AN APPROACH FOR INVESTIGATING
SALT-IMPACTED SITES

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SALT IMPACTED SITES:

- Why Are We Concerned?
- Approach to Investigation
- Remedial Options
- Salt Impacts Remedial Program Case Study
WHY ARE WE CONCERNED?

- Environment Canada Assessment Report estimated that approximately 4.9 million tonnes of road salt are released to the environment in Canada every year.
- In August 2000, Environment Canada provisionally declared road salt as a Canadian Environmental Protection Act (CEPA) toxic substance.
WHY ARE WE CONCERNED?

In February 2002, draft remedial standards involving sodium and chloride impacts in soils and groundwater were proposed under the BC Contaminated Sites Regulation

- Remedial programs at highways maintenance yards (road salt storage)
- Oil and gas exploration in Northern BC
APPRAOCHE TO INVESTIGATION

GEOPHYSICS

EM-31
  • Conductivity survey
  • Contours horizontal extents of salt impacts
  • Identification of “hot spots”
  • Aids in boreholes/CPT placement
APPROACH TO INVESTIGATION
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GEOPHYSICS

EM-39

- Down hole conductivity survey
- Vertical delineation of salt impacts
- Identification of gravity driven salt plumes
- Aids in well screen placement
APPROACH TO INVESTIGATION

Conventional Drilling
(Boreholes coupled with down hole EM-39)

vs

Direct Push Technology
(Cone Penetration Testing)
CONVENTIONAL DRILLING

ADVANTAGES
Can be installed in any soil conditions

DISADVANTAGES
Time efficiency
- two step process
- No in situ groundwater or soil samples
Direct Push Technology

The freshwater/saltwater wedge is easily determined from soil resistivity.
DIRECT PUSH TECHNOLOGY

ADVANTAGES
- Time efficient (vertical delineation completed as hole is advanced)
- In situ groundwater sampling
- Detailed stratigraphic logs produced including resistivity data

DISADVANTAGES
- Refusal in soils with gravel and cobbles
  - Two step process
  - No in situ groundwater or soil samples
SALT IMPACTED SOILS:
REMEDIAL OPTION 1

REMEDIAL SOIL EXCAVATION AND OFF-SITE DISPOSAL

- Excavated material can be screened and reserved for future winter road application
SALT IMPACTED SOILS: REMEDIAL OPTION 2

CALCIUM AMENDMENT ADDITION AND SOIL FLUSHING (IN SITU)

- Calcium amendments added to surface
- Irrigation of impacted area
- Collection of leachate in sub-horizontal catchment drains for disposal or treatment
SALT IMPACTED SOILS: REMEDIAL OPTION 3

REMEDIATION SOIL EXCAVATION AND SOIL FLUSHING (EX-SITU)

- Excavation of impacted soils
- Placement of excavated soils in a partially sub-grade, PVC lined cell
- Collection of salt-impacted water flushed through the cell in a perforated piping network installed beneath the cell
SALT IMPACTED GROUNDWATER:
REMEDIAL OPTION 1

MONITORED NATURAL ATTENUATION
FOLLOWING SOIL REMEDIAL EXCAVATION

- Preliminary risk assessment required
- Source removal through excavation of soil hot spots
- Natural precipitation/flushing events remediate remaining soil and groundwater impacts
- Quarterly monitoring of groundwater perimeter wells
SALT IMPACTED GROUNDWATER: REMEDIAL OPTION 2

EVAPORATION

• Heating and evaporation of extracted groundwater and/or leachate collected from soil flushing activities
• Collection of salt in trap beneath evaporation unit
• Potential re-use of salt in winter road application
SALT IMPACTED GROUNDWATER: REMEDIAL OPTION 3

REVERSE OSMOSIS (RO)

- Extracted groundwater and/or soil treatment leachate passed through a small RO unit
- Separation of salt from water at ambient temperatures
- RO system pressure requirements increase with dissolved salt concentrations
- Generally more expensive than evaporator units
BACKGROUND

- Subject site has been a highways yard since the late 1960’s
- Sodium chloride used in winter road de-icing was historically stored in two locations: ① inside a salt shed; and ② in an uncovered sand/salt pile
- Extensive soil and groundwater impacts were documented in the vicinity of both storage locations (PSI and DSI)
REMEDIAL PROGRAM CASE STUDY

REMEDIAL APPROACH

1. EM-31 and EM-39 Surveys
2. Installation of Perimeter Monitoring Wells
3. Remedial Excavation and Off-Site Disposal
REMEDIAL APPROACH

4  Construction of New Salt Shed with Leachate Collection System
REMEDIAL APPROACH

5 Monitored natural attenuation of groundwater (pre and post excavation groundwater monitoring)
6 Development of a conceptual groundwater model
7 Overview Ecological Risk Assessment
REMEDIAL PROGRAM CASE STUDY

REMEDIAL RESULTS

- Decreasing trends in sodium and chloride concentrations were observed in site perimeter wells.
- The observed trends demonstrated that soils were being flushed by natural infiltration events and/or seasonal fluctuations in the water table.
REMEDIAL PROGRAM
CASE STUDY

REMEDIAL RESULTS

- The Overview Ecological Risk Assessment concluded that the site posed little to no risk to down gradient receptors based on sodium and chloride concentrations in perimeter wells.
- The environmental liability of the site was demonstrated to be low and the site was subsequently sold.