

PETROFIX APPLIED AT REGIONAL AIRPORT SITE TO TREAT BTEX

CASE STUDY:

**Grid Approach Used to Remediate
Hydrocarbon Contaminants at Former
Naval Auxiliary Air Station, Manteo**





Overview

Grid Approach Design Applied Using Direct Push Injection



PetroFix is being used on other CERCLA/RCRA-funded sites to quickly reduce contaminant levels and accelerate site closure



Visual confirmation in soil cores and monitoring wells allows the field crew to make real-time adjustments to ensure proper distribution

A Petroleum hydrocarbon release caused by leaking underground storage tanks (USTs) required remediation at the Dare County Regional Airport in Outer Banks, North Carolina. After the leak was discovered in 2008, a contractor removed two 50,000-gallon concrete underground storage tanks and four steel USTs that were previously used to store fuel at the site. Additionally, 455 tons of hydrocarbon-impacted soil and approximately 300 tons of sludge were excavated during the tank closure activities. Sampling performed at the time of the UST closures identified hydrocarbon-impacted soil at the locations of the concrete tanks and along the fuel distribution pipe.

Previous Remediation Attempts

6 USTs
Removed

2 x 50,000 gal. concrete USTs and 4 steel tanks removed

455 Tons
Excavated

455 tons of hydrocarbon-impacted soil were excavated

300 Tons
of sludge

300 tons of sludge were removed from the site during excavation

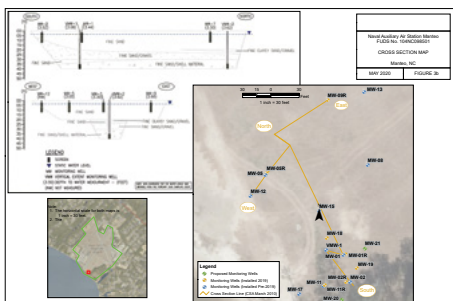


Image from the comprehensive site assessment (CSA) performed in February of 2009.

A Comprehensive Site Assessment (CSA) was performed in February of 2009 to delineate the extent of hydrocarbon-impacted soils which exceeded groundwater standards. In March of 2011, the responsible party removed an additional 1,366 tons of hydrocarbon-impacted soil from the site as part of its soil and groundwater remedial efforts.

The overall objective of the ongoing remedial activities is to gain site closure by exhibiting four consecutive groundwater sampling events showing concentration below applicable North Carolina Groundwater Quality Standards (GWQS). The post-excitation groundwater analysis showed hydrocarbon concentrations above the NCDEQ GWQS in four monitoring wells. It was determined that an additional remedial approach beyond monitored natural attenuation (MNA) was needed to reach regulatory standards. After a thorough evaluation of viable remedies, the responsible party selected PetroFix, a micron-scale, liquid-carbon amendment, to address the contaminant levels and achieve their site goals of No Further Action (NFA). REGENESIS has seen proven results to greatly reduce petroleum contaminants by applying PetroFix using a direct-push approach. Additionally, an accompanying online design assistant application enables environmental professionals to design their own remedial applications for a variety of site types.



After years of monitoring and remediation attempts, PetroFix was chosen because of its proven ability to reduce petroleum contaminants and ensure site closure



Background

Routine Sampling Reveals Contamination



Aerial view of the Dare County Regional Airport in Manteo, North Carolina

The Dare County Regional Airport was originally established as a Naval Auxiliary Air Station and was officially commissioned on March 3, 1943. The US Navy utilized the site as an auxiliary training field and fuel storage complex during World War II. In 1947, following the war, Dare County asked for the return of the airfield. Since then the facility has been operated by a Fix Base Operator (FBO) and later by the Dare County Airport Authority, which took over the airport in 1983 and continues to oversee the airport's daily operations.

In 2008, following the discovery of a petroleum hydrocarbon release, a contractor was hired to remove six underground storage tanks that had previously housed fuel. In addition to the tank removals, 455 tons of hydrocarbon-impacted soil and approximately 300 tons of sludge were excavated. Sampling performed at the time of the UST closures identified hydrocarbon-impacted soil at the locations of the concrete tanks and along the fuel distribution pipe.

Over the years, monitoring results have been mixed, initially showing a decrease in contaminant concentrations. However, in the last four years concentrations levels have fluctuated and it is unclear if degradation has stalled, if site conditions have changed, or if the monitoring well network is not adequately representing groundwater conditions at the site. Results of the post-excavation groundwater analysis showed hydrocarbon concentrations above NCDEQ GWQS in four monitoring wells. More recent monitoring results from June and September of 2019 are consistent with recent results.

Reported GW Concentrations (mg/L)

Contaminant	Detected Levels
Benzene	0.011 mg/L
Ethylbenzene	0.002 mg/L
TPH-GRO	0.750 mg/L
Xylenes	0.001 mg/L



Timeline

PetroFix Chosen to Address Petroleum Hydrocarbons at Regional Airport



● **1943**

Naval Auxiliary Air Station, Manteo was officially commissioned on March 3, 1943.



● **1947**

Following World War II, Dare County asked for the return of the airfield.



● **1983**

The Dare County Airport Authority took over the airport and continues to oversee its daily operations.



● **2008**

Due to leaking underground storage tanks (USTs), a contractor removed two 50,000-gallon concrete USTs and four steel USTs, previously used to store fuel at the site.



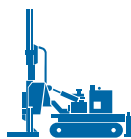
● **2009**

A Comprehensive Site Assessment (CSA) was performed to delineate the extent of the hydrocarbon-impacted soils.



● **2011**

The responsible party removed an additional 1,366 tons of hydrocarbon-impacted soil from the site as part of its soil and groundwater remedial efforts.



● **2019**

Monitoring results consistently show hydrocarbon concentrations above NCDEQ and GWQA in four monitoring wells.



● **2020**

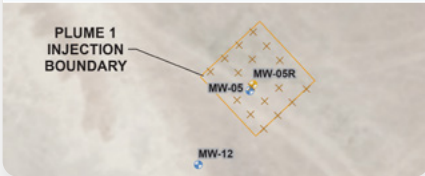
4,800 lbs of PetroFix were injected into 68 injection points.

Treatment

PetroFix Applied Using a 6' Grid Approach to Treat the Plumes

The design incorporated 4,800 lbs. of PetroFix for a total of 23,337 gallons applied using direct-push injection at 68 points in a grid design with 6 ft. spacing between points. The injections were emplaced at a vertical injection interval of 3 – 12.5 ft. below ground surface (bgs). Using REGENESIS' detailed documentation on applying PetroFix, the field personnel oversaw that equipment needed for the injection was obtained, such as multi-port injection tooling and flow and pressure meters, and that observation soil cores were taken pre- and post-injection on the first day of field work to document PetroFix distribution at the site.

Plume 1 Treatment Area



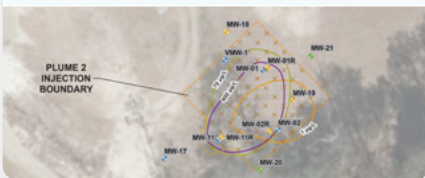
Treatment Area Information

Treatment Surface Area	625 sq. ft.
Delivery Points	17
Treatment Interval	3-12.5 ft. bgs.
Soil Type	Course / Fine Mix

PetroFix Information

PetroFix Applied	1,200 lbs
Total Volume (Diluted)	4,913 gal

Plume 2 Treatment Area

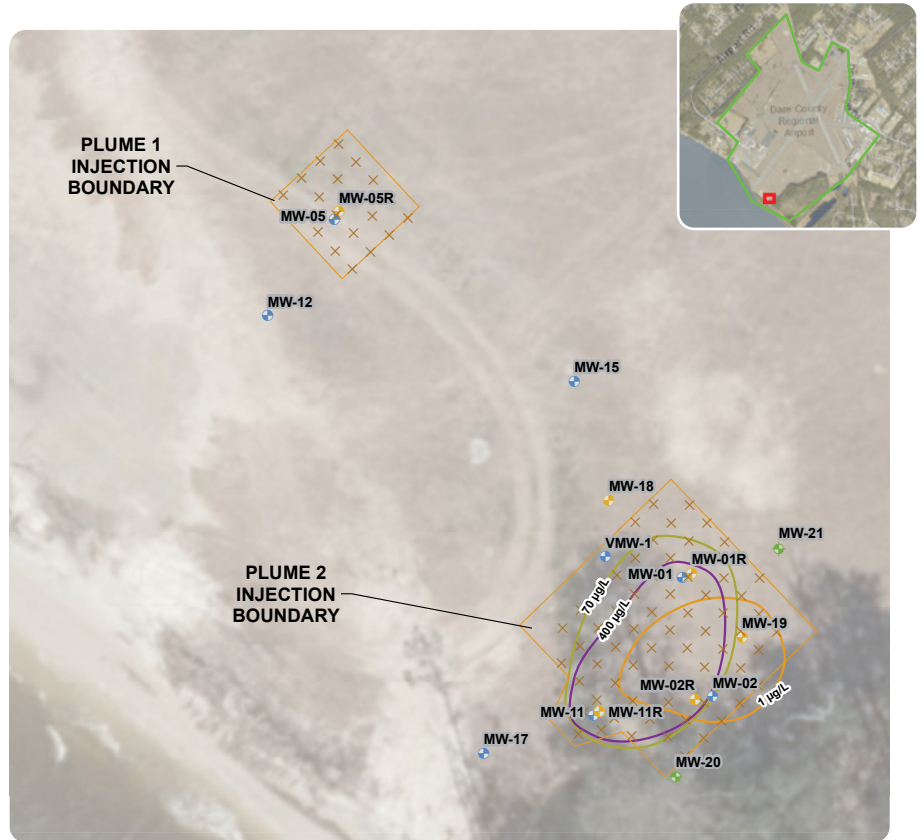


Treatment Area Information

Treatment Surface Area	2500 sq. ft.
Delivery Points	69
Treatment Interval	3-12.5 ft. bgs.
Soil Type	Course / Fine Mix

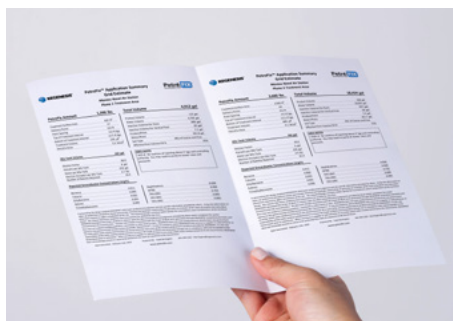
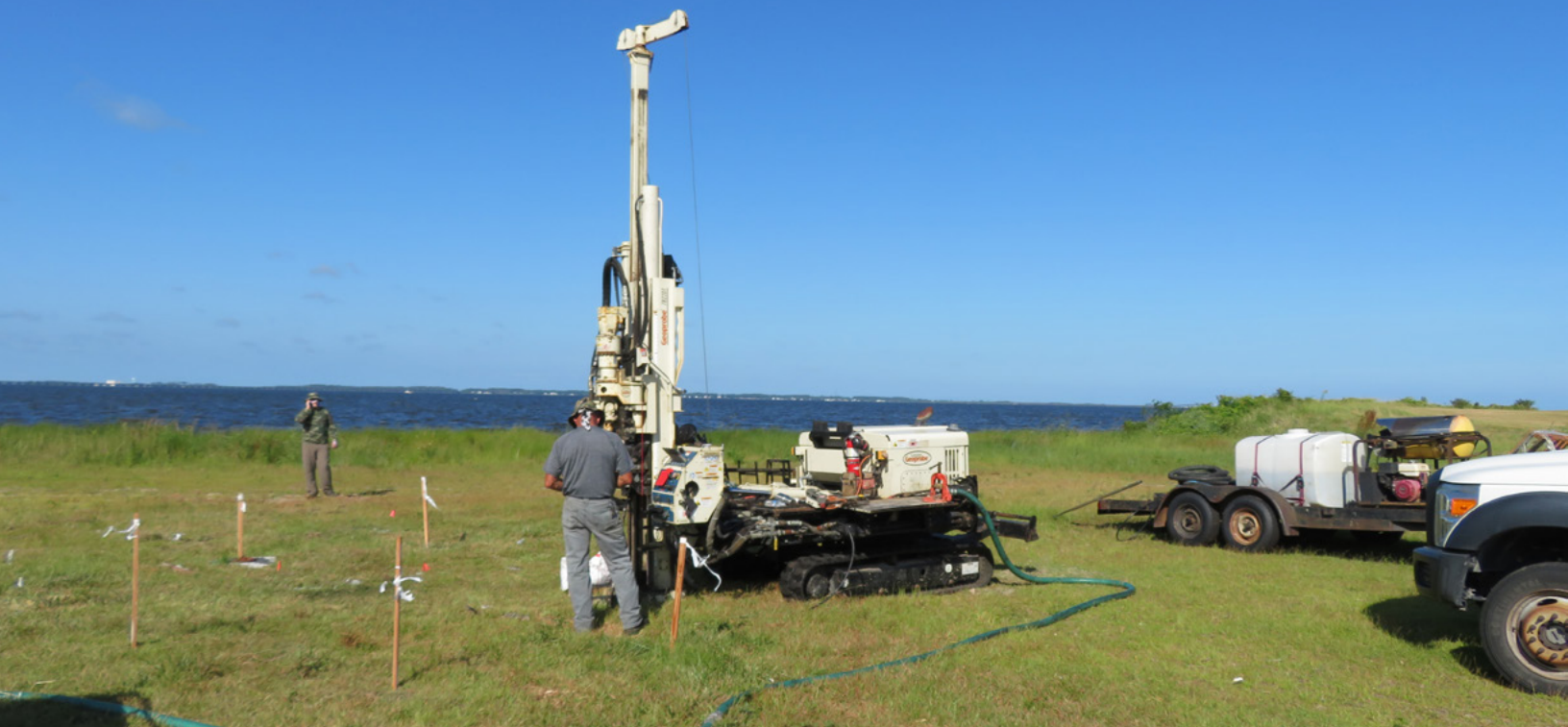
PetroFix Information

PetroFix Applied	3,600 lbs
Total Volume (Diluted)	18,424 gal



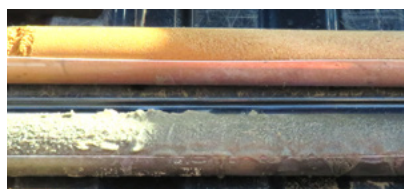
Legend

- Proposed Temporary Injection Points
- Boundary of Injections
- Proposed Monitoring Wells
- Monitoring Wells (Installed 2019)
- Monitoring Wells (Installed Pre-2019)
- Benzene, September 2019
- Isopropylbenzene, September 2019
- C5-C8 Aliphatics, September 2019



The PetroFix app provides an output that can be printed to help drillers inject the correct mix of product and rate specific to the site.

It was also important to document whether PetroFix was successfully being injected and distributed through the subsurface. By using REGENESIS' detailed documentation on applying PetroFix, the field personnel oversaw that equipment needed for the injection was obtained, such as multi-port injection tooling and flow and pressure meters, and that observation soil cores were taken pre- and post-injection on the first day of field work to document PetroFix distribution at the site. Based on visual confirmation of PetroFix in soil cores or observed in monitoring wells the field crew was able to determine if PetroFix was being successfully distributed and if not to make real-time adjustments to injection tooling, injection volumes, and injection pressures to accomplish the distribution goals for the project.



Pre-injection soil core (3-12 ft bgs.)



Post-injection soil core shows PetroFix distribution within the target treatment interval.



Results

Compared to Thermal, and Air-Sparging Approaches, PetroFix was Considered Most Cost-Effective



PetroFix is safe, fast, effective and easy-to-apply and it is designed to specifically sorb and biodegrade petroleum hydrocarbons (PHC), diesel, BTEX, MTBE, and TPH-G. PetroFix was applied at this site because of its unique ability to remove hydrocarbons from the dissolved phase by adsorbing them on to activated carbon particles and then stimulating hydrocarbon biodegradation by adding electron acceptors. The field crew is confident in the success of PetroFix and anticipate seeing a decrease in contaminant concentrations as they closely monitor the site. The field crew is using PetroFix on other CERCLA/RCRA-funded sites to quickly reduce levels and accelerate site closure.

Technology Used

PetroFix Remediation Fluid



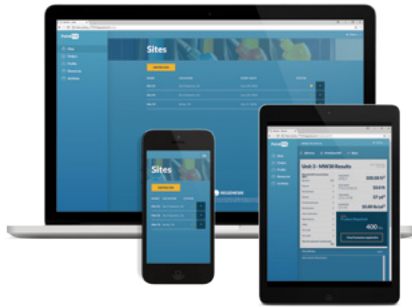
PetroFix Remediation Fluid is a concentrated, water-based, activated carbon suspension specifically designed to treat PHC plumes stemming from bulk storage, gas station and UST spills. Safe, fast, effective and easy-to-apply, PetroFix is designed to specifically sorb and biodegrade petroleum hydrocarbons (PHC), diesel, BTEX, MTBE, and TPH-G. Composed of a mix of micron-scale activated carbon and electron acceptors to promote biodegradation, PetroFix offers an in-situ approach designed specifically for sites where PHC levels are above regulatory standards for complete remediation, at the lowest total cost-to-closure. PetroFix can also be applied to excavation sites.



A driller uses a GeoProbe to place PetroFix within the target treatment interval via direct-push injection



The PetroFix Design Assistant: You Design Use our Online Software to Generate an Estimate When you Need it



To make applying PetroFix simple and easy to use, REGENESIS created an innovative and effective online tool for developing recommended dosage and designs for your site. The PetroFix Design assistant equips environmental professionals with the tools to design individually-tailored remediation plans. This self-design, self-apply tool guides users toward effective designs that will yield the best results and allows users to easily order PetroFix through REGENESIS' customer service department. Educational resources and best practices are also offered along with an online video tutorial which walks the user step-by-step through the design and ordering process.

1 Create Your Account

Begin by creating an account with details about your site including the surface area and average vertical thickness and whether or not NAPL is present at this time.

2 Recommended Treatment

After providing the soil grain size and the groundwater contaminant levels, the Design Assistant will provide results showing the suggested treatment including the recommended volume, dosing, and product required for treatment.

3 Order PetroFix

Once all areas for the site are submitted, start the order process directly within the Design Assistant.



Simple
Easy to Use

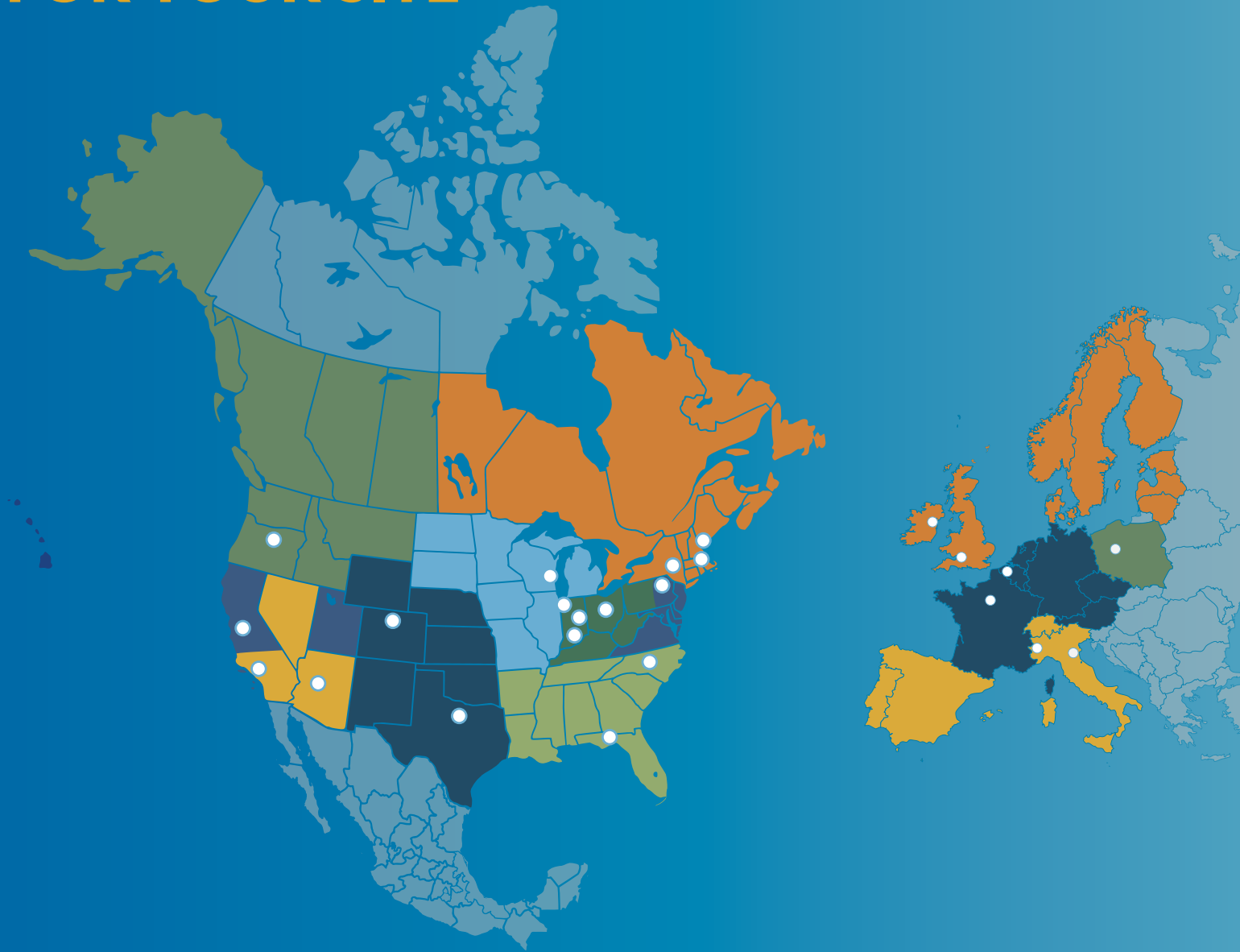


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