Application of Knowledge Gained and Tools Developed at the Bemidji Site to a Crude Oil Spill Site in Cass Lake, MN

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Cass Lake, MN
Crude Oil Spill Site

- Located in north-central Minnesota
- Unconfined sand and gravel aquifer
- Groundwater flow is to southeast
- Velocity ~ 6 m/yr
Prior Knowledge of Plume Extent

Cass Lake Pumping Station

KNOWN EXTENT OF BENZENE PLUME
(March, 2006)

EXTENT OF CRUDE OIL
(March, 2006)

Weeping flange

CRUDE OIL PIPELINES

RAILROAD TRACKS

Observation well

Direction of ground-water flow
Study Objectives

- Characterize the three-dimensional extent of the dissolved plume of BTEX (benzene, toluene, ethylbenzene, and xylenes)
- Evaluate the long-term outlook for natural attenuation of BTEX in the aquifer
- Compare with intensely studied USGS “Bemidji” site.
Study Approach

- Conduct reconnaissance of the dissolved hydrocarbon plume – using a push-probe technique to investigate a series of vertical profiles at increasing distance down gradient
- Use field gas chromatograph (GC) to quantify BTEX concentrations
- Obtain aquifer core material for microbial population characterization (MPN) and solid phase iron measurements
- Install permanent monitoring wells
Cass Lake – Bemidji comparisons

- Lateral flow rate at Cass Lake reduced by a factor of 3.
- Both plumes are about the same length, but Cass Lake plume is more narrow.
- Benzene attenuation rate at Cass Lake is reduced about a factor of 4, but overall BTEX concentrations are much reduced.
- Cass Lake microbial populations much reduced.
- Cass Lake oil is more weathered.
- Temperature increases were found in both plumes (see Warren and Bekins poster)
Concluding remarks

- Methanogenesis is well established at the Cass Lake site.
- Use of the push probe and field GC BTEX analysis was crucial to discovery of the plume.