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FINAL TECHNICAL MEMORANDUM PERFLUORINATED COMPOUND USE ASSESSMENT

NSY PORTSMOUTH ME

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Final Technical Memorandum
Perfluorinated Compound Use Assessment
Portsmouth Naval Shipyard, Kittery, Maine
April 2015

1.0 INTRODUCTION

Overview. This memorandum was prepared by Resolution Consultants on behalf of the Naval Facilities Engineering Command (NAVFAC), under Navy CLEAN contract N62470-11-D-8013, Contract Task Order WE05. The objective of this memorandum is to identify potential sources for perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) in groundwater at Portsmouth Naval Shipyard (PNSY), and to assess if any areas should be considered for further PFOA/PFOS assessment.

Background. Perfluorinated Compounds (PFCs), including PFOS and PFOA, are a class of compounds widely used in diverse applications, such as carpet and fabric protection and treatment, surfactants, food packaging, chromium plating, and personal care products (e.g., shampoo). PFCs are also key components of aqueous film-forming foams (AFFFs), which are widely utilized for fire protection on industrial and Department of Defense (DoD) facilities (e.g., fire training areas). PFCs are ubiquitous in the environment throughout the world, including in human and ecological populations, due to their multiple uses as surfactants and surface protectors (such as Teflon®) in a variety of consumer goods (Giesy and Kannan, 2001). Although there are many different PFCs used, the two primary PFCs of environmental concern are PFOA and PFOS.

2.0 POTENTIAL SOURCES

This section identifies applications where PFCs have been most commonly used, the extent that these activities have been performed at PNSY, and the potential for PFOA/PFOS in groundwater at PNSY. The locations of potential use of PFCs at PNSY discussed herein are shown on Figure 1.

Fire Fighting. One of the potential sources of PFCs to the environment at DoD facilities has been the use of AFFF for firefighting. In the mid-1960s, the Navy developed AFFF to be used

for Class B fires (highly flammable or combustible liquid fires, including gas tankers and refineries). AFFF are water-based (60-90%) and frequently contain hydrocarbon-based surfactants such as sodium alkyl sulfate, and fluorosurfactants, such as fluorotelomers, PFOA, and/or PFOS. Perfluorine salts compose approximately only 1% of AFFF by weight (SAME, 2012). AFFFs have the ability to spread over the surface of hydrocarbon-based liquids (i.e., create a film) and have been demonstrated to be most effective for firefighting spills of jet fuels. Historical reports of uncontrolled spills and the repeated use of AFFF during fire training and firefighting have been correlated to higher concentrations of PFCs in biota, surface water, and groundwater (Place and Field, 2012). Traditional AFFFs, including PFOA- and PFOS-based foams, were manufactured using fluorinated surfactants with carbon chain lengths between C6 and C12. Fluorinated surfactants with chain lengths longer than C6 can breakdown in water to PFOA, and in contrast fluorinated surfactants with chain lengths of C6 or less do not breakdown to PFOA (EPA, 2014; FFFC, 2014). In response to the United States Environmental Protection Agency (EPA) 2010/2015 PFOA Stewardship Program initiated in 2006, manufacturers of firefighting foams have switched production to C6 and fluorine-free firefighting foams (EPA, 2014).

PNSY has conducted firefighting, and AFFF has been stored at PNSY. However, AFFF has not been used to actively fight fires or in firefighting training. PNSY Fire Department maintains one fire station at Building 29 (see Figure 1) that serves the entire installation. PNSY has never had an open firefighting practice area (Weston, 1983). A self-contained firefighting training area was opened in 2014; however, AFFFs are not used within this area (PNSY Environmental Department, Code 106.3, 2014). Historical records indicate that AFFFs have been stored at the fire station (MEDEP, 1992; see next section); however, there is no record that AFFFs have ever been used for responding to fires at PNSY (PNSY Environmental Department, Code 106.3, 2014). For the notable fire on the submarine USS Miami in May 2012 while in dry dock only water was used in fighting this fire (PNSY Environmental Department, Code 106.3, 2014).

Fire Suppression Systems. Analogous to firefighting, firefighting foams are used for fire suppression systems. Examples of fire suppression systems include in hangers, refineries, bulk oil storage terminals, and dry docks. PNSY has had and maintains fire suppression systems that contain AFFF, but PFOA/PFOS-based foams have not been used within these systems. PNSY has not hosted hangers or refinery operations. The dry docks at PNSY have an installed fire suppression system that only uses water, and AFFFs are not used (PNSY Environmental Department, Code 106.3, 2014).

A fuel oil tank farm, consisting of three to five aboveground tanks constructed at different times, was located at the southwest corner of Seavey Island, north of Operable Unit 2 (see Figure 1). The tank farm primarily stored #6 fuel oil and lesser quantities of marine diesel, and the tank farm was licensed under a Maine Oil Terminal Facility Permit from the Maine Department of Environmental Protection (MEDEP). A fire suppression system was installed at the tanks, but this system did not include AFFF. PNSY Fire Department had the capacity to spray AFFF foam from trucks if needed for the tanks. The license from MEDEP dated May 13, 1992 indicated that spare foam (550 gallons of 3% AFFF and 30 gallons of Jet-X foam, and 450 gallons of 3% AFFF foam being held as spare by Supply) were located at the Fire Department (Building 29) for firefighting at the tanks in addition to the hydrant at the pier (MEDEP, 1992). PNSY Environmental Department indicated that there is no information to indicate that AFFF was ever used at the tank farm. The tanks and associated soil containing hydrocarbons around the tanks were removed in the late 1990s under a MEDEP supervised cleanup.

Currently the Shipyard stores firefighting foam in tanks inside three buildings: Building 337 (Hazardous and Flammable Material Storage Building), Building 357 (Hazardous Waste Storage Facility), Building 18 (within a room labeled Fire Suppression room for the fire protection of the hazardous material storage/paint mixing area). The specific foam stored at Buildings 337 and 357 is Ansul Ansulite 3%, which is a C6 or less, non-PFOA/PFOS based product (Ansul, 2014; Australia Department of Defense, 2007). Ansulite products were concluded to have the lowest environmental risk ranking in a study to derive relative environmental risk ranking of various firefighting foams (Australia Department of Defense, 2007). The volume of the foam storage tanks inside Buildings 337 and 357 was not reported. Two releases of Ansulite 3% have occurred at Building 337 from accidental discharge of the fire suppression system into the building (PNSY Environmental Department, Code 106.3, 2014). In one case the Ansulite 3% was confined to the secondary containment within the room where the release occurred. For the second release, on August 21, 2004, the secondary containment was overwhelmed, and the released foam was discharged to the bottle truck bay and from the bottle truck bay through a storm drain to the river. The quantity of foam estimated to have escaped the containment during that release could not be provided by the PNSY Environmental Department. However, there is a low potential for the two releases at Building 337 to impact groundwater, because one was contained within the room and the other discharged directly to the Piscataqua River. In addition, the release was of a C6 product that does not breakdown in water to PFOA. In Building 18, the foam is stored within a 100 gallon "Arrow" bladder tank, and no releases were reported (NAVFAC PWD ME, 2014). The locations of Buildings 18, 29, 337, and 357, the former tank farm, and the dry docks are

shown on Figure 1.

Electroplating. Electroplating is another industrial activity where PFCs were used and have resulted in PFCs detected in environmental media. Metal plating is used for hard plating (to provide a surface that is resistant to corrosion and has a low coefficient of friction) and decorative plating (to provide a bright surface with tarnish resistance). The addition of polyfluorinated surfactants (PFOS and derivatives) to chromic acid baths lowers the surface tension by forming a thin foamy layer on the surface of the chrome bath. This mist suppressant layer dramatically reduces the formation of chromium aerosols, which are carcinogenic, allergenic, and pose risks to the environment (Danish Ministry of the Environment, 2011). PFCs have been used as mist suppressants in chromium plating solutions since the 1930s-1940s, and after PFOS was commercialized in the 1950s, this became a popular surfactant for chrome plating solutions (Enthone, Inc, 2014). In 1994, US EPA issued regulations to limit air emissions of chromium from electroplating and anodizing tank operations (EPA, 2004), which required that hard plating operations have a fume hood and scrubbers to capture chrome off gassing from the plating bath surface (EPA, 2004). Decorative chrome platers were exempt from the hood requirement and were allowed to use a PFOS-based fume suppressant blanket. Plating facilities equipped with a fume hood are thus much less likely to have used PFCs or released them to the environment.

PNSY has conducted electroplating operations, and it is possible that PFCs were used. A large electroplating area was operated within Building 79 from the 1940s until 1972, and chromium, cadmium, and lead electroplating were all performed. As reported in the Initial Assessment Study (IAS), wastewater and spent baths from plating operations at Building 79 were released into floor drains that discharged to the Piscataqua River near Berth 6 “from a review of sewerage plans” (Weston, 1983). Chrome, lead, and cadmium plating sludges were mixed in with normal refuse and were disposed of directly into the Jamaica Island Landfill (JILF) (Operable Unit 3), which is located at the eastern extent of PNSY as shown on Figure 1, between 1945 and 1972 (Weston, 1983). In 1978 over 100,000 cubic yards of sediment was dredged from Berths 6, 11, and 13. Approximate dredge extents were shown on Figure 8-6 of the IAS (see Attachment A). If PFOA or PFOS were discharged to the river during plating operations, which ceased in 1972, any PFOA or PFOS in Berth 6 sediments would have been largely removed through the dredging in 1978. The dredged materials were disposed of in the southern portion of the JILF. The exact locations of the disposal area within the JILF are unknown.

Based on the timing of the operations (before 1972) it is unknown if PFOS-based fume suppressant was used at Building 79; however, the operations at Building 79 had a low potential to significantly impact groundwater with PFOA/PFOS because wastewater from electroplating was discharged to the river, and plating sludges were disposed of at the JILF. Additionally these activities ceased greater than 40 years ago.

Following closure of the large electroplating area, a small brush electroplating process was operated at Building 80 (Weston, 1983). Brush plating is performed using a brush saturated with plating solution, and the operator dips the brush in plating solution then applies it to the item. Brush plating offers several advantages over tank plating, including portability and lower plating solution volume requirements. As reported in the IAS, the process generated approximately 120 gallons annually of waste electrolytes and water that were disposed of in containers through the hazardous waste storage facility (Weston, 1983). Currently brush plating primarily occurs in Buildings 240 and 300; however, it is a mobile operation by design and could occur in other buildings. Current brush plating is conducted as hard plating, and almost exclusively by applying nickel without the use of an immersion tank. The plating is conducted under a local exhaust system, and no PFCs are used as vapor suppressants for brush plating (PNSY Environmental Department, Code 106.3, 2014). With brush plating used as a mobile process with a local exhaust system, use of PFCs as part of plating operations has likely not occurred since the large electroplating operation in Building 79 was terminated in 1972. Therefore, it is concluded there is a low probability that PFOS and PFOA were released to groundwater from brush plating operations. Buildings 79, 80, 240, and 300 are shown on Figure 1.

Landfills. Due to the wide use of PFCs in diverse applications and their subsequent disposal, landfills have been found to be sources of PFCs to groundwater (Eggena, et. al., 2010; Li, et. al., 2012, MDH, 2007). PNSY contains one on-site landfill, and it is possible that PFCs may have been disposed in that landfill. The JILF (see Figure 1) was used by PNSY from approximately 1945 to 1978 for disposal of general refuse, trash and construction rubble; incinerator ash; plating sludges containing chrome, lead, and cadmium (as noted above); asbestos insulation; volatile organic compounds; contaminated dredge spoils; and waste paints and solvents (Kearney & Baker/TSA, July 1986).

The RCRA Facility Assessment (RFA) stated that a 1971 report on solid waste disposal methods at PNSY indicated the disposal of 500 five-gallon containers of firefighting chemicals (Kearney &

Baker/TSA, July 1986). The report did not provide any additional details on the type of firefighting chemicals. Various firefighting chemicals are used to fight Class A (ordinary combustibles), Class C (electrical), and Class D (metal) fires. Many of these are dry-chemical powders that do not contain PFCs and that are available in five gallon buckets. In addition, AFFF were developed in the mid-1960s and did not start to be commercially distributed until the late 1960s. Prior to development of AFFF and other fluoroprotein firefighting chemicals, protein foams were commonly used for firefighting. Protein foams were composed of animal additives (hooves, feathers, bone meal) and had a shelf-life of five to ten years, compared with AFFF which have a shelf-life of greater than 20 years (Koetter, 2014). Therefore, it is likely that the firefighting chemicals disposed of at the landfill in 1971 were protein foams, which did not contain PFCs, that had expired or were other non-PFC containing chemicals. The exact locations of the disposal of these items within the landfill are unknown (Kearney & Baker/TSA, July 1986). Based on the disposal of plating sludge, dredge spoils (including Berth 6), firefighting chemicals, and a variety of consumer products that may contain PFCs, JILF is considered a potential source of PFOA and PFOS into groundwater.

Burnable Dumpsters. PNSY had formerly stored burnable dumpsters, but no PFCs would have been used. Solid Waste Management Unit (SWMU) 25 was titled Burnable Dumpsters. This unit consisted of over 100 disposable dumpsters located across PNSY which collected burnable wastes consisting of primarily paper as well as spent sorbent materials (Kearney & Baker/TSA, July 1986). The dumpsters were transported off-site for incineration. Hazardous wastes were reported not to be incinerated using these dumpsters. As there was no evidence of a release of hazardous constituents from this unit at PNSY, no further action was recommended in the RFA (Kearney & Baker/TSA, July 1986). PFCs would not have been used or released with burnable dumpster operations, because highly flammable materials or combustible liquids were not disposed into burnable dumpsters.

3.0 CONCLUSIONS

This memorandum identifies common operations that typically involve PFCs and provides an assessment of whether those operations and potential PFC uses existed at PNSY. Based on this evaluation, the former and current operations at the PNSY that could have the potential for using or storing PFCs are firefighting and fire suppression systems, former electroplating operations, and the JILF. As presented herein, the potential for PFOA/PFOS releases to the groundwater associated with firefighting, fire suppression systems, and electroplating

operations at PNSY are low. Therefore, the only potential concern for PFOA/PFOS in groundwater is from disposal of materials at the JILF that may have contained PFCs, including plating sludges, dredged sediment from Berth 6 that received electroplating wastewater, firefighting chemicals, and consumer products that may have contained PFOA/PFOS (i.e., carpet and fabric, surfactants, food packaging, and personal care products).

The overall general groundwater flow directions below PNSY are from the original island interior radially outward toward the island coastline. Groundwater flow beneath the island is a localized system that is not affected by the mainland groundwater flow system. Therefore if PFOA and/or PFOS are present in groundwater, these chemicals would be located between the location of use and the shoreline. Due to the small area of PNSY on an island and the close proximity to the shoreline of the potential uses listed herein, the likelihood for large groundwater plumes is limited by the Piscataqua River.

The greatest human health exposure risks for PFOA/PFOS are from ingestion of drinking water and food, and currently the only toxicity values available for PFOA and PFOS are for ingestion. There are no Federal drinking water standards or regulations for PFOA or PFOS and few states have developed individual guidelines or regulations for PFOA and/or PFOS. Due to the potential presence of PFOA in Maine drinking water, the Maine Center for Disease Control and Prevention (MECDC) developed a health-based Maximum Exposure Guideline (MEG) for PFOA in drinking water (MECDC, 2014). MEGs, which are guidance levels and not regulatory standards, apply specifically to drinking water sources. Due to the brackish/saline characteristics of groundwater beneath much of PNSY, the overburden aquifer is not used for any potable or industrial use. Potable water is supplied to PNSY from the Kittery Water District, and Kittery's potable water supply originates from surface reservoirs located in the vicinity of York, Maine, approximately 9 miles north of PNSY. In addition as part of the remedy for Operable Unit 3, Land Use Controls (LUCs) are in place to prevent using any fresh water for drinking within the JILF boundary. Therefore if PFOA was detected in groundwater at concentrations exceeding the MEG, no action would need to be taken because potable water is provided from outside PNSY, the groundwater is not currently used or anticipated to be used for drinking, and institutional controls are in place at the JILF to prevent future use of groundwater as a potable water source. Further, the remedy in place for Operable Unit 3 consists of an engineered cover over the JILF with LUCs in place to prevent direct contact exposure with residual waste and groundwater.

Based on the evaluation within this technical memorandum, groundwater sampling will be performed at the JILF in support of the next Five Year Review. During this sampling event monitoring wells closest to the river and at the periphery of the landfill will have groundwater samples collected to assess the presence of PFOA and PFOS and the potential for transport to the marine environment.

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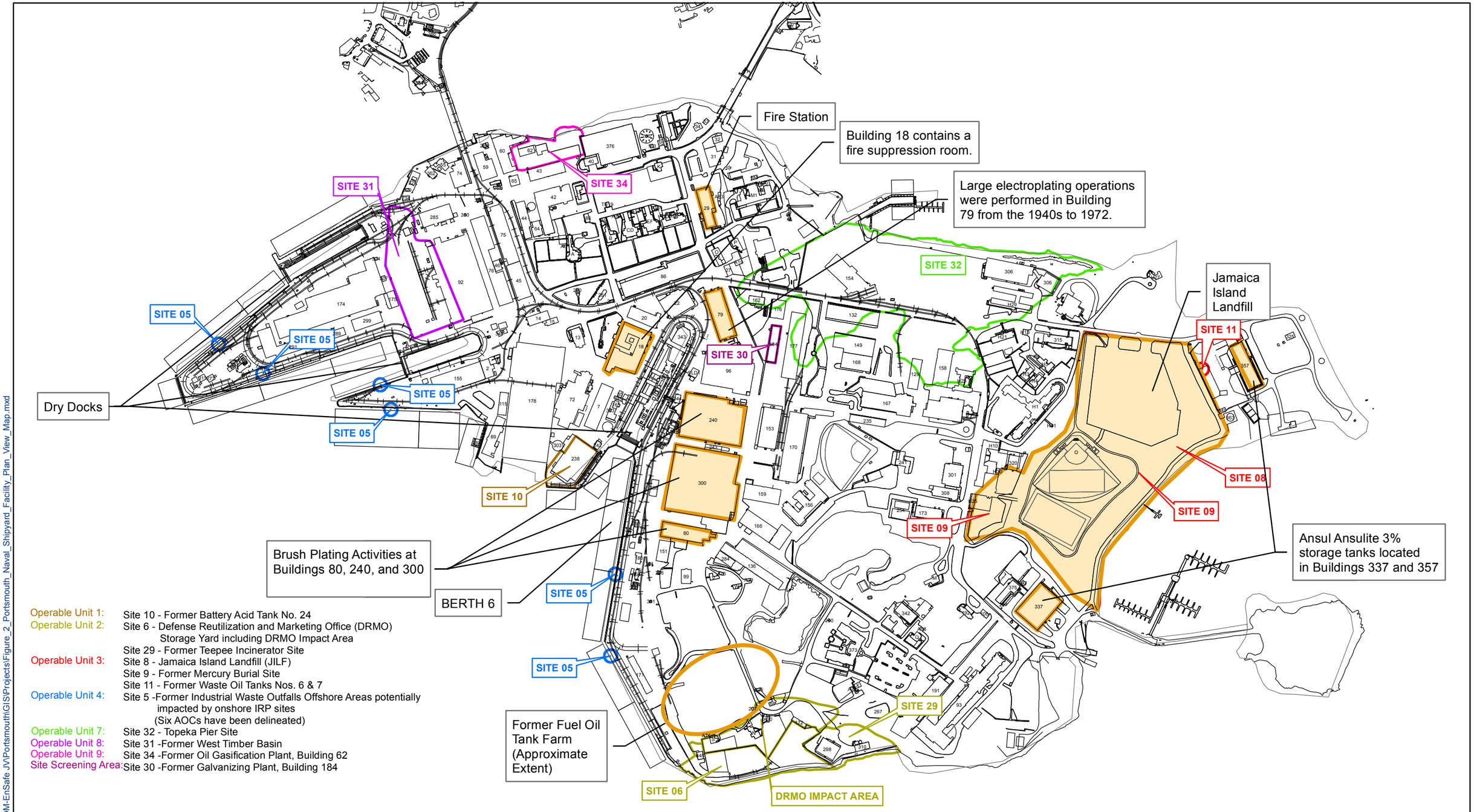

Operable Unit 1: Site 10 - Former Battery Acid Tank No. 24
Operable Unit 2: Site 6 - Defense Reutilization and Marketing Office (DRMO) Storage Yard including DRMO Impact Area
Site 29 - Former Teepee Incinerator Site
Operable Unit 3: Site 8 - Jamaica Island Landfill (JILF)
Site 9 - Former Mercury Burial Site
Site 11 - Former Waste Oil Tanks Nos. 6 & 7
Operable Unit 4: Site 5 -Former Industrial Waste Outfalls Offshore Areas potentially impacted by onshore IRP sites (Six AOCs have been delineated)
Operable Unit 7: Site 32 - Topeka Pier Site
Operable Unit 8: Site 31 -Former West Timber Basin
Operable Unit 9: Site 34 -Former Oil Gasification Plant, Building 62
Site Screening Area: Site 30 -Former Galvanizing Plant, Building 184

Buildings/areas where PFCs may have been used or disposed of as discussed in the Technical Memorandum.

0 250 500 Feet

N W E S

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PORTSMOUTH NAVAL SHIPYARD KITTERY, MAINE 60249579			FACILITY PLAN VIEW AND AREAS OF POTENTIAL USE OF PERFLUORINATED COMPOUNDS
DATE: 05/13/14	DRWN: R.N.M		FIGURE 1

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Attachment A

1978 Sediment Dredge Extents from Initial Assessment Study

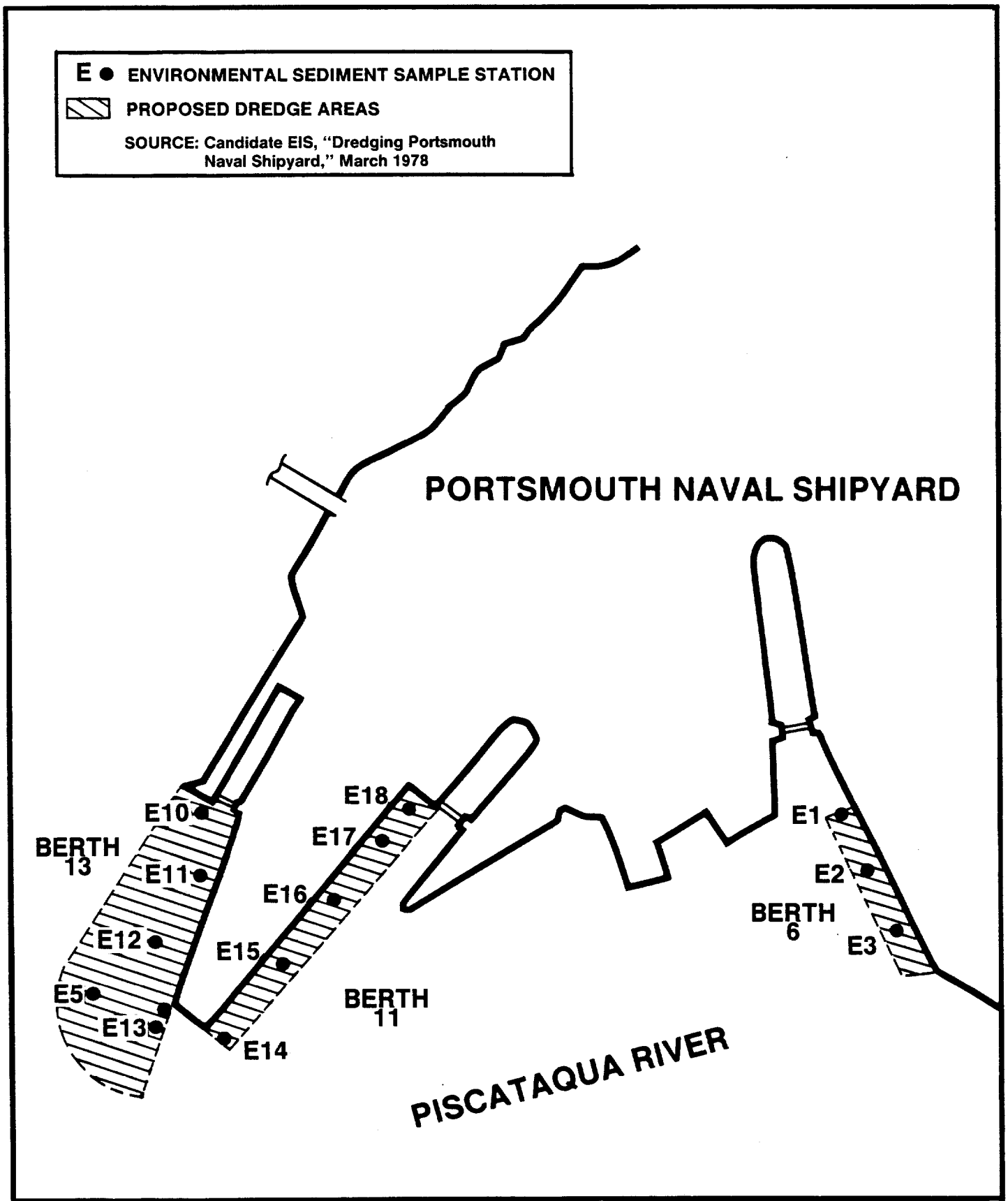

FIGURE 8-6
LOCATIONS OF TEST BORINGS AT SITE 2, INDUSTRIAL WASTE OUTFALLS

INITIAL ASSESSMENT STUDY
PORTSMOUTH NAVAL SHIPYARD