



EISBR Pilot Program:

Site

- Denitrification Demonstration Test
Cape Cod, MA.

Contaminants of Concern

- Nitrate

Geology/ Hydrology

- Site geology consists of mostly medium to coarse sands with gravel and silt lens.
- Depth to water at approximately 35 feet bgs.

Treatment Program

- Denitrification PRB through application of Terra Systems SRS-NR (Slow Release Substrate-Nitrate Removal) EVO and sodium bicarbonate.
- PRB length of 110 feet, consisting of 17 direct-push injection points (7 points in a single row and 10 points in a pair of rows).
- Injection interval from 36 to 68 feet bgs.
- Total solution volume injected was ~11,000 gallons.
- Field monitoring data during the injections indicated negligible change to turbidity and conductivity in downgradient monitoring wells achieving project objective to minimize migration of EVO and establish a robust PRB.

Project Status

- SRS-NR EVO is anticipated to last in the aquifer and support denitrification for 3+ years. Quarterly performance monitoring will be conducted starting in 2017 to evaluate performance including nitrate removal, EVO migration and persistence.

ISOTEC Case Study No. 80

ENHANCED IN-SITU BIOREMEDIATION (EISBR): DENITRIFICATION PERMEABLE REACTIVE BARRIER UTILIZING EMULSIFIED VEGETABLE OIL

Nitrate Plume Demonstration Test
Cape Cod, Massachusetts

SITE BACKGROUND

ISOTEC was retained to implement a Denitrification Permeable Reactive Barrier (PRB) demonstration test for the treatment of nitrate in groundwater using Emulsified Vegetable Oil (EVO). Septic systems are used to manage nearly 85 percent of the wastewater flow from residences and businesses on Cape Cod. As a result, nitrate emanating from septic systems travels as a plume without significant attenuation in groundwater to coastal waters. The Project represented the first to implement a “Hybrid” approach under the Cape Cod 208 Water Quality Plan, approved by both the USEPA and Massachusetts Department of Environmental Protection, which uses non-traditional technologies including PRBs. Application of EVO introduces a carbon food substrate into the subsurface to enhance activity of naturally occurring denitrifying bacteria.

Site soils consist of sandy formation with high groundwater flow velocities (1 to 2 feet per day). Gravel and clayed silt lenses exist within the subsurface. Groundwater is encountered at approximately 35 feet bgs, with the nitrate plume extending at least to 70 feet bgs.

TREATMENT PROGRAM AND IMPLEMENTATION

The demonstration test PRB was approximately 110 feet long and consisted of 17 direct push injection points. The vertical injection interval was 36 to 68 feet bgs. This PRB was established utilizing the first ever use of a custom Terra Systems EVO solution formulated specifically for extended longevity in a permeable aquifer with high groundwater flow velocity.



Total volume of EVO injected for the PRB was ~11,000 gallons (approximately 14% effective pore volume), applied at a 4:1 ratio with sodium bicarbonate as pH buffer. Performance monitoring conducted during the injection program indicated negligible changes in turbidity or conductivity in monitoring wells 7 and 10 feet downgradient, which achieved the treatment objective to minimize migration of EVO and to establish a robust PRB.



PROJECT STATUS

PRB performance and longevity is being assessed through a quarterly monitoring program. SRS-NR EVO is anticipated to last in the aquifer and support denitrification for 3+ years. Quarterly performance monitoring will be conducted starting in 2017 to evaluate performance including nitrate removal, EVO migration and persistence.