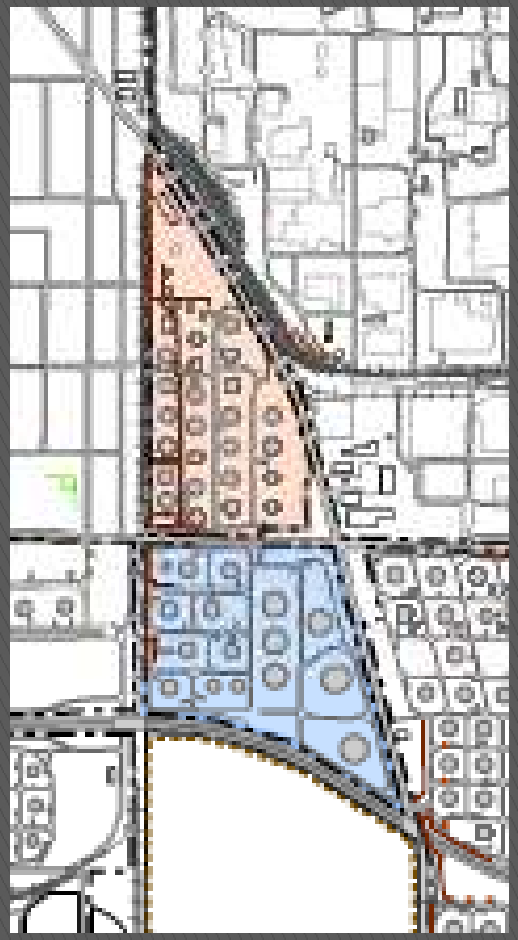
Practical Application of LNAPL Transmissivity – Case Study

Presented at IPEC
November 12, 2013



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Petroleum Above Ground Storage Tank Fields

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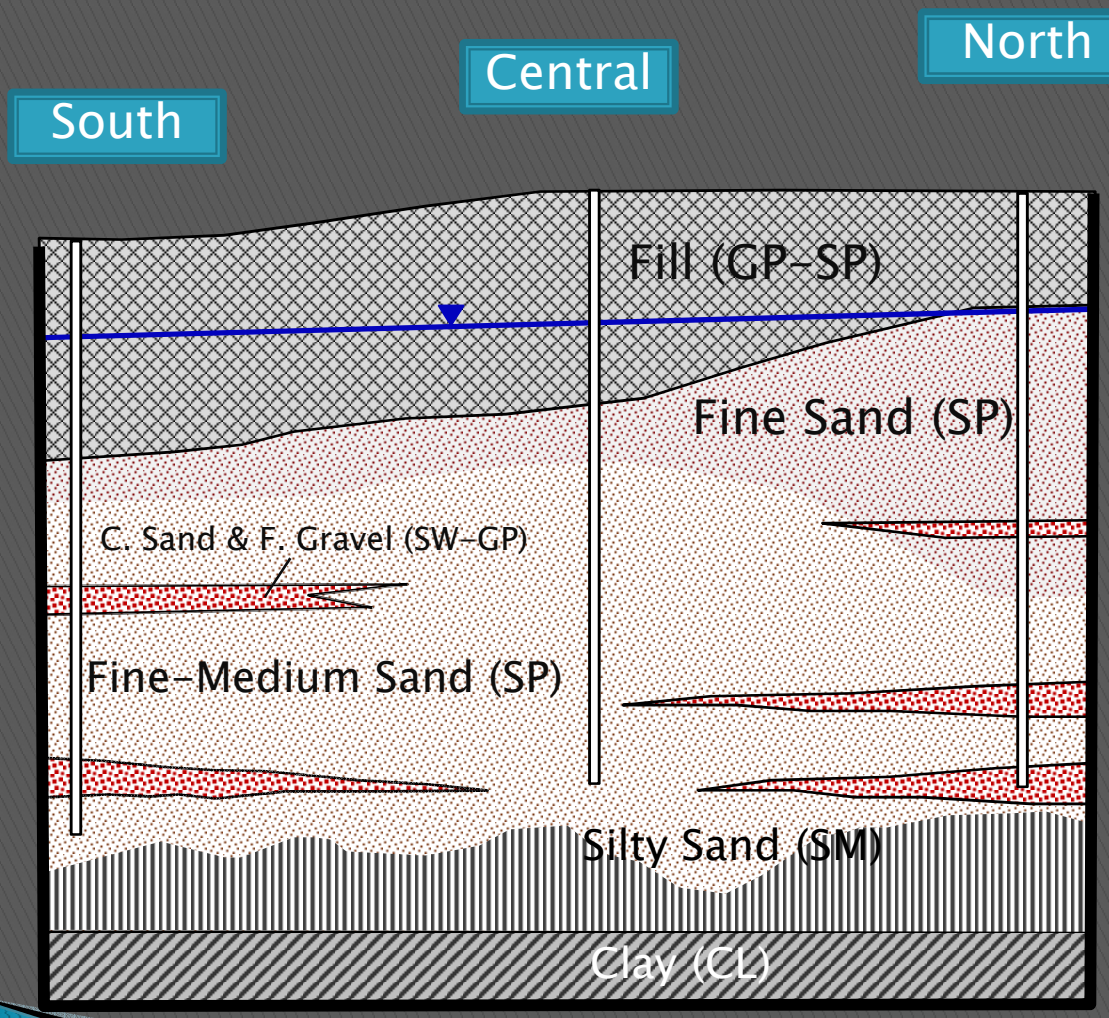
Site Geology



2 to 6 ft of coarse fill with Slag & debris

Water table at 2 to 8 ft bgs With seasonal fluctuations

22 to 30 ft of medium to fine dune sand with occasional coarse sand & gravel stringers – unit grades downward to a fine silty sand

70 ft of laucustrine clay & Glacial till

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Site Background

- Site Hydrogeology
  - Groundwater Table 0 to 16 feet bgs
  - Flow Direction –Northwest
  - Gradient – 0.006 feet/foot
- Light Nonaqueous Phase Liquid (LNAPL)
  - Present in 54 of 131 existing monitoring wells
  - Apparent thickness ranges from 0.01 to 6.08 feet

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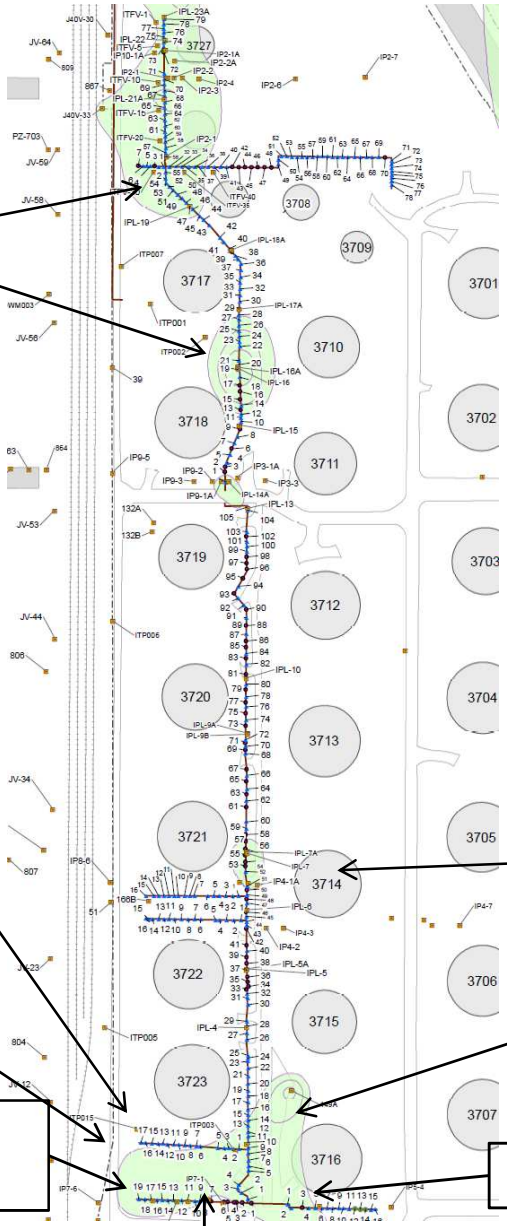
LNAPL Type – North Field



2011: Middle Distillate

1998: HVN
2011: Middle Distillate

1997: DAN

1998: HSFO, HSGO

1998: Naphtha
2011: Crude Oil w/ Gasoline

1990 and 2011: Crude Oil w/ Gasoline

1994: Naphtha

1994: Diesel

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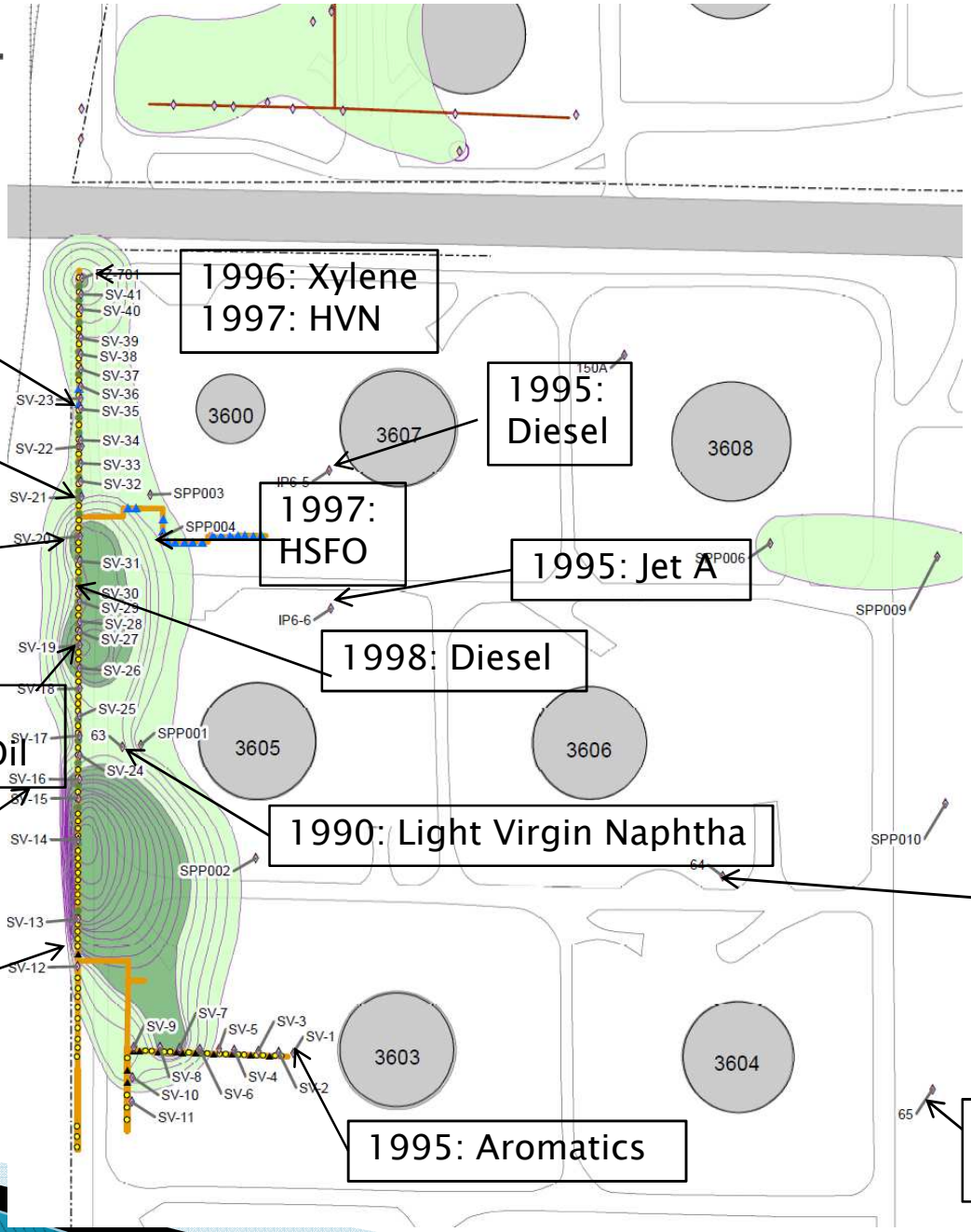
LNAPL Type – South Field



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Interim Remediation Systems

- Three Well Point Systems with Product Skimming Hose (PSH) Wells
- Final Effluent to On-Site WWTF
- Vapors processed via Thermal Oxidizer

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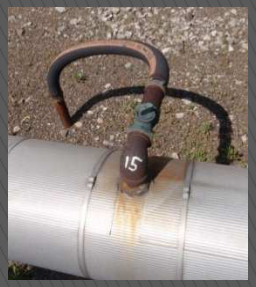
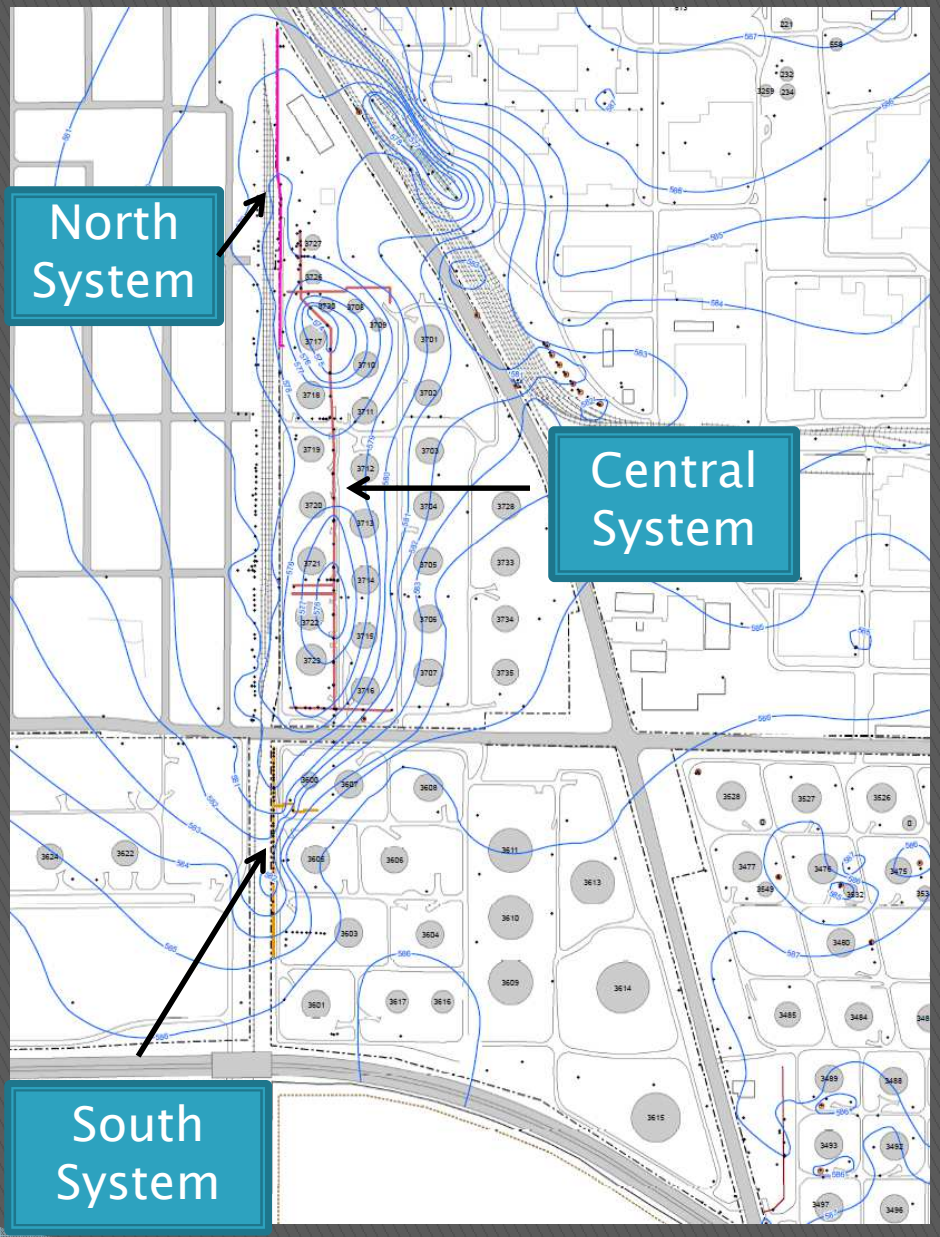
Well Point and PSH Systems

System Operations

- 407 Wellpoints
- 318 PSHs
- Flow Rate:
  - 60- 220 gpm
- Oil/Water Recovery Ratio:
  - 0 to Film
- Gradient Monitoring
  - Via Monthly Transducer Data





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Remediation Objectives

- Agreed Order Compliance
  - Inward Hydraulic Gradient
  - LNAPL Containment
  - LNAPL Recovery
- Risk Mitigation
- Current Systems Performance Optimization
- Appropriate Remediation Technology Selection and Optimization

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Project Goals

- LNAPL Management Using a Risk-Based Approach (Modeled after ITRC)
  - LNAPL Characterization and Delineation
  - Develop Comprehensive Conceptual Site Model (CSM)
  - Develop Future Remedy to Meet Objectives
- Evaluate Interim Remediation System Performance
  - Determine if effective and efficient in meeting Remediation Objectives
  - Analyze LNAPL characterization data from existing PSHs and monitoring wells to target optimization efforts

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LNAPL Transmissivity

- T_n as driver for operations of current interim remediation system
- T_n as one line of evidence for a future remedy selection via the ITRC risk based approach

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LNAPL Transmissivity

- Field Testing Methods
  - Baildown Testing
  - Manual Skim Testing
  - Oil/Water Ratio Testing

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LNAPL Transmissivity Results

- Tn ft2/day

0-0.1

0.1-0.8

0.8 -3.0

3.0 -10.0

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Remediation System Optimization

- System Modifications
- Gradient Monitoring
- Well Point Tuning
- Increase LNAPL Recovery

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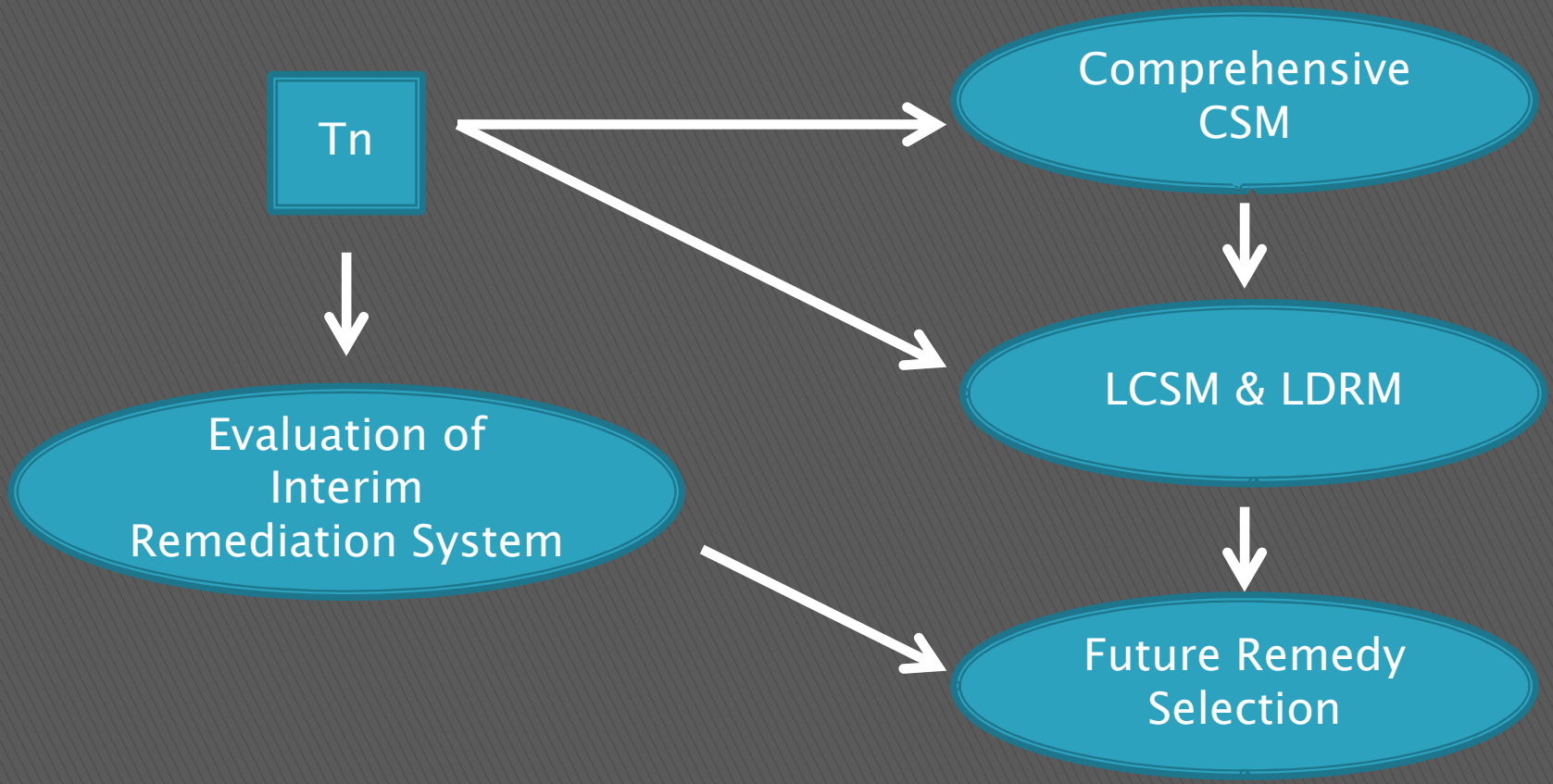
LNAPL Management



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LNAPL Characterization

- LNAPL Source Delineation and Characterization
  - Additional boreholes/MWs to vertically and horizontally characterize the LNAPL
    - TPH Profiling
    - LNAPL Saturations in Soil Cores
    - Physical and Chemical LNAPL Properties
- LNAPL Natural Depletion Processes
  - CO2 Flux and Temperature Profiling
- Dissolved-Phase Groundwater Sampling

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Remedy Selection Decision Document

- Use the Risk-Based ITRC Approach for LNAPL Technology Screening
  - Remedial Objective
  - Remediation Goal
  - Performance Metrics
- LNAPL Remedial Technologies
  - Multiphase Extraction
  - Bioslurping/EFR
  - Recovery Wells
  - French Drains
  - Passive/Reactive Treatment Walls
  - Air Sparging/Soil Vapor Extraction
  - Upgrade of the Current Well Point System
- Not all technologies considered can be implemented as stand-alone options

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