**Step 6:** re-classify site

**Step 7:** develop remediation/risk management strategy

**Step 8:** implement remediation/risk management strategy

**Step 9:** confirmatory sampling and final report

**Step 10:** long-term monitoring (if required)t





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## Thank you – Questions?