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RECORD OF DECISION OPERABLE UNIT 3 (OU 3) SITE 4 FORMER UNDERGROUND STORAGE TANKS NWIRP BETHPAGE NY

10/01/2015

TETRA TECH

Record of Decision

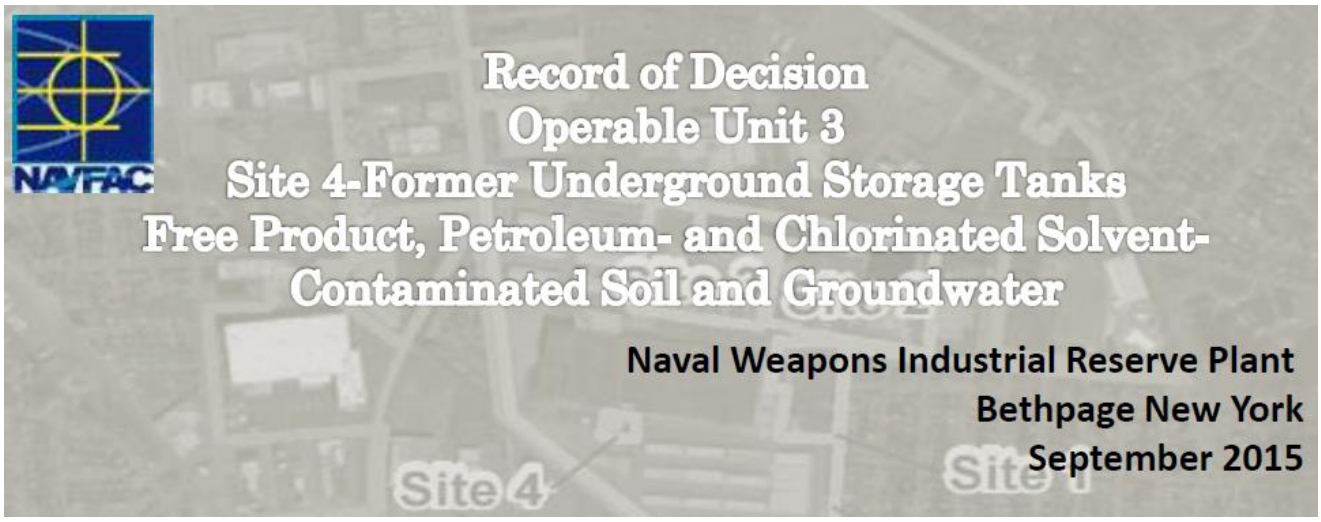
Operable Unit 3

Site 4 - Former Underground Storage Tanks

Naval Weapons Industrial Reserve Plant
Bethpage, New York

Mid-Atlantic Division
Naval Facilities Engineering Command

October 2015



1.0 DECLARATION

1.1 Site Name and Location

This Record of Decision (ROD) presents the Selected Remedy for Operable Unit (OU) 3 Site 4 – Former Underground Storage Tanks at Naval Weapons Industrial Reserve Plant (NWIRP) Bethpage, located in Nassau County, New York (NWIRP OU3 ROD). This Site has also been referred to as Area of Concern (AOC) 22. The Selected Remedy for Site 4 was identified as Alternative 4 in the Proposed Plan and was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) . The decision is based on information contained in the Administrative Record file for Site 4. Information not specifically summarized in this ROD or its references, but contained in the Administrative Record has been considered in making the decision. The Department of the Navy's Environmental Restoration Program (ERP) is responsible for ensuring that appropriate CERCLA response alternatives are developed and implemented as necessary to protect public health, welfare, and the environment. No enforcement activities have been recorded at Site 4.

1.2 Statement of Basis and Purpose

This document presents the selected remedy for Site 4 – Former Underground Storage Tanks (Figure 1-1). The Navy is the federal lead agency in accordance with federal law and the NCP at NWIRP Bethpage. The petroleum hydrocarbon contamination at Site 4 is commingled with other CERCLA hazardous substances; and therefore, these remedial actions are being conducted under CERCLA. The Navy, in consultation with the New York State Department of Environmental Conservation (NYSDEC) pursuant to 10 United States Code (U.S.C.) §2705(a) and (b) and 42 U.S.C. §9620(f), and the New York State Department of Health (NYSDOH) is implementing this remedial decision document which incorporates applicable or relevant and appropriate State requirements. This site is not listed on the National Priorities list (NPL); however, a copy of this document will be sent to United State Environmental Protection Agency (USEPA) Region II offices for informational purposes.

The decision presented in this document is based on the Administrative Record for the site and upon public input to the Proposed Plan presented by the Navy. NYSDEC, the lead state regulatory agency, actively participated throughout the investigation, has reviewed this ROD and the materials on which it is based, and concurs with the selected remedy (Appendix A).

Figure 1-1 –Facility Location Map

1.3 Assessment of the Site

The response action selected in this ROD is necessary to protect the public health or welfare, or the environment from actual or threatened releases of hazardous substances into the environment. Soil and groundwater are addressed under this ROD. For soil, investigations have identified the presence of chemicals of concern (COCs), which consist of the following polynuclear aromatic hydrocarbons (PAHs): benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and naphthalene. For groundwater, the COCs associated with Site 4 are non-chlorinated volatile organic compounds (VOCs) (benzene, ethylbenzene, and total xylenes) and a semi-volatile organic compound (SVOC) naphthalene. This ROD, remedial alternatives, and the selected remedy specifically address these Site 4 COCs in soil and groundwater. This ROD also addresses another SVOC (pentachlorophenol), and two metals (cobalt and manganese) in groundwater. These COCs are believed to be present because petroleum at the site created conditions that caused these chemicals to become mobile. A remedy that addresses the residual petroleum would allow these COCs to naturally attenuate. In addition, all of the Site 4 COCs are commingled with CERCLA hazardous substances (i.e., chlorinated solvents) that are identified in the NWIRP OU2 ROD, and which cannot be effectively separated from the petroleum products. Any action that addresses the Site 4 COCs will also treat the NWIRP OU2 COCs that are intercepted/commingled with Site 4 COCs during treatment. Cadmium was identified in one upgradient monitoring well; and therefore, it is not associated with Site 4. It will be addressed by planned modifications to the ROD for Site 1 and will not be discussed further in this ROD.

1.4 Description of the Selected Remedy

The remedy selected for Site 4 soil and groundwater COCs consists of the injection of steam or heat into soil to allow free product to form on the water table, a free product removal system, and biosparging of soil and groundwater. These actions will specifically target the PAHs and VOCs. Once the cleanup levels for these COCs are achieved, the other Site 4 COCs consisting of cobalt, manganese, and pentachlorophenol will attenuate. The remedy also includes Land Use Controls (LUCs) to prevent human exposure to contaminated soil and groundwater. LUCs would target areas that require notifications and/or inspections during implementation of the selected remedy, until cleanup levels are achieved. Monitoring would also be conducted to determine the effectiveness of the remedy. Both soil and groundwater samples would be collected to demonstrate a reduction in soil concentrations and potential leaching to groundwater.

1.5 Statutory Determinations

As discussed in Section 2.0 (Decision Summary), the Selected Remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. This remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment). Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after the initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

1.6 ROD Data Certification Checklist

The information required to be included in the ROD and the section it can be found are summarized in Table 1-1. Additional information can be found in the Administrative Record file for NWIRP Bethpage, Site 4 – Former Underground Storage Tanks.

Table 1-1 Record of Decision (ROD) Certification Checklist

Data	Location in ROD
Chemicals of concern and their respective concentrations.	2.7 and 2.8
Baseline risk represented by the chemicals of concern.	2.7
Cleanup levels established for chemicals of concern and the basis of these levels.	2.8
How source materials constituting principal threats are addressed.	2.11
Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of ground water used in the baseline risk assessment and ROD.	2.6
Potential land and groundwater use that will be available at the site as a result of the Selected Remedy.	2.12.1
Estimated capital, annual operation and maintenance (O&M), and total present work costs, discount rate, and the number of years over which the remedy cost estimates are projected.	2.10 and Appendix C
Key factor(s) that led to selecting the remedy (i.e., describe how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision).	2.12.1

1.7 Authorizing Signature

This Operable Unit 3 Soil and Groundwater, Site 4 ROD represents the selected remedy for Site 4 – Former Underground Storage Tanks, soil and groundwater at NWIRP Bethpage in Nassau County, New York.

CAPT Jorge P. Rios, CEC, USN
Commanding Officer
Naval Facilities Engineering Command Mid-Atlantic
U.S. Department of Navy

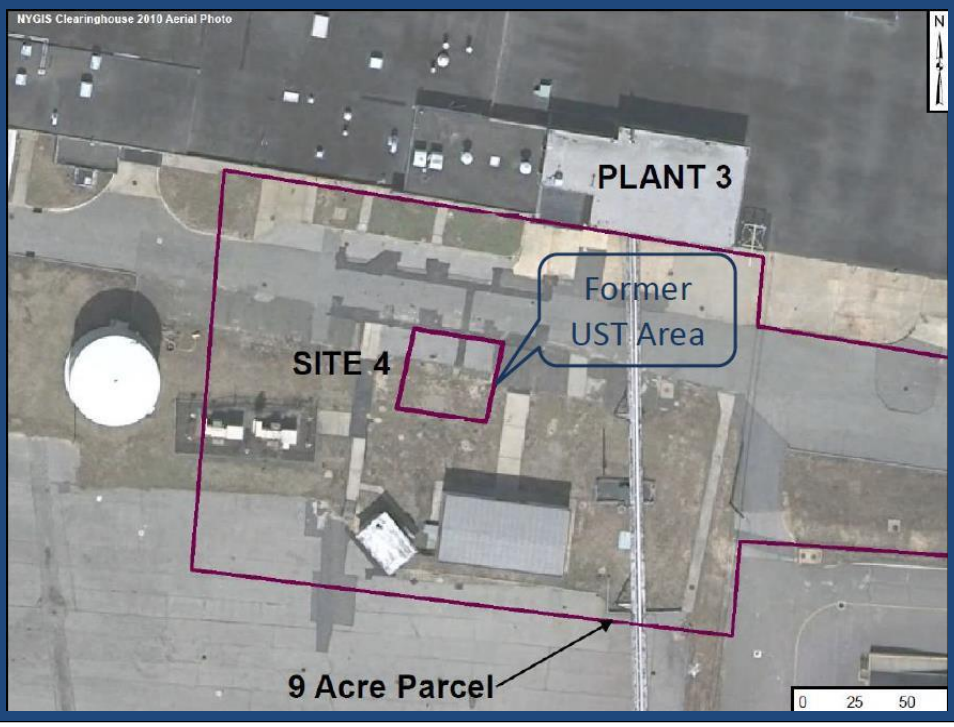
12 NOV 2015
Date

2.0 DECISION SUMMARY

2.1 Site Description

The former Naval Weapons Industrial Reserve Plant (NWIRP) is located in Nassau County on Long Island (Figure 1-1). It was located on the Grumman facility, and was operated by Grumman and later Northrop Grumman (NG) from 1942 to the mid-1990s. The plant's primary mission was the research prototyping, testing, design engineering, fabrication, and primary assembly of military aircraft. In 1996, operations ended at the facility. At this time, the NWIRP was approximately 109.5 acres in size. In 2002, 4.5 acres of the property were transferred to Nassau County. In February 2008, the Navy transferred an additional 96 acres of the remaining 105-acre main parcel to Nassau County. Site 4 is on the remaining 9-acre parcel being retained by the Navy for environmental investigations and remediation, but has been leased to Nassau County for economic re-development (Figure 2-1). Current transfer and lease documents provide LUCs and notifications of areas in which residual contamination is still present. The site is open to the public and is currently being used for commercial, industrial, and redial activities.

Figure 2-1 – Site Location Map



Environmental concerns were first identified during a 1997 Northrop Grumman investigation of former underground storage tanks (USTs) near Plant No. 3. The area was referred to as AOC 22. The USTs reportedly contained Nos. 4 and 6 Fuel Oils and were removed sometime between 1980 and 1984.

In 1999, the Navy included AOC 22 under the Environmental Restoration Program (ERP) and the area is now known as Site 4. Additional investigations have identified petroleum-contaminated soil and semi-solid petroleum product above and below the water table, which is approximately 50 feet below ground surface (bgs). Clean soils have been confirmed at a depth of 73 feet bgs.

2.2 Site History and Enforcement Activities

After the ROD for OU1 (NWIRP Sites 1, 2, and 3) was issued in 1995, Site 4 was characterized under several investigations and studies between 1997 and the present. In 1997, Northrop Grumman conducted a soil investigation at the former UST location (Site 4). Soil samples were collected from depths ranging from 8 to 65 feet bgs. Testing found petroleum in soils at concentrations up to 18,000 milligrams per kilogram (mg/kg) and at depths near the water table. The petroleum hydrocarbons were of the Diesel Range Organics (DRO) fraction and are consistent with No. 4 and No. 6 fuel oils reportedly used at this location.

In 1999, the Navy conducted soil and groundwater investigations associated with a RCRA Facility Assessment, which was issued concurrent with a Focused Feasibility Study (FFS)(Tetra Tech, 2003). Petroleum-contaminated soil was observed beginning at 20 feet bgs and extended at least to the water table (approximately 50 feet bgs) within 5 to 10 feet of the former UST foot print. At a distance of approximately 10 to 40 feet from the former UST area, petroleum contaminated soils were only observed at the water table. At a distance greater than 60 feet, there was no evidence of petroleum contaminated soils. Results from the 1999 investigation concluded that there was no VOC contamination in the soil. The SVOCs detected above NYSDEC criteria were PAHs, constituents of total petroleum hydrocarbons (TPH).

In groundwater, chlorinated VOCs were present in upgradient monitoring wells MW03 and MW05, which indicated that the presence of these chemicals may be from a source further upgradient. These chlorinated solvents were subsequently addressed in the NWIRP OU2 ROD. Wells MW01 and MW02, down gradient of the former USTs, contained the highest concentrations of non-chlorinated VOCs and PAHs. Concentrations of benzene, ethylbenzene, xylenes, and naphthalene were detected in excess of the NYSDEC groundwater criteria. Free product was also observed in these wells at a maximum thickness of 0.02 feet (1/4 inch). Results from free product analysis indicated the product was characteristic of weathered heavy fuel oils and was not classified as hazardous.

In 2003, a FFS (Tetra Tech, 2003) evaluated several alternatives to address the Site 4 soil and groundwater COCs including capping (cover) with deed restrictions, groundwater monitoring, excavation/off-site disposal, and in-situ treatment options of bioremediation, chemical oxidation, and thermally enhanced soil vapor extraction.

In 2004, the Navy proceeded with a pilot-scale in-situ bioremediation study at the site. A Closed-Loop Bioreactor (CLB) pilot-scale system study was an innovative technology that combined in-situ and ex-situ bioremediation, Fentons reagent, and soil washing. The CLB system featured no discharge of soil vapors and added pure oxygen to promote biodegradation. The systems operation ended in the spring of 2006.

In September 2006, testing found that TPH concentrations in the 20-, 30- and 40-foot depth intervals decreased over time, with reductions ranging from 76 percent in the 30-foot depth interval to 19 percent in the 50-foot depth interval. However, the TPH concentration in the 60-foot depth interval increased by 28 percent, suggesting that one effect of the CLB pilot-study was to cause the petroleum contamination to migrate downward. At a depth of approximately 70 feet bgs, which is approximately 18 feet below the current water table, TPH results ranged from 37.5 mg/kg to 5,100 mg/kg. Subsequent testing in 2010, determined that clean soils were present at 73 feet bgs.

Groundwater samples were collected before, during, and after the CLB System operation to evaluate potential migration of contaminants from treatment. Groundwater samples from MW01 and MW02 could not be collected after the start of the CLB System because free product flowed into these wells and then solidified. With the exception of free product solidifying in monitoring wells MW01 and MW02, initially, there were no obvious impacts to groundwater from the operation of the pilot-scale system. By 2011, the concentrations of iron, manganese, cobalt, pentachlorophenol, and two PAHs increased in MW06, a monitoring well down gradient of Site 4.

In 2010 and 2011, bench-scale treatability studies were performed to characterize the nature of petroleum product near the water table, and determine if the residual petroleum material exists as a free product, is adsorbed onto soil, and/or is immobile. The study also evaluated the feasibility of using thermal and solvent-based extraction to allow recovery of the petroleum product above and below the water table, and the ability to biodegrade solvent-based extraction residues using circulated air via biosparging. Soil column studies were conducted to simulate the effect of heating the product in-situ, using solvents such as diesel and a soybean-based solvent (VertecBio Gold #4[Vertec]) to facilitate recovery of product in- situ. The studies found that when soils were submersed in water, some of the product was released from the soil and floated to the water surface. When heated, additional product was released, and higher temperatures were observed to produce the most floating product. Heating soils to a temperature of 120 to 140 degrees Fahrenheit (°F) did not produce explosive conditions. Based on visual observation of the color of the treated soil, both solvents released product from soils, with the Vertec releasing more product. The bench scale study was successful in demonstrating that the product can be desorbed from the soil when heated, or rinsed with either diesel or Vertec.

Based on an evaluation of the data collected, the Navy concluded that activities at this site could proceed to the Feasibility Study and remedy selection stages described in later sections of this ROD.

No enforcement activities have been recorded at Site 4. On November 5, 1997 NYSDEC was notified of this spill when NG's environmental consultant discovered contaminated soil in the area during a Phase 1 Investigation (Spill No. 97-09123). NYSDEC's file on this spill was closed on November 25, 2008.

2.3 Community Participation

The Navy and NYSDEC provide information regarding cleanup of NWIRP Bethpage to the public through the Navy's community relations programs, which include Restoration Advisory Board (RAB) meetings, public meetings, the Administrative Record for the Site, and announcements published in local newspaper (Bethpage Tribune).

The RAB was established for NWIRP Bethpage in 1998. RAB meetings continue to be held to provide an information exchange among community members, the Navy, NYSDOH, NYSDEC, and Nassau County. RAB meetings are held two times per year (April and November).

The Navy maintains a public repository (Administrative Record), which includes supporting technical documents and correspondence related to the site and NWIRP Bethpage, at the Bethpage Public Library, 47 Powell Avenue, Bethpage, New York 11714, (516)931-3907. A public web site with the Administrative Record can be accessed at the following web page: http://go.usa.gov/DyXF.

Community concerns were used to evaluate each remedy in the 2013 Feasibility Study/Corrective Measures Study (FS/CMS) and the 2014 Proposed Plan. A public comment period was held from October 24, 2014 to December 10, 2014. The Proposed Plan was discussed during the November 5, 2014 RAB meeting. As indicated in the Responsiveness Summary (Section 3) of this ROD, no comments were received during the public comment period.

2.4 Scope and Role of Response Action

As with many CERCLA Sites, the problems at Bethpage are complex. As a result, the Navy has organized the work into three operable units (OUs):

- NWIRP OU1: Contamination of soil at Sites 1, 2, and 3 and shallow groundwater at Site 1;
- NWIRP OU2: Contamination of regional groundwater; and
- NWIRP OU3 Contamination of soil and groundwater at Site 4.

The Navy selected a remedy for NWIRP OU1 in a ROD signed on July 5, 1995. The major components of the selected remedy for these sites include further delineation of COCs, soil excavation, and the construction, operation, and maintenance of an air sparge/soil vapor extraction (AS/SVE) system. A soil cover was installed at Site 2. Remedial activities completed at Site 3 included excavation of contaminated soils and the installation of a soil cover. Construction activities at these two sites were completed in 2002. Additional investigations are ongoing at Site 1. The AS/SVE system treated VOC contamination in soil and groundwater in the upper water table.

The Navy also selected a remedy for NWIRP OU2 in a ROD signed on April 13, 2003. Because of multiple sources of regional groundwater contamination, including non-Navy sources, a separate Navy-specific ROD was developed to address the Navy's portion of onsite and offsite groundwater contamination. The contaminated groundwater plumes emanating from NWIRP Bethpage and adjacent property owned and operated by NG are estimated to affect groundwater underlying more than 3,000 acres and extending as much as 770 feet deep. The OU2 remedy identifies off property hotspot remediation, groundwater monitoring, LUCs, and well head treatment for impacted water supply wells; and recognizes the importance of the On-site Containment (ONCT) system (located at the southern boundary of the NG Property) that NG had constructed and is operating and maintaining, to the regional cleanup of groundwater. In addition to VOC-contaminated water originating on the NG property, and other nearby sites, the ONCT contains and remediates VOC-contaminated groundwater emanating from the Navy's property. The remedial program is ongoing.

The third operable unit (NWIRP OU3), the subject of this ROD, addresses the contamination of soil and groundwater at Site 4. The primary risk pathways at this site are through potential direct contact to PAH-contaminated soils and potential ingestion of PAH- and VOC-contaminated groundwater. PAHs and non-chlorinated VOCs are associated with residual petroleum product at the site. In addition, this contamination is commingled with CERCLA hazardous substances (i.e., chlorinated solvents) that are identified in the NWIRP OU2 ROD, and which cannot be effectively separated from the petroleum products. For example, MW2 which contains naphthalene, at 20 micrograms per liter (µg/L), benzene at 12 µg/L, ethylbenzene at 11 µg/L, also contains trichloroethene at 67 µg/L and vinyl chloride at 27 µg/L. The remedy for this OU will also treat these CERCLA hazardous substances.

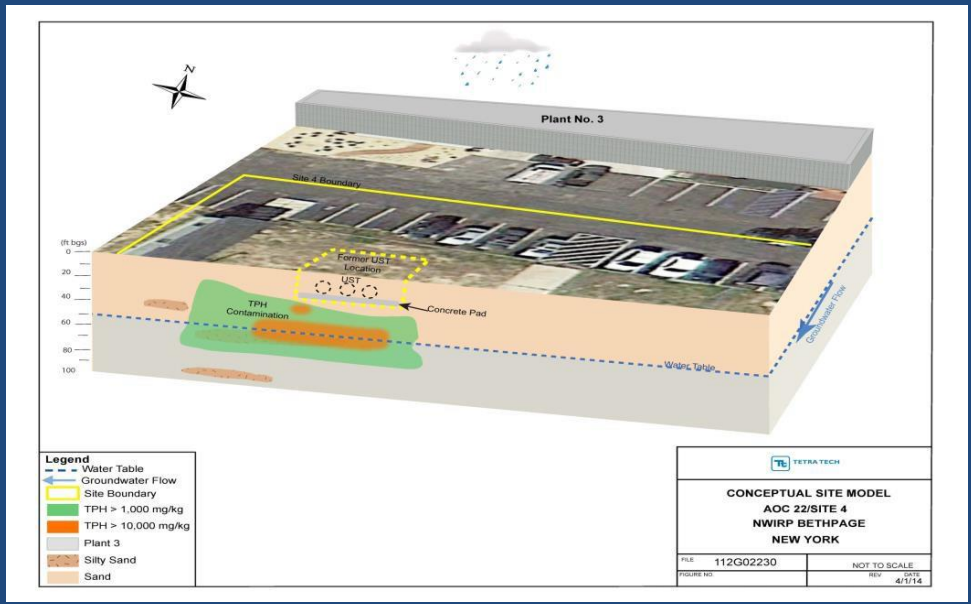
This OU also addresses cobalt, manganese, and pentachlorophenol that was detected in groundwater in one well during the latest sample event. These chemicals are not believed to be components of the petroleum, but are believed to be present in groundwater because of environmental conditions resulting from the natural biodegradation of the petroleum that contributed to the mobilization of these chemicals from the soil.

This is the final response action for NWIRP OU3 - Site 4 and addresses the source area (petroleum product at the site). Downgradient impacts to groundwater will then naturally attenuate.

2.5 Site Characteristics

A Conceptual Site Model (CSM) conveys what is known or suspected about contamination sources, release mechanisms, and the transport and fate of those COCs. It provides the basis for understanding contaminant fate and transport issues and assessing potential remedial technologies at the site. The CSM for Site 4 is derived from available data and accepted principles of contaminant fate and transport. Figure 2-2 shows a three-dimensional CSM interpretation of the site.

Figure 2-2 Conceptual Site Model



NWIRP Bethpage is located on a relatively flat, featureless, glacial outwash plain. This site and nearby vicinity are highly urbanized. Because of this, most of the natural physical features have been reshaped or destroyed. Elevations range from 140 feet above mean sea level (msl) in the north to less than 110 feet above msl at the southwest corner. Site 4 is located south of Plant No. 3 (Figure 2-1).

The geology at NWIRP Bethpage consists of a mixture of coarse sands, gravels, and clayey deposits. The Upper Glacial Formation (commonly referred to as glacial deposits) forms the surface deposits across the entire NWIRP. The glacial deposits beneath the site consist of coarse sands and gravels. These deposits are generally about 40 to 45 feet thick; local variations in thickness are common due to the irregular and undulating contact of the glacial deposits with the underlying Magothy Formation. The contact between the two formations was defined in the field as the horizon where gravel becomes very rare to absent, and finer sands, silts, and clays predominate. The generally coarse nature of both formations near their contact, however, may make this differentiation either difficult or rather subjective.

The results of the drilling program confirm regional observation that there are no singular, extensive clay units beneath the NWIRP. Clay units encountered at any particular location do not persist along strike or in either direction of dip. The stratigraphic section at and below the subsurface depths of 100 feet may be considered “clay-prone” because the number of individual clay units significantly increases below this depth, but none of these clays are laterally persistent.

The Magothy aquifer is the major source of public water in Nassau County. The most productive water bearing zones are the discontinuous lenses of sand and gravel that occur within the generally siltier matrix. The gravel layer is the major water-bearing zone and is commonly found in the basal Magothy.

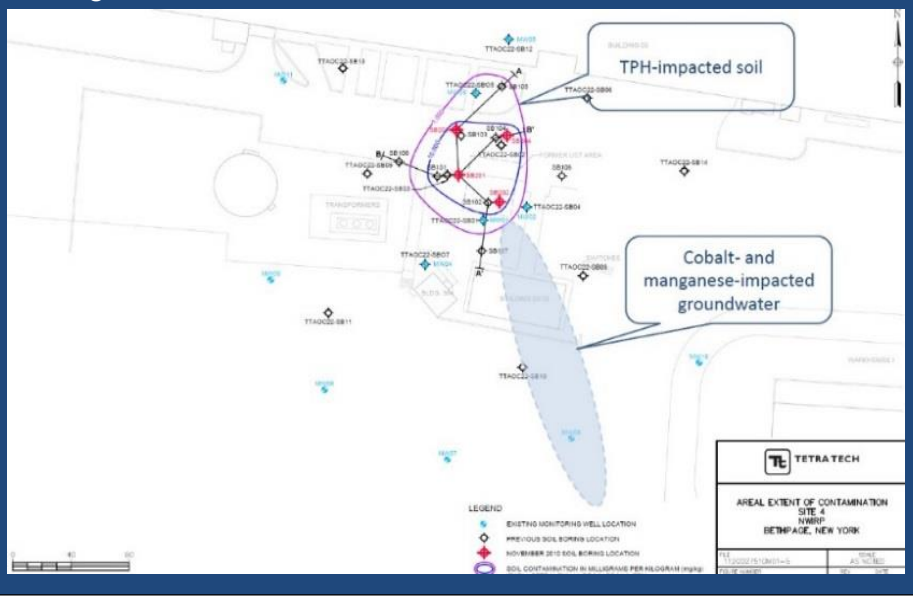
Hydraulic characteristics beneath Site 4 were investigated by conducting rising head slug tests in three of the five constructed permanent groundwater monitoring wells in order to obtain site-specific values. The average horizontal hydraulic conductivity determined using slug test data for the upper portion of the Magothy Formation underlying Site 4 was 55 feet per day. Past investigations and estimated values for the same portion of the Magothy Formation have ranged from 50 to 100 feet per day.

Water levels are periodically gathered from each of the permanent groundwater monitoring wells to determine the preferred direction of shallow groundwater underlying Site 4. These data revealed that the dominant direction of shallow groundwater flow towards the south and southwest. During the course of most recent investigations, it was also noted that the static water levels changed on the order of one to two feet, likely as a result of the combination of minimal precipitation/recharge in conjunction with regional aquifer demands.

Based on the results of investigations and chemical and physical data, the source of fuel contamination is the former USTs that reportedly contained Nos. 4 and 6 fuel oils. Because the primary Site 4 COCs (PAHs) are associated with the petroleum, TPH can be used as a surrogate for evaluating compliance with the cleanup goals. The TPH method is simple and reliable, especially for evaluating media with relatively high concentrations of organics that may interfere with PAH analysis. Based on a correlation that was developed between TPH and PAH concentrations, when TPH concentrations are approximately 1,000 mg/kg or less, the soil is generally compliant with the cleanup goals. When the TPH concentrations are greater than 10,000 mg/kg, the cleanup levels are exceeded. As a result, TPHs of 1,000 and 10,000 mg/kg are the basis for establishing the extent of soil contamination at the site. The estimated areal extent of contamination is approximately 0.14 acre (Figure 2-3) and the estimated volume of contaminated soil is approximately 6,800 cubic yards and contains 47 tons of TPH. Of that volume, approximately 1,300 cubic yards and approximately 30 tons of TPH is greater than 10,000 mg/kg. In addition, a concentration of 10,000 mg/kg or higher is generally indicative of conditions in which free product may form. Free product has been identified in the site soil and on the groundwater. The areal extent of this soil is approximately 0.08 acre.

The areal extent and depth of the PAH- and non-chlorinated VOC-impacted groundwater is similar to that of the 1,000 mg/kg TPH soil, or 0.014 acre. The depth of this groundwater ranges from the water table at approximately 50 feet bgs to approximately 73 feet bgs. In addition, cobalt-, pentachlorophenol-, and manganese- impacted groundwater has been identified in one water table monitoring well 150 feet downgradient of the TPH-impacted soil. This contamination is commingled with CERCLA hazardous substances (i.e., chlorinated solvents) that are identified in the NWIRP OU2 ROD, and which cannot be effectively separated from the petroleum products.

Figure 2-3 – Areal Extent of Contamination



2.6 Current and Potential Future Land and Water Uses

Site 4 and the nearby vicinity are highly urbanized. Ninety-six (96) acres of the Navy-owned property at the former NWIRP Bethpage was transferred to Nassau County in 2008. In 2011, Steel-Los III bought the majority of the property and is currently renovating the property to attract new tenants. Plant No.3, the warehouse located north of Site 4, is currently leased out for economic redevelopment. Site 4 is currently sub-leased to Steel-Los III and is being used as office space, parking, equipment storage, and the treatment system for the Site 1 vapor intrusion mitigation system. In addition, buried utilities including electrical and storm sewers run through the site. Upon successful remediation, Site 4 will be transferred to Nassau County. Reasonably anticipated future land use is for commercial and/or industrial purposes. Because of the limited free space available at Site 4 and potential for future expansion needs, excavation and/or use of soil to the water table is possible.

On-site groundwater is currently not used as a potable water supply. However, groundwater could be used as a drinking supply in the future. Because of the presence of chlorinated VOCs, groundwater use restrictions are currently in place. As identified in 2008 Finding of Suitability to Transfer (FOST), extraction of groundwater from within the boundaries of the 105-Acre parcel is prohibited. These restrictions do not address Site 4 COCs.

2.7 Summary of Site Risks

A quantitative risk assessment was conducted for Site 4 using both risk-based soil and groundwater screening values in the 2013 FS/CMS.

Identification of COCs

Maximum detected concentrations in Site 4 subsurface soils were compared to USEPA Regional Screening Levels (RSLs), USEPA Soil Screening Level (SSL), NYSDEC Unrestricted Use Soil Cleanup Objectives (SCOs), and NYSDEC SCOs for the Protection of Groundwater during the FS/CMS. Chemicals with concentrations exceeding one or more of these values were considered COCs. COCs in soils consist of PAHs that are associated with TPH: 2-methylnaphthalene; acenaphthalene; benzo(a)anthracene; benzo(a)pyrene; benzo(a)fluoranthene; chrysene; fluorine; indeno(1,2,3-cd)pyrene; naphthalene; and pyrene. There are no relevant criteria associated with TPH contamination, however free product recovery would also remove the PAHs that are a component of the free product. There are no associated risks with surface soils. Contaminated soils begin at approximately 20 feet bgs.

Maximum detected concentrations in Site 4 groundwater samples were compared to NYSDOH maximum contaminant levels (MCLs) and USEPA RSLs in the FS/CMS. VOCs (benzene, ethylbenzene, and total xylenes), SVOCs (naphthalene and pentachlorophenol), and metals (cobalt, iron, and manganese) with concentrations exceeding MCLs, or in the absence of an MCL, an RSL were considered COCs.

Exposure Assessment

Current and potential future exposure pathways through which humans might encounter the COCs identified in the previous step were evaluated. The results of the exposure assessment were used to refine the CSM (Figure 2-2), which identifies potential contaminant sources, contaminant release mechanisms, transport routes, and receptors under current and future land use scenarios. Subsurface soil and groundwater were identified as the media of concern for the COCs. Receptor exposure was considered under nonresidential land use (construction, maintenance, and industrial workers and trespassers) and future hypothetical residential land use. Activities at the Site are restricted to prevent residential use of groundwater. Because Site 4 COCs are not very volatile, intrusion of vapors into occupied structures was not considered to be a complete pathway. Current and hypothetical future exposure pathways at Site 4 are summarized in Table 2-1.

Table 2-1 – Receptors and Exposure Routes	
Receptor	**Exposure Route**
Construction/Excavation Workers (Future)	Subsurface soil/groundwater incidental ingestion Subsurface soil/groundwater dermal contact Inhalation of volatiles in groundwater (in a trench during excavation)
Maintenance/Industrial Workers (Current/Future)	Subsurface soil/groundwater incidental ingestion Subsurface soil/groundwater dermal contact Inhalation of air/dust/emissions (if soil greater than 15 feet below ground surface is excavated)
Trespassers (Adolescent and Adult) (Future) *Current trespassers would not be exposed because the site is currently paved.	Subsurface soil/groundwater incidental ingestion Subsurface soil/groundwater dermal contact Inhalation of air/dust/emissions (if soil greater than 15 feet below ground surface is excavated)
Residents (Children/Adult) (Hypothetical Future)	Subsurface soil/groundwater incidental ingestion Subsurface soil/groundwater dermal contact Inhalation of air/dust/emissions Inhalation of volatiles in groundwater Ingestion of groundwater

Toxicity Assessment

Toxicity assessment involves identifying the types of adverse health effects caused by exposure to site COCs and determining the relationship between the magnitude of exposure and the severity of adverse effects for each COC. Toxicity values for both cancer and non-cancer effects were considered during the risk assessment.

2.7.1 Summary of Human Health Risk Assessment

The risk assessment estimates what risks the site poses if no action were taken. It provides the basis for taking action and identifies the COCs and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the risk assessment for this site.

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime because of exposure to the carcinogen. These calculated risks are probabilities that are usually expressed in scientific notation (e.g. $1X10^{-6}$). An excess Incremental Lifetime Cancer Risk (ILCR) of $1X10^{-6}$ indicates that an individual experiencing the reasonable and maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. USEPA's generally acceptable risk range for site-related exposures is 10^{-4} to 10^{-6}. Excess lifetime cancer risk is calculated from the following equation.

$$\text{Risk} = (\text{Maximum Detection} / \text{USEPA RSL}) \times 1X10^{-6}$$

For non-carcinogens, the ratio of exposure to toxicity is called a Hazard Quotient (HQ). An HQ less than 1 indicates that toxic non-carcinogen effects from the chemical are unlikely. An HQ greater than 1 indicates that site-related exposures may present a risk to human health. The HQ is calculated from the following equation.

$$\text{Non-cancer HQ} = \text{Maximum Detection} / \text{USEPA RSL}$$

The COCs in soil, maximum concentrations, and risk calculations are presented in the Site 4 FS/CMS. The maximum detections of the selected COCs for soil were used to develop site-specific risk calculations. The calculated ILCR for a potential future resident at Site 4 exceeds $1X10^{-4}$. Under CERCLA, an ICLR greater than $1X10^{-4}$ is considered to be unacceptable. Benzo(a)pyrene was the primary contributor to the ILCR with a

calculated ILCR of 1.8 X 10^{-4}. Other COCs with ICLRs less than $1x10^{-4}$ but greater than $1X10^{-6}$ were benzo(a) anthracene (ILCR of $2.8X10^{-5}$), benzo(b)fluroanthene (ILCR of $2.2X10^{-5}$), indeno(1,2,3-cd)pyrene (ICLR of $1.3X10^{-6}$), and naphthalene (ILCR of $1.3X10^{-6}$). The HQs for the COCs were less than 1.0. Of these FS/CMS COCs, 2-methylnaphthalene, acenaphthalene, fluorene, indeno(1,2,3-cd)pyrene, and pyrene were only flagged as COCs because of a theoretical concern with leaching to groundwater. Since groundwater testing did not identify these soils COCs in the groundwater and even if they leach to groundwater, these COCs are relatively immobile. As a result, no further action will be taken for them.

The COCs in groundwater, maximum concentrations, and risk calculations are presented in the Site 4 FS/CMS. The maximum detections of the selected COCs for groundwater were used to develop site- specific risk calculations. The calculated ILCR for a future resident exceeds $1X10^{-4}$ and the HQ is greater than 1. Naphthalene and pentachlorophenol were the carcinogenic contributors to the ILCR, with individual ILCRs greater than $1X10^{-4}$. Naphthalene, cobalt, and manganese were the non-carcinogenic contributors to the HQ, with individual HQs greater than 1.0. In addition, benzene, ethylbenzene, and xylenes are present at concentrations greater than NYSDOH MCLs. During the initial screening of COCs, because its HQ was greater than 0.1, iron was also flagged for additional evaluation. Based on the more detailed risk evaluation, iron was not retained as a COC in this ROD.

2.7.2 Summary of Ecological Risk Assessment

Over 90 percent of NWIRP Bethpage is covered by buildings, impermeable parking areas, roadways, and other development. No natural aquatic habitats exist on the activity. Since the areas surrounding Site 4 have been developed for industrial use, there are no noted risks to ecological receptors.

2.7.3 Risk Assessment Summary

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

2.8 Remedial Action Objectives

The Remedial Action Objectives (RAOs) are statements that define the extent to which sites require cleanup to protect human health and the environment and comply with Applicable or Relevant and Appropriate Requirements (ARARs). The objectives reflect the COCs, exposure routes and receptors, and acceptable chemical concentrations (or range of acceptable chemical concentrations) for soil and groundwater at Site 4. The RAOs for soil and groundwater are as follows:

- Prevent human exposure to soil with COCs exceeding Cleanup Levels;
- Prevent leaching of COCs that would result in groundwater concentrations exceeding Cleanup Levels;
- Prevent human exposure to groundwater with COCs exceeding Cleanup Levels; and
- Comply with ARARs.

To address these risks, Cleanup Levels for soil were developed based on USEPA risk-based cleanup levels and NYSDEC for Unrestricted Use SCOs and for Protection of Groundwater (Table 2-2). Also presented in the table are the maximum concentrations detected at the site.

Table 2-2 – Soil Cleanup Levels

Chemical	Maximum Concentration of Detection (µg/kg)	USEPA Risk Based Cleanup Levels (µg/kg)[1]	NYSDEC Unrestricted Use SCOs (µg/kg)[2]	NYSDEC SCO (Protective of Groundwater) (µg/kg)[3]	Cleanup Level (µg/kg)[4]
Benzo(a)anthracene	4,200 J	15,000	1,000	1,000	1,000
Benzo(a)pyrene	2,700 J	1,500	1,000	22,000	1,000
Benzo(b)fluoranthene	3,300 J	15,000	1,000	1,700	1,000
Chrysene	8,600 J	1,500,000	1,000	1,000	1,000
Naphthalene	15,000 J	129,000	12,000	12,000	12,000

µg/kg – microgram per kilogram
J – Estimated value
1 – United States Environmental Protection Agency (USEPA) Risk Based Screening Levels. Values are based on an ILCR of $1X10^{-4}$ ILCR. These values were modified to reflect the revised November 2014 Soil Screening levels.
2 – New York State Department of Environmental Conservation (NYSDEC) Subpart 375-6; Remedial Program Soil Cleanup Objectives (SCO), Table 375.6.8(b): Unrestricted Use.
3 - NYSDEC Subpart 375-6: Remedial Program SCOs, Table 375-6.8(b): Restricted Use SCOs for the Protection of Groundwater.
4 – The Cleanup Levels are selected based on the most conservative promulgated value that is consistent with USEPA risk-based concentrations.

Several chemicals were identified in the Proposed Plan as COCs. Indeno(1,2,3-cd)pyrene was one of the COCs for which the ICLRs are in the range of $1X10^{-4}$ to $1X10^{-6}$, but the maximum site concentration is less than NYSDEC SCOs. As a result, no additional action will be taken under this ROD for these COCs. In addition, 2-methylnaphthalene, acenaphthalene, fluorene, and pyrene were initially flagged as COCs solely because the maximum site concentration exceeded the USEPA soil to groundwater screening values. The maximum site concentration did not exceed any human health direct contact risk estimates (i.e., HQ less than 1) or NYSDEC SCOs, and were not detected in groundwater at concentrations that would exceed groundwater criteria that would indicate this pathway is complete. As a result, no additional action will be taken under this ROD.

Cleanup levels for Site 4 groundwater were developed based on USEPA Risk Based Screening Levels and MCLs and NYSDOH MCLs (Table 2-3). Also presented in the table are the maximum concentrations detected at the site.

Table 2-3 – Groundwater Cleanup Levels

Chemical	Maximum Concentration (2011)	USEPA MCL or Risk Based Level (µg/L)[1]	NYSDOH MCL (µg/L)[2]	Cleanup Level (µg/L)[3]
Metals				
Cobalt	49.5	6.0	NA	6.0
Manganese	2,570	430	NA	430
Semi-volatile organics				
Naphthalene	20	17	50	17[(4)]
Pentachlorophenol	8.5	1.0	1.0	1.0
Volatiles organics				
Benzene	17	5	5	5
Ethylbenzene	18	700	5	5
Xylenes (total)	7.6	10,000	5	5

µg/L – microgram per liter
1- United States Environmental Protection Agency (USEPA) Regional Screening Level (RSL) Summary Table November 2014. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables. The value presented under the USEPA column is the Maximum Contaminant Level (MCL) for the given chemical (if available). If an MCL is not available, the ILCR of $1X10^{-4}$ is used.
2 – New York State Department of Health (NYSDOH) Part 5, Subpart 5-1: Public Water Systems; Table 1: Inorganic Chemicals and Physical Characteristics Maximum Contaminant Level Determination; Table 3: Organic Chemicals Maximum Contaminant Level (MCL) Determination; Table 9D: Organic Chemicals - Principal Organic Contaminants Minimum Monitoring Requirements. http://www.health.ny.gov/regulations/nycrr/title_10/part_5/subpart_5-1_tables.htm.
3 – The Cleanup Level is selected based on the most conservative promulgated value that is consistent with EPA risk-based concentrations.
4 – This value was modified from that presented in the Proposed Plan to reflect the revised November 2014 RSLs. The new RSLs were updated by the USEPA using more current exposure assumptions. The November 2014 RSL is approximately 21 percent less stringent than the previous RSLs presented in the Proposed Plan.

Iron was identified in the FS/CMS and Proposed Plan as a COC. The HQ for iron was less than 1.0. As a result, no additional action will be taken under this ROD.

2.9 Description of Alternatives

Remedial alternatives to address soil and groundwater at Site 4 were developed and are detailed in the 2013 FS/CMS. Based on screening technologies, seven remedial alternatives were retained for detailed comparative analysis. A description is provided in Table 2-4.

Table 2-4 – Description of Remedial Alternatives

Alternative	Components	Details	Cost	
1 – No Action	None	Allow the COCs to breakdown naturally over time.	Capital Cost Annual O&M Total Present Value Timeframe	$0 $0 $0 $0
2 – Monitored Natural Attenuation (MNA) and Land Use Controls (LUCs)	MNA	MNA (all mechanisms including biodegradation, dilution, etc.,) coupled with regular monitoring of soil and groundwater.	Capital Cost Annual O&M Total Present Value Timeframe	$30,000 $35,000 to $85,000 per year $1,100,000 30 years
	LUCs	Targets areas that require notifications and inspections during implementation of this alternative, until clean up levels are achieved.		
3 – Steam Injection and Free Product Recovery	Steam Injection	Use of steam to heat COCs to allow Free Product to form on the water table. Targets saturated and unsaturated soils with greater than 1,000 mg/kg of TPH.	Capital Cost Annual O&M Total Present Value Timeframe	$1,800,000 $35,000 to $320,000 per year $3,400,000 16 years
	Free Product Recovery (Bioslurping)	Utilizes vacuum-induced bioslurping to remove a mixture of free product, groundwater, and soil gas.		
	LUCs	Targets areas that require notifications and inspections during implementation of this alternative, until clean up levels are achieved.		
4 – Biosparging with Steam Injection and Free Product Recovery	Steam Injection	Use of steam to heat COCs to allow Free Product to form on the water table. Targets soil with greater than 10,000 mg/kg of TPH.	Capital Cost Annual O&M Total Present Value Timeframe	$1,800,000 $35,000 to $350,000 per year $2,900,000 10 years
	Free Product Recovery (Bioslurping)	Utilizes vacuum-induced bioslurping to remove a mixture of free product, groundwater, and soil gas. System would run two days a month for one year.		
	Biosparging	Air is injected into the groundwater to provide oxygen to promote aerobic degradation. Targets soils with greater than 1,000 mg/kg TPH.		
	LUCs	Targets areas that require notifications and inspections during implementation of this alternative, until clean up levels are achieved.		

Table 2-4– Description of Remedial Alternatives (continued)

Alternative	Components	Details	Cost	
5 – Solvent Extraction with Biosparging and Free Product Recovery	Solvent Extraction	Vertec would be injected above and below the water table to saturate the TPH contaminated soil (greater than 10,000 mg/kg). Most of the extraction fluids would be recovered from the water table. Remaining Vertec would biodegrade.	Capital Cost	$1,600,000
	Free Product Recovery (Skimming)	Free product is recovered from the well via submersibile pump, without the removal of groundwater.	Annual O&M	$35,000 to $840,000 per year
	Biosparging	Air is injected into the groundwater to promote aerobic degradation. Targets saturated soil greater than 10,000 mg/kg TPH.	Total Present Value	$3,700,000
	LUCs	Targets areas that require notifications and inspections during implementation of this alternative, until clean up levels are achieved.	Time Frame	10 years
6A – Full Excavation	Excavation	Removal of soil containing greater than 1,000 mg/kg. An area of 80 by 100 feet would be excavated to a depth of 71 feet below ground surface. Shoring would be required to achieve the depth and protect buildings in close proximity.	Capital Cost	$7,800,000
	Disposal	Approximately 7,000 cubic yards containing 47 tons of TPH would be disposed at a landfill off site.	Annual O&M	$35,000 to $65,000 per year
	Dewatering	Since the excavation extends approximately 20 feet below the water table, soil would have to be dewatered. Water would be treated or disposed off-site.	Total Present Value	$8,000,000
	Reuse	Approximately 14,000 cubic yards of soil would be removed and stockpiled onsite for reuse. Additional soil would be required to restore the site.	Time Frame	4 years
6B – Partial Excavation	Excavation	Removal of soil containing greater than 10,000 mg/kg. An area of 70 by 70 feet would be excavated to a depth of 71 feet below ground surface (bgs). Shoring would be required to achieve the depth and protect buildings in close proximity.	Capital Cost	$4,100,000
	Disposal	Approximately 1,400 cubic yards containing 30 tons of TPH would be disposed at a landfill off site.	Annual O&M	$35,000 to $65,000 per year
	Dewatering	Since the excavation extends approximately 20 feet below the water table, soil would have to be dewatered. Water would be treated or disposed off-site.	Total Present Value	$4,500,000
	Reuse	Approximately 6,600 cubic yards of soil would be removed and stockpiled onsite for reuse. Additional soil would be required to restore the site.	Timeframe	12 years

2.10 Comparative Analysis of Alternatives

A comparative analysis of alternatives with respect to the nine evaluation criteria was completed and is provided below. Table 2-5 depicts a relative ranking of the alternatives. Alternative 1 (No Action) does not achieve RAOs and is not considered further in this ROD.

Threshold Criteria

Overall Protection of Human Health and the Environment. Alternative 2 would be protective of human health and the environment because RAOs are expected to be met through LUCs, natural degradation, and monitoring of soil and groundwater. Soil COCs could continue to migrate to groundwater, which would be monitored and continuing risks would be mitigated through administrative restrictions which would prevent the use of contaminated groundwater.

Alternatives 3, 4, and 5 are protective of human health and the environment because contaminated soils will be remediated through in-situ treatment and residual soil and groundwater contamination will be reduced to the cleanup levels through natural biodegradation. Alternatives 3 and 4 would treat source soils with steam injection and/or biosparging to mobilize free product for removal. Alternative 5 would treat soils through solvent injection to mobilize free product to the water table and allow for its removal. Residual soil and groundwater contamination are expected to decrease through natural attenuation processes once source free product is removed. Biosparging would aid natural attenuation processes in Alternatives 4 and 5 and also degrade residual solvent in Alternative 5. LUCs would be in place while contamination remains, and would be protective of human health and the environment.

Alternative 6A achieves protection of human health and the environment through removal of contaminated media, whereas Alternative 6B achieves this protection through removal of the most contaminated soils and allows the remaining contaminated soils to be remediated through natural attenuation processes. Off-site disposal of contaminated soil at a permitted facility would be protective of human health and the environment.

Compliance with ARARs. The ARARs include any Federal or State promulgated standards, requirement, criteria, or limitations that are determined to be legally applicable or relevant and appropriate to a CERCLA site or action. To be considered (TBC) criteria are non-promulgated advisories or guidance issued by Federal or State government and do not have the status of potential ARARs but may be considered along with ARARs. The ARARs for the Site 4 soil and groundwater are provided in Appendix B. Alternatives 2 through 6B would comply with ARARs, including the chemical-, location-, and action- specific ARARs.

Long-term Effectiveness and Permanence. Alternatives 2, 3, 4, 5, 6A, and 6B would be effective in the long term. At the completion of the remedy, site COCs would be below cleanup levels and allow unlimited use/unlimited exposure in the area.

Reduction of Toxicity, Mobility, or Volume through Treatment. There would be no reduction of toxicity, mobility or volume through treatment with Alternatives 2, 6A, or 6B. PAH and TPH contamination in soils would degrade through natural biological activity.

Under Alternative 3, thermal treatment and free product recovery will remove approximately 9,100 gallons of TPH. Under Alternative 4, a combination of thermal treatment, air agitation, and free product recovery will remove approximately 7,900 gallons of TPH. Under Alternative 5, solvent extraction would remove approximately 9,800 gallons of TPH. The recovered TPH would be sent off-site to be burned or recycled. Alternatives 4 and 5 also use biosparging to degrade TPH and PAHs and would form aerobic conditions that would allow metals in groundwater to precipitate. Granular Activated Carbon (GAC) treatment of extracted groundwater and air would be used to treat water and air streams. The GAC would be landfilled or regenerated. Remaining contamination will be reduced through natural attenuation and verified by monitoring. Chlorinated solvents that are present in the free product, soil, soil vapor, and groundwater will be treated along with the TPH in each of these alternatives.

Alternatives 6A and 6B would not have a reduction of toxicity, mobility, or volume through treatment. For Alternative 6A, approximately 7,000 cubic yards of soil contaminated with 47 tons of TPH would be removed from the site through full excavation. For Alternative 6B, approximately 1,400 cubic yards contaminated with 30 tons of TPH would be removed from the site through partial excavation. Remaining contamination associated with Alternative 6B would degrade through natural biological activity.

Short-term Effectiveness. Alternative 2 would be effective in the short term. LUCs would be protective while contamination remains, and soil and groundwater would be monitored for remaining risks.

Alternatives 3 through 6B would also be effective in the short term. Each of the alternatives results in some potential risk to site workers. Steam injection and free product recovery systems under Alternatives 3 and 4 would provide added risks to workers from thermal burns. In addition, Alternatives 3, 4, and 5 would form offgas and wastewater streams that would need to be treated. LUCs would be protective while contamination remains. Cleanup levels will be attained after free product removal, treatment, and natural attenuation of residual contamination occurs.

Because large quantities of waste will be transported through the community, Alternatives 6A and 6B result in some risk to the community during implementation. In addition, there is some risk to site workers during the excavation, which would be controlled through safe work practices. Engineering controls like dust suppression and air quality monitoring as well as spill prevention, containment, and erosion control will be implemented.

Alternative 6A will achieve the cleanup levels in the shortest time (4 years), followed by Alternatives 4 and 5 (10 years), Alternative 6B (12 years), Alternative 3 (16 years), and Alternative 2 (30 years).

Implementability. Each of the alternatives are implementable. Alternative 2 is easy to implement, with readily available resources.

Alternatives 3, 4, and 5 are more difficult to implement. Vendor and equipment are available. Free product recovery and biosparging technologies are commonly available. However, steam injection systems are implemented on a more limited basis, and the number of vendors available to conduct the work are more limited. Solvent extraction would be considered an innovation technology.

Alternatives 6A and 6B would be the most difficult to implement. Feasibility of these alternatives is uncertain due to the depth of excavation required. The shoring system is one of the most significant portions involved in planning this alternative. Contamination exists in saturated soils, and removal of saturated soils must take into account dewatering and other processes. Storage availability of soils on site is limited. Existing structures and utilities would need to be removed or relocated during implementation of this alternative. Construction worker safety would be a significant issue.

Cost. Each alternative was assessed based on capital costs (initial cost to implement) and annual O&M costs. The total cost is based on the net present value of the capital and O&M costs. Alternative 2 is estimated to cost $1,100,000, Alternative 3 is estimated to cost $3,400,000, Alternative 4 is estimated to cost $2,900,000, Alternative 5 is estimated to cost $3,700,000, Alternative 6A is estimated to cost $8,000,000, and Alternative 6B is estimated to cost $4,500,000, see Table 2-5.

Modifying Criteria

State Acceptance. State involvement has been solicited through the CERCLA process. NYSDEC concurs with the Selected Remedy.

Community Acceptance. A public comment period was held from October 24, 2014 through December 10, 2014. The Proposed Plan was discussed during the November 5, 2014 RAB meeting. No comments requiring amendment to the Proposed Plan were received from the public during the meeting and public comment period.

Table 2-5 – Summary of Comparative Analysis of Alternatives

Criterion	Alternative 2 Land Use Controls and Monitored Natural Attenuation	Alternative 3 Steam Injection and Free Product Recovery	Alternative 4 Biosparging with Steam Injection and Free Product Recovery	Alternative 5 Solvent Extraction and Free Product Recovery with Biosparging	Alternative 6A Excavation and Disposal of Soils Greater than 1,000 mg/kg TPH	Alternative 6B Excavation and Disposal of Soils Greater than 10,000 mg/kg TPH
Overall Protection of Human Health and the Environment	●	◊	◊	◊	◊	◊
Compliance with ARARs	●	◊	◊	◊	◊	◊
Long-term Effectiveness and Performance	◊	◊	◊	◊	◊	◊
Reduction of Toxicity, Mobility, or Volume through Treatment.	NA	●	◊	●	NA	NA
Short-term Effectiveness	●	○	◊	◊	○	○
Implementability	◊	●	●	○	○	○
Time to Reach RAO (years)	30 years	16 years	10 years	10 years	4 years	14 years
Cost						
Capital	$30,000	$1,800,000	$1,800,000	$1,600,000	$7,800,000	$4,100,000
O&M	$35,000 to $85,000 per year	$35,000 to $320,000 per year	$35,000 to $350,000 per year	$35,000 to $840,000 per year	$35,000 to $65,000 per year	$35,000 to $65,000 per year
Net Present Value	$1,100,000	$3,400,000	$2,900,000	$3,700,000	$8,000,000	$4,500,000

NA = Not Achieved ○ = Low Ranking ● = Moderate Ranking ◊ = High Ranking

2.11 Principal Threat Waste

Based on the results of investigations and chemical and physical data, the source of fuel contamination is the USTs that reportedly contained Nos. 4 and 6 fuel oil. Petroleum-contaminated and semi-solid petroleum products are present near and below the groundwater table. The concentrations of PAHs in soil correlate with the location of the petroleum product. The presence of the product also corresponds to the location of the impacted groundwater. These petroleum-contaminated soils are considered to be "principal threat wastes" because the COCs are found at concentrations that pose a significant risk. As per the NCP, treatment should be used to address principal threats at a site wherever practicable and engineering controls can be used for wastes that pose a relatively low long-term threat or where treatment is impracticable. For alternatives that include free product recovery, the principal threat wastes would be thermally destroyed in off property combustion processes (Alternatives 3, 4, and 5). For alternatives that include biosparging, the principal threat wastes would be destroyed through biodegradation. Alternatives 2, 6A, and 6B would address principal threat wastes through containment.

2.12 Selected Remedy

The selected remedy, Alternative 4, consists of injecting steam into soils to allow free product to form on the water table, a free product removal system for this material, and biosparging of residual contamination in the soil and groundwater. Institutional controls would remain in place while contamination remains at the site above levels that allow for unlimited use and unrestricted exposure. LUCs would target areas that require notifications and/or inspections during implementation of this alternative, until cleanup levels are achieved. The LUC boundaries and associated restrictions can be modified as cleanup progresses and then be removed when the cleanup levels are achieved. Monitoring would also be conducted to determine the effectiveness of this alternative. Both soil and groundwater samples would be taken to determine if a reduction in soil concentrations was occurring and if residual soil contamination was continuing to leach to groundwater.

Steam injection is an in-situ technology in which steam is introduced into the areas of contaminated soil. This heating and agitation enhances the release of free product from the soil matrix. Some VOCs and SVOCs can be

stripped from the contaminated zone and removed along with the free product removal system. Steam is delivered to the subsurface through vertical injection wells. Based on the 2011 and 2012 bench scale studies, the soil and groundwater must be heated from approximately 50 °F to at least 100 °F to allow the petroleum to flow to the water table and form a floating free product. This temperature must then be maintained for a period of months or years. The minimum heat requirement is estimated to be approximately 260 million British Thermal Units. The treatment zone obtained for each steam injection targets the soils with greater than 10,000 mg/kg of TPH.

The free product recovery system utilizes vacuum-induced bioslurping to remove a mixture of free product, groundwater, and soil gas. The system is estimated to operate periodically, with the actual requirements identified during the design and potentially modified during the operation. Treated water would be discharged to the sanitary sewer and the free product would be disposed off-site or recycled as either oil or for asphalt.

Biosparging will target soils with greater than 1,000 mg/kg of TPH. Wells will be screened below contamination in the saturated zone at 70 feet bgs. During biosparging, air is injected into the subsurface to provide additional oxygen to increase biological degradation. Biosparging uses low air flow rates to stimulate microbial activity through direct air injection into residual contamination. Volatile compounds are biodegraded as vapors move through biologically active soils. Vapors from free product recovery and biosparging would be treated with GAC prior to discharge.

LUCs are to be used to protect human health prior to the completion of the remedy (i.e., achieving the cleanup levels presented in Tables 2-2 and 2-3) that are not otherwise specifically required for implementation of the Remedial Action. The LUCs will consist of: 1) Groundwater extraction from within the boundaries of Site 4 is prohibited without the prior written approval of the NYSDEC. If future occupants wish to pursue groundwater extraction, language will be included in the appropriate deed(s) of transfer requiring prior notification to and securing written permission from NYSDEC; 2) Prior to excavating or otherwise disturbing subsurface soil at Site 4, NYSDEC shall review and approve plans for such action; 3) To prevent potential impact to indoor air quality, any new structures built on Site 4 shall, if deemed necessary by NYSDEC, include a sub-slab venting/ depressurization system designed by an engineer licensed to practice in the State of New York. If the property is transferred prior to the cleanup levels being achieved, these LUCs, as appropriate, will be memorialized in the Finding of Suitability to Transfer (FOST) for this site. The LUCs will be finalized in the Remedial Design for the Site.

The estimated incremental capital and present value cost of the selected remedy is at $1,800,000 and $2,900,000, respectively. Annual costs vary significantly based on the activity being conducted each year and range from early-year operation, monitoring, and maintenance of $350,000 per year to out-year inspection costs of approximately $35,000. Appendix C contains a detailed cost estimate of the Selected Remedy.

This remedy was selected based on a careful evaluation of the nine criteria. Potential exposure to human health is limited and would be further controlled via LUCs and monitoring. The final requirements for long-term evaluation of the remedy will be developed in an Operation, Maintenance, and Monitoring Plan. The monitoring is anticipated to consist of groundwater sampling from eight (8) monitoring wells on an annual basis with VOC, SVOC, and metal analysis. In addition, two (2) soil sampling events may be conducted to evaluate the presence of residual post-treatment petroleum hydrocarbons and PAHs. Treatment would be used for soil as well as groundwater contamination. Monitoring in this area would continue until cleanup levels have been achieved.

Based on information currently available, the lead agency believes the Selected Remedy meets threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. The Navy expects the Selected Remedy to satisfy the following statutory requirements of CERCLA Section 121(b): 1) be protective of human health and the environment; 2) comply with ARARs; 3) be cost-effective; 4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practical; and 5) satisfy the preference for treatment as a principal element.

2.12.1 Expected Outcomes of the Selected Remedy

The Selected Remedy is expected to remove the bulk of site contamination through free product recovery, followed by enhanced and natural biodegradation to achieve the final cleanup levels. Monitoring and LUCs would be used to track the remediation and to limit activities until the cleanup levels are achieved. These actions would eventually allow for unlimited use and unrestricted exposure to Site 4 media. In addition, the Selected Remedy would eliminate organics that promote the degradation of chlorinated solvents into more toxic and mobile forms and reduce the mobility of several metals detected at the site, including cobalt and manganese. Similarly, at the completion of the remedy, groundwater use would not be restricted for site-related COCs.

Future land use is anticipated to be consistent with current land use, which is primarily commercial and industrial

development. The effectiveness of the remedy on the cleanup of soil COCs will be evaluated twice over ten years and prior to property transfer and the effectiveness of the remedy on the cleanup of groundwater COCs will be evaluated annually. In accordance with LUCs, the use of groundwater will be restricted to monitoring or remedial purposes.

Design of the remedy is anticipated to be completed within one year after signing of the ROD. Following the design, construction and operation of the thermal component is anticipated to require two years, to be followed by four years of biosparging, and four additional years of monitoring. An updated and more detailed schedule will be developed in the Remedial Design.

When all of the COCs have achieved their cleanup levels, site closure will be initiated. Site 4 is expected to be transferred to Nassau County and utilized for economic redevelopment. The Navy and NYSDEC will evaluate the soil and groundwater LUC component of the Selected Remedy for termination at site closeout.

2.13 Statutory Determinations

Protection of Human Health and the Environment- The selected remedy will protect human health and the environment through the removal of free product and enhance and natural biodegradation of residual soil and groundwater COCs. Steam heating will be used to enhance the migration and collection of free product. Vapor extraction will be conducted as needed to ensure that COCs do not volatilize and migrate to nearby occupied structures. During implementation, monitoring and treatment of remediation wastes will be conducted to ensure that protection of the community and surrounding areas are not effected.

Compliance with ARARs and TBC Criteria- Section 121(d) of CERCLA, as amended, specifies, in part, that remedial actions for cleanup of hazardous substances must comply with requirements and standards under federal or more stringent state environmental laws and regulations that are applicable or relevant and appropriate (i.e., ARARs) to the hazardous substances or particular circumstances at a site or obtain a waiver. See also 40 Code of Federal Regulation (CFR) § 300.430(f)(1)(ii)(B). ARARs include only federal and state environmental or facility siting laws/regulations. In addition to ARARs, the lead and support agencies may, as appropriate, identify other advisories, criteria, or guidance to be considered for a particular release. The TBC category consists of advisories, criteria, or guidance that were developed by USEPA, other federal agencies, or states that may be useful in developing CERCLA remedies [see 40 CFR §300.400(g)(3)]. In accordance with 40 CFR §300.400(g), the Navy identified the ARARs and TBCs for the selected remedy. Appendix B lists the chemical-, location-, and action-specific ARARs and TBCs.

Cost-Effectiveness- The Selected Remedy is cost-effective and represented a reasonable value for the money to be spent. The following definition was used to determine cost effectiveness, “A remedy shall be cost-effective if its costs are proportional to its overall effectiveness.” (NCP §300.430(f)(1)(ii)(D)) This analysis was accomplished by evaluating the overall effectiveness of those alternatives that satisfied the threshold criteria. The costs are proportional to overall effectiveness by achieving long-term effectiveness and permanence within a reasonable timeframe.

The estimated present worth cost of the Selected Remedy is $2,900,000 and represents the lowest of the treatment-based alternatives. It is $1,800,000 more expensive than a containment alternative, but the Selected Remedy has the advantage of removing and/or treating all of the contaminates in an approximate 10 year period, whereas contaminated soil and groundwater would remain indefinitely under the containment alternative.

Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable- The Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a practicable manner at Site 4. COCs are either removed through free product recovery for reuse or destruction off site or destroyed in-situ using enhanced and natural biodegradation. Because long-term effectiveness and permanence along with reduced toxicity and volume are achieved in the shortest timeframe with the Selected Remedy, the Navy and NYSDEC determined that the Selected Remedy Provides the best balance of tradeoffs in terms of the balancing criteria, while also considering the statutory preference for treatment as a principal element and considering State and community acceptance.

Preference for Treatment as a Principal Element- The selected Remedy uses treatment as a principal element, and therefore satisfies the statutory preference for treatment.

Five-year Review Requirements- Until cleanup levels are achieved, hazardous substances, pollutants, or COCs remain on site above levels that allow for unlimited use and unrestricted exposure; therefore, in accordance with CERCLA Section 121(c) and the NCP at 40 CFR § 300.430 (f)(4)(ii), a statutory review will be conducted by the Navy within 5 years after initiation of the remedial action to ensure that the remedy is, or will

be, protective of human health and the environment. If the remedy is determined to no longer be protective of human health and the environment because, for example, LUCs have failed or long-term treatment objectives are not being met, then additional remedial actions would be evaluated by Navy and the Navy may be required to undertake additional remedial action. Once the cleanup levels are achieved, five- year reviews will no longer be required.

2.14 Documentation of Significant Changes

CERCLA Section 117(b) requires that an explanation be provided for any significant change(s) to the preferred remedy presented in the Proposed Plan that was published for public comment. There was no significant change to the proposed remedy. Several minor modifications were made, as follows. Several soil COCs were flagged as COCs because of a theoretical concern with leaching to groundwater. Since groundwater testing did not identify these soils COCs in the groundwater and because of their low mobility, migration in groundwater is very unlikely, no further action will be taken for them in this ROD. Cobalt and manganese were added as groundwater COCs to this NWIRP OU3 ROD for Site 4. These metals were originally planned to be addressed by the planned modification to the Site 1 remedy identified in the NWIRP OU1 ROD, but further evaluation determined that these metals were linked to the Site 4 contamination. The cleanup level for naphthalene has increased by 21 percent. This change resulted from a difference in the way the USEPA calculates the exposure dose.

3.0 RESPONSIVENESS SUMMARY

3.1 Stakeholder Comments and Lead Agency Responses

The public comment period was held from October 24, 2014 to December 10, 2014. Comments were requested from the general public, current RAB members, and representatives from NYSDEC and NYSDOH. The Proposed Plan was public noticed in the Bethpage Tribune on October 31, 2014 and discussed during a RAB meeting held on November 5, 2014. Participants included representatives of the Navy, NYSDOH, and NYSDEC. Over 100 community members attended the meeting. There were no comments on the Site 4 Proposed Plan.

3.2 Technical and Legal Issues

No technical or legal issues with Site 4 Record of Decision were identified.

APPENDIX A
CONCURRENCE LETTER

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Environmental Remediation, Remedial Bureau A
625 Broadway, 12th Floor, Albany, NY 12233-7015
P: (518) 402-9625 I F: (518) 402-9627
www.dec.ny.gov

October 1, 2015

Lora Fly, Project Manager
Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic
9742 Maryland Avenue
Norfolk, VA 23511-3095

Re: Naval Weapons Industrial Reserve Plant Site (NWIRP)
Bethpage, Nassau County, AOC 22-Site 4 ROD.

Dear Ms. Fly:

The New York State Department of Environmental Conservation has reviewed the draft Record of Decision for the Operable Unit 3 (OU 3): Spill Response Area of Concern Site 4/ (AOC) 22 for the Naval Weapons Industrial Reserve Plant (NWIRP) Bethpage site. The Site 4/AOC 22 ROD selects Alternative 4, for which the remedy will address the No. 6 fuel oil release with steam extraction and bio-sparging. Based upon the review of this document, the State concurs with the NWIRP Site 4-AOC 22 ROD for execution and immediate implementation.

If you have any questions, please contact Mr. Steven Scharf, of my staff, at (518) 402-9620.

Sincerely,

James B. Harrington, P.E.
Director
Remedial Bureau A

cc: J. Swartwout, DEC
S. Scharf, DEC
W Parish, Region 1
N. Acampora, Region 1 Spills
B. Fonda, Region 1
C. Bethany, NYSDOH
S. Karpinski, NYSDOH

APPENDIX B
ARARs

TABLE 3-1
CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) SITE 4 (AOC 22) FS/CMS
NWIRP BETHPAGE

MEDIA	REQUIREMENT	DESCRIPTION	PREREQUISITE	CITATION	ARAR DETERMINATION	COMMENT
FEDERAL						
Soil, groundwater	United States Environmental Protection Agency (USEPA) Regional Screening Levels (for human health)	Generic risk-based screening values and toxicity values for human health established for USEPA Region III and now generalized for all Regions. Typically used for human health risk assessment screening, risk calculations, and Preliminary Remediation Goal (PRG) development.	Contaminated environmental media can be screened against these generic values for a preliminary indicator of risk. Also, one can prepare site-specific values if needed using the reference materials.	EPA *Regional Screening Levels (RSLs)* (November 2014) http://www.epa.gov/reg3hwmd/risk/hu man/rb- concentration _table/Generic_Tables	To be considered	Values were used to determine baseline risk in the Remedial Alternatives Analysis in PRG development. New York State Department of Health Maximum Contaminant Levels (MCLs) fall within USEPA risk criteria (10^{-4} to 10^{-6}) incremental lifetime cancer risk or a hazard index less than 1.
NEW YORK STATE						
Groundwater	New York Water Classifications and Quality Standards	Regulations for the control and prevention of water pollutants. Naval Weapons Industrial Reserve Plant (NWIRP) Site 4 is in Nassau County with groundwater classified as GA.	Standards are used to protect the public health or welfare and enhance water quality.	6 New York Codes, Rules, and Regulations (NYCRR) Parts 701.15 and 702.3	Relevant and Appropriate	Standards applicable for actions involving the selection of groundwater remediation goals based on Site groundwater being classified as GA.
Groundwater	New York Public Water Supply Regulations	Drinking water quality standards for New York.	Potential site COC impact on public water supply to be addressed by, or potentially caused by, environmental action.	10 NYCRR Part 5, Subpart 5-1	Applicable	The aquifer, which is a drinking water source, is impacted by site chemicals of concern. New York State Department of Health MCLs are considered in the development of remediation goals.
Soil	New York State Department of Environmental Conservation (NYSDEC) Soil Cleanup Objectives	Provides a basis and procedure to determine soil cleanup levels.	Contaminated soil can be screened for risk.	Chapter IV, Part 375, Subpart 375-6, Table 375-6.8(a)	Applicable	Soil cleanup standards impact selection of soil remediation goals.
Soil	NYSDEC Soil Cleanup Objectives for the Protection of Groundwater	Provides a basis and procedure to determine soil cleanup levels to prevent the exposure pathway of soil contamination transfer to groundwater in a human health risk scenario.	Contaminated soil can be screened for the risk of contamination migrating from soils to groundwater.	Chapter IV, Part 375, Subpart 375-6, Table 375-6.8(b)	Applicable	Soil cleanup standards impact selection of soil remediation goals.

TABLE 3-2
LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) SITE 4 (AOC 22) FS/CMS
NWIRP BETHPAGE, NEW YORK

MEDIA	REQUIREMENT	DESCRIPTION	PREREQUISITE	CITATION	ARAR DETERMINATION	COMMENT
FEDERAL						
Groundwater	Safe Drinking Water Act (SDWA) Sole Source Aquifer	SDWA prevents federal funding from being committed to any project that may contaminate a "sole source aquifer," meaning any United States Environmental Protection Agency (USEPA)-designated aquifer that is the only principal drinking water supply for a given area which, if contaminated, would present a significant human health hazard.	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) activities normally do not increase pre-existing contamination of sole source aquifers.	40 Code of Federal Regulations (CFR) 149.3	Applicable	The aquifer beneath Nassau County is a sole source aquifer (43 CFR 26611). Alternatives that extract and treat site groundwater would comply with these requirements.
NEW YORK STATE						
Groundwater	New York State Department of Environmental Conservation (NYSDEC) Water Classifications and Standards of Quality and Purity	Provides a classification of groundwater and surface waters in the area.	Standards are used to protect the public health or welfare and enhance water quality.	6 New York Codes, Rules, and Regulations (NYCRR) 701.15	Relevant and Appropriate	Groundwater in this area is classified as Class GA. 6 NYCRR 701.15, "The best usage of Class GA waters is as a source of potable water supply."

TABLE 3-3
ACTION-SPECIFIC APPLICABLE OR RELEVANT AND
APPROPRIATE REQUIREMENTS (ARARs) SITE 4 (AOC 22) FS/CMS
NWIRP BETHPAGE, NEW YORK

MEDIA	REQUIREMENT	DESCRPTION	PREREQUISITE	CITATION	ARAR DETERMINATION	COMMENT
Groundwater	Safe Drinking Water Act (SDWA) Underground Injection Control (UIC) Program	Regulations establish minimum requirements for UIC programs.	Actions are taken when chemicals of concern (COCs) that could be introduced by way of a UIC program could endanger drinking water sources.	40 Code of Federal Regulations (CFR) 144.81 and 0.82	Applicable	Applicable for steam and air injection and discharge of condensate at the site if required.
Fuel and Oil	Materials Management	When cumulative onsite bulk storage volume of fuel and/or oil is greater than 1,320 gallons, comprised of containers greater than 55 gallons, the greater than 55-gallon-containers (e.g., drums or tanks) must be secondarily contained, inspected routinely, have a Spill Prevention Control and Countermeasures (SPCC) plan prepared, and meet other specific SPCC requirements.	Fuels and oils stored on site in containers greater than 55 gallons when cumulative onsite bulk storage volume is greater than 1,320 gallons.	40 CFR 112.3 and -.6	Applicable	Applicable for bulk petroleum storage and management.
Fuels and Oil	Materials Management	State regulation of bulk oil storage tanks (greater than 1,100 gallons), including design requirements, reporting, and inspections. Program is administered by Nassau County.	Applies to new petroleum tank construction with more than 1,100 gallons of capacity.	6 New York Codes, Rules, and Regulations (NYCRR) Parts 615.8 to .14	Applicable	Applicable for bulk petroleum storage and management.
Hazardous Waste	New York Identification and Listing of Hazardous Wastes Regulations	Characterization and identification of wastes.	Generation of hazardous wastes.	6 NYCRR 371.3, 372.2, and 373-1.1	Applicable	Prior to offsite disposal, waste materials will be characterized for hazardous waste classification.
Air	New York Air Pollution Control Regulations	Regulations for the control and prevention of air pollutants.	Would be applicable to alternatives that generate off-gas.	6 NYCRR Parts 212.9	Applicable	The need for off-gas treatment will need to be considered.

APPENDIX C
COST ESTIMATES

Alternative 4 - Biosparge Treatment with Limited Free Product Recovery

Capital Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1.	**Baseline GW Sampling, analysis and reporting**				
1.1	Laboratory Analysis (VOCs, SVOCs, and Metals)	11	Each	$400	$4,400
1.2	Field Labor	4	Day	$1,200	$4,800
1.3	UPF-SAP/Work Plan for long term monitoring	1	Each	$30,000	$30,000
1.4	Reporting	1	Each	$20,000	$20,000
	Subtotal (Item 1)				**$59,200**
2.	**General Mobilization/Demobilization**				
2.1	Construction Facilities (trailer, utilities) - 6 months	6	month	$2,000	$12,000
2.2	Decon Pad Construction	1	LS	$800	$800
2.3	Utility Clearance	1	LS	$2,000	$2,000
2.4	Construction Oversight & Start-Up (Supervisor,QC/H&S,Geologist)	2	Month	$40,000	$80,000
	Subtotal (Item 2)				**$94,800**
3.	**Building Utilities**				
3.1	Building	600	SQ FT	$300	$180,000
3.2	Water Supply	1	Each	$20,000	$20,000
3.3	Sewer Connection	1	Each	$10,000	$10,000
3.4	Electricity Connection	1	Each	$50,000	$50,000
3.5	Construction Oversight Start-Up (Supervisor,QC/H&S)	2	Month	$40,000	$80,000
	Subtotal (Item 4)				**$340,000**
4.	**Air Injection**				
4.1	Air Injection Wells (1 inch diameter) 14 at 70 ft	980	FT	$80	$78,400
4.2	Air Injection Piping (1 inch steel)	100	FT	$50	$5,000
4.3	Piping Misc	1	LS	$10,000	$10,000
4.4	Blower	1	Each	$15,000	$15,000
4.5	Power and controls	1	LS	$25,000	$25,000
4.6	Construction Oversight (Supervisor,QC/H&S,Geologist)	1	Month	$60,000	$60,000
4.7	Craft Labor	1	Month	$32,000	$32,000
	Subtotal (Item 4)				**$225,400**
5.	**Limited Steam Injection**				
5.1	Steam Injection Wells (1 inch diameter) 6 at 50 ft	300	FT	$80	$24,000
5.2	Steam Generator/blowdown pump	1	LS	$14,000	$14,000
5.3	Water Supply Connection	1	LS	$5,000	$5,000
5.4	Steam Injection Piping - (1 inch steel - underground)	180	FT	$50	$9,000
5.5	Piping Misc.	1	LS	$15,000	$15,000
5.6	Power and Controls	1	LS	$50,000	$50,000
5.7	Condensate Recovery	0	LS	$20,000	$0
5.8	Underground Utility Protection	1	LS	$20,000	$20,000
5.9	Construction Oversight (Supervisor,QC/H&S,Geologist)	1	Month	$60,000	$60,000
5.10	Craft Labor	1	Month	$32,000	$32,000
	Subtotal (Item 5)				**$229,000**

Capital Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
6.0	**Free Product Recovery**				
6.1	Product Recovery Well (6 inch diameter) 1 at 60 ft	60	FT	$100	$6,000
6.2	Product Recovery Piping	80	LF	$50	$4,000
6.3	Piping Misc.	1	LS	$20,000	$20,000
6.4	Vacuum Recovery System (Tank and Blower)	1	LS	$45,000	$45,000
6.5	Pump to Oil Water Separator (2 gpm)	1	LS	$10,000	$10,000
6.6	Oil Water Separator w/ Secondary Containment	1	LS	$30,000	$30,000
6.7	Water Treatment System	1	LS	$30,000	$30,000
6.8	Air Treatment	1	LS	$15,000	$15,000
6.9	Power and controls	1	LS	$10,000	$10,000
6.10	Construction Oversight (Supervisor,QC/H&S)	1	Month	$40,000	$40,000
6.11	Craft Labor	1	Month	$32,000	$32,000
	Subtotal (Item 6)				**$242,000**
7.	**Construction Completion Report/O&M Manual**	1	LS	$30,000	**$30,000**
8.	**System Removal and Disposal**	1	LS	$100,000	**$100,000**
	Contingency (20%)				$264,080
	Design & Engineering (13%)				$171,652
	Total Construction Cost				**$1,756,132**

Annual O&M Cost (4)

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1.	**5-Year Review/LUCs**	1	Each	$30,000	**$30,000**
2.	**GW Sampling, Analysis, and Reporting**				
2.1	Laboratory Analysis (VOCs, SVOCs, and Metals)	11	Each	$400	$4,400
2.2	Field Labor	4	Day	$1,200	$4,800
2.3	Annual Reporting	1	Each	$20,000	$20,000
	Contingency (20%)				$5,840
	Subtotal (Item 2)				**$35,040**
3.	**Soil Sampling, Analysis, and Reporting**				
3.1	Laboratory Analysis (TPH and PAHs)	20	Each	$200	$4,000
3.2	Field Labor	4	Day	$1,200	$4,800
3.3	Drilling/Split Spoon to 70 ft (4 borings)	4	each	$3,500	$14,000
3.4	Reporting	1	Each	$20,000	$20,000
	Contingency (20%)				$8,560
	Subtotal (Item 3)				**$51,360**
4.	**Air Injection**				
4.1	Electrical (4 kw, 2 other)	52560	KW-Hrs	$0.18	$9,461
4.2	System Maintenance	1	LS	$3,200	$3,200
4.3	Operator	26	days	$750	$19,500
	Contingency (20%)				$6,432
	Subtotal (Item 4)				**$38,593**
5.	**Limited Steam Injection**				
5.1	Water	12	Month	$120	$1,440
5.2	Electrical (Steam 9 KW, 2 other)	96360	KW-Hrs	$0.18	$17,345
5.3	System Maintenance	1	LS	$6,000	$6,000
5.4	Operator	52	day	$750	$39,000
5.5	Contingency (20%)				$12,757
	Subtotal (Item 5)				**$76,542**
6.	**Limited Free Product Recovery**				
6.1	Electrical (30 KW 40 hours per month)	14400	KW-Hrs	$0.18	$2,592
6.2	System Maintenance	1	LS	$2,400	$2,400
6.3	Product Transportation and Disposal	3,950	Gallons	$3	$11,850
6.4	GAC Treatment	5,000	lb	$3	$15,000
6.5	Water and Air monitoring	12	month	$2,500	$30,000
6.6	Operator (4 days per month)	48	day	$750	$36,000
6.7	Contingency (20%)				$19,568
	Subtotal (Item 6)				**$117,410**
7.	**O&M Reporting and Management**	1	Each	$30,000	**$30,000**

Cost Summary (without discount factor).

		Capital	O&M	Duration	Total Cost
1	Baseline and Annual GW Sampling, analysis and reporting	$59,200	$35,040	10	$409,600
2	General Mobilization/Demobilization	$94,800	$0	1	$94,800
3	Building Utilities	$340,000	$0	1	$340,000
4	Air Injection	$225,400	$38,593	4	$379,772
5	Limited Steam Injection	$229,000	$76,542	2	$382,084
6	Limited Free Product Recovery	$242,000	$117,410	2	$476,821
7	Construction Completion Report/O&M Manual	$30,000	$0	1	$30,000
8	Contingency (20%)	$264,080	$0	1	$264,080
9	Design & Engineering (13%)	$171,652	$0	1	$171,652
10	5-Year Review/LUCs	$0	$30,000	3	$90,000
11	Soil Sampling, Analysis, and Reporting	$0	$51,360	2	$102,720
12	O&M Reporting and Management	$0	$30,000	4	$120,000
13	System Removal	$100,000		1	$100,000
	Total Alternative 4	$1,756,132			$2,961,52

Present Value Calculation

As of	interest rate (OBM)	2.00%	
Cost	NPW	DF	
		NPW	
2013	1,756,132	1,756,132	
2014	327,585$	321,162	0.980
2015	348,945$	335,395	0.961
2016	103,633$	97,656	0.942
2017	154,993$	143,190	0.924
2018	35,040$	31,737	0.906
2019	65,040$	57,754	0.888
2020	35,040$	30,504	0.871
2021	35,040$	29,906	0.853
2022	35,040$	29,320	0.837
2023	35,040$	28,745	0.820
2024	30,000$	24,128	0.804
2025	-	-	
2026	-	-	
	2,961,528	2,885,628	10

APPENDIX D
ACRONYMS AND ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS

°F	Degrees Fahrenheit
µg/kg	microgram per kilogram
µg/L	microgram per liter
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
AS/SVE	Air Sparging/Soil Vapor Extraction
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLB	Closed-Loop Bioreactor
CFR	Code of Federal Regulation
CMS	Corrective Measures Study
CSM	Conceptual Site Model
COC	Chemical of Concern
DRO	Diesel Range Organics
ERP	Environmental Restoration Program
FFS	Focused Feasibility Study
FS	Feasibility Study
GAC	granular activated carbon
HQ	Hazard Quotient
ILCR	Incremental Lifetime Cancer Risk
LUC	Land Use Control
MCL	Maximum Contaminant Level
mg/kg	milligram per kilogram
MNA	Monitored Natural Attenuation
msl	mean sea level
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NG	Northrop Grumman
NIRIS	Naval Installation Restoration Information Solution
NPL	National Priorities List
NWIRP	Naval Weapons Industrial Reserve Plant
NYCRR	New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Conservation
NYSDOH	New York State Department of Health
O&M	Operation and Maintenance
ONCT	Onsite Containment System
OU	Operable Unit
PAH	Polynuclear aromatic hydrocarbons
PRG	Preliminary Remediation Goal
RAB	Restoration Advisory Board
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
RSL	Regional Screening Levels
SARA	Superfund Amendments and Reauthorization Act of 1986
SCO	Soil Cleanup Objective
SDWA	Safe Drinking Water Act
SSL	Soil Screening Level
SVOC	Semi-volatile organic compound
TBC	To be considered
TPH	Total Petroleum Hydrocarbon
UST	Underground Storage Tank
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound

REFERENCES

Reference Number	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administration Record
1	Chemical of Concern (COC)	Section 1.3	Feasibility Study/Corrective Measures Study, Site 4 (Area of Concern [AOC] 22) – Former Underground Storage Tanks, Naval Weapons Industrial Reserve Plant, Bethpage, New York. Section 2.5. Tetra Tech, June 2013.
2	RCRA Facility Assessment	Section 2.2	RCRA Facility Assessment/Focused Feasibility Study for the Former Underground Storage Tanks, Plant 3 Area of Concern 22. Revision 1. Tetra Tech, January 2003.
3	total petroleum hydrocarbons	Section 2.2	RCRA Facility Assessment/Focused Feasibility Study for the Former Underground Storage Tanks, Plant 3 Area of Concern 22. Revision 1. Section 2.4. Tetra Tech, January 2003.
4	Focused Feasibility Study	Section 2.2	RCRA Facility Assessment/Focused Feasibility Study for the Former Underground Storage Tanks, Plant 3 Area of Concern 22. Revision 1. Tetra Tech, January 2003.
5	Closed-Loop Bioreactor (CLB)	Section 2.2	Soil and Groundwater Report in Support of Closed Loop Bioreactor Pilot-Scale Study, for AOC 22, Site 4, Former Underground Storage Tanks, Naval Weapons Reserve Plant (NWIRP) Bethpage, New York. Tetra Tech, September 2007.
7	Bench-scale treatability studies	Section 2.2	Feasibility Study/Corrective Measures Study, Site 4 (Area of Concern [AOC] 22) – Former Underground Storage Tanks, Naval Weapons Industrial Reserve Plant, Bethpage, New York. Appendix B. Tetra Tech, June 2013.
8	Feasibility Study/ Corrective Measures Study	Section 2.3	Feasibility Study/Corrective Measures Study, Site 4 (Area of Concern [AOC] 22) – Former Underground Storage Tanks, Naval Weapons Industrial Reserve Plant, Bethpage, New York. Appendix B. Tetra Tech, June 2013.
9	Proposed Plan	Section 2.3	Proposed Plan, Site 4 – Former Underground Storage Tanks Free Product, Petroleum- and Chlorinated Solvent-Contaminated Soil, October 2014.
10	Conceptual Site Model (CSM)	Section 2.5	Feasibility Study/Corrective Measures Study, Site 4 (Area of Concern [AOC] 22) – Former Underground Storage Tanks, Naval Weapons Industrial Reserve Plant, Bethpage, New York. Section 2.5. Tetra Tech, June 2013.
11	USEPA Regional Screening Levels (RSL)	Section 2.7	USEPA Regional Screening Levels (updated November 2014). Accessed January 2015. http://www.epa.gov/reg3hwmd/ risk/human/rb-concentration_table/Generic_ Tables/index.htm.
12	USEPA Soil Screening Levels (SSL)	Section 2.7	USEPA Regional Screening Levels (updated November 2014). Soil Screening Levels. Accessed January 2015. http://www.epa. ov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Reference Number	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administration Record
13	NYSDEC Unrestricted Use SCOs	Section 2.7	NYSDEC, 6 NYCRR Part 375 Environmental Remediation Programs, Subparts 375-1 to 375-4 & 6. December 2006. http://www.dec.ny.gov/regs/15507.html
14	NYSDEC SCO for the Protection of Groundwater	Section 2.7	NYSDEC, 6 NYCRR Part 375 Environmental Remediation Programs, Subparts 375-1 to 375-4 & 6. December 2006. http://www.dec.ny.gov/regs/15507.html
15	USEPA Maximum Contaminant Level (MCL)	Section 2.8	USEPA Regional Screening Levels (updated November 2014). http://www.epa.gov/reg3hwmd/ risk/human/rb-concentration_table/Generic_Tables/index.htm
16	NYSDOH MCLs	Section 2.7	New York State Department of Health (NYSDOH) Maximum Contaminant Level (MCL). 10 NYCRR, Part 5, Subpart 5-1 Public Water Systems, Tables 1 through 3. http://www.health.ny.gov/regulations/
17	Applicable or Relevant and Appropriate Requirements (ARARs)	Section 2.10	Feasibility Study/Corrective Measures Study, Site 4 (Area of Concern [AOC] 22) – Former Underground Storage Tanks, Naval Weapons Industrial Reserve Plant, Bethpage, New York. Section 3.2. Tetra Tech, June 2013.
18	To Be Considered (TBC)	Section 2.10	Feasibility Study/Corrective Measures Study, Site 4 (Area of Concern [AOC] 22) – Former Underground Storage Tanks, Naval Weapons Industrial Reserve Plant, Bethpage, New York. Section 3.2. Tetra Tech, June 2013.
19	Nine evaluation criteria	Section 2.10	Feasibility Study/Corrective Measures Study, Site 4 (Area of Concern [AOC] 22) – Former Underground Storage Tanks, Naval Weapons Industrial Reserve Plant, Bethpage, New York. Section 4.2. Tetra Tech, June 2013.

Detailed site information in this ROD in blue text is contained in the Administrative Record and Naval Installation Restoration Information Solution (NIRIS).