

Effective Site Management by Evaluating Cost of Remediation and Completeness Using CLOSSES

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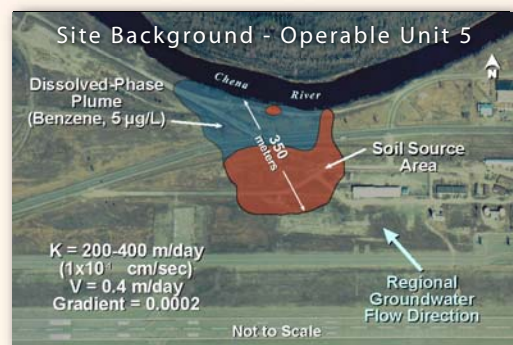
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Introduction - What is CLOSSES?

CLOSSES – Cleanup Operations and Site Exit Strategy

- An approach for evaluating remedial processes at contaminant source areas
- A “tool box” of screening-level models and statistical evaluations
- A basis for optimizing operation and monitoring of remediation systems

Overview of Site



Remediation at Site

- Remedial objective – protect the Chena River from influx of contaminants of concern
- Remedial approach – active treatment and natural attenuation
- Remediation goals
- Benzene – 5 mg/L
- Treatment of groundwater and soil by AS/SVE (386 AS and 70 SVE wells)
- Active treatment to remove volatile organic hydrocarbons
- Low volatility hydrocarbons not removed
- Significant residual hydrocarbon following active treatment
- Installation of 386 AS and 79 SVE wells
- Installation and O&M of treatment systems
- Expected treatment duration
- Source area treatment – 5 years
- Downgradient treatment – 10 years

Comparison of Expected and Actual Remediation Costs

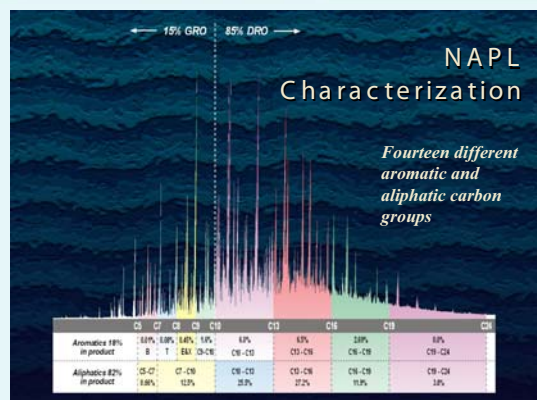
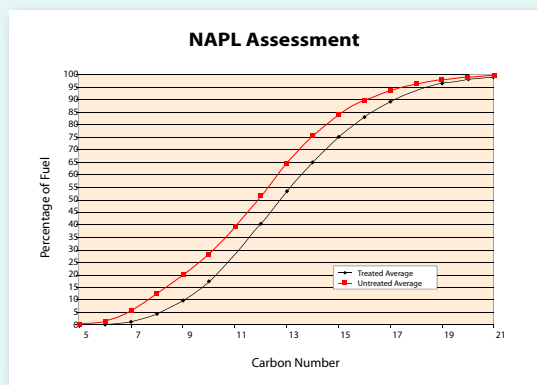
Cost Item	ROD Estimate (2002 \$\$)	Costs Updated for IRAR (2002 \$\$)
Capital cost	5,282,168	3,978,126
Annual operating cost	6,700,425	10,738,500
Total cost	11,982,593	14,716,626

IRAR = interim remedial action report

Monitoring Data Evaluation

Optimization at Site

- NAPL – four samples pre-treatment and four after one year of treatment
- Soil – three rounds of 16 comparative borings
- Vapor – 134 off-gas samples during treatment
- Groundwater – 295 samples from 64 wells



Soil Assessment

- Trends from 16 comparative borings show GRO and VOCs reduced >95%
- DRO reduced by >65%
- Reductions in both vadose and smear zones

Monitoring Assessment

- Frequency and spatial orientation of groundwater and soil sampling
- Trends in both groundwater and soil concentrations
- Mann-Kendall trend analysis
- Cost-Effective Sampling (CES)
- Provide information used to improve monitoring program (monitoring frequency and location)

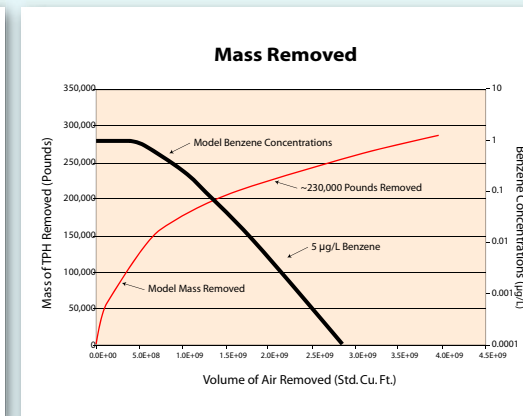
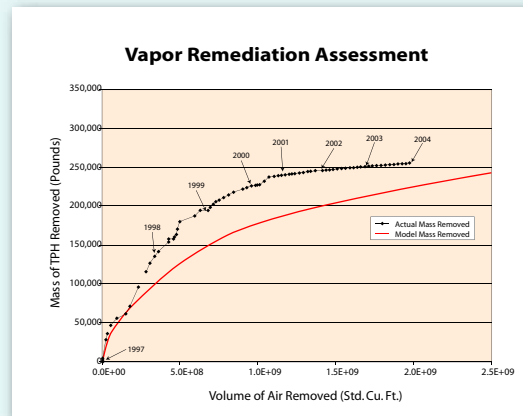
Remediation Assessment Tools - TTCU Models

Remediation Assessment Tools - TTCU Models

- Screening level tools that predict the effects of treatment in contaminant source areas
- Phase-partitioning calculations for hydrocarbon mixtures
- Predict changes in groundwater and soil contamination concentrations in response to treatment

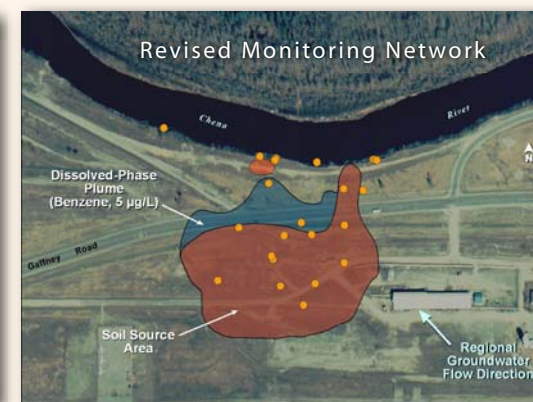
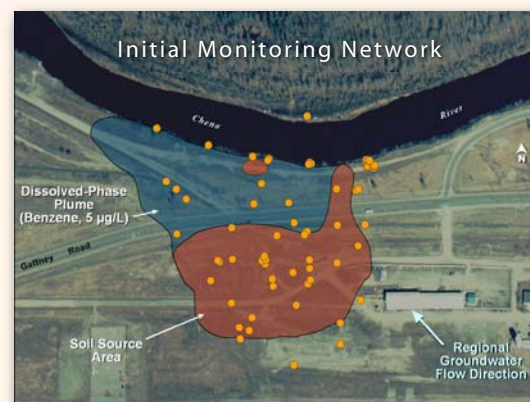
Vapor Assessment

- 500,000 pounds of TPH removed from the source area
- Mass removed greater than predicted to be protective of groundwater
- Actual mass removed is similar to model prediction



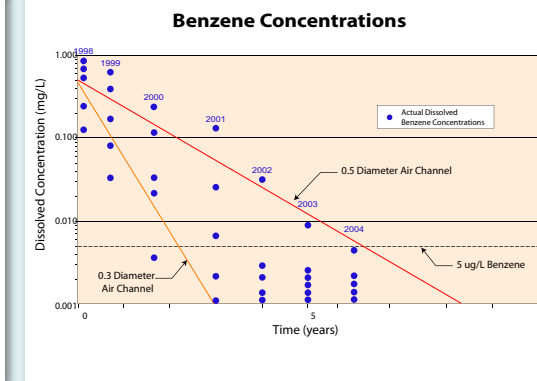
Results

- Discontinued comparative soil sampling – \$45,000/year
- Reduced groundwater sampling program by more than 40% – \$120,000/year



Mass of TPH to Remove to Prevent Benzene Migration to Groundwater

	TPH Mass (lbs)	Soil Concentration (mg/kg)
Contamination pre-treatment	2,000,000	9,400
Treatment required	320,000	1,500
Remaining contamination	1,680,000	7,900



Summary Cost Savings

Cost Item	2002 IRAR Revised Estimate (1998 \$)	2003 Revised Estimate (2002 \$)	Cost Savings (2002 \$)
Capital Cost	3,978,126	3,978,126	0
Annual Operating Cost	10,738,500	8,145,900	2,592,600
Total Cost	14,716,626	12,124,026	2,592,600

- **CLOSSES** provides a framework for evaluating site data and making site management decisions
- Consistency between monitoring data and screening models provides confidence that site remedial processes are reasonably well understood
- Implementing interim changes can provide substantial cost savings in operation and monitoring at sites