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Final Report

PHASE II
RI/FS WORK PLAN

NAVAL EDUCATION AND TRAINING CENTER NEWPORT, RHODE ISLAND

Contract No. N62472-86-C-1282
March 1993

Prepared For:

Northern Division
Naval Facilities Engineering Command
Lester, Pennsylvania

TRC
TRC Environmental Corporation

FINAL PHASE II RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

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TRC

U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

VOLUME I
BACKGROUND INVESTIGATION REPORT

RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared by:
TRC Environmental Corporation
Windsor, Connecticut

Prepared for:
Northern Division - Naval Facilities
Engineering Command
Lester, Pennsylvania

March 1993

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1.0 INTRODUCTION

This report presents the current situation at each of the four remedial investigation and feasibility study sites at the Naval Education and Training Center (NETC) in Newport, Rhode Island Figure 1). The Remedial Investigation and Feasibility Study (RI/FS) is being conducted under contract N62472-86-C-1282 for the NORTHNAVFACENGCOM. TRC Environmental Corporation (TRC) was authorized to begin work on the Phase II RI/FS Work Plan on August 6, 1992. This Phase II RI/FS Work Plan addresses the following four sites:

Site 01 - McAllister Point Landfill
Site 09 - Old Fire Fighting Training Area
Site 12 - Tank Farm Four
Site 13 - Tank Farm Five

Previous investigations at NETC Newport included: an Initial Assessment Study (IAS) in 1983; a Confirmation Study (CS) in 1986; a Closure Plan for Tanks 53 and 56 at Tank Farm Five in 1988; and a Phase I RI/FS investigation completed in 1991. The Initial Assessment Study (IAS), conducted by Envirodyne Engineers, Inc., St. Louis, Missouri, for the Navy in 1983, identified sites where contamination is suspected to exist and which may pose a threat to human health or the environment. A total of eighteen potential sites were identified by the IAS (Table 1). Six of these sites which were judged to require further study and were investigated under a Confirmation Study (CS), conducted by Loureiro Engineering Associates, Avon, Connecticut, completed in 1986. The Phase I RI/FS investigation was conducted on four sites. Three of the NETC sites, McAllister Point Landfill, Melville North Landfill, and Tank Farm 4, were investigated in both the IAS and CS. Tank Farm 5 was studied in the IAS, and tank numbers 53 and 56 were extensively studied as part of a tank closure plan. The Old Fire Fighting Area has not been sampled or extensively studied. The numbers for the four RI/FS sites were assigned during the IAS and were retained during the Phase I RI/FS investigation for consistency and to avoid confusion.

In April 1973, the Shore Establishment Realignment Program (SER) resulted in drastic reductions in Navy personnel at the Newport base and initiated the process of excessing (selling) large portions of the base's real estate. Disposition of each of the five RI/FS areas by the

General Services Administration (GSA) is pending the results of the IR Program. The status of the eighteen potentially contaminated sites is presented in Table 2.

The entire NETC was listed on the U.S. Environmental Protection Agency (EPA) National Priorities List (NPL) of abandoned or uncontrolled hazardous waste sites in November 1989. The NPL identifies those sites which pose a significant threat to the public health and environment. The four RI/FS sites at NETC (McAllister Point Landfill, Old Fire Fighting Training Area, and Tank Farm Four and Five) are currently being studied (Phase I was completed in 1991) by the Navy under the Department of Defense Installation Restoration (IR) Program. This program is similar to the U.S. EPA's Superfund Program authorized under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

A Federal Facilities Interagency Agreement (FFA) was signed by the Navy, the State of Rhode Island, and the EPA on March 23, 1992. The FFA outlines response action requirements under the Department of Defense Installation Restoration Program at the NETC. The FFA was developed, in part, to ensure that environmental impacts associated with past and present activities at NETC are thoroughly investigated and remediated, as necessary. The four RI/FS sites and the additional six study areas were listed in the FFA (Figure 2).

The fifth Phase I RI/FS site not listed in the FFA is Site 02, the Melville North Landfill. The non-NPL status of this site and its resulting exclusion from the FFA, is due to the site not being owned by the Navy at the time of the NPL listing of the NETC. However, the Melville North Landfill site is being addressed under a Phase II RI/FS. The scope of the Melville North Landfill RI/FS is presented in another work plan. Six additional sites (Tank Farm One, Tank Farm Two, Tank Farm Three, Coddington Cove Rubble Fill Area, NUSC Disposal Area, and the Gould Island Electroplating Shop) or study areas (as referred to in the FFA) are also currently planned for initial investigations under Study Area Screening Evaluations (SASEs).

This report is organized into two main sections, NETC Background, and History of Response Actions. The first four subsections of the Site Background section address the regional physiography, geology, and hydrology of the NETC, as well as its general history. The second section, History of Response Actions, presents a chronology of environmental regulatory actions which have impacted the NETC and the Navy's response to those actions.

2.0 SITE BACKGROUND

This section presents a review of the history, geology, and hydrology of NETC Newport and the individual sites being addressed in this investigation. Extensive information in these areas has already been gathered in the IAS (Envirodyne Engineers, 1983), CS (Loureiro Engineering Associates, 1985), and Phase I RI/FS (TRC, 1991). Therefore, blocks of text will be incorporated from these reports and referenced with a "IAS" or "CS" and the appropriate reference page numbers.

2.1 History of the NETC

The NETC is located north of Newport, Rhode Island, (Figure 1) on the west shore of Aquidneck Island facing the east passage of Narragansett Bay. The history of the base is as follows:

> The Newport area was first used by the Navy during the Civil War when the Naval Academy was moved from Annapolis, Maryland to Newport in order to protect it from Confederate troops. The Naval Academy operated at Newport for about four years before returning to Annapolis.
>
> In 1869, the experimental Torpedo Station at Goat Island was established. This was the Navy's first permanent activity at Newport. The station was responsible for developing torpedoes and conducting experimental work on other forms of naval ordinance.
>
> In 1881, Coasters Harbor Island was acquired by the Navy from the City of Newport and used for training purposes. In 1884, the Naval War College was established on the island. A causeway and bridge linking the island to the mainland was constructed in 1892. In 1884, the USS Constellation was permanently anchored as a training ship for the Naval War College.
>
> The Melville area was established as a coaling station for the steam-powered ships in 1900. The Navy purchased 160 acres of land and constructed the Narragansett Bay Coal Depot. With the advent of ships burning liquid fuel, it became necessary to add oil tanks. Consequently, in 1910, four fuel oil tanks were added in the Melville area. These tanks are still used today.
>
> In 1913, the Navy established the Naval Hospital on the mainland of Aquidneck Island, directly adjacent to Coasters Harbor Island. At this time, the main hospital building was constructed.

The outbreak of World War I caused a significant increase in military activity at Newport. Some 1,700 men were sent to Newport and housed in tents on Coddington Point and Coasters Harbor Island. A bridge was built at this time connecting Coddington Point with Coasters Harbor Island. In 1918, Coddington Point was purchased by the Navy. Much of the base organization was then transferred to Coddington Point. During the war, numerous destroyers and cruisers were fueled by the Melville coal depot and fuel tanks. By this time, a pipeline had been extended to the north fueling pier and two additional oil tanks constructed.

Following World War I, fuel oil gradually replaced the use of coal by the Navy fleet. In 1921, the Coal Depot was changed to the Navy Fuel Depot. In 1931, the coal barges and coaling equipment were sold to the highest bidder.

In 1923, some two hundred buildings, which were part of the emergency war camps established on Coddington Point, were stripped and sold for scrap. The station was put on caretaker status in 1933. The base remained relatively inactive until the onset of World War II.

Reactivation of the base occurred in the late 1930s as a result of military build-up in Europe. Just prior to the reactivation, a 1938 hurricane and tidal wave had destroyed or severely damaged over 100 buildings and much of the sea walls. In 1940, Coddington Cove was acquired for use as a supply station, and hundreds of Quonset huts were constructed throughout the base. Additional barracks were constructed on Coasters Harbor Island, increasing the base housing capacity to over 3,500 men. Power plant facilities were also constructed at this time. Coddington Point was reactivated to house thousands of recruits. The Anchorage housing complex in the Coddington Cove area was constructed in 1942. In the Melville area, additional fuel facilities were constructed along with a Motor Torpedo Squadron Boat Training Center and nets for harbor defense were constructed. Tank Farms 1 through 5 were constructed during this time period. The Fire Fighting School, Fire Control Training Building, and the Steam Engineering Building were constructed in 1944.

The Torpedo Station at Goat Island was very active during World War II and had expanded its operation to Gould Island. The Torpedo Station employed more than 13,000 people and manufactured 80 percent of all torpedoes used by our country during the war. The station was the largest single industry ever operated in Rhode Island.

Following World War II, naval activities at Newport converted to a peace time status. This resulted in a reduction of naval activity. Some 300 Quonset huts and buildings were removed, and the entire naval complex was consolidated into a single naval command designated the U.S. Naval Base in 1946.

The Naval Base adjusted to its peace time status by increasing its activities in the fields of research and development, specialized training, and preparedness for modern warfare. There was a brief period during the Korean War when some 25,000 sailors trained at Newport.

In 1951, the Torpedo Station was permanently disestablished after 83 years of service. Future manufacture of torpedoes was to be awarded to private industry. In place of the Torpedo Station, a new research and development facility, the Naval Underwater Ordinance Station, was established and given the responsibility of overseeing the private contractors. The Officer Candidate School was also established in 1951.

In 1952, the Training Station and other naval schools were disestablished, and the U.S. Naval Station and the U.S. Naval Schools Command were established.

In 1955, Pier 1 was constructed, with Pier 2 being added in 1957. Newport became the headquarters of the Commander Cruiser-Destroyer Force Atlantic in 1962. Some 55 naval warships and auxiliary craft were homeported at Newport. New housing and bachelor quarters were added in the late 50's and early 60's.

Major expansion of the Naval War College occurred during the late 50's and early 70's, transforming the college into a major university. In July of 1971, the Naval Schools Command was restructured and named the Naval Officer Training Center (NOTC).

In April of 1973, the Shore Establishment Realignment Program (SER) was announced and resulted in the largest reorganization of Naval forces in the Newport area. The fleet stationed in Newport was relocated to other naval stations on the east coast. SER resulted in the disestablishment of the Naval Communication Station and the Fleet Training Center and related activities. The Public Works Center, Naval Supply Center, Naval Station and Naval Base were absorbed by NOTC. In April of 1974, NOTC was changed to the Naval Education and Training Center (NETC).

The drastic changes which resulted from SER caused a reduction of Navy personnel, both military and civilian, in excess of 14,000. Coupled with the reductions at the Naval Construction Battalion Center at Davisville, and the closure of the Naval Air Station at Quonset Point, SER had severe economic impacts in the Narragansett Bay area.

The reorganization brought about by SER resulted in the Navy excessing some 1,629 acres of its 2,420 acres. Some of the land has been leased to the State of Rhode Island pending final sale of the land by the General Services Administration. Table 1 [IN IAS] shows an area by area breakdown on land holdings prior to SER and following.

The Navy also leases 44 acres of land in Coddington Cove to the State of Rhode Island and Economic Development Corporation. The state has subleased this property to a private enterprise engaging in shipbuilding and repair. Available information indicates that the Navy intends to reclaim 41 acres of this property prior to mid-1994. Also, a fish food processing operation utilizes the cold storage warehouse in Building 42 near Pier 1.

The above information on the history of the installation was obtained from the most recent Master Plan (NORTHDIV, 1980), the 1981 Annual Report of the Navy in the Rhode Island Area (NETC Public Affairs Office, 1981), and the Command Histories at the Naval History Office in Washington, DC.

(IAS, pp. 5-6 to 5-14)

2.2 Regional Physiography

This section is divided into three subsections: climate, terrestrial features, and marine features. Regional geology and hydrology will be addressed in separate sections following this discussion. Additional site-specific studies regarding site terrestrial and marine features will be performed under the Phase II Ecological Risk Assessments.

2.2.1 Climate

The climate at NETC Newport is presented below. Much of the climatological information was obtained from the IAS report, and is referenced as such with page numbers which follow excerpts.

The climate at NETC is greatly influenced by its proximity to Narragansett Bay and Atlantic Ocean, which tend to modify the area's temperatures. Winter temperatures are somewhat higher and summer temperatures lower than more inland areas. Winters are moderately cold in the area, and summers are generally mild with many summer days cooled by sea breezes. . . .

The average annual precipitation for the area is 42.75 inches, but this has varied from as little as 25.44 inches to as much as 65.06 inches. Measurable precipitation (.01 inch or greater) occurs on about one day out of every three and is evenly distributed throughout the year. Thunderstorms are responsible for much of the rainfall from May through August. These thunderstorms often produce heavy amounts of rainfall, but their duration is relatively short. Summer thunderstorms are frequently accompanied by high winds which may result in property damage, especially to small boats. The average snowfall during winter is close to 40 inches, ranging from a low of 11.3 inches to a high of 75.6 inches. February is usually the month of greatest snowfall, but January and

march are close seconds. It is unusual for the ground to remain snow covered for any long period of time. . . .

Severe weather from tropical cyclones (winds 39 to 73 miles per hour) and hurricanes (winds greater than 73 miles per hour) is a serious threat in the area of NETC. The probability that a tropical cyclone will invade the area is one in five in any year, while the probability of hurricane force winds invading the area is less than one in fifteen in any year (Outleasing EIS, 1977). The most damage from these severe storms results when they strike at high tide.

(IAS, pp. 5-14 to 5-15)

2.2.2 Terrestrial Features

The topography of the NETC area was shaped by the bedrock geology, glaciation, and recent erosion. The bedrock geology controlled the locations of the ancient river valleys which glaciers subsequently gouged out of the bedrock. The hills are the result of bedrock highs. A mantle of till, on average 20 feet thick, was spread over the bedrock during the Wisconsin glaciation. As the glaciers melted, ocean levels rose and flooded the river valleys forming the passages of Narragansett Bay.

Elevations at NETC range from near mean sea level to 175 feet in the Melville North area. Many areas of NETC have low elevations which are susceptible to flooding during hurricane storm surges. The 100 and 500 year tidal flood elevations for the NETC area are 12.6 feet and 15.6 feet above mean low water, respectively. Areas below these elevations are subject to flooding.

Ninety percent of the land within the boundaries of NETC has slopes of from 0 to 9 percent (Master Plan, 1980). The remaining land has slopes in the categories of 10 to 25 percent and greater than 25 percent. Maps showing slopes on all NETC areas are included in the most recent Master Plan for NETC.

(IAS, pg. 5-15)

The soils in the area of NETC formed in glacial deposits of till and outwash. . . . There are also a few areas with tidal marsh soils along the shores of Narragansett Bay. These tidal marsh areas receive deposits of silt and clay during tidal inundation and from upland areas. These sediments are deposited along with the plant remains of the salt tolerant plants growing in the marshes.

(IAS, pg. 5-21)

There are five basic types of soils at the NETC: mucks, beaches, loams, sands, and urban complexes. The mucks are found in tidal flats and inland depressions which hold ponded water. Loams (mixture of sand, silt, clay, and organic matter) and sands are found in upland areas on-site and generally drain rapidly. Urban complexes are mixtures of natural soils, imported soils, and urban materials.

The flora and fauna of the NETC is strongly influenced by human activity.

The southern portion of the base is heavily industrial with machine shops and other support facility operations. The north portion of the base is divided in land usage between residential, vacant (held for expansion), tank farms, and storage-fueling facilities (industrial). There are no land areas on NETC which have not been disturbed at some time during base operations. . . .

Southern Rhode Island has relatively few forests of mature climax successional stage. Fires, logging, and the agricultural conversion of forest land prior to the Civil War have greatly reduced the extent of climax forest acreage. The predominant forest vegetation in southern Rhode Island is that of abandoned fields in early successional stages, and forests of immature hardwoods. Pure stands of mature softwoods are the least abundant. . . .

The upland vegetation within the NETC is restricted primarily to perennial weeds and grasses. The majority of trees is located near residences, drainageways and around the tank farms. The upland vegetation of NETC reflects complete management (mowing) or recent disturbance of the area.

The habitats available for lowland vegetation on the NETC are located on the waterfront along Narragansett Bay and surrounding the small impoundments and their drainage further inland. Those areas located on the waterfront are comprised of borrow pits along the railroad tracks and abandoned disposal areas where excavation has created depressions.

The largest of these depressions is the Melville North landfill. This area was excavated during landfill operations and depressions were created. These depressions support a limited diversity of wetland flora including reeds and various shrub and grass species. Borrow pits can be found along the railroad tracks which parallel the shoreline extending from McAllister Point northward to the Melville North landfill. These are individually less than one acre in size and contain similar wetland species with a lack of diversity.

All lowlands on NETC have been artificially created and are in a disturbed condition. The potential for maintaining diversified floral species within the lowlands of NETC is poor. This area did not previously contain these habitats, and sills and drainage are not conducive to their successional development.

The fauna of the region have been affected by similar disturbances (clearing, excavation, construction) which led to the impoverishment of the flora. Field studies have indicated impoverished fauna, particularly of herptile and mammal types. Widespread habitat destruction over a period of several hundred years has caused emigration or elimination of many species. As a result, the present regional fauna consist primarily of species of wide distribution and ecological tolerances, high adaptability, and nonrestrictive habitat requirements.

No large animals such as deer, turkey, or cougar are known within the boundaries of NETC. However, red fox, raccoon, rabbit, and gray squirrel are present in the woodlands.

Mammalian forms expected to be found on base include: the Eastern chipmunk, New England cottontail rabbit, white-footed mouse, short tailed shrew, gray squirrel, and red squirrel. Several of these species inhabit the few remaining wooded areas on base slated to be excessed.

Various herptiles occupy NETC habitats. Common ones include the red backed salamander, American toad, wood frog, eastern gartersnake, northern black racer and the wood turtle.

Common herptiles of the wet areas include the American toad, spring peeper, bullfrog and northern watersnake (Natrix sipedon), along with the snapping turtle.

Avian species which may be found within the NETC upland habitats include the bobolink, meadowlark, chimney swift, kingbird, eastern phoebe (Sayorius phoebe), barn shallow, red-tailed hawk and kestrel.

In addition, game birds, such as the ring-necked pheasant, bobwhite quail and the mourning dove, are highly dependent on the plant communities on the base.

(IAS, pp. 5-37 to 5-39)

2.2.3 Marine Features

The Narragansett Bay marine features are presented below. Much of the marine features information was obtained from the IAS report, and is referenced as such with page numbers which follow excerpts.

Narragansett Bay occupies three former river valleys which have been drowned by the advance of the Atlantic Ocean. Narragansett Bay is 20 miles long and 11 miles wide. The bay has a surface area of 102 square miles. Figure 5.3-7 shows Narragansett Bay and the surrounding areas. The shape of the former river valleys has changed little since the last glaciation. The bay is divided into an eastern and western passage by Conanicut

Island. The average depth of the bay is 30 feet. In the western passage, the average depth is 25 feet, while in the eastern passage, the average depth is 50 feet. The eastern passage, which NETC fronts, allows deep water access up to the south end of Prudence Island. Channel depth exceeds 80 feet in the eastern passage from Gould Island seaward, and depths in excess of 150 feet occur near the mouth of the bay.

Freshwater flows into the bay at an average rate of 1,239 cubic feet per second from a drainage area of 1,850 square miles. This accounts for 90 percent of the annual flow of fresh water into the bay. The other 10 percent is provided by direct rainfall into the bay and sewage effluent. An average of some 43 inches per year of precipitation falls directly into the bay. The freshwater input into the bay is small compared to the large volume of saline water in the bay. The relatively small freshwater input into the bay results in the bay water being well mixed with only small salinity gradients through the bay. Salinity ranged from about 22 parts per thousand (ppt) in the Providence River to 32 ppt at the mouth of the bay.

Tides are semi-diurnal in Narragansett Bay with a mean range of 3.6 feet at the mouth of the bay and 4.6 feet at the head. Abut 13 percent of the volume of water in the bay is exchanged each tidal cycle (Oviatt and Nixion, 1973). This is over 250 times the mean tidal river flow into the bay during a tidal cycle. The tidal movement is the single most important factor in water circulation in the bay. Tidal currents range in velocity from 0.07 to 2.3 feet per second (Atlantic Scientific, 1982). The faster velocities occur in the east and west passages near the mouth of the bay, while slower velocities occur in the upper bay.

Non-tidal current in the bay moves slowly at an average of 0.34 feet per second (Olsen, 1980). Although the non-tidal currents are slow, they are important in the exchange of water out of the bay and into Rhode Island Sound. The amount of time needed to transport a particle of water from Providence to the mouth of the bay is some 45 to 50 days (Olsen, 1980). However, this time can vary depending on the winds. Research seems to indicate that southeast winds blowing up the bay may prevent surface waters from flowing down the bay (Olsen, 1980).

The sediments in the bay are contaminated with heavy metals, hydrocarbons, and sewage sludge (Master Plan, 1980). A survey conducted by EPA (EPA, 1975) has shown the presence of heavy metal concentrations in the sediments in interstitial waters north of the Naval Complex. The values found were 7,048 mg/l manganese, 2,351 mg/l zinc, 559 mg/l iron, 55 mg/l lead, 46 mg/l nickel, 44 mg/l copper, and less than 1 mg/l cadmium. These contaminants are the result of industrial and municipal discharges into the bay. No sediment samples have been taken in the area of the Naval Complex. [Note: Sediment samples collected from the vicinity of McAllister Point Landfill and Tank Farm Four are discussed within the site-specific background information sections of Volume III of this Work Plan.]

The water quality for Narragansett Bay as determined by the State of Rhode Island is shown in Figure 5.3-8 (Figure 3). Most of the bay is Class SA, which means it suitable for direct shellfish harvesting, bathing and other water contact sports. Areas classified as SB are suitable for shellfish harvesting after depuration and for bathing and other recreational activities. Areas classified as SC are suitable for fish, shellfish, and wildlife habitat areas, but the shellfish cannot be harvested. The entire shoreline of NETC is closed to shellfishing.

(IAS, pg 5-28, 5-31)

The marine ecosystem of Narragansett Bay forms the shoreline of the base for approximately 9 miles. The bay is of great economic and aesthetic importance of the entire southern portion of Rhode Island. It is an estuary and the fishery resources of the bay are extremely important. The annual value of the combined commercial and sport fishing is estimated at several million dollars.

In Narragansett Bay, the phytoplankton are by far the most important primary producers, synthesizing organic matter from carbon dioxide and inorganic nutrients with sunlight as the energy source. In shallower, less turbid estuaries, seaweeds and sea grasses may assume this role. . . .

The phytoplankton and zooplankton are rich and varied in Narragansett Bay. The species composition is relatively uniform from station to station indicating a good movement of the water mass within the bay. The estimated productivity figure of 84 grams of carbon per square meter per year is also indicative of good environmental conditions. . . .

Most species of finfish move in and out of Narragansett Bay following well established seasonal patterns. These migratory movements, although different for each species, provide for distinct summer and winter populations of finfish. The migrations are related primarily to temperature, and the major shifts between winter and summer populations take place when the water temperature is about 10°C (50°F).

Narragansett Bay is visited each year by a great many species of fish because it lies along the boundary between southern and northern populations. Thus, herring from Georges Bank may visit the bay at the end of their southward midwinter migrations, and species such as scup and occasional exotic tropical strays brought up by the Gulf Stream make their appearance during the summer. In all, over 100 species may appear in any given year, about half of which are occasional visitors.

In various studies during the 1970's a total of 99 species of fish have been taken from Narragansett Bay (Oviatt and Nixon, 1973; Jeffries and Johnsons, 1974; Camp, Dresser and McKee, 1978; Department of the Navy, 1978). Ten species accounted for 91 percent of the fish catch with the winter flounder, the sand dab, scup and butterfish the

most commonly occurring fish taken. These four species are also of commercial importance. . . .

A year-long, bay-wide survey (excluding Mount Hope Bay and the Sakonnet River) of bottom fish made in 1972 yielded an annual minimum estimate of 117 individuals, or 28.5 pounds per acre. This translates into a standing crop of 1.9 million pounds of bottom fish. (The margin of error gives a range of 0.8 to 2.9 million pounds.) This is comparable to other estimates made using similar sampling techniques in New England estuaries and offshore fishing grounds. This bay-wide survey showed that despite the constant movement of species in and out of the bay, the total biomass of bottom fish is remarkably steady.

There are fewer species of pelagic fish than of bottom fish in the bay, but they make up for this by their numbers and their importance to fishermen. All the pelagic species are highly seasonal, with anchovies and sea herring appearing in the winter, and menhaden, bluefish, and striped bass in the summer. When schools of menhaden are present, their biomass may be far greater than that of the bottom fish. Population estimates for the bay are for as much as 16 million pounds of menhaden and 2 million pounds of bluefish and stripers. . . .

The benthic community in Narragansett Bay plays a critical role in the functioning of the ecosystem. Benthic filter feeders consume significant amounts of phytoplankton, and the bay's high primary productivity may be attributable in good part to the recycling activity of the benthos. . . .

The shellfish of Narragansett Bay include both bivalve molluscs (clams, oysters, scallops) and decapod crustaceans (crabs, shrimp, lobster). Lobster are caught both within and outside of Narragansett Bay. Lobsters are trapped in much of Narragansett Bay including the Coddington Cove area. Some lobster traps are located a short distance from Pier 2.

Bivalves harvested in the region of Narragansett Bay include the northern quahog - known as they bay quahog in Rhode Island), soft shell clam, and Atlantic bay scallop.

The quahog is the most valuable shellfish resource within the bay system. The number of people harvesting this organism for individual or commercial use is increasing. Shellfishing areas open to the public do not include the NETC shoreline.

Quahogs are the most abundant benthic animal of their size in Narragansett Bay (URI, 1980, Bulletin #40). In recent years, the total Rhode Island harvest ranged from 5 million pounds of meats in 1955 to 2 million pounds in 1978, the great majority of which are taken from the bay. . . .

Water pollution continues to take a heavy toll in the reduced numbers of quahogs available for harvesting. The primary criterion used in closing areas to shellfishing is the abundance of fecal coliforms in the water; these are an indicator of sewage and the pathogenic bacteria and viruses it may contain. A shellfish depuration plant is capable of killing harmful microorganisms that might be found within the shellfish, but not has been built in the bay area. Unfortunately, pathogenic microorganisms are only one aspect of the pollution in the upper bay. There are signs that Providence River quahogs are not healthy and may be dying off at least in some areas. Several researchers are concerned that they may be accumulating significant levels of petroleum or heavy metals, which are not removed by the usual depuration methods.

Aquaculture within the bay includes the eastern oyster and the blue mussel. Two species of clams are harvested offshore and landed at bay fishing ports. They are the Atlantic surf clam and the ocean quahog. Most of the northern areas of the bay are closed permanently or opened on a conditional basis. Most of the lower bay localities are opened. The shellfish area just south of the Newport Naval Facility is permanently closed because of municipal sewage discharge.

A small commercial fishery for squid occurs in the bay. A large squid trap is presently located in Coddington Cove (RI DEM, 1982) Sportsmen harvest squid with rod and reel throughout the spring and early summer months in the lower bay.

The blue crab and the rock crab are taken throughout the bay by recreational fishermen. Both of these species inhabit the shallow bays, sounds, and pools during the warm months and migrate to deeper water in the fall. The commercial fishing for blue crabs ended in 1938 with a severe population decline. The reason for the decline is not understood, but pollution from heavy metals and chlorinated hydrocarbons may have played an important role. At present, the population of blue crabs is increasing. The commercial use for rock crabs will be expanded with the development of new techniques for extracting the crab meat from the shells.

(IAS, pp. 5-40 to 5-47)

2.3 Regional Geology

The regional geology for NETC Newport is presented below. Much of the regional information was obtained from the IAS report, and is referenced as such with page numbers which follow the excerpts.

NETC is located at the southeastern end of the Narragansett Basin. This basin is a complex synclinal mass of Pennsylvanian aged sedimentary rocks and is the most prominent geologic feature in eastern Rhode Island and adjacent Massachusetts. Narragansett Basin is an ancient north to south trending structural basin originating near

Hanover, Massachusetts. The basin has a length of approximately 55 miles and varies from 15 to 25 miles wide. The western margin of the basin is in the western portion of Providence, Rhode Island, and the eastern margin runs through Fall River, Massachusetts. Exposures of older rocks on Conanicut Island and in the vicinity of Newport suggest that the southern extent of the basin is near the mouth of Narragansett Bay.

The rocks of the Narragansett Basin are non-marine sedimentary rocks of Pennsylvanian age. The rocks are chiefly conglomerates, sandstones, shales, and anthracite. Total thickness of the strata in the Narragansett Basin has been estimated at 12,000 feet. Both vertical and lateral irregularities in the lithologic character of the rock are present within the basin. Many folds and some faults occur throughout the basin, but the character and amount of the folding and faulting are not clearly known. The sedimentary rocks of the basin are believed to have been deposited in a lowland area which was surrounded by an upland area of considerable relief. The presence of coal beds within the basin also indicates that there were fairly extensive swampy areas. Figure 5.3-2 shows a general geologic map of Rhode Island.

The bedrock of the Narragansett Basin has been divided into the following five units: the Rhode Island Formation, Dighton Conglomerate, Wansulta Formation, Pondville Conglomerate, and Felsite at Diamond Hill. AT NETC and most of the surrounding area, the bedrock is entirely of the Rhode Island Formation, and thus, only this unit will be examined in detail. Figure 5.3-3 represents a detailed look at the geology at NETC and the surrounding areas.

The Rhode Island Formation is the most extensive and thickest of the Pennsylvania formations in Rhode Island. The vast majority of the Narragansett Basin is underlain by this formation. Included within the Rhode Island Formation are fine to coarse conglomerate, sandstone, lithic graywacke, graywacke, arkose, shale and a small amount of meta-anthracite and anthracite. Most of the rock is gray, dark gray, and greenish, but the shale and anthracite are often black. Crossbedding and irregular, discontinuous bedding is characteristic of the formation. Rocks of the Rhode Island Formation, which are in the northern portions of the basin, are strong and indurated but are not metamorphosed. However, those rocks in the southern portion of the basin, such as the NETC, are metamorphosed, and these rocks contain quartz-mica schist, feldspathic quartzite, garnet-stacrolite schist, and some quartz-mica-sillimanite schist. The beds of meta-anthracite and anthracite are mostly thin, but many areas within basin have been mined. Vein quartz, fibrous quartz, and pyrite are commonly associated with these coal layers, and the ash content is high.

Within the Rhode Island Formation, there are a few areas of thick conglomerates. These conglomerate layers are gray to greenish in color and are mostly very coarse. These conglomerates consist of pebbles, cobbles, and boulders (up to several feet long), interbedded with sandstone and graywacke. The stones are predominantly quartzite and

have been elongated as a result of tectonic forces in the southern portion of the basin. These thick conglomerate layers are more resistant to erosion than are the surrounding rocks and thus, are topographically higher. Coasters Harbor Island is mostly covered with this conglomerate material.

Throughout the Narragansett Basin, the Pennsylvanian rocks are underlain by pre-Pennsylvanian igneous and metamorphic rocks such as Bulgarmarch granite, Metacom granite gneiss, porphyritic granite and slate and quartzite. For the most part, these basement rocks are deeply buried beneath the Pennsylvanian rocks. However, these older rocks occur north of NETC in the Bristol area and south of NETC in the Fort Adams and Newport Neck areas and on the southern tip of Conanicut Island. Rose Island and Goat Island also have older metamorphic rocks of slate and quartzite.

Overlying the Pennsylvanian rocks of the Narragansett Basin are surficial deposits of Pleistocene sediments. These Pleistocene sediments owe their origin to the Wisconsin glaciation which covered the area with ice several thousand feet thick. As the glaciers receded some 10,000 to 12,000 years ago, they deposited unconsolidated glacial materials of variable thicknesses throughout the Narragansett Basin area. The unconsolidated glacial material ranges from 1 to 150 feet thick, being thicker in the valleys and thinner in the uplands. The glacial material consists of till, sand, gravel, and silt. These glacial deposits were derived from shale, sandstone, conglomerate, and in a few places, coal.

The glacial materials serve as the parent materials for the soils in the area. Areas where sand and gravel were deposited serve as important regional mineral sources. . . .

(IAS, pp. 5-18, 5-21)

Much of the geologic information contained in this section was obtained from Geological Survey Bulletin 1295 (Quinn, 1971). . . .

(IAS, pg. 5-21)

Several soil borings were completed into bedrock as part of a Remedial Investigation conducted at four RI/FS sites within the NETC (TRC, 1991). Bedrock was encountered at four of the RI sites. Generally, the bedrock consisted of a grey-green to black, highly weathered to competent, carboniferous shale. Rock cores indicated a high degree of fracturing with quartz and iron oxide deposits present along the fracture planes. Depth to bedrock varied amongst boring locations from approximately one to 33 feet below ground surface.

Glacial till deposits were encountered overlying the bedrock at NETC during the RI investigations. The till material was characterized as containing fine to coarse sand with varying

amounts of silt, with some horizons containing weathered shale fragments. A single Shelby Tube sample of the till indicated a triaxial permeability of 2.7 x 10^{-7} cm/sec (7.7 x 10^{-4} feet/day). Natural deposits of sand and silt and organic muck were also encountered.

2.4 Regional Hydrology

The regional hydrology for NETC Newport will be discussed in two following subsections covering surface water and ground water.

2.4.1 Regional Surface Water Hydrology

The regional surface water hydrology for NETC Newport is presented below. Much of the regional information was obtained from the IAS report, and is referenced as such with page numbers which follow the excerpts.

> NETC is located within the Narragansett Bay Drainage Basin. This drainage basin covers an area of 1,850 square miles, 1,030 square miles of which are in Massachusetts and 820 square miles of which are in Rhode Island. All surface water drainage from the basin is into Narragansett Bay. Three major rivers, the Taunton, Blackstone, and Pawtucket, as well as the Providence River and a number of smaller rivers and streams, drain into Narragansett Bay. Discharge from Narragansett Bay is into the Atlantic Ocean between Point Judith and Sakonnet Point in Rhode Island.
>
> Throughout NETC, the surface drainage is westward toward Narragansett Bay with the exception of one area in Tank Farm #2 which drains eastward into Melville Reservoir. Surface drainage at NETC is provided by the Melville Ponds, Normans Brook, Lawton Brook and Reservoir, Gomes Brook, a stream and pond in the northeastern portion of NUSC, and a stream discharging into Coasters Harbor. The surface drainage for NETC is shown in Figure 5.3-6. All these streams discharge into Narragansett Bay. . . .
>
> Except for the stream and pond at NUSC and the stream which empties into Coasters Harbor, all of the other streams and ponds are on land which is being excessed by the
>
> Navy. The Melville Ponds have been disposed of by GSA and are now part of the Melville Public Fishing Area.
>
> While these streams and ponds receive drainage from many of the areas within NETC, a substantial portion of the NETC area drains directly into Narragansett Bay or infiltrates into the soil before reaching a stream or body of water. Direct runoff into Narragansett Bay would especially occur following thunderstorms. . . .

(IAS, pp. 5-26, 5-28)

The potential for pollutant migration by surface drainage at NETC is greatly increased by its proximity to Narragansett Bay. Many of the waste disposal areas, such as the McAllister Point landfill, Melville North disposal site and Gould Island disposal site, are located right along the shoreline of Narragansett Bay. Surface drainage from these areas is directly into the bay. The NETC area is frequently subjected to thunderstorms during which intense periods of rainfall are common. Surface drainage into the bay would be greatest following these thunderstorms.

Pollutants from these portions of NETC drain into the Melville Ponds, Normans Brook, Lawton, Brook, Gomes Brook, and the NUSC stream and would also migrate off-site. All of the streams discharge directly into Narragansett Bay.

(IAS, pg. 5-34)

2.4.2 Regional Surface Water Classifications

The surface water quality classifications for Narragansett Bay, as determined by RIDEM, are shown on Figure 3. Most of the Narragansett Bay is classified as Class SA, which means it is suitable for bathing and contact recreation, shellfish harvesting for direct human consumption, and fish and wildlife habitat.

Areas classified as Class SB are suitable for public drinking water with appropriate treatment, agricultural uses, bathing, other primary contact recreational activities, and fish and wildlife habitat. Areas classified as Class SC are suitable for boating, other secondary contact recreational activities, fish and wildlife habitat, industrial cooling, and good aesthetic value.

Two freshwater streams located on NETC property have been classified as Class B surface waters. Class B surface waters are suitable for public water supply with appropriate treatment, agricultural uses, bathing, other primary contact recreational activities, and fish and wildlife habitat. The following is a description of water quality classifications for Narragansett Bay in the NETC area, as obtained directly from the State surface water quality regulations (RIDEM, Division of Water Resources, Section 6 - Water Quality Standards, Appendix A, Narragansett Bay Drainage Basin):

SECTION	CLASSIFICATION
The waters within 500 feet of the firing pier of the US Navy Torpedo Testing Station, Gould Island	SA
The waters in the area easterly from a line drawn from Coggeshall Point southwesterly to the southeastermost point of Dyer Island and the area easterly from a line drawn from Carr Point northwesterly to the southeasternmost point of Dyer Island	SC
The waters in the vicinity of Taylor Point which are within a 300 foot radius of the Jamestown marine outfall sewer (7 acres)	SC
The waters in the vicinity of Taylor Point, exclusive of those waters described above, south of a line from the northernmost extremity of Taylor Point to Can Buoy 13, north of a line from a point of land approximately 1000 feet south of the Newport Bridge to the northernmost extremity of Rose Island, and within 1000 feet of the shoreline of Jamestown (49 acres)	SB
Unnamed Brook from Greene Lane, Middletown, Rhode Island to East Passage, Narragansett Bay (1-1/2 mile)	B
Unnamed Brook upstream of Greene Lane to headwaters	B
East of a line from Ida Lewis Rock to the southern extremity of Goat Island, east of the line from the northern extremity of Goat Island to the west shore of Coasters Harbor Island, east of a line from the west shore of Coasters Harbor Island to the western extremity of Coddington Point and south and east of a line from the southwestern extremity of Coddington Point to the northern most point of the Coddington Cove breakwater	SC
The area within 1000 feet off of Monroe Street (in the Fort Adams Naval housing complex) on the west shore of Fort Adams, east of line from Fort Adams Light to Rose Island Light to Buoy (FLR) Bell 14 and a line from Buoy (FLR) Bell 14 through Nun Buoy 16 at Coddington Point and its extension to the end (southeastern most point) of the Coddington Cove breakwater	SB
Waters within a 600 foot radius of Greene Lane, Middletown	SB
The waters in the vicinity of Fort Adams, Newport, which are within a 300 foot radius of the Fort Adams marine outfall sewer (4.1 acres)	SC
The waters in the vicinity of Coasters Harbor which are within 500 feet of the Newport marine outfall sewer (18 miles)	SC

(Rhode Island Water Quality Standards, 1988)

2.4.3 Area Water Use

Public water in the City of Newport and Town of Middletown is supplied and managed by the Newport Water Department. The Town of Portsmouth purchases water from the Newport Water Department but operates its own distribution system. Approximately two thirds of Portsmouth is serviced by public water with the remaining one third supplied water from private water wells. While no specific records exist as to private well use in the information reviewed, in general, the majority of private wells are reportedly located on the eastern portion of Aquidneck Island (Personal Communication, Town of Portsmouth, 1992).

The Newport Water Department receives its water supply from a series of seven surface water reservoirs located on Aquidneck Island and two surface water reservoirs (Tiverton and Fall River) on the mainland. The seven surface water reservoirs on Aquidneck Island are:

1. Lawton Valley Reservoir,
2. St. Marys Pond,
3. Sisson Pond,
4. Easton North Pond,
5. Easton South Pond,
6. Paradise or Nelsons Pond, and
7. Gardners Pond.

Each of these reservoirs is supplied water via rainfall and runoff and is not augmented by ground water supply wells. The Newport Water Department stated that the safe yield of the reservoir system is approximately 11 to 13 million gallons per day (MGD). Water use in 1991 was 7.07 MGD, and adequate capacity reportedly exists for projected water usage on Aquidneck Island for the next ten to twenty years, or more (Personal Communication, Newport Water Department, 1992). Figure 6 indicates the location of surface water reservoirs (Lawton Valley, Sisson Pond, St. Marys Pond, and the Easton North Pond) in the vicinity of the Newport Naval Base.

The Prudence Island Utilities Company supplies ground water to approximately 800 people on Prudence Island, Portsmouth, located east and off-shore of the Melville area.

The locations of known public ground water supply wells and surface water reservoirs within the NETC Newport vicinity are shown on Figures 4 and 5. The locations of ground

water supply wells were obtained from the February, 1992 RIDEM Ground Water Section Facilities Inventory map for the Prudence Island quadrangle (USGS). The map shows the locations of known public ground water supply wells, in addition to known or suspected sources of ground water contamination. RIDEM Ground Water Section personnel indicated that the location of the supply wells within the Prudence Island Quadrangle had been field verified by RIDEM personnel.

Private wells are reported to withdraw water from till, bedrock, and stratified-drift aquifers. Of these aquifers, bedrock is considered the most reliable source of ground water, and well yields are commonly sufficient for domestic supplies (Johnston, U.S.G.S., undated).

The location, depth, and yield of private bedrock wells in the Prudence Island and Newport Quadrangles are shown on Figures 5.3.9 and 5.3.10 [Figures 4 and 5] as obtained from the IAS report. The IAS report indicated that bedrock wells in the area range from approximately 14 to 1,300 feet deep. Well yields from 55 gallons per minute (GPM) to less than 1 GPM are reported in the IAS report.

2.4.4 Regional Ground Water Hydrology

The regional ground water hydrology for NETC Newport is presented below. Much of the regional information was obtained from the IAS report, and is referenced as such with page numbers which follow the excerpts.

> Many areas on Aquidneck Island, on which NETC is located, obtain their water supply from wells. Areas relying on ground water are mostly north of the Middletown area, but there are wells throughout the entire island. Most ground water is used for domestic needs, although some is used by small industries and businesses.
>
> Ground water on Aquidneck Island is obtained from the unconsolidated glacial deposits of till and outwash and from the underlying Pennsylvanian bedrock. Throughout the area, depth to ground water ranges from less than one foot to about 30 feet, depending upon the topographic location, time of year, and character of subsurface deposits. The average depth to the ground water is around 14 feet on Aquidneck Island and moves from areas of high elevations to Narragansett Bay or the Sakonnet River.
>
> Seasonal water level fluctuations are common in the area. These fluctuations range from less than 5 feet to as much as 20 feet on the hills. In the valleys and lowland areas, the fluctuations are generally less than 5 feet. During the late spring and summer, the water

table usually declines as a result of evaporation and the uptake of water by plants, and rises during autumn and following winter thaws.

The unconsolidated glacial deposits range in thickness from less than one foot near the rock exposures to about 50 feet throughout Aquidneck Island. Most of the glacial deposits are till, but isolated outwash areas occur. In the NETC area, the glacial deposits are till with a thickness of less than 20 feet. Wells completed in the till are usually dug and range in depth from less than 10 feet to as much as 75 feet. The average depth for these wells is about 20 feet. These dug wells are usually 2 to 3 feet in diameter and are usually dug down to the top of the bedrock.

The yield of till wells varies considerably depending upon the type and thickness of the water-bearing deposits penetrated. Yields range from less than one to as much as 120 gallons per minute. Under normal weather conditions, till wells yield a few hundred gallons of water per day and are adequate for domestic supplies. The large diameter of dug wells also provides substantial water storage area between periods of use. Each foot of water in a 3-foot diameter well represents storage of 53 gallons. However, these wells are subject to going dry during seasonal or unusual droughts.

Bedrock wells in the area range from 14 to 1,300 feet in depth. The average depth for these bedrock wells is 135 feet. Yields from bedrock wells range from less than one to as much as 55 gallons per minute. Most wells yield less than 10 gallons per minute. The yields vary considerably in the bedrock over short distances because the joints and fractures which transmit water to the wells occur intermittently. Joints and fractures are most numerous and widest near the top of the bedrock and become fewer and narrower with depth. Bedrock wells seldom go dry, but yields can be extremely low if not enough fractures and joints occur in the area of the well.

The chemical characteristics of the ground water are similar throughout the area, and the water is generally satisfactory for most ordinary uses. Most ground water in the area is soft or only moderately hard, with ground water from till generally containing less mineral matter and being softer than ground water from bedrock. Areas where the ground water has high iron content are scattered throughout the area, being most numerous around Newport and Middletown and the northern part of Portsmouth. Wells which have a high iron content usually penetrate only rocks of Pennsylvanian age.

In scattered locations near the shoreline, over-pumping has led to salt water intrusion in some wells. Bedrock wells are not as easily contaminated with salt water as are till wells, but the chance of contamination increases as the depth of the well below sea level increases.

> No wells were identified within the boundaries of NETC other than on Gould Island, although there are numerous wells in close proximity. These wells are upgradient of NETC. . . .

(IAS, pp. 5-31 to 5-34)

> The ground water at NETC is very shallow, being less than 10 feet below the surface in most areas. This shallow depth makes ground water contamination at NETC very possible. Those pollutants which do find their way into the ground water would migrate to the west and discharge into Narragansett Bay. NETC extends along the western shoreline of Aquidneck Island, and the ground water only has to migrate a short distance before discharging into Narragansett Bay.
>
> The soils occurring at NETC have permeabilities which are moderate to moderately rapid, and they do not restrict the vertical movement of water. The glacial till, from which these soils were derived, is generally less permeable than the overlying soils but does not represent a barrier to the vertical migration of water. Therefore, it is possible that any contaminant transported in this water could contaminate the ground water. There are also isolated areas where the bedrock occurs at the surface. Contamination is possible in these areas through the cracks and fissures which commonly occur in the bedrock.

(IAS, pg. 5-34)

Information obtained from the Phase I Remedial Investigations indicated that, in general, ground water on NETC flows from east to west towards Narragansett Bay. Depth to ground water ranged from approximately four to 28 feet below ground surface at the four RI/FS sites. Slug tests conducted on monitoring wells at these sites indicated that the hydraulic conductivity of the till unit ranged from 0.22 to 0.44 feet per day and upper bedrock hydraulic conductivity ranged from 0.029 to 0.21 feet per day. The RI report noted that bedrock test data produced hydraulic conductivities higher than those normally attributed to shale (3.28×10^{-4} to 3.28×10^{-8} feet per day (Driscoll, 1987).

2.4.5 Ground Water Classifications

The Rhode Island Department of Environmental Management (RIDEM) has classified ground water in Rhode Island to protect and restore the quality of the state's ground water resources for use as drinking water and other beneficial uses, and to assure protection of the public health and welfare, and the environment. The ground water under the four RI/FS sites has been classified as follows:

RI/FS Sites	RIDEM Ground Water Classification
Site 01 - McAllister Point Landfill	Class GAA-NA
Site 09 - Old Fire Fighting Training Area	Class GB
Site 12 - Tank Farm Four	Class GAA-NA
Site 13 - Tank Farm Five	Class GAA-NA

Ground water classified GAA includes those ground water resources which the Director (RIDEM) has designated to be suitable for public drinking water without treatment and which are located in one of the three following areas:

1. Ground water reservoirs and portions of their recharge areas as delineated by RIDEM;

2. A 2,000 foot radius circle around each community water system well or within the delineation of a wellhead protection area to each well delineated by RIDEM;

3. Ground water dependant areas, such as Block Island, that are physically isolated from reasonable alternative water supplies and where the existing ground water supply warrants the highest level of protection.

Ground water classified GA is known or presumed to be suitable for drinking water without treatment. Ground water classified GB may not be suitable for drinking water without treatment due to known or presumed degradation. GB classified ground water is primarily located at highly urbanized areas or is located in the vicinity of disposal sites for solid waste,

hazardous waste or sewerage sludge. Areas which are unclassified are presumed by RIDEM to be Class GA ground water.

Non-attainment (NA) areas are those areas which are known or presumed to be out of compliance with the standards of the assigned classification. The goal for non-attainment areas is restoration to a quality consistent with the classification.

The RIDEM Ground Water Quality Regulations were codified into Rhode Island law in May 1992 (Regulation DEM-GW-01-92, May 1992). A series of proposed amendments to RIDEM rules and regulations for ground water quality were announced in March 1993. A summary of the proposed amendments are provided along with the regulations in Appendix A of Volume III of this Work Plan. Figure 6 indicates the relative location of the four RI/FS sites and RIDEM ground water classes.

3.0 HISTORY OF RESPONSE ACTIONS

This section presents a brief chronology of the interaction between the Rhode Island Department of Environmental Management (RIDEM), other regulators, and NETC Newport concerning environmental issues at the Naval base.

3.1 Chronology of Regulatory and Navy Actions

The following chronology pertinent to NETC Newport site investigations was obtained from the IAS report, the Confirmation Study, the Draft Tank Closure Plan for Tanks 53 and 56, the Phase I RI/FS and a review of information in RIDEM files:

Mid-1960's - burning of oil tank bottom sludges discontinued because of air pollution regulations.

Unknown Date - all of NETC shoreline closed to shellfishing due to concerns about bioaccumulation of contaminants in Narragansett Bay from sites on the facility.

Post 1971 - required scrubbers were installed on the Navy's classified document incinerator.

September 11, 1980 - the Navy Assessment and Control of Installation Pollutants (NACIP) program was initiated. The purpose of the program is to systematically identify, assess, and control environmental contamination from past use and disposal of hazardous substances at Navy and Marine Corps installations. (Note: This study is being conducted under this program.)

1982 - the RIDEM adopted hazardous waste regulations which classified waste oil as a hazardous waste.

March 1983 - Initial Assessment Study (IAS) of NETC completed.

1984 - the Navy ceased using Tanks 53 and 56 at Tank Farm Five for waste oil storage.

1986 - the RIDEM implemented new regulations for the operation and closure of underground storage tanks used to hold oils and hazardous materials.

May 1986 - Confirmation Study Report (CS) on the NETC was completed.

1988 - Tank Closure Plan for Tanks 53 and 56 located at Tank Farm Five completed and closure option selected for implementation.

1991 - Phase I RI/FS Report on five sites at the NETC was completed.

4.0 REFERENCES

Department of the Army, New England Division, Corps of Engineers, 1988. Gould Island, McAllister Point and Allen Harbor Sediment and Mussel Sampling.

Envirodyne Engineers, Inc., 1983. Initial Assessment Study Naval Education and Training Center, Newport, RI, prepared for the Navy.

Environmental Resource Associates, Inc., 1987. Tank Closure Plan for Tanks 53 and 56, Tank Farm 5, Naval Education and Training Center, Newport, RI, prepared for the Navy.

Freeze, R.A. and J.A. Cherry, 1979. Ground Water. Prentice Hall, Englewood Cliffs, New Jersey, 604 p.

Loureiro Engineering Associates, 1986. Confirmation Study Report, Naval Education and Training Center, Newport, RI, prepared for the Navy.

SEA Consultants, Inc., 1987. Design Development Final Submission, Design Analysis Report, Expansion of Child Care Center, Building 144, NETC, Newport, Rhode Island, prepared for the Navy.

State of Rhode Island Department of Environmental Management, 1988. Water Quality Regulations for Water Pollution Control.

U.S. Navy, 1943. Fire Fighters School Location Plan Map, Public Works Drawing No. 7146-78, U.S. Naval Operating Base, Newport, R.I., Naval Training Station, Coasters Harbor Island.

4.1 Additional Sources (As presented in the Initial Assessment Study)

Atlantic Scientific (Beverly Hills, CA), 1982. "Predraft Environmental Impact Statement - Possible Long-Range Homeporting at Naval Education and Training Center, Newport, RI," prepared for Naval Facilities Engineering Command, Northern Division, Contract No. N62472-81-C-1148.

Department of the Navy, Naval Education and Training Center, Newport, RI, 1981. "Annual Hazardous Waste Report for CY 1981," Obtained from files of Naval Facilities Engineering Command, Northern Division, Philadelphia, PA.

Jeffries, H.P. and W.C. Johnson, 1974. "Seasonal Distributions of Bottom Fishes in the Narragansett Bay Area: Seven Year Variations in the Abundance of Winter Flounder," J. Fish. Res, BD. C. 31:1057-1066.

4.0 REFERENCES (Continued)

Naval Facilities Engineering Command, Northern Division, 1977. "Candidate Environmental Impact. Statement for the Outleasing of Approximately 44 Acres of land and Facilities Thereon at the U.S. Naval Base, Newport, RI."

Naval Facilities Engineering Command Northern, Division, 1980. "Master Plan for the Naval Complex, Newport, Rhode Island," Obtained from files of Naval Facilities Engineering Command, Northern Division, Philadelphia, PA.

NOAA Sea Grant/URI Ocean Engineering, 1980, "Tides and Tidal Currents of Narragansett Bay," Obtained from files of Naval Facilities Engineering Command, Northern Division, Philadelphia, PA.

Olsen, S., et al., 1980, "An Interpretive Analysis of Narragansett Bay," Coastal Resources Center, University of Rhode Island, Marine Bulletin No. 40.

Oviatt, C.H. and S.W. Nixon, 1973. "The Demersal Fish of Narragansett Bay: An Analysis of Community Structure, Distribution and Abundance." Estuarine and Coastal Marine Science 1:361-378.

U. S. Environmental Protection Agency (Washington, DC), 1975 "Notification of Hazardous Waste Site," Forms for sites at Naval Education Training Center, Newport, RI, Obtained from files of Naval Facilities Engineering Command, Northern Division, Philadelphia, PA.

Quinn, A.W., 1971. "Bedrock Geology of Rhode Island," Geological Survey Bulletin 1295.

TABLES

TABLE 1

SUMMARY OF NETC HAZARDOUS WASTE SITES

No.	Site	Characteristics/Studies/Plan of Action
1	McAllister Point Landfill	1955-1970s - The landfill received all waste generated at the Newport Naval Complex. This site contains wastes from operation (machine shops, electroplating, etc.), Navy housing, and ships homeported in Newport. Materials disposed of at this site would be mostly domestic-type refuse but also include spent acids, paints, solvents, waste oils (lube, diesel, and fuel), and PCB-contaminated oil. An IAS and CS were conducted of the site. Site is being investigated under the current RI/FS.
2	**Melville North Landfill**	WWII-1955 - The landfill received mostly domestic-type refuse and also spent acids, waste paints, solvents, waste oils, and PCBs. Several areas are covered with oil and oily sludge on the site. The site has been excessed and is owned by Melville Marine Industries. An IAS and CS were conducted of the site. Site is being investigated under a separate RI/FS as a Formerly Used Defense Site (FUDS).
3	**Structure #214 - Melville North**	1980-1982 - Substation #214. The site has been excessed and is considered a Formerly Used Defense Site (FUDS). NETC cleaned the site under a removal action.
4	Coddington Cove Rubble Fill	1978-1982 - Rubble dump which contains inert items including scrap lumber, tires, wire, cable, and empty paint cans. An IAS conducted of the site recommended no further action. The site is being investigated under a Study Area Screening Evaluation (SASE).
5	Melville North Area	1978-1982 - Twenty barrels of waste oil stored on an asphalted area. Oil was spilled in the area. The site has been excessed and is considered a Formerly Used Defense Site (FUDS). An IAS was conducted of the site. NETC cleaned the site under a removal action.
6	**STP Sludge Drying Bed**	1982-1983 - Site is located in Melville North at the old sewage treatment plant. Oily waste has been disposed of at this site. Site has been excessed. An IAS was conducted of the site. NETC cleaned the site under a removal action.

TRC

No.	Site	Characteristics/Studies/Plan of Action
7	Tank Farm #1	WWII-1970 - Located in Melville North. Contains six 60,000-barrel underground storage tanks (USTs) for diesel oil, fuel oil, jet fuel, 100 octane gasoline, and aviation fuel. Tank bottom sludge generated from cleaning the tanks was placed in on-site pits. Approximately 6,000 gallons of tank bottom oil sludge was reportedly disposed of at the site. An IAS and CS were conducted of the site. The site is currently being investigated under a DFSP contract.
8	NUSC Disposal Area	Early 1970s - Located in Coddington Cove. Contains rubble, inert materials including scrap lumber, tires, wire, cable, and empty paint cans. An IAS conducted on the site recommended no further action. The site is being investigated under a SASE.
9	Old Fire Fighting Training Area	WWII-1972 - Located on Coaster's Harbor Island. Waste oils were used at the site to train personnel in fire fighting operations. Site has been excavated to remove contaminated soils. An IAS conducted of the site recommended no further action. Oil discovered at the site during a recent geotechnical investigation for the expansion of an operating facility on the site indicated the need for further investigation of the site. The site is being investigated under the current RI/FS.
10	Tank Farm #2	WWII-1970 - Located in Melville. Contains eleven 60,000-barrel USTs for fuel. Approximately 100,000-175,000 gallons of sludge were disposed in on-site pits. An IAS was conducted of the site. The site is being investigated under a DFSP contract.
11	Tank Farm #3	WWII-1970 - Located in Melville. Contains seven 60,000-barrel USTs for fuel. Tank sludge bottoms were disposed in burning chambers. The burning chambers had steel sides and sand bottoms. An IAS was conducted on the site. The site is currently being investigated under a DFSP contract.
12	Tank Farm #4	WWII-1970 - Located in Melville. Contains twelve 60,000-barrel USTs for fuel. Approximately 10,000-190,000 gallons of tank sludge bottoms were disposed of on site. An IAS and CS were conducted of the site. Site is being investigated under the current RI/FS.
13	Tank Farm #5	WWII-1970 - Located in the mid portion of the Newport Naval Base. Contains eleven 60,000-barrel USTs for fuel. Tank bottom sludge was burned on site. Approximately 10,000-175,000 gallons of oily sludge was disposed of on site. A tank closure investigation is being conducted for two USTs at the site. An IAS was conducted of the site. Site is being investigated under the current RI/FS.
14	Gould Island Disposal Area	WWII - All wastes generated on the island consisting of domestic trash, metal scrap, wood, pipes, rusted drums, two diesel oil tanks, and concrete. Wastes from electroplating and degreasing operations may also have been disposed of at the site. An IAS and CS were conducted of the site. Site will be investigated by the Army Corps of Engineers.

No.	Site	Characteristics/Studies/Plan of Action
15	Gould Island Bunker #11	WWII - Site had drums containing possible hazardous waste from electroplating operations. An IAS was conducted on the site. NETC cleaned the site under a removal action.
16	Gould Island Incinerator	WWII - Six-ton capacity incinerator. An IAS conducted on the site concluded that no action is required at site.
17	Gould Island Electroplating Shop	WWII - Wastes generated from electroplating and degreasing operations. Wastes included muriatic acid, chromic acid, copper cyanide, sodium cyanide, sodium hydroxide, nickel sulfate, Anodex leaner and degreasing solvents. An IAS and CS were conducted of the site. The site is being investigated under a SASE.
18	**Structure #214 - Melville North**	1980-1982 - Area adjacent to structure #214. Drums of waste oil and oily spillage. Site has been excessed and is considered a Formerly Used Defense Site (FUDS). NETC cleaned the site under a removal action.

Notes: Bolded text indicates a FUDS (Formerly Used Defense Site) site.

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TABLE 2

STATUS SUMMARY OF NETC NEWPORT HAZARDOUS WASTE SITES

No.	Site	Present Owner	Action
1	McAllister Point Landfill	Navy	IAS/CS, RI/FS
2	Melville North Landfill	Private	IAS/CS, RI/FS[1]
3	Transformer Vault Substation #214 - Melville North	Private	Navy Clean-Up[5]
4	Coddington Cove Rubble Fill	Navy	IAS, SASE[2]
5	Melville North Area	Private	IAS, Navy Clean-up[5]
6	STP Sludge Drying Bed	Private	IAS, Navy Clean-up[5]
7	Tank Farm One	Navy	IAS/CS[3]
8	NUSC Disposal Area	Navy	IAS, SASE[2]
9	Old Fire Fighting Training Area	Navy	IAS, RI/FS[4]
10	Tank Farm Two	Navy	IAS[3]
11	Tank Farm Three	Navy	IAS[3]
12	Tank Farm Four	Navy	IAS/CS, RI/FS
13	Tank Farm Five	Navy	IAS, RI/FS
14	Gould Island Disposal Area	State	IAS/CS, RI/FS[5]
15	Gould Island Bunker #11	State	IAS, Navy Clean-Up[5]
16	Gould Island Incinerator	State	No Action[5]
17	Gould Island Electroplating Shop	Navy	IAS/CS, SASE[2]
18	Structure #214 - Melville North	Private	IAS, Navy Clean-Up

(1) The RI/FS for this site will be conducted as part of a separate investigation

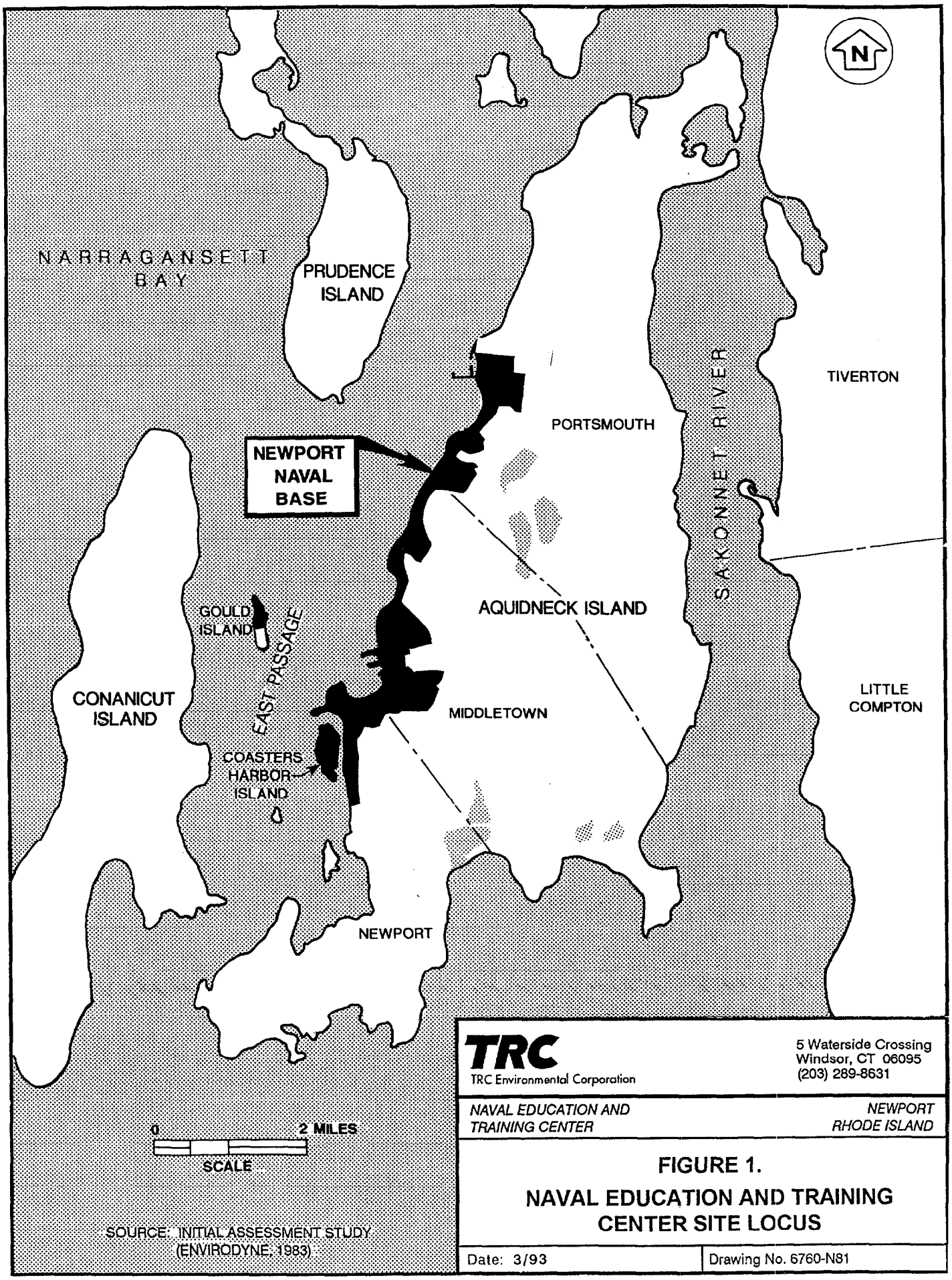
(2) A Study Area Screening Evaluation (SASE) will be performed on each of these sites to determine need for an RI/FS.

(3) These Tank Farms are currently being investigated under a DFSP contract. SASE's of these sites are awaiting findings of the DFSP investigations.

(4) A Confirmation Study was not performed. During a geotechnical investigation of the site, evidence of oil-contaminated soil was found thus, the site is being studied under the RI/FS.

(5) This site will be investigated by the Army Corps of Engineers (ACE).

FIGURES



SOURCE: INITIAL ASSESSMENT STUDY (ENVIRODYNE, 1983)

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NAVAL EDUCATION AND TRAINING CENTER

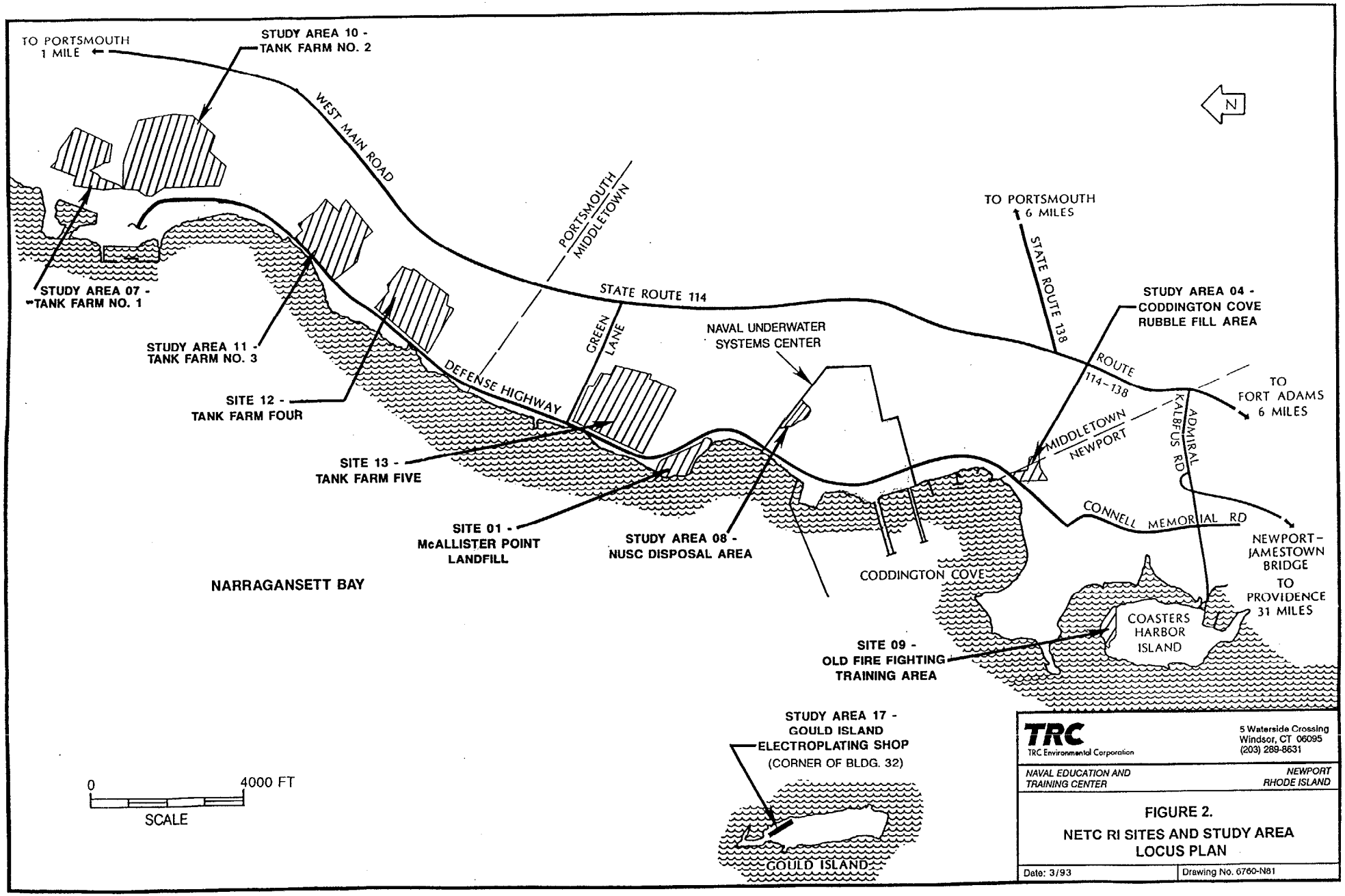
NEWPORT RHODE ISLAND

FIGURE 1.

NAVAL EDUCATION AND TRAINING CENTER SITE LOCUS

Date: 3/93

Drawing No. 6760-N81


TO PORTSMOUTH
1 MILE
STUDY AREA 10 -
TANK FARM NO. 2
WEST MAIN ROAD
PORTSMOUTH
MIDDLETOWN
STATE ROUTE 114
GREEN LANE
DEFENSE HIGHWAY
STUDY AREA 07 -
TANK FARM NO. 1
STUDY AREA 11 -
TANK FARM NO. 3
SITE 12 -
TANK FARM FOUR
SITE 13 -
TANK FARM FIVE
SITE 01 -
McALLISTER POINT
LANDFILL
STUDY AREA 08 -
NUSC DISPOSAL AREA
NAVAL UNDERWATER
SYSTEMS CENTER
NARRAGANSETT BAY
TO PORTSMOUTH
6 MILES
STATE ROUTE 138
STUDY AREA 04 -
CODDINGTON COVE
RUBBLE FILL AREA
ROUTE
114-138
MIDDLETOWN
NEWPORT
ADMIRAL
KALBFUS RD
TO
FORT ADAMS
6 MILES
CONNELL MEMORIAL RD
NEWPORT-
JAMESTOWN
BRIDGE
TO
PROVIDENCE
31 MILES
CODDINGTON COVE
COASTERS
HARBOR
ISLAND
SITE 09 -
OLD FIRE FIGHTING
TRAINING AREA
STUDY AREA 17 -
GOULD ISLAND
ELECTROPLATING SHOP
(CORNER OF BLDG. 32)
GOULD ISLAND
N
0
4000 FT
SCALE
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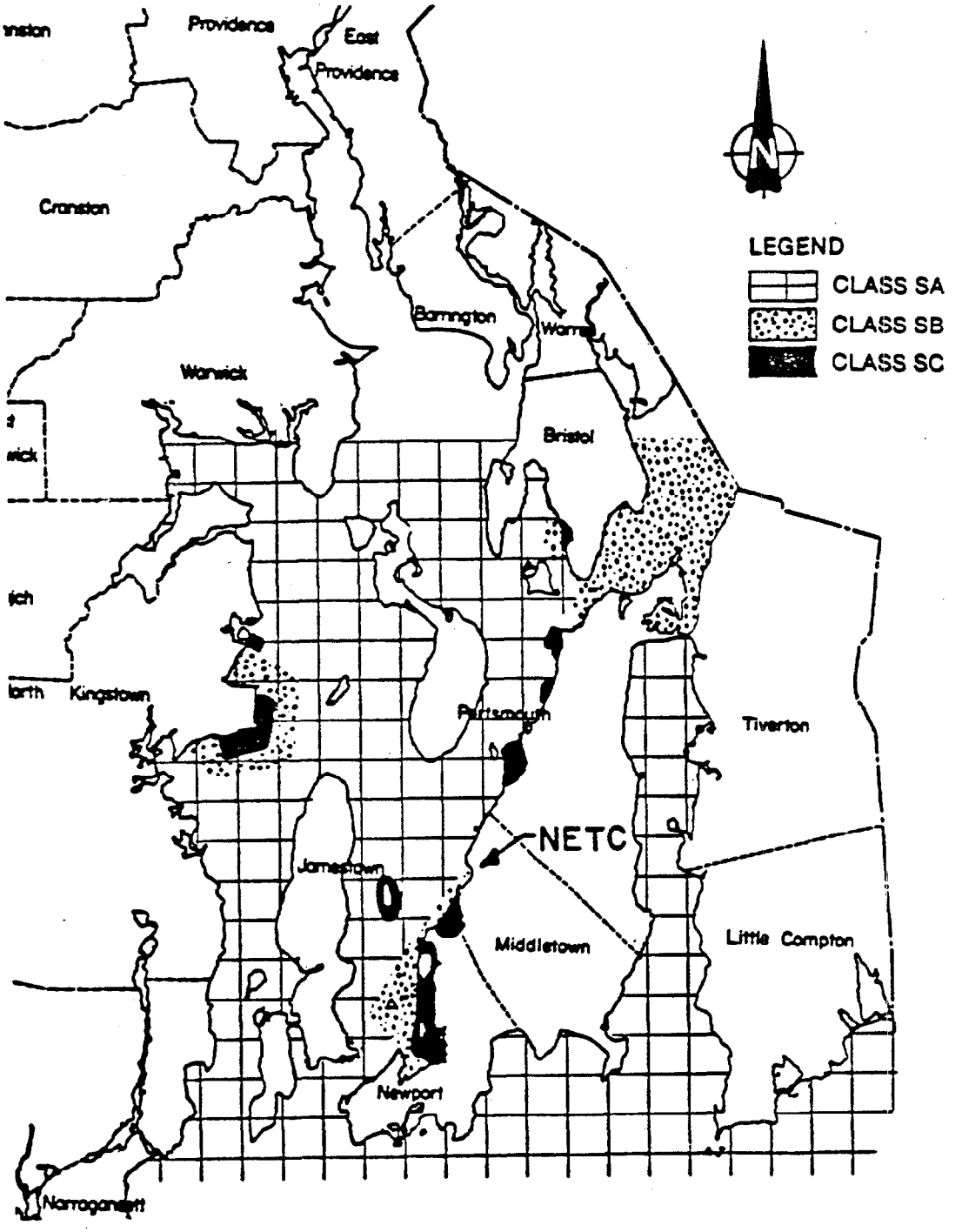
NAVAL EDUCATION AND
TRAINING CENTER
NEWPORT
RHODE ISLAND
FIGURE 2.
NETC RI SITES AND STUDY AREA
LOCUS PLAN
Date: 3/93
Drawing No. 6760-N81



SOURCE: FIGURE 5.3-8 OF 1983 IAS REPORT (ENVIRODYNE)

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NAVAL EDUCATION AND TRAINING CENTER

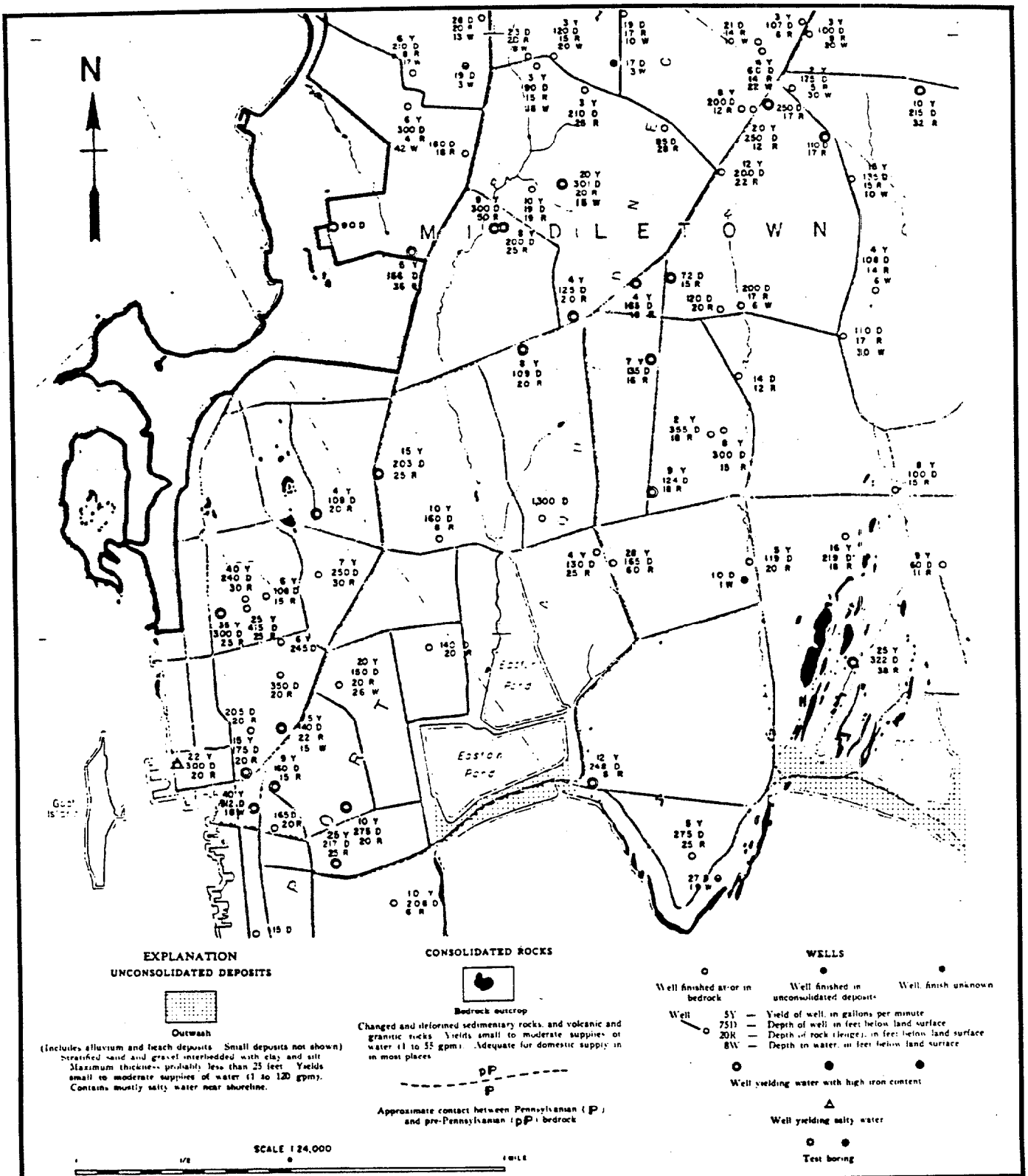
NEWPORT RHODE ISLAND

FIGURE 3.

SURFACE WATER QUALITY MAP OF NARRAGANSETT BAY

Date: 3/93

Drawing No. 6760-N81



SOURCE: FIGURE 5.3-9 OF 1983 IAS REPORT (ENVIRODYNE)

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NAVAL EDUCATION AND TRAINING CENTER

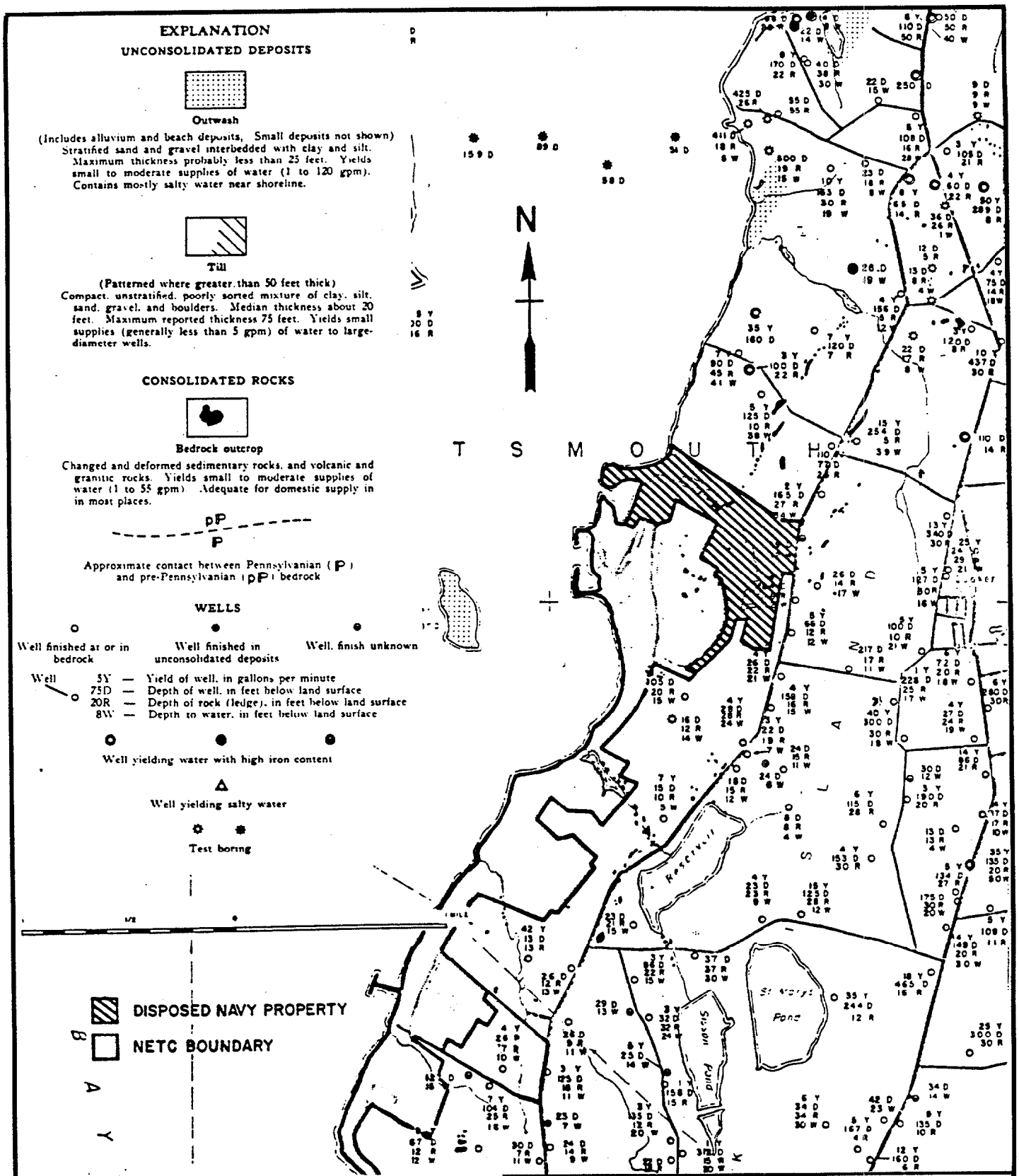
NEWPORT RHODE ISLAND

FIGURE 4.

BEDROCK WELL MAP A

Date: 3/93

Drawing No.: 6760-N81



SOURCE: FIGURE 5.3-10 OF 1983 IAS REPORT (ENVIRODYNE)

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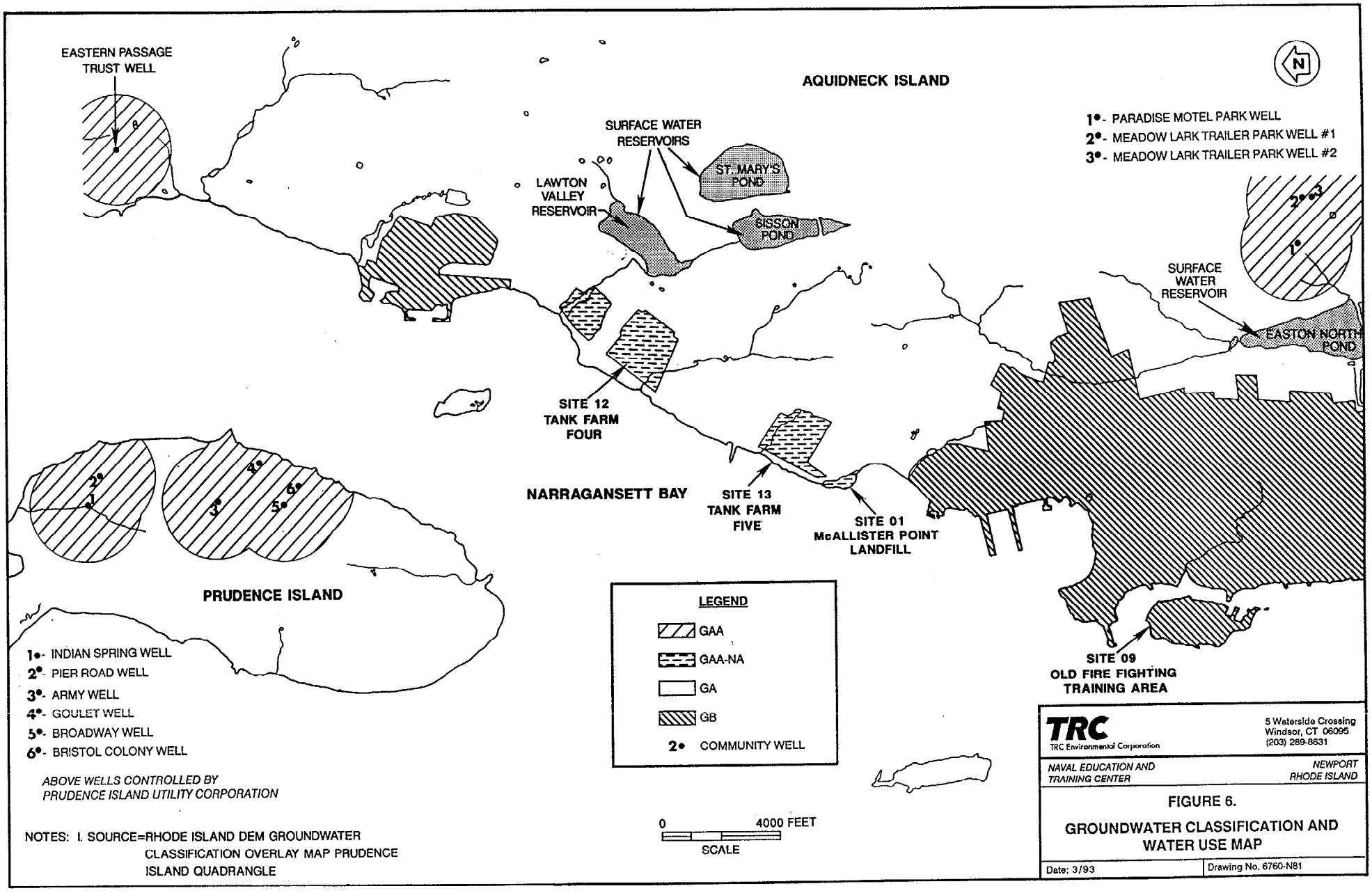
NAVAL EDUCATION AND TRAINING CENTER — *NEWPORT RHODE ISLAND*

FIGURE 5.

BEDROCK WELL MAP B

Date: 3/93 | Drawing No.: 6760-N81


EASTERN PASSAGE TRUST WELL
AQUIDNECK ISLAND
SURFACE WATER RESERVOIRS
ST. MARY'S POND
LAWTON VALLEY RESERVOIR
SISSON POND
1•- PARADISE MOTEL PARK WELL
2•- MEADOW LARK TRAILER PARK WELL #1
3•- MEADOW LARK TRAILER PARK WELL #2
SURFACE WATER RESERVOIR
EASTON NORTH POND
SITE 12 TANK FARM FOUR
NARRAGANSETT BAY
SITE 13 TANK FARM FIVE
SITE 01 McALLISTER POINT LANDFILL
SITE 09 OLD FIRE FIGHTING TRAINING AREA
PRUDENCE ISLAND
1•- INDIAN SPRING WELL
2•- PIER ROAD WELL
3•- ARMY WELL
4•- GOULET WELL
5•- BROADWAY WELL
6•- BRISTOL COLONY WELL
ABOVE WELLS CONTROLLED BY PRUDENCE ISLAND UTILITY CORPORATION
LEGEND
GAA
GAA-NA
GA
GB
2• COMMUNITY WELL
0 4000 FEET
SCALE
NOTES: I. SOURCE=RHODE ISLAND DEM GROUNDWATER CLASSIFICATION OVERLAY MAP PRUDENCE ISLAND QUADRANGLE
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NAVAL EDUCATION AND TRAINING CENTER
NEWPORT RHODE ISLAND
FIGURE 6.
GROUNDWATER CLASSIFICATION AND WATER USE MAP
Date: 3/93
Drawing No. 6760-N81

U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

VOLUME II
PROJECT PLAN

PHASE II RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared by:
TRC Environmental Corporation
Windsor, Connecticut

Prepared For:
Northern Division - Naval Facilities
Engineering Command
Lester, Pennsylvania

March 1993

TRC-EC Project No. 6760-N81-110
Contract No. N62472-86-C-1282

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1 SUMMARY OF ANALYTICAL LEVELS APPROPRIATE TO DATA USES

2 APPROPRIATE ANALYTICAL LEVELS - BY DATA USE

1.0 INTRODUCTION

The Plan of Action presented in the Phase II RI/FS Work Plan was prepared in accordance with Navy Requirements (Scope of Work, Amendment 20 to Appendix "A", Contract N62472-86-C-1282) and Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA prepared by USEPA (1988). The Work Plan builds on the extensive data base available for the Naval Education and Training Center, Newport (NETC-Newport), Rhode Island. The data base includes the following major investigation efforts:

- Initial Assessment Study (IAS), Envirodyne Engineers, Inc. (1983).
- Verification Step, Confirmation Study (CS), Loureiro Engineering Ass. (1986).
- Tank Closure Plan for Tanks 53 and 56, Tank Farm Five, Environmental Resources Associates (1988).
- Draft Final Report - Phase I (RI), TRC Environmental Consultants Inc. (1991).

The Phase II Work Plan was developed to provide site-specific information sufficient to support informed risk management decisions regarding appropriate site remedies.

In preparing the Phase II Work Plan, pertinent comments received by the Navy on the Draft Phase I Remedial Investigation Report (December 1991) were incorporated into the Phase II plan of action. Comments received by the Navy on the Phase I RI report included those from USEPA Region I and the U.S. Fish and Wildlife, USEPA risk assessment group, USEPA follow-up responses, and RIDEM. Additionally, comments received on the Phase I - RI/FS Work Plan from USEPA and RIDEM were addressed, as appropriate.

The project plans for the Phase II work effort include the site-specific Field Sampling Plans (FSP), a Quality Assurance Project Plan (QAPP), and a project Health and Safety Plan (HASP). In addition, this Work Plan includes discussions of NETC and site-specific background information which has been updated to include the results of the Phase I - RI, a discussion of ARARs and preliminary action alternatives, a Data Evaluation and Assessment Plan which addresses data management and the RI Report outline, and a supplemental Human Health Risk

Assessment. A discussion of treatability studies and pilot testing is included in the Treatability Study and Feasibility Study (FS) Plan.

The Phase II Work Plan was developed to assure that the field investigations meet the objectives described in EPA's guidance, including:

- Define the nature and extent of contamination (waste types, concentrations, distributions).
- Provide a basis for the evaluation of contaminant fate and transport mechanisms.
- Update Phase I Human Health Risk Assessment.
- Perform an Ecological Risk Assessment.
- Update Phase I identification of federal/state contaminant- and location-specific ARARs.
- Provide a data base sufficient to support the detailed evaluation of remedial alternatives within a Feasibility Study.

In developing the Work Plan, the approach was to:

- Identify data gaps in the Phase I RI;
- Identify data quality objectives (DQO's);
- Identify types of actions that may be appropriate for addressing site problems and define associated data requirements for the technical evaluation of the actions' applicability;
- Identify interim remedial measures, where appropriate, to mitigate potential threats or prevent further environmental degradation;
- Identify optimal sequence of site actions and site activities; and
- Identify procedures that may be used to streamline the Phase II RI/FS.

These work plan criteria are described in more detail in the following sections.

2.0 PROJECT PLAN CRITERIA

2.1 Data Gaps

The Phase I RI provided an initial evaluation of the presence, nature, and extent of contamination at the investigation sites. Surface soils, subsurface soils or fill, sediments, surface water, and ground water were sampled and initially characterized at the sites. The geologic and hydrogeologic characteristics for each of the site were also investigated. A Human Health Risk Assessment was performed on the basis of the Phase I RI results. However, the sites were not "fully characterized" by the site assessment activities. Based on a review of all existing data and regulatory review comments, the following data gaps were identified as requiring further investigation (site activities planned to address these data gaps are noted in parenthesis after each item):

Site 01 - McAllister Point Landfill

- Background Soil and Ground Water Quality (off-site surface soil samples and upgradient monitoring wells).
- Landfill Cap Soil Quality (surface soil samples).
- Extent of Phase I Detected Surface Soil Contamination.
- Shoreline Surface Soil/Sediment Quality (surface soil samples).
- Shoreline Site Bank Material Soil/Fill Quality (surface soil samples).
- Ash Fill Location and Extent at Northern End of Site (surface and soil borings).
- Extent of landfill and site (surface soil samples, soil borings, and geophysics).
- Characteristics of fill materials (surface soil samples and soil borings).
- Site Bedrock Topography (borings and geophysics).
- Ground Water Quality in Shallow and Bedrock Aquifers (nested monitoring well sampling).
- Extent of Phase I Detected Ground Water Contamination (soil gas and monitoring wells).

- Leachate Spring Locations and Water Quality (leachate surveys and sampling).
- Surface Water and Ground Water Interactions (multi-level piezometers, ground water sampling, surface water station).

Site 09 - Old Fire Fighting Training Area

- Background Soil and Ground Water Quality (off-site surface soil samples and upgradient monitoring wells).
- Extent of Phase I Detected Surface Soil Contamination (surface soil samples).
- Extent of Site (surface soil samples and borings).
- Overall Site Surface Soil Quality (surface soil samples).
- Source of Phase I Geophysical Anomaly in Central Mounded Portion of Site (geophysics and test pits).
- Characteristics Soil/Fill of Mounded Areas in the Central and Western Portions of Site (surface soil samples, test pits, and borings).
- Bedrock Topography and Characteristics (borings and geophysics).
- Ground Water Quality in Shallow and Bedrock Aquifers (nested monitoring well sampling).
- Extent of Phase I Detected Ground Water Contamination (monitoring wells).
- Shoreline Surface Soil/Sediment Quality (surface soil samples).

Site 12 - Tank Farm Four

- Background Soil and Ground Water Quality (surface soil samples and upgradient monitoring wells).
- Overall Site Surface Soil Quality (surface soil samples).
- Extent of Phase I Detected Surface Soil Contamination (surface soil samples).
- Overall Site and Downgradient Ground Water Quality (bedrock and overburden monitoring wells).

- Ground Water and Surface Water Interaction (piezometers and monitoring wells).
- Surface Water and Sediment Quality in On-site Brook (on-site and off-site sampling).
- Unknown Structure ("Ruins") Characteristics (survey and sampling).

Site 13 - Tank Farm Five

- Background Soil and Ground Water Quality (surface soil samples and monitoring wells).
- Overall Site Surface Soil Quality (surface soil samples).
- Extent of Phase I Detected Surface Soil Contamination (surface soil samples).
- Overall Site and Downgradient Ground Water Quality (bedrock and overburden monitoring wells).
- Ground Water and Surface Water Interaction (piezometers and monitoring wells).
- Surface Water and Sediment Quality in On-site Brook (on-site and off-site sampling).

Additional site characterization activities at each of the sites includes the collection of samples for media treatability information (e.g., grain size analyses, TOC, etc.).

2.2 Data Quality Objectives (DQOs)

The development of data quality objectives involves the following:

- the specification of the decision making process and identification of why new data are needed based on the identification of data users, the evaluation of existing data, the development of conceptual site models, and the specification of data quality objectives for the project;
- the identification of data uses or needs to ensure adequate data are developed; and
- the specification of methods by which data of acceptable quality and quantity will be obtained.

Project objectives include the further characterization of the investigation sites with respect to the nature and extent of contamination, the chemical and physical characteristics of

the sites, the site contaminant fate and transport concerns, the human health and ecological risks, and the application of potential remedial alternatives.

The Phase II RI/FS Work Plan has been developed in consideration of the following data quality objectives. The data developed during the Phase II RI will need to be of sufficient quality to support the activities involved in meeting the project objectives (i.e., data evaluation, human health risk assessment, treatability study and feasibility study activities). The USEPA guidance provided in "Data Quality Objectives for Remedial Response Activities" (USEPA, March 1987) was used to determine the analytical levels required to support the site characterization activities. Table 1 provides information on the analytical levels appropriate to various data uses. Table 2 identifies appropriate analytical levels for generic RI/FS data uses. The data quality objective levels to be utilized for this investigation include:

Level I - screening - organic vapor detection using field instruments for soil gas surveys and health and safety monitoring;

Level II - field analysis for soil gas surveys;

Level III - engineering (laboratory analyses other than EPA CLP, such as physical soil tests);

Level IV - Confirmational (such as TCL, TAL, including data validation); and

Level V - Non-standard (including analysis for non-conventional parameters like TOC, BOD, TPH, and modified CLP methods).

The combined use of these data quality objective levels will satisfy the data requirements of site characterization, human health risk assessment, and feasibility study activities.

2.3 Sequenced Site Actions/Activities

The Phase II Remedial Investigation described in the Work Plan will be conducted in a staged approach in which sampling and analyses are sequenced to direct and optimize subsequent field activities. Soil gas and geophysical surveys will be used to further evaluate potential locations for the placement of borings and monitoring wells. Surface and subsurface soil samples will be collected to define the nature and extent of soil and fill contamination. Ground water samples will be collected and analyzed to define the horizontal and vertical extent of ground water contamination. Other field activities to be accomplished as part of the Phase II RI include structure sampling, hydrogeologic well testing, and supplemental geologic characterization. A summary of the field investigation activities planned for the Phase II RI at NETC-Newport are as follows:

- Geophysical Surveys (electromagnetic conductivity, magnetometer, and seismic refraction)
- Soil Gas Surveys (portable gas chromatograph)
- Surface Soil Sampling
- Test Borings
- Monitoring Well Installation
- Ground Water Sampling
- Surface Water Sampling
- Sediment Sampling
- Structure Sampling
- Hydraulic Well Testing

2.4 Streamlining of Phase II - RI/FS Activities

The results of the Phase I RI and background data indicated that additional field investigations are needed to fill in the data gaps, further address Phase I investigation findings, and address regulatory requirements documented in review comments. To streamline Phase II RI/FS activities, existing data has been evaluated to determine if interim actions can be taken at any of the sites studied. These activities include the collection of analytical data during the Phase II RI which will aid in the evaluation of remedial technologies, and the planned interactive process for identifying potential treatability study needs and conducting treatability studies, as described in Volume VIII of this Work Plan. The project planning for Phase II has developed a cost-effective approach which will ensure that adequate data are available for defensible Human Health and Ecological Risk Assessment and Feasibility Study, if required.

Streamlining the approach at NETC-Newport recognizes that removal of all uncertainties is usually not feasible and focuses instead on collecting sufficient data to characterize the sites sufficiently to support site remedy selections. It is critical that sufficient data is collected during Phase II to either support a "no action" finding or allow the Navy to proceed toward the ultimate goal of site clean-up.

TABLES

TABLE 1

SUMMARY OF ANALYTICAL LEVELS APPROPRIATE TO DATA USES

DATA USES	ANALYTICAL LEVEL	TYPE OF ANALYSIS	LIMITATIONS	DATA QUALITY
SITE CHARACTERIZATION MONITORING DURING IMPLEMENTATION	LEVEL I	• TOTAL ORGANIC/INORGANIC VAPOR DETECTION USING PORTABLE INSTRUMENTS • FIELD TEST KITS	• INSTRUMENTS RESPOND TO NATURALLY-OCCURING COMPOUNDS	• IF INSTRUMENTS CALIBRATED AND DATA INTERPRETED CORRECTLY, CAN PROVIDE INDICATION OF CONTAMINATION
SITE CHARATERIZATION EVALUATION OF ALTERNATIVES ENGINEERING DESIGN MONITORING DURING IMPLEMENTATION	LEVEL II	• VARIETY OF ORGANICS BY GC; INORGANICS BY AA; XRF • TENTATIVE ID; ANALYTE-SPECIFIC • DETECTION LIMITS VARY FROM LOW ppm TO LOW ppb	• TENTATIVE ID • TECHNIQUES/INSTRUMENTS LIMITED MOSTLY TO VOLATILES, METALS	• DEPENDENT ON QA/QC STEPS EMPLOYED • DATA TYPICALLY REPORTED IN CONCENTRATION RANGES
RISK ASSESSMENT PRP DETERMINATION SITE CHARACTERIZATION EVALUATION OF ALTERNATIVES ENGINEERING DESIGN MONITORING DURING IMPLEMENTATION	LEVEL III	• ORGANICS/INORGANICS USING EPA PROCEDURES OTHER THAN CLP CAN BE ANALYTE-SPECIFIC • RCRA CHARACTERISTIC TESTS	• TENTATIVE ID IN SOME CASES • CAN PROVIDE DATA OF SAME QUALITY AS LEVELS IV, NS	• SIMILAR DETECTION LIMITS TO CLP • LESS RIGOROUS QA/QC
RISK ASSESSMENT PRP DETERMINATION EVALUATION OF ALTERNATIVES ENGINEERING DESIGN	LEVEL IV	• HSL ORGANICS/INORGANICS BY GC/MS; AA; ICP • LOW ppb DETECTION LIMIT	• TENTATIVE IDENTIFICATON OF NON-HSL PARAMETERS • SOME TIME MAY BE REQUIRED FOR VALIDATION OF PACKAGES	• GOAL IS DATA OF KNOWN QUALITY • RIGOROUS QA/QC
RISK ASSESSMENT PRP DETERMINATION	LEVEL V	• NON-CONVENTIAL PARAMETERS • METHOD-SPECIFIC DETECTION LIMITS • MODIFICATION OF EXISTING METHODS • APPENDIX 8 PARAMETERS	• MAY REQUIRE METHOD DEVELOPMENT/MODIFICATION • MECHANISM TO OBTAIN SERVICES REQUIRES SPECIAL LEAD TIME	• METHOD-SPECIFIC

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TABLE 2

APPROPRIATE ANALYTICAL LEVELS - BY DATA USE

DATA USE / ANALYTICAL LEVEL	SITE CHARACTERIZATION (INCLUDING HEALTH & SAFETY)	RISK ASSESSMENT	EVALUATION OF ALTERNATIVES	ENGINEERING DESIGN OF REMEDIAL ACTION	MONITORING DURING IMPLEMENTATION OF REMEDIAL ACTION	PRP DETERMINATION	OTHER _____
LEVEL I	✓				✓		
LEVEL II	✓		✓		✓		
LEVEL III	✓	✓	✓	✓	✓	✓	
LEVEL IV		✓	✓	✓		✓	
LEVEL V		✓		✓		✓	
OTHER				✓			

NOTE: CHECK APPROPRIATE BOX (ES)

CDM SF DOO 1.001

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U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

VOLUME III
FIELD SAMPLING PLANS

PHASE II RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared by:
TRC Environmental Corporation
Windsor, Connecticut

Prepared for:
Northern Division - Naval Facilities
Engineering Command
Lester, Pennsylvania

March 1993

TRC-EC Project No. 6760-N81-110
Contract No. N62472-86-C-1282

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U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

VOLUME III-1
-MCALLISTER POINT LANDFILL-
SITE 01

PHASE II RI/FS
WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared by:
TRC Environmental Corporation
Windsor, Connecticut

Prepared for:
Northern Division - Naval Facilities
Engineering Command
Lester, Pennsylvania

March 1993

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1.0 INTRODUCTION

The objective of this volume of the Work Plan is to define the level of Phase II investigation necessary to assess the nature and extent of environmental contamination at Site 01, the McAllister Point Landfill site located on the NETC. This volume of the Work Plan describes site-specific objectives in Section 1.1, summarizes available site background information in Section 2.0, presents the site-specific field sampling activities in Section 3.0, and summarizes site-specific health and safety information in Section 4.0.

1.1 SITE-SPECIFIC INVESTIGATION OBJECTIVES

The general objectives of the RI site investigation are to determine the nature and extent of site contamination, sources of contamination, potential contaminant migration pathways, potential contaminant receptors, and associated exposure pathways. This information is necessary to determine whether, and to what extent, a threat to human health or the environment exists, and to provide the information required to develop and evaluate remedial action alternatives for the site, as necessary.

The scope of the Phase I and Phase II sampling efforts for this site have been developed to meet site-specific RI/FS objectives. The site-specific objectives have been refined based upon the findings of the Phase I RI. Below is a list of the RI objectives for the McAllister Point Landfill investigation:

- determine the site background soil and ground water quality;
- determine the nature and extent of site surface soil contamination;
- determine the extent of the fill material on the site;
- determine the nature of the fill material contamination;
- determine the nature and extent of ground water contamination;
- determine the source location of the ground water contamination;
- determine the nature and extent of sediment and biota contamination in the adjacent bay.

The Phase II site investigation is being conducted to address areas of concern discovered under the Phase I investigation and any site investigation data gaps. The Phase II investigation activities will include geophysical and soil gas surveys, surface soil sampling, soil boring sampling, monitoring well installation and sampling, and leachate sampling. Soil and ground water samples will be collected from the site and analyzed as described in Section 3.0 of this plan.

2.0 SITE BACKGROUND INFORMATION

2.1 SITE LOCATION AND DESCRIPTION

The McAllister Point Landfill is located in the central portion of the Newport Naval Base (see Figure 1). The site is approximately 11.5 acres in size and is situated between Defense Highway and Narragansett Bay. A set of Penn Central Railroad tracks run in a north-south direction along the eastern side of the site. Access to the site is off of Defense Highway, across the railroad tracks, through a gate in the south-central portion of the site. A map of the site is presented as Figure 2 with site topography shown on Figure 2A.

A short section of chain-link fence borders the eastern edge of the site at the site entrance and transects the south central portion of the site. An opening in the portion of the fence which transects the site allows travel between the central and southern portions of the site. Overhead power lines run along the eastern edge of the site.

The site is characterized by a mounded area in the central to north-central portion of the site and flat areas at the northern and southern ends. Ground elevations across the main portion of the site vary between approximately 15 and 35 feet above mean low water level (mlw). Along the western edge of the site, the grade drops off quickly to the shoreline, in some areas by as much as 20 feet.

The site is vegetated with grass, weeds, and some small trees. A small, lightly wooded area is present at the northern end of the mounded area. A more mature wooded area is present just off the northeastern edge of the site between the railroad tracks and Defense Highway. Several depressions are present in the central portion of the site where standing water collects during heavy precipitation events. The Navy routinely clears vegetation along overhead power lines which run between the edge of the site and the railroad tracks.

2.2 SITE HISTORY

The McAllister Point Landfill was investigated in both the Initial Assessment Study (IAS) and Confirmation Study (CS). The following site history information was obtained from the IAS report (Envirodyne, 1983).

This is the site of a sanitary landfill which was operational over a 20-year period. The site was first used in 1955 following the closure of the landfill in Melville North. The site continued to be used as a landfill until the mid-1970's and encompasses approximately 6 acres. The site is located on land which is being excessed by the Navy.

During the years that the site was operational, it received all the wastes which were generated at the naval complex. This included wastes from all the operational areas (machine shops, ship repair, NUSC, etc.), Navy housing areas (domestic refuse), and from the 55 ships which were homeported at Newport prior to the 1973 SER action. Generally, 25 to 30 of these ships were in port at any one time. Each day, fourteen 40-cubic yard containers were emptied from the pier areas and disposed of in the landfill. The materials disposed of at this site included spent acids, paints, solvents, waste oils (diesel, lube and fuel), and PCB-contaminated transformer oil.

The operators of the landfill indicated that it was common practice for barrels filled with liquids to be brought to the landfill. These barrels contained paints, oils and other unidentifiable liquids. The barrels were crushed by the bulldozer operator before being covered. It was also discovered through interviews with base personnel that at least two transformers, each of which contained approximately 100 gallons of PCB-contaminated oil, and at least 4 or 5 capacitors were disposed of in the landfill. The Superfund notification for McAllister Point indicated that PCBs were disposed of at the site.

For the period 1955 through 1964, wastes were simply trucked to the site, spread out with a bulldozer, and then covered over. In 1965, an incinerator was built at the landfill. From 1965 through 1970-71, some 98 percent of all the wastes were burned before being disposed of in the landfill. The incinerator was closed about 1970 as a result of the air pollution it was causing. During the remaining years that the site was operational, all wastes were again disposed of directly into the landfill.

The site is located along the shoreline of Narragansett Bay as shown in Figure 1-2 [see Figure 1]. Throughout the time period that the site was operational, the landfill was extended out into the bay using the wastes as fill material. The site used to be subject to periodic flooding until the elevation of the site was increased through additional filling. . . .

Operations at the site were discontinued in the mid-1970's. Following this, all wastes generated at NETC were disposed of at the City of Newport's transfer station. A final covering of soil three feet thick was placed over the NETC landfill following its closure. (IAS, pp. 6-25, 6-31)

The site is still planned to be excessed by the Navy. Currently, the site is zoned by the Navy as "open space" (e.g., recreational use, parking).

2.2.1 Aerial Photography

Historic site maps and plans for the NETC facility as well as historic aerial photos and photo prints were reviewed to identify the locations and extent of historic site activities and previous site structures and their uses. A detailed list of the photos and maps reviewed and associated descriptions is presented in Appendix B of the Phase I RI report (TRC, 1991). Summaries of the information obtained from the site map and aerial photo reviews for the site are presented below.

Aerial photos and facility maps were reviewed covering the years from 1938 to 1988. Activity on the site dates back to 1938, with a railroad spur entering the site near the current site entrance, and running north into the center of the site. Throughout the 1940's and 1950's, large open depressions are visible on the site, along with material storage areas and what appeared to be above-ground tanks. From 1958 through 1970, an incinerator was visible in the north-central portion of the site. From 1965 through 1975, the shoreline of the central portion of the site changed shape, indicating filling of Narragansett Bay in this area. In the 1981 and 1988 aerial photos, the site appeared to be generally inactive.

2.3 PREVIOUS SITE INVESTIGATIONS

An Initial Assessment Study (Envirodyne Engineers, 1983) conducted on the site in 1983 identified areas on NETC where potential contamination from past waste disposal or handling practices may pose human health or environmental risks. The McAllister Point Landfill site was reviewed under the IAS. Based upon the historic use of the site as a landfill for hazardous wastes and the potential contaminant migration pathways at the site, the site was recommended for a Confirmation Study (CS).

A CS was conducted at this site from 1984 to 1985. The CS involved the collection and analysis of sediment, mussel, landfill leachate, surface soil, and ground water samples at or near the site. The surface soil samples indicated that low levels of contamination may be associated with the landfill cap material. Leachate spring samples from the western edge of the landfill

exhibited levels of metals, cyanide, phenol, and some other organic constituents. The sediment and mussel samples indicated the presence of inorganic contaminants in samples collected adjacent to the site, especially near the southern end of the landfill, with levels decreasing with distance from the site. The polychlorinated biphenyls (PCB) levels detected in mussels samples appeared to be attributable to bay-wide contamination, on the basis of similar levels also detected in background mussel samples. Site ground water samples exhibited elevated levels of metals.

The Phase I Remedial Investigation (RI), which was conducted from 1989 to 1990, included site geophysical surveys, surface soil sampling, soil boring sampling, leachate sampling, and ground water sampling. The findings and results of the Phase I RI for the McAllister Point Landfill are summarized below:

Soil Assessment - Volatile organic compounds (VOCs), base neutral/acid extractable organic compounds (BNAs) (including polynuclear aromatic hydrocarbons (PAHs)), pesticides, PCBs, and inorganics were all detected in on-site soils. The major areas of the site where contaminants were detected in the soil at elevated levels include the following:

- Northern area - carcinogenic PAHs;
- North-central area - BNAs, carcinogenic PAHs, and inorganics;
- Central landfill area - VOCs, BNAs, PCBs, and inorganics;
- South of access road - BNAs, carcinogenic PAHs, and inorganics; and
- Shoreline - BNAs, carcinogenic PAHs, and inorganics.

Significant VOC contamination (i.e., greater than 1 ppm total VOCs) was detected in soils and fill in the central portion of the landfill area, but VOC levels were not consistently high throughout the depth of the soil horizons sampled.

BNAs were detected at elevated levels (i.e., greater than 10 ppm total BNAs) throughout the site, with the highest levels (i.e., greater than 100 ppm total BNAs) detected at spot locations in the central and southern portions of the site. Elevated levels of total carcinogenic PAHs (i.e., greater than 1 ppm) were also detected at locations where total BNA concentrations were less than 10 ppm. These locations were generally in the northern portion of the site, with smaller areas identified in the southern portion of the site and along the shoreline.

Pesticides were detected at low levels (i.e., 10's of ppb) in surface soil samples across the site, while PCBs were detected in surface and subsurface soils. PCBs were detected in surface soils along the shoreline and in subsurface soils in the north-central and southern portions of the site. No test boring soil samples analyzed for PCBs exceeded the 1 ppm RIDEM PCB soil action level.

Inorganics levels in the soils and fill were compared to off-site background surface soil levels. Inorganics were detected in soil and fill samples collected from across the site at levels exceeding background levels. The highest inorganic levels were detected in soils from the central and south-central portions of the landfill, in the northern portion of the site (ash area), in the southern portion of the site, and along the shoreline.

Ground Water Assessment - VOCs, BNAs, PCBs, and inorganics were all detected in site ground water samples. The major areas of the site where contaminants were detected at levels exceeding action levels include the following:

- Northern area - inorganics;
- North-central area - inorganics;
- Central landfill area - VOCs, and inorganics; and
- South of access road - VOCs, PCBs, and inorganics.

VOC detections, consisting mostly of petroleum-related VOCs (e.g., xylene, benzene) were limited to wells located in the central and southern portions of the site. VOCs were also detected in soil boring samples collected at the depth of the water table from the north-central to southern portions of the site, indicating the potential for ground water contamination throughout this area. Oil was observed in one well (MW-5S) in the southern portion of the site five months after it was sampled. No BNAs were detected above ground water action levels and no pesticides were detected in ground water samples. A PCB concentration of 150 ppb was detected in the well in the southern portion of the site (MW-5S) in which oil was subsequently observed. The highest levels of inorganic analytes were detected in wells from the north-central to southern portions of the site.

Sediment/Mussel Assessment - In early March 1988, the Water Quality Laboratory Engineering Division of the U.S. Army Corps of Engineers (ACOE) collected a series of six (6) sediment and mussel samples (MP#1 through MP#6) in Narragansett Bay near McAllister Point Landfill. In addition, one set of control samples (MP#7) were collected near the site. This sampling was performed along with similar sampling near Gould Island and in Allen Harbor at the request of the Navy.

The sampling was performed in the intertidal zone. All samples were taken as close to the waters edge as possible during the low tide period. As a result of the presence of large stones, boulders, and debris in the sediments, a steel shovel and crow bar were used in collecting the sediment samples. The sediment samples were collected from a depth of four to eight inches using a stainless steel spoon. Mussel samples were collected using unspecified methods.

The sediment samples were analyzed for total petroleum hydrocarbons (TPH), PCBs, and six metals (cadmium, chromium, copper, nickel, lead, and zinc). The tissue samples were also analyzed for the same six metals. The analyses were performed using unspecified analytical techniques by the Hubbardton, Massachusetts ACOE Water Quality Laboratory. The sediment sample results indicate the presence of TPH at concentrations from 30 ppm (MP#7) to 1,100 ppm (MP#6), PCBs from 0.01 ppm (MP#7) to 2.03 ppm (MP#3) and the presence of elevated levels of metals. Levels of copper and zinc above the control sample levels were detected in the mussel tissue samples. The sample analytical results and sample locations are provided in the ACOE sampling report in Appendix A.

2.4 SITE GEOLOGY

The soil boring activities performed at the site under the Phase I site RI, as well under previous subsurface investigations, provided information on the site geology. Previous subsurface investigation activities included the drilling and sampling of three soil borings completed for the installation of three monitoring wells. Subsurface investigation activities conducted during the Phase I RI included the drilling and sampling of thirteen (13) test borings and seven (7) well borings. The locations of the Phase I RI wells and borings, as well as the three previous site investigation wells, are shown on Figure 4.

The overburden soils on this site consists of fill and glacial till deposits. All of the soil borings except for test boring B-13 (off-site and upgradient) and all of the monitoring well borings, except for well MW-23 previously installed off-site, encountered fill material. The thickness of the fill material ranged from 3 feet (M-1) at the periphery of the site, to 24 feet (M-3) in the central portion of the landfill. The boring for well MW-21, previously installed at the western edge of the central portion of the landfill, reportedly encountered 38 feet of fill material. The fill material encountered consisted of a wide variety of municipal and industrial wastes (e.g., plastic, wood, paper, garbage, construction debris, paints), as well as what appears to be ash from the incinerator which reportedly operated on the site. The fill material appears to have been deposited directly upon the bedrock surface across a majority of the site.

Overlying the fill material, at several locations across the landfill, is a clay-silt layer ranging in thickness from 0 to 4 feet. This layer is presumably the cover material or "cap" which was reportedly placed on-site when the landfill was closed in 1973. The cover material is discontinuous across the site, and was found primarily in the central portion of the landfill (soil borings B-3, B-4, B-5, and B-6). A clay-silt horizon was also encountered overlying the fill material in well boring M-5 and test boring B-10, both completed at the southern end of the landfill, and in B-1, completed in the northern portion of the landfill; however, this material did not appear to be the same "cap" material encountered in the central landfill area.

Glacial till deposits were observed directly beneath the fill and overlying the bedrock at the periphery of the site (at well borings M-1 and M-5, and test boring B-10). Till was observed directly overlying the bedrock at the off-site location of soil boring B-13. Till was also encountered in boring B-4 in the central landfill area, and in B-8 in the southern portion of the site. These borings were completed within the till layer. The till encountered consisted primarily of fine to coarse sand and silt, with some horizons containing weathered shale fragments. The till varied in thickness from 4.5 feet (B-13) to 11.5 feet (M-5). One undisturbed Shelby tube soil sample was collected from the till, at the southern end of the site (M-5). The Shelby tube was collected from 14 to 15.5 feet below grade. The undisturbed soil sample was tested by Empire Soils Investigations, Inc. for triaxial permeability, particle size, and Atterberg limits. The till sample was determined to have a permeability of 2.69×10^{-7} cm/sec (7.626×10^{-4} ft/day). Grain size analysis indicated the till sample consisted of 23.5%

gravel, 44.6% sand, 13.4% silt, and 18.5% clay. According to its Atterberg limits, the soil sample was classified as "non-plastic", which is typical of till.

The bedrock encountered at the McAllister Point Landfill consists of a gray-green to black, highly weathered to competent, carboniferous shale. Cores of the shale exhibited a high degree of fracturing with quartz and iron-oxide deposits common along fractures. All but four of the soil borings were completed to the depth of the bedrock surface. The depth to bedrock at the site varied from 4 feet (at MW-7) to 24 feet (at MW-3D). The bedrock surface exhibits a uniform, westward slope, towards Narragansett Bay.

2.5 SITE HYDROLOGY

The following are discussions on the site surface water hydrology and ground water hydrology.

Surface Water Hydrology

There are no surface water bodies present on the McAllister Point Landfill site. The general site topography slopes in an east to west direction. Surface water on the site (precipitation or runoff from surrounding higher elevations) either evaporates, infiltrates into the site soils, or flows overland to surrounding lower elevation areas or the adjacent Narragansett Bay. During periods of heavy rainfall, ponded water forms in a small depression located in the north-central portion of the site. The western edge of the entire site, which borders Narragansett Bay, is at an elevation approximately 10 feet higher than the beach shoreline along bay, which may hinder surface runoff into the bay. Springs have been observed discharging from the bottom of the landfill bank along the western edge of the site, into the bay.

Ground Water Hydrology

Ground water levels were measured in the nine monitoring wells installed during the Phase I site RI in April, July, and September of 1990, and in January of 1991. A representative ground water contour map is presented as Figure 3. The ground water contour maps for this site indicate that the site ground water is flowing from east to west, towards the Narragansett Bay.

Single well hydraulic conductivity tests (slug tests) were performed in four of the monitoring wells at the site (MW-1, MW-3D, MW-5D, and MW-7). All of these wells are screened within the bedrock at the site. Monitoring wells MW-1 and MW-7 are screened in the weathered upper zone of the bedrock. The hydraulic conductivities determined from the slug tests range from 0.07 ft/day (wells MW-7 and MW-3D) to 0.20 ft/day (well MW-5D). These hydraulic conductivity values are higher than values normally attributed to shale (3.28×10^{-4} to 3.28×10^{-8} ft/day) (Driscoll, 1987) and probably reflect the highly weathered and fracture nature of the upper portion of the bedrock at the site. Slug tests were not conducted in monitoring wells screened in the fill material at the site, due to the shallow ground water levels (i.e., insufficient water) in the shallow wells.

- Vertical Hydraulic Gradients

Vertical hydraulic gradients were determined at the two sets of nested monitoring wells constructed during the Phase I site RI, MW-3S/D and MW-5S/D. Vertical hydraulic gradients are used to evaluate whether contamination can migrate downward through an aquifer. A positive hydraulic gradient indicates an upward flow, and a negative gradient indicates a downward flow. An upward flow would tend to retard contaminant transport down through an aquifer, whereas a downward vertical gradient provides a means by which contamination can migrate toward the bottom of the aquifer.

On all four of the dates that water levels were measured, a downward, or negative, hydraulic gradient was observed in both of the well pairs. The calculated vertical gradients ranged from -0.115 ft/ft (MW-3S/D on 4/3/90) to -0.242 ft/ft (MW-3S/D on 9/20/90). This indicates that ground water from above the bedrock surface (in the fill or overburden) would tend to flow downward into the bedrock at these two locations.

- Horizontal Hydraulic Gradients

Horizontal hydraulic gradients were also determined, during the Phase I site RI, from the water level measurements at the site. Horizontal gradients are used, along with the aquifer hydraulic conductivity and effective porosity, in determining horizontal ground water flow velocities, and hence the rate at which an aquifer may transport contaminant solutes. Horizontal

gradients were calculated for the shallow wells (screened in the fill and overburden materials), and the three deep wells at the site (screened in bedrock) on the basis of the average of the four sets of ground water level measurements taken at the site. The horizontal gradient represents the change in head, measured in feet, per horizontal foot of travel through the medium.

Calculated shallow average horizontal hydraulic gradients ranged from 0.0056 ft/ft (MW-5S to MW-6), to 0.038 ft/ft (MW-4 to MW-3S). Deep average horizontal gradients were calculated as 0.0077 ft/ft (MW-5D to MW-3D) and 0.0049 ft/ft (MW-3D to MW-1).

- Average Linear Velocities

The calculated average horizontal hydraulic gradients, along with hydraulic conductivity and effective porosity values, were used to calculate average linear ground water velocity values at the site.

Calculated average linear velocities for the shallow ground water ranged from 0.0061 ft/day (MW-6 to MW-5S) to 0.0417 ft/day (MW-3S to MW-4). The average linear velocities of the deep ground water were calculated as 0.0091 ft/day (MW-5D to MW-3D) and 0.0057 ft/day (MW-3D to MW-1). It is important to note that the calculated average linear velocity values are lower than the "true microscopic velocities" because water particles must travel along irregular paths that are longer than the linearized paths represented by the calculated average linear velocities (Freeze and Cherry, 1979). In addition, the estimated effective porosity value of 52% for the fill at the site may be too high or low, causing the linear velocity estimates to be too low or high, respectively.

- Tidal Influence

Continuous ground water level measurements were recorded in five of the monitoring wells, as part of the Phase I site RI, (MW-1, MW-3S, MW-3D, MW-5S, and MW-5D) for three days (August 21 to August 24, 1990). Ground water levels were recorded every 15 minutes during the three-day time period. At the same time, continuous surface water levels were recorded at a gauging station located in Narragansett Bay, adjacent to the site.

Tidal influences were observed in each of the monitoring wells except MW-3S. The influence upon monitoring wells MW-3D and MW-5S were small enough to be considered

negligible. The strongest tidal influence was encountered in monitoring well MW-5D. The piezometric water level in MW-5D fluctuated by as much as 2.12 feet between high and low tide. The water level fluctuations in the wells paralleled the six hour tidal period observed in the Narragansett Bay tidal station adjacent to the site. The amount of tidal fluctuation is a function of proximity to Narragansett Bay and whether the well screen intercepts the bedrock

3.0 SAMPLING PLAN

3.1 INTRODUCTION

The program of investigation described in this section has been developed to achieve both overall and site-specific project objectives. Field sampling methodology for individual investigation activities (e.g., soil gas survey, surface soil sampling) is described in Appendix B. The quality assurance/quality control procedures for field sampling and laboratory analyses are presented in the project Quality Assurance Project Plan (QAPP) provided in Appendix D. A summary of the Phase II McAllister Point Landfill sampling program is presented in Table 1. The planned Phase II sample locations are shown on Figure 5.

3.2 RECONNAISSANCE SURVEYS

Prior to initiating sampling activities a site walkover will be conducted by field investigation team members to familiarize themselves with the current site conditions. An attempt will be made to conduct this survey during the spring, however the actual start of the field activities may result in completing this survey during other times of the year. The site will be visually surveyed with respect to any changes in site access restrictions, the Phase I monitoring well locations, and the planned Phase II sampling locations. Site-specific health and safety considerations, including emergency evacuation procedures, will be reviewed during the visit. Pertinent features, such as overhead and subsurface utilities, and other potential hazards will also be reviewed with Navy personnel with respect to affected sampling activities.

During the site walkover survey, a Phase II baseline ambient air survey will be conducted across the site. The ambient air survey will be conducted with either a flame or photo-ionization detector to assess ambient conditions for the presence of volatile organic compounds (VOCs) and establish the Phase II site baseline conditions. The ambient air surveys will be completed using equipment and methods outlined in the Field Sampling Methodology Plan provided as Appendix B of this Work Plan.

3.3 GEOPHYSICAL SURVEYS

Electromagnetic conductivity (EM-31) and seismic refraction surveys are planned at this site. In Phase I, EM and magnetometer surveys were completed on a 50-foot spaced grid across the site. During the Phase II geophysical investigation attention will be given to the area of "elevated conductivity in the central portion of the site" reported during Phase I RI geophysical explorations. The Phase II follow-up EM survey will be used to further aid in determining the nature and extent of fill, the potential source(s) of ground water contamination at the southern end of the site, and the extent of any salt water intrusion at the site. The EM survey will be conducted along 10-foot spaced traverses at the ends of the site and around Phase I well nest MW-5, and at 50-foot spaced traverses along the western edge of the site. In addition to recording EM readings at grid points and the top of the bank, continuous EM readings will be also observed between grid points. Any EM readings which are observed to significantly deviate from normal (e.g., negatives, highs, lows) between the grid points will also be recorded.

A seismic refraction survey will be conducted across the site to aid in characterizing the bedrock topography beneath the site. The seismic survey will also aid in characterizing the overburden materials. The seismic survey specifications (e.g., spread lengths geophone spacing) will be determined and established by the geophysical subcontractor prior to the survey activities. This information will be forwarded to the EPA and RIDEM prior to the survey for review and comment. The location of the geophysical surveys is provided on Figure 5A.

3.4 SOIL GAS SURVEY

A soil gas survey is planned at this site to aid in investigating areas of subsurface volatile organic compound soil and ground water contamination discovered in Phase I as well as to assist in defining the final locations of site borings and monitoring wells. The soil gas survey will be conducted on the 25-foot concentric grid pattern around Phase I well nests MW-3 and MW-5. It is estimated that approximately twelve (12) soil gas points will be sampled around each well nest. As is necessary, additional soil gas survey points will be completed around points indicating elevated concentrations of soil gas to further locate "hot spots".

The soil gas survey will be conducted with a van-mounted hydraulic probe device and field gas chromatograph. The portable GC will be used to identify the concentrations of

individual VOCs and a total VOCs concentration. The soil gas sampling and analysis methodology is presented in the Field Sampling Methodology discussion provided in Appendix B of this Work Plan.

3.5 SOIL SAMPLING

Soil samples will be collected as surface soil samples and soil boring samples under this site investigation. Below is a discussion on each of the planned soil sampling activities.

3.5.1 Surface Soil Sampling

Surface soil samples will be collected from nineteen (19) locations (SS-18 to SS-36) on the site. The planned locations of the surface soil samples are shown on Figure 6. These samples will be collected from the following general locations: around areas of documented Phase I surface soil contamination, surface soil areas not sampled in Phase I (e.g., "capped area"), the site boundaries, and the site shoreline. The rationale for each of the planned surface soil samples is presented in Table 2. Shoreline samples which may be periodically inundated (SS-29 through SS-36) will also be analyzed for TOC and be subjected to a grain size analysis.

In addition, three (3) "background" surface soil samples (SS-18 to SS-20) will be collected from two locations east of the site across Defense Highway and one location in the small wooded area between the site and Defense Highway. An attempt has been made to select background soil sample locations believed to be representative of site background soil conditions and away from other potential sources of contamination (e.g., roadway, railroad tracks). The proposed locations for the background samples will be confirmed with the EPA and RIDEM during a site visit prior to the surface soil sampling activities.

Surface soil sampling will be conducted according to the method described in the Field Sampling Methodology Plan provided in Appendix B of this Work Plan. Surface soil samples will be analyzed for the full organic target compound list (TCL) and inorganic target analyte list (TAL).

Surface soil samples will also be collected from each of the planned test and well boring locations, as described in Section 3.5.2 of this plan. The 0- to 1-foot portion of the first 2-foot split spoon sample will be collected as the surface soil sample at each boring location consistent

with EPA risk assessment requirements. The soil boring samples will also be analyzed for the full TCL/TAL. The VOC fraction of surface soil samples will be collected as a discrete increment from the 0.5 to 1 foot portion of the first split spoon as described in Appendix B. Soil for the remaining analytical fractions will be homogenized prior to filling sampling containers. Samples from within the area of previously observed ash (SS-24, SS-25, and SS-26) will also be analyzed for dioxin/furans.

3.5.2 Soil Boring Sampling

Test borings will be completed and sampled at thirteen (13) locations (B-14 to B-26) across the site. In addition, soil samples will be collected from the Phase II site well borings planned at nine (9) different well locations. The planned test boring and monitoring well locations are shown on Figures 7 and 8, respectively.

Test borings are planned to further investigate the characteristics of the fill and soil at the site and the extent of subsurface soil contamination detected in Phase I. The Phase II test boring rationale is presented in Table 3. The well borings are associated with the Phase II ground water monitoring wells planned for the site. The Phase II monitoring well rationale is discussed in Section 3.6 and presented in Table 4.

Two test borings (B-14 and B-26) are planned at the northern and southern ends of the site to further investigate the site boundaries. Three (3) test borings (B-15, B-16, and B-17) are planned in the north central portion of the site to investigate the extent of the ash fill located in this area. Test boring B-18 is planned to investigate a low lying area in the north central portion of the site. The two borings B-19 and B-20 are planned in the central portion of the site to further investigate the fill contamination detected in this area in Phase I. Boring B-21 is planned in the central site portion to further investigate the characteristics of the landfilled material in this area. Boring B-22 is planned to further investigate soil contamination discovered in this area in Phase I (at SS-6). Boring B-23 is planned in this area to investigate the characteristics of the fill in this area of the site. Boring B-24 if planned to further investigate subsurface soil contamination detected in these areas in Phase I. Boring B-25 is planned to assess the source of the oily soils identified at the southern portion of the site during the Phase I RI. Boring B-26 is intended to characterize subsurface soil in the southern portion of the site.

The well borings planned northern ash area, central fill area, and southern end of the site will also provide subsurface soil characteristic information for these site areas. The planned test boring and well locations may be reassessed based upon any significant findings of the site geophysical and soil gas surveys. If these preliminary surveys indicate other more optimum locations for investigating subsurface soil and ground water contamination (e.g., higher VOCs, major EM anomaly), the test borings and/or well will be relocated to investigate any such locations. The findings of the geophysical and soil gas surveys (e.g., anomalies, detected VOCs) will be reviewed with EPA and RIDEM prior to initiating the test boring investigation.

Soil samples will be collected continuously from the on-site soil borings to the depth of competent bedrock (estimated on-site to be approximately 25 feet below ground surface). Split spoon soil samples will be screened with an OVA and Hnu immediately upon being opened. A 10-foot Nx core (2 63/64" O.D. core) of the bedrock will be collected at each of the planned four bedrock well locations. Well borings completed at well locations planned for only a shallow well will be tremie backfilled with a cement/bentonite, as necessary, for the placement of a well screen which intercepts the ground water table.

A minimum of two soil samples will be collected from each of the on-site soil borings for the full TCL/TAL analysis. The two soil samples which will be submitted for laboratory analysis will include the soil samples collected from the 0- to 2-foot interval (the 0- to 1-foot portion for analysis) and from the last sample interval of the observed fill material. If insufficient sample volume for analysis is present within the 0 to 1 foot portion of the split spoon (i.e. recovery is low), additional sample volume will be collected using either hand auguring procedures (non-VOC fractions), or from a second split spoon collected immediately adjacent to the first. If signs of potential contamination (e.g., oil, stains, odors) are observed in a boring, a third sample will also be collected from the depth of greatest observed contamination (i.e., most stained or oily, highest OVA/HNu reading). If no fill material or signs of potential contamination are observed in a boring, only the surface sample and sample from directly above the water table will be submitted for laboratory analysis. Only the surface interval (0- to 1-foot) sample will be collected for analysis at the three off-site well boring locations. Sample collection procedures for surface samples (0-2 foot) from soil borings will be the same as those

employed for surficial soil samples (Section 3.5.1). In addition, one soil sample from borings B-15, B-16, and B-17 will also be analyzed for dioxins/furans.

In addition, to the soil samples collected for chemical analyses, a soil sample from just below the depth of the water table (i.e., within the saturated zone) will also be collected from each well location for total organic carbon (TOC) analysis, cation exchange capacity analysis, and grain size determination. The information from these tests will be used in evaluating ground water treatment options.

Geologic descriptions and other sample characteristics (e.g., stains, odors) and observations (e.g., OVA/HNu readings, depth to water) will be recorded in a field notebook.

3.6 GROUND WATER SAMPLING

Monitoring wells were installed at seven locations in Phase I (MW-1 through MW-7). Shallow ground water table wells were installed at six of these locations (all except MW-1). Bedrock wells were installed at four of the locations (MW-1D, MW-3D, MW-5D, and MW-7). In addition, three shallow overburden wells (MW-21 to MW-23) were installed under a previous site investigation.

In Phase II, a total of fourteen (14) monitoring wells are planned at nine (9) new locations. The planned Phase II wells consist of four (4) shallow ground water table wells and five (5) shallow ground water table wells paired with bedrock wells. Generally, the monitoring wells are planned to further assess the nature and extent of ground water contamination detected at the site in Phase I. The planned locations of the monitoring wells are shown on Figure 8. In general, the monitoring wells are located to determine the ground water quality upgradient of the site, the ground water quality at the downgradient edges of the site, the extent of site ground water contamination. The rationale for each of the planned well locations is provided in Table 4.

Ground water samples will be collected from each of the monitoring wells. Wells will be developed after installation. Water levels will be measured in the wells after development and just prior to well purging. The procedures for well development, purging, and sampling are provided in the Field Sampling Methodology Plan provided in Appendix B.

In addition to collecting ground water samples from the site, leachate samples will be collected from any observed leachate springs along the western edge of the site. Visual surveys for leachate springs will be performed throughout the Phase II RI activities in an attempt to observe and sample leachate springs present at the site.

Ground water samples from Phase II monitoring wells and leachate samples will be analyzed for the TCL/TAL parameters less the pesticide/PCB fraction, and total chloride. In addition, the temperature, pH, conductivity, dissolved oxygen, redox potential, and salinity of each ground water and leachate sample will be measured in the field immediately following sample collection. Five of the ground water samples (three shallow and two bedrock) will also be field filtered for dissolved metals analysis, and analyzed for BOD, COD, and total suspended solids for ground water treatability information. Field filtering procedures are described in Section 7.5 of Appendix B. In addition, ground water samples will be collected from each existing (Confirmation Study and Phase I RI) monitoring well at the site. Samples from all but two (MW-5S and MW-5D) of the existing wells will be analyzed for the full TCL/TAL parameters less the pesticide/PCB fraction, based on the absence of pesticides and PCBs reported during Phase I ground water analysis. However, given the presence of oil within the MW-5 well nest, the ground water samples from this location will be analyzed for the full TCL/TAL including the PCB fraction.

In addition to collecting ground water samples from the monitoring wells and obtaining routine water level measurements, single well hydraulic conductivity testing (i.e., slug tests) will be performed on several of the site monitoring wells. Slug tests will be performed on site monitoring wells to aid in determining the characteristics of the site aquifers. Both rising and falling head slug tests will be performed on the newly installed bedrock wells. Rising head slug tests will be conducted on wells screened across the water table.

Multi-level piezometers (three levels per cluster) will also be installed at four locations along the western edge of the site as indicated on Figure 5. The piezometer stations will used to evaluate the conductivity (leachate plume) and salinity changes of the ground water as a function of depth and tidal fluctuations. The findings of the piezometer ground water monitoring will be used to evaluate the extent of salt water intrusion, the ground water quality characteristics, and any leachate plume characteristics. A plan indicating construction details

of the piezometers is provided as Figure 9 with further information on construction provided in Appendix B.

A continuous water level monitoring network will be established using three piezometer nests (P2, P3 and P4). Water levels will be recorded within both the shallow and bedrock piziometers once every fifteen minutes for a period of three months. A weekly check will be performed for the first two weeks of operation, and monthly thereafter to verify the integrity of the monitoring network. In addition, ground water pH, temperature, specific conductivity, and salinity will be measured in each piezometer nest once every two weeks over the three month monitoring period. At the end of the three months, hydrographs will be evaluated to assess the number and location of continued water level recorder activity. The need for further monitoring will be reevaluated based on proposed or actual land use changes.

3.7 LAND SURVEY

Following completion of field sampling activities the site will be surveyed by a State of Rhode Island registered surveyor. The location and elevation of the Phase II sampling points will be determined in the survey. Each sampling location will be referenced to the State of Rhode Island Grid Coordinate System. Completed monitoring wells will be surveyed for elevation at the top of the protective casing, top of the well casing, and adjacent land surface. Elevations will be referenced to mean low water (mlw) and a United States Geological Survey benchmark to the nearest 0.01 foot. The Phase II survey information will be incorporated on the map of the Phase I site survey.

4.0 SITE-SPECIFIC HEALTH AND SAFETY SUMMARY

4.1 INTRODUCTION

The purpose of this health and safety summary is to summarize the site-specific health and safety information. This section describes the nature of wastes or contamination suspected and present at the site, the site access and work zones, and the initial level of personnel protection and monitoring planned for each site investigation activity. In addition, a list of site emergency contacts and maps of the route to the Newport Hospital from the site is provided as Table 5 and Figures 10 and 10A, respectively.

4.2 NATURE OF WASTES

Historical information indicates that the McAllister Point Landfill was used for the disposal of wastes, including spent acids, paints, solvents, oils, and PCB-contaminated oils. The Phase I RI findings indicates the presence of elevated levels of volatile organic compounds, polynuclear aromatic hydrocarbons, and metals in site soils. The highest levels of VOCs, BNAs, and metals were generally detected in the central and southern portions of the site.

Fill is present across the site at depths of 3 feet at the site periphery to 24 feet in the central portion of the landfill. The fill material encountered in Phase I consisted of an assortment of what appeared to be municipal and industrial wastes (e.g., plastic, wood, paper, garbage, construction debris, paints, ash). Elevated levels of volatile organic compounds and metals were detected in the site ground water. PCBs were also detected in a well (MW-5S) at the southern end of the site in which oil was also observed.

Previous investigations also showed elevated levels of metals, petroleum hydrocarbons, and PCBs in adjacent bay sediments; and elevated concentrations of metals in adjacent bay mussels.

4.3 SITE ACCESS/WORK ZONES

This site will be divided into four designated contiguous work zones: a support zone, a personnel decontamination area, a heavy equipment decontamination area, and an exclusion zone. The support zone for this site will be the company vehicles used by the field investigation crew. The vehicles will be located on the foundations located in the central portion of the site. The vehicles will provide temporary relief from any adverse weather conditions and will store necessary field sampling and safety/emergency equipment (e.g., car phone, first aid kit, drinking water, HASP). The command center for the RI activities will be at the portable field office trailer located on Site 13, Tank Farm Five.

A contamination reduction station, or personnel decontamination area, will be established adjacent to the support zone on the concrete foundation area. All personnel exiting the exclusion zone (work area) must pass through the decontamination zone prior to entering the support zone vehicles or leaving the site. Personnel shall undergo appropriate decontamination, as required by the activity-specific procedures and level of personnel protection. The heavy equipment decontamination area (e.g., for drill rigs, backhoes) will be located just south of the personnel decontamination area and support zone at the pool lined-decontamination area established on the site in Phase I. Split spoon decontamination will occur in a designated area adjacent to the heavy equipment decontamination area.

The exclusion zone shall consist of the entire site area located outside of the support zone, support zone corridor, and decontamination areas. Access to the exclusion zone shall be restricted by first passing through the decontamination and support zones, signing in on the daily site log, and donning the appropriate level of personnel protective equipment. At off-site well drilling locations, the exclusion zone will consist of at least a 25-foot exclusion zone around active drill rig operations. This exclusion zone will be demarcated with caution tape or barricades. The OSC or alternate will be responsible for keeping nonessential personnel outside of the exclusion zone boundaries during the investigation activities. In the event that authorized visitors are present on the site during field activities, the OSC or designee shall insure that they adhere to site safety requirements and maintain a safe distance outside of the exclusion zone. All personnel allowed to enter the exclusion zone shall be required to follow safety procedures described in the project HASP in Appendix C and directions of the OSC.

Disposal of field-generated materials is described in the Investigation Derived Waste Plan provided in Appendix E of this Work Plan.

4.4 PERSONNEL PROTECTION AND MONITORING

Based on the findings of the Phase I RI and suspected site contaminants, the field investigation activities will be initiated in either Modified Level D or Level C personnel protection (as defined in the HASP in Appendix C). A list of anticipated initial levels of personnel protection for each of the specific investigation activities is presented in Table 6. Levels of personnel protection will be upgraded or downgraded as conditions dictate.

During field sampling activities, continuous monitoring of ambient air will be conducted with an OVA and Hnu. During drilling activities, continuous ambient monitoring of combustible gas levels will also be conducted with an LEL/O2 meter. Air monitoring will also be performed "downhole" during drilling.

TABLES

TABLE 1

SITE 01 – McALLISTER POINT LANDFILL
SITE INVESTIGATION SUMMARY

ACTIVITY / SAMPLE MATRIX	SCOPE OF WORK	NUMBER OF SAMPLES	SAMPLE ANALYSIS
GEOPHYSICS			
EM–31	50' & 10' Spacing	NA	NA
Seismic Refraction	Multiple traverses	NA	NA
SOIL GAS	2 areas	24 Points	Modified 601/602
SURFACE SOIL	19 Locations	19 8 3	TCL/TAL TOC, Grain Size Dioxins/Furans
TEST BORING SOIL	13 Locations	26 – 39 3	TCL/TAL Dioxins/Furans
WELL BORING SOIL	9 Borings	13 – 18 9	TCL/TAL TOC, Grain Size, Cation Exchange
GROUND WATER	14 new wells at 9 locations:	14 5	TCL/TAL less Pest/PCBs Chloride Dissolved TAL, BOD, COD,TSS, Chloride
	12 existing wells	12	TCL/TAL less Pest/PCBs Chloride
LEACHATE	5 Locations Assumed	5	TCL/TAL, Chloride

Note: "NA" indicates that activity is not applicable.
TCL indicates sample will be analyzed for Target Compound List.
TAL indicates sample will be analyzed for Target Analyte List.
In addition to dissolved (filtered metals), five ground water samples will also be analyzed for BOD, COD, and TSS for treatability information.

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TABLE 2

Site 01 - McAllister Point Landfill
Surface Soil Location / Rationale

SAMPLE NUMBER	LOCATION / RATIONALE
SS-18	Determine background surface soil quality for Site 01.
SS-19	Determine background surface soil quality for Site 01.
SS-20	Determine background surface soil quality for Site 01.
SS-21	Further characterize surface soil quality at northern end of Site 01.
SS-22	Further characterize surface soil quality at northern end of Site 01.
SS-23	Further characterize surface soil quality at northern end of Site 01.
SS-24	Characterize surface soil quality in the north central (ash area) portion of Site 01.
SS-25	Characterize surface soil quality in the north central (ash area) portion of Site 01.
SS-26	Characterize surface soil quality in the north central (ash area) portion of Site 01.
SS-27	Characterize surface soil quality in the south central portion of Site 01.
SS-28	Characterize surface soil quality at the southern edge of Site 01.
SS-29	Further investigate shoreline soil/sediment contamination detected during the Phase I investigation.
SS-30	Further investigate shoreline soil/sediment contamination detected during the Phase I investigation.

TABLE 2
(continued)
Site 01 - McAllister Point Landfill
Surface Soil Location / Rationale

SAMPLE NUMBER	LOCATION / RATIONALE
SS-31	Further investigate shoreline soil/sediment contamination detected during the Phase I investigation.
SS-32	Further investigate shoreline soil/sediment contamination detected during the Phase I investigation.
SS-33	Further investigate shoreline soil/sediment contamination detected during the Phase I investigation.
SS-34	Further investigate shoreline soil/sediment contamination detected during the Phase I investigation.
SS-35	Further investigate shoreline soil/sediment contamination detected during the Phase I investigation.
SS-36	Further investigate shoreline soil/sediment contamination detected during the Phase I investigation.
TOTAL:	16 LOCATIONS 3 BACKGROUND SAMPLES 19 SAMPLE LOCATIONS

TABLE 3

Site 01 - McAllister Point Landfill
Test Boring Location / Rationale

BORING NUMBER	LOCATION / RATIONALE
B-14	Characterize subsurface soil at the northern end or boundary of Site 01.
B-15	Determine the northern extent of an ash layer identified during the Phase I investigation.
B-16	Determine the eastern extent of an ash layer identified during the Phase I investigation.
B-17	Determine the southern extent of an ash layer identified during the Phase I investigation.
B-18	Characterize subsurface soil in the north central section of Site 01.
B-19	Determine the western extent of fill contamination identified during the Phase I investigation (at B-5 & MW-3).
B-20	Determine the eastern extent of fill contamination identified during the Phase I investigation (at B-5 & MW-3).
B-21	Characterize subsurface soil and fill in the southwest central section of Site 01.
B-22	Determine the southern extent of fill contamination identified during the Phase I investigation (at B-5 & MW-3).
B-23	Characterize subsurface soil in the south central section of Site 01.
B-24	Characterize subsurface soil in the southern section of Site 01.
B-25	Determine source of oily soils/ground water in the southern section of Site 01, identified during the Phase I investigation (at MW-5S).
B-26	Characterize subsurface soil at the southern edge of Site 01.
TOTAL:	13 BORING LOCATIONS

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TABLE 4

Site 01 - McAllister Point Landfill
Monitoring Well Location / Rationale

WELL NUMBER	LOCATION / RATIONALE
MW-8S/R	Determine ground water quality downgradient of ash layer identified during the Phase I investigation.
MW-9S	Determine ground water quality north of contamination detected in Phase I (at MW-3S/D and B-5).
MW-10S	Determine ground water quality south of contamination detected in Phase I (at MW-3S/D and B-5).
MW-11S/R	Determine ground water quality downgradient (west) of contamination detected in Phase I (at MW-3S/D and B-5).
MW-12S	Determine ground water quality north of contamination detected in Phase I (at MW-5S/D).
MW-13S	Determine ground water quality south of contamination detected in Phase I (at MW-5S/D).
MW-14S/R	Determine upgradient/off-site water quality for southern portion of Site 01.
MW-15S/R	Determine upgradient/off-site water quality for central portion of Site 01.
MW-16S/R	Determine upgradient/off-site water quality for northern portion of Site 01.
TOTAL:	9 SHALLOW WELLS 5 ROCK WELLS 14 WELLS

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TABLE 5

SITE 01 - McALLISTER POINT LANDFILL
SITE EMERGENCY CONTACTS

NETC Emergency Numbers:

Command Duty Officer	841-3456 or 3457
Security Office - Police	841-3241
NETC Fire Protection	841-3333
Public Works Trouble Desk	841-4001

Utilities:

Rhode Island Dig Safe	800-225-4977
NETC Dig Safe	841-2464

Newport Emergency Numbers:

Newport Police Dept.	847-1306
Newport Fire Dept.	846-2211
Newport Hospital	
General Number	846-6400
Emergency Room	846-6400 ext. 1120
Poison Control Center	277-5727

Additional Resources:

Dr. Erdil, or Dr. Stahl - TRC Company Physicians, Immediate Medical Care, Hartford, Connecticut - (203) 296-8330
Mr. James Peronto - TRC Project Manager - (203) 289-8631
Ms. Rachel Marino - NETC Environmental Coord. - (401) 841-3735
Mr. Robert Hanley - NETC Safety Officer - (401) 841-2478

TABLE 6

SITE 01 - McALLISTER POINT LANDFILL PERSONNEL PROTECTION SUMMARY

Activity	*Intitial Level of Protection*
Reconnaissance Survey	*D*
Geophysical Surveys	*D*
Soil Gas Survey	*D*
Surface Soil Sampling	*D*
Soil Boring	*Mod. D*
Ground Water Sampling	*Mod. D*
Land Survey	*D*

NOTE: *The personnel protection levels will be upgraded or downgraded as conditions warrant according to criteria specified in the project Health and Safety Plan (HASP).*

FIGURES

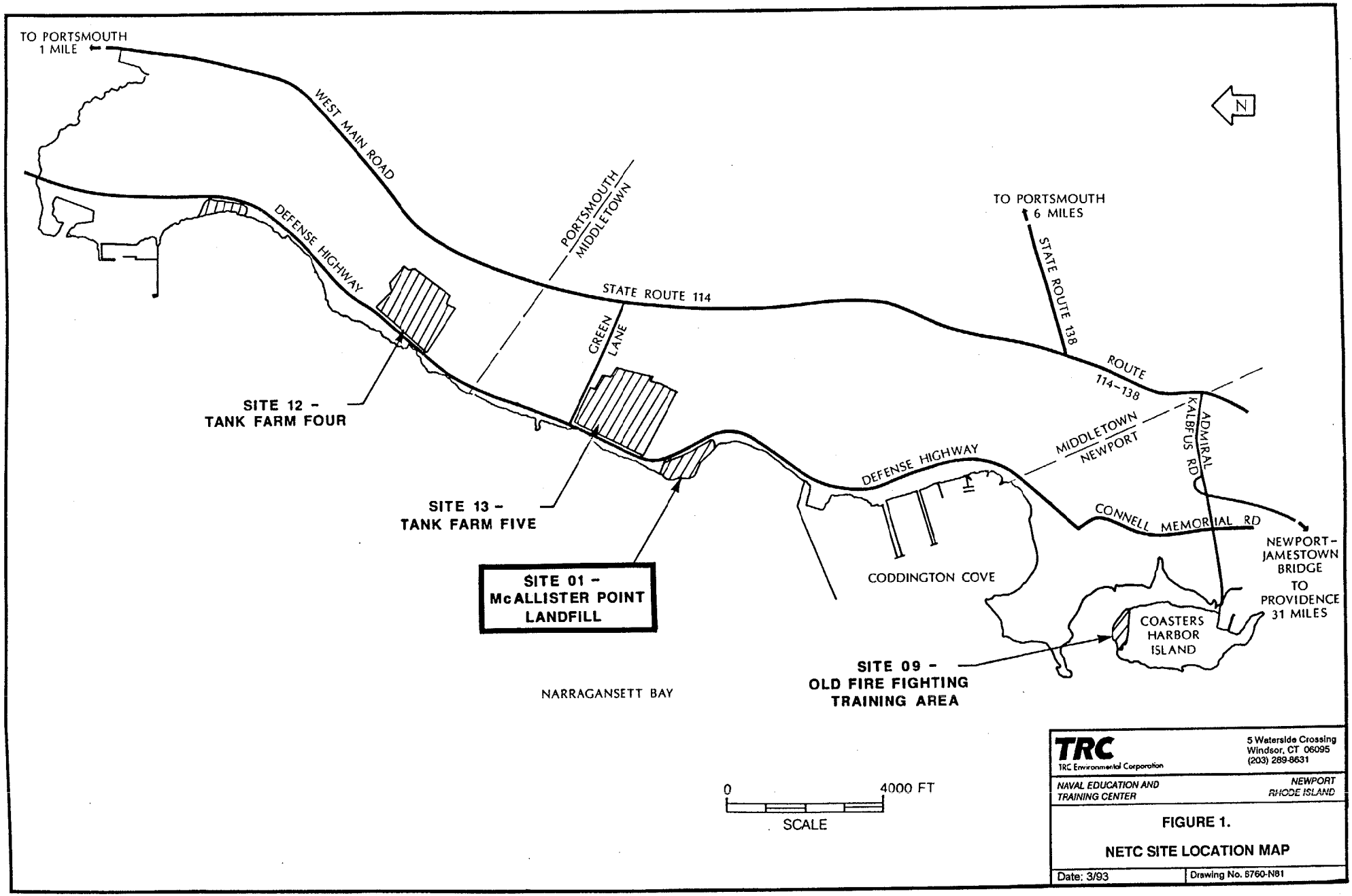

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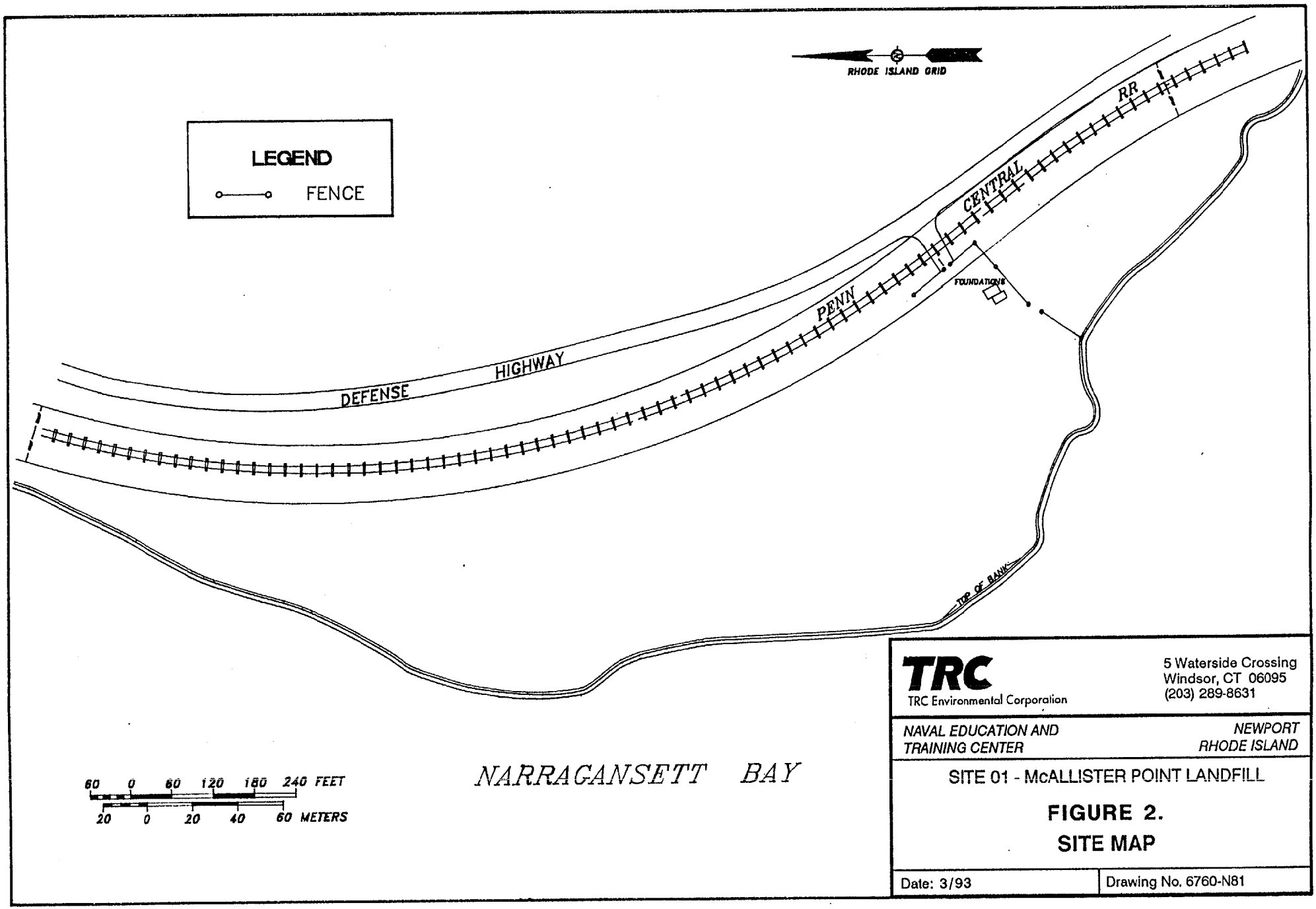
FIGURE 1.

NETC SITE LOCATION MAP

Date: 3/93

Drawing No. 5760-N81



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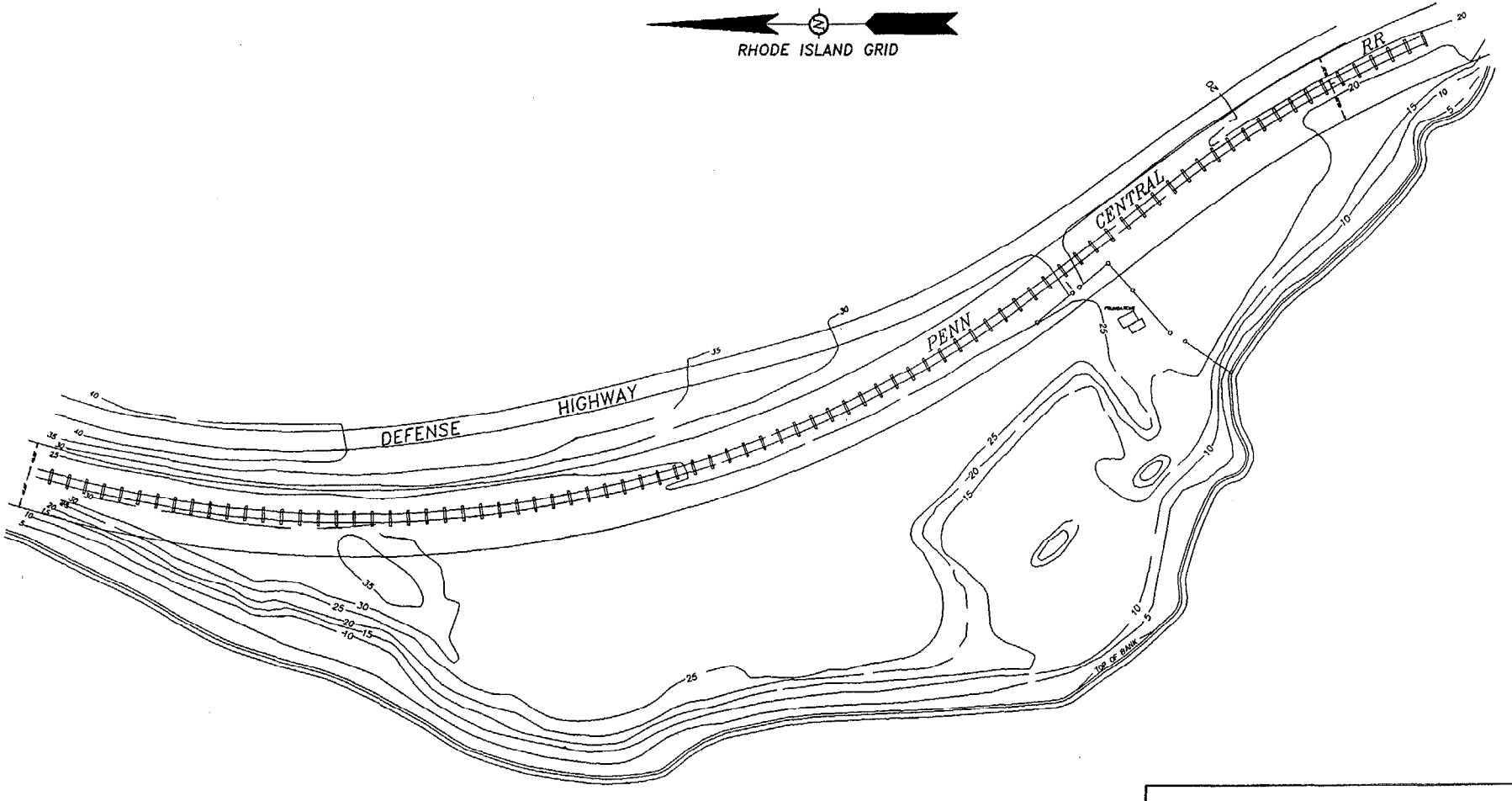
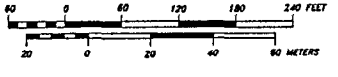
SITE 01 - McALLISTER POINT LANDFILL

FIGURE 2.
SITE MAP

Date: 3/93

Drawing No. 6760-N81





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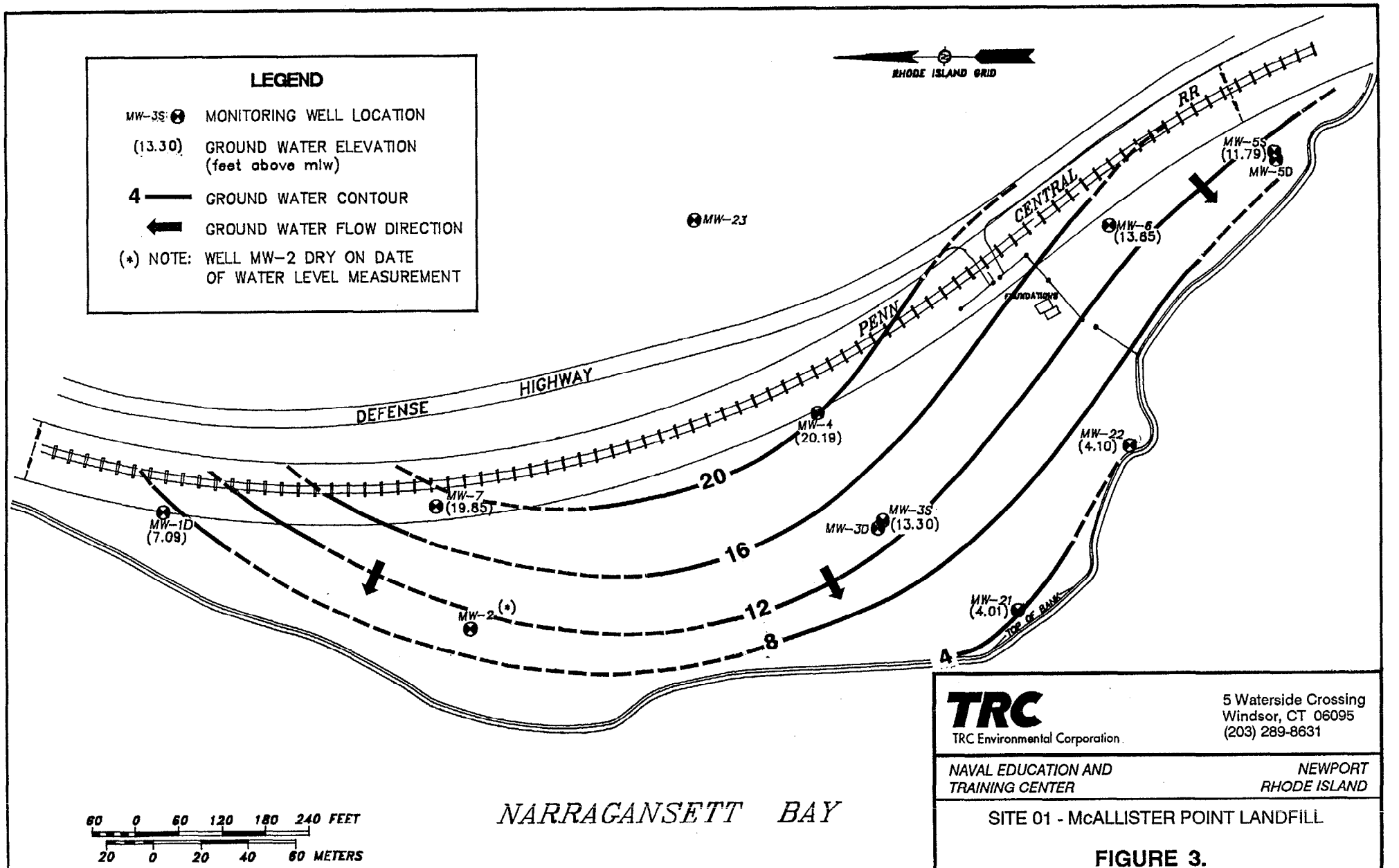
SITE 01 - McALLISTER POINT LANDFILL

FIGURE 2A.
SITE TOPOGRAPHIC MAP

Date: 3/93

Drawing No. 6760-N81



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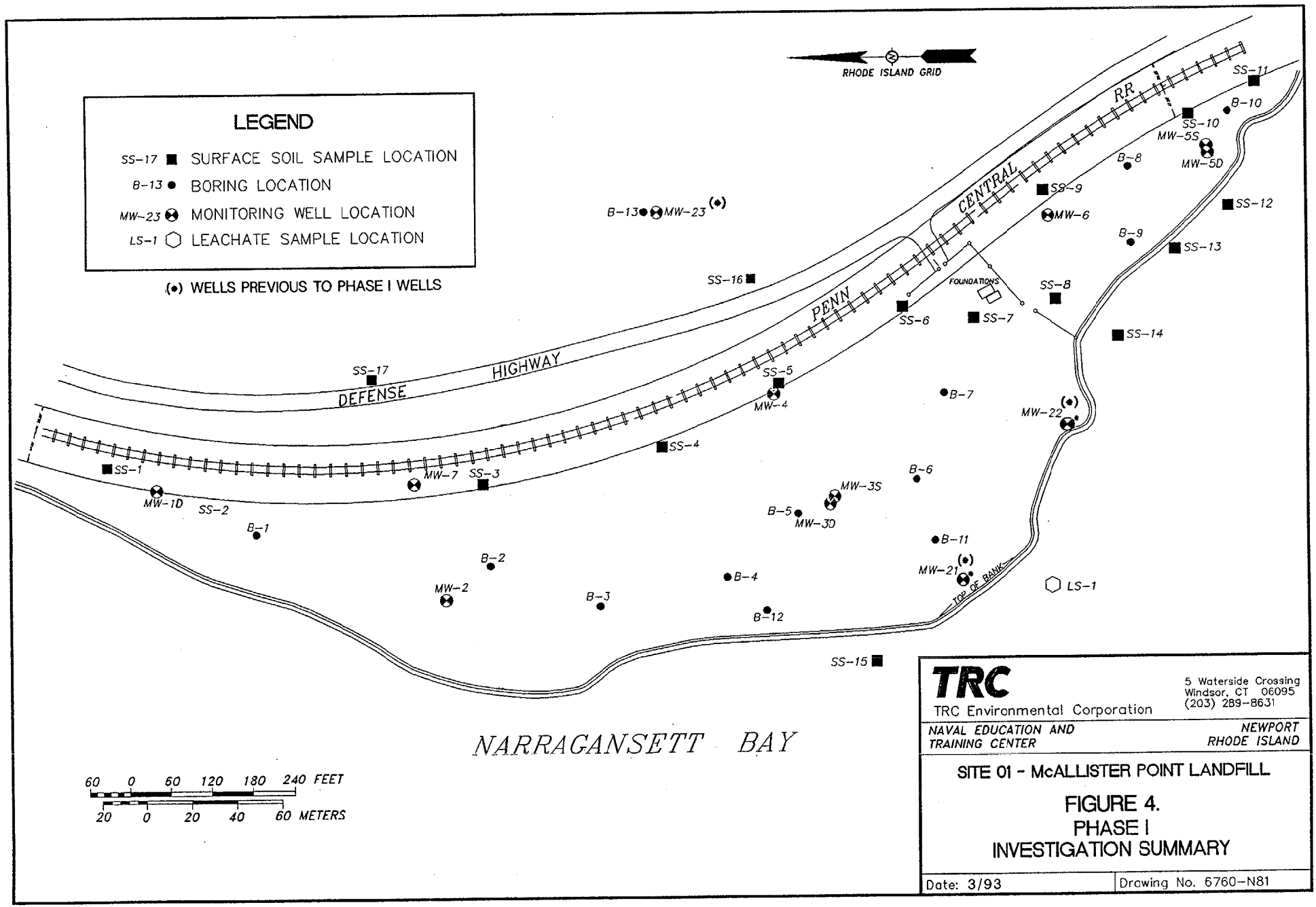
SITE 01 - McALLISTER POINT LANDFILL

FIGURE 3.
GROUND WATER TABLE CONTOUR MAP

Date: 3/93

Drawing No. 6760-N81



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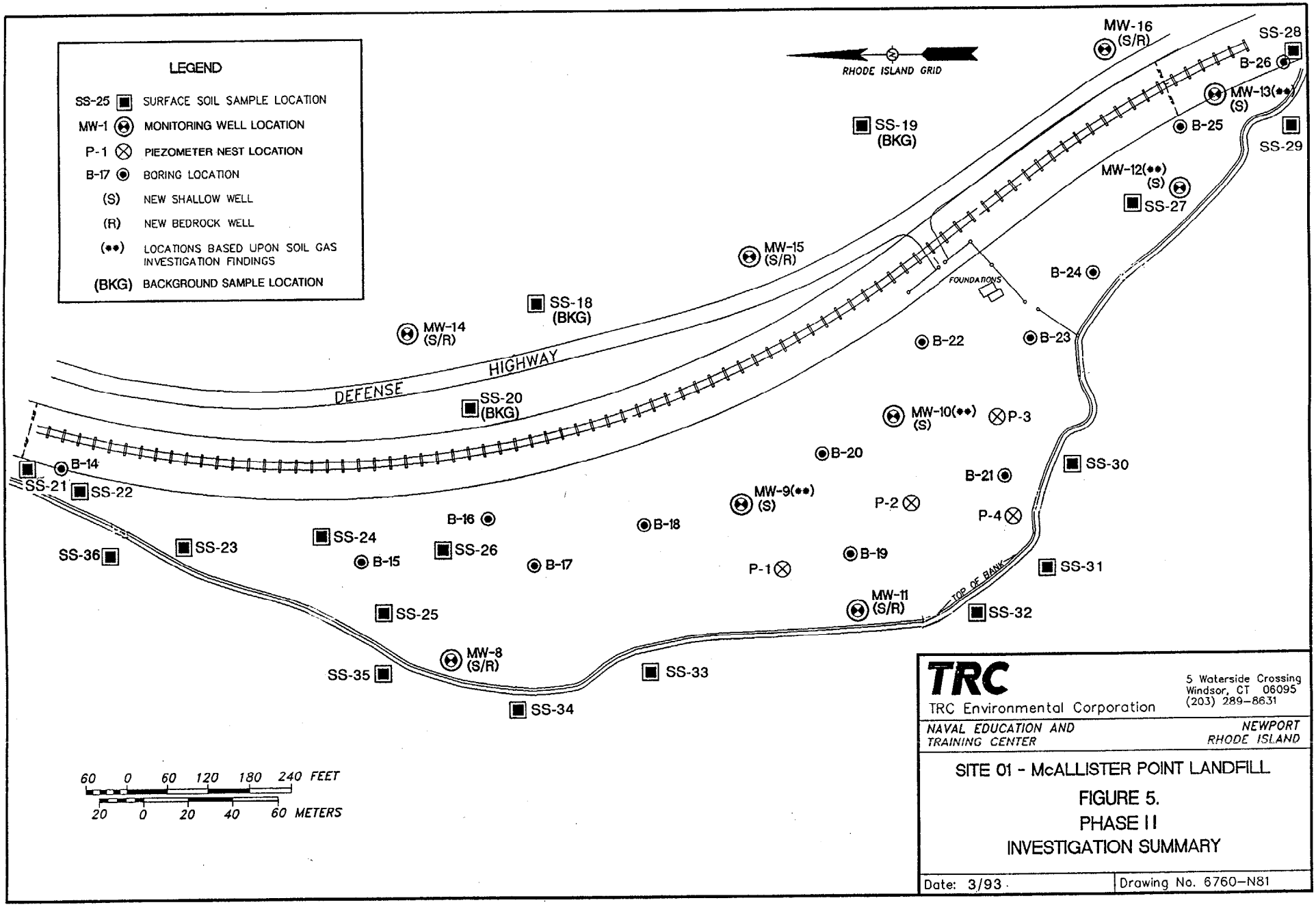
SITE 01 - McALLISTER POINT LANDFILL

FIGURE 4.
PHASE I
INVESTIGATION SUMMARY

Date: 3/93
Drawing No. 6760-N81



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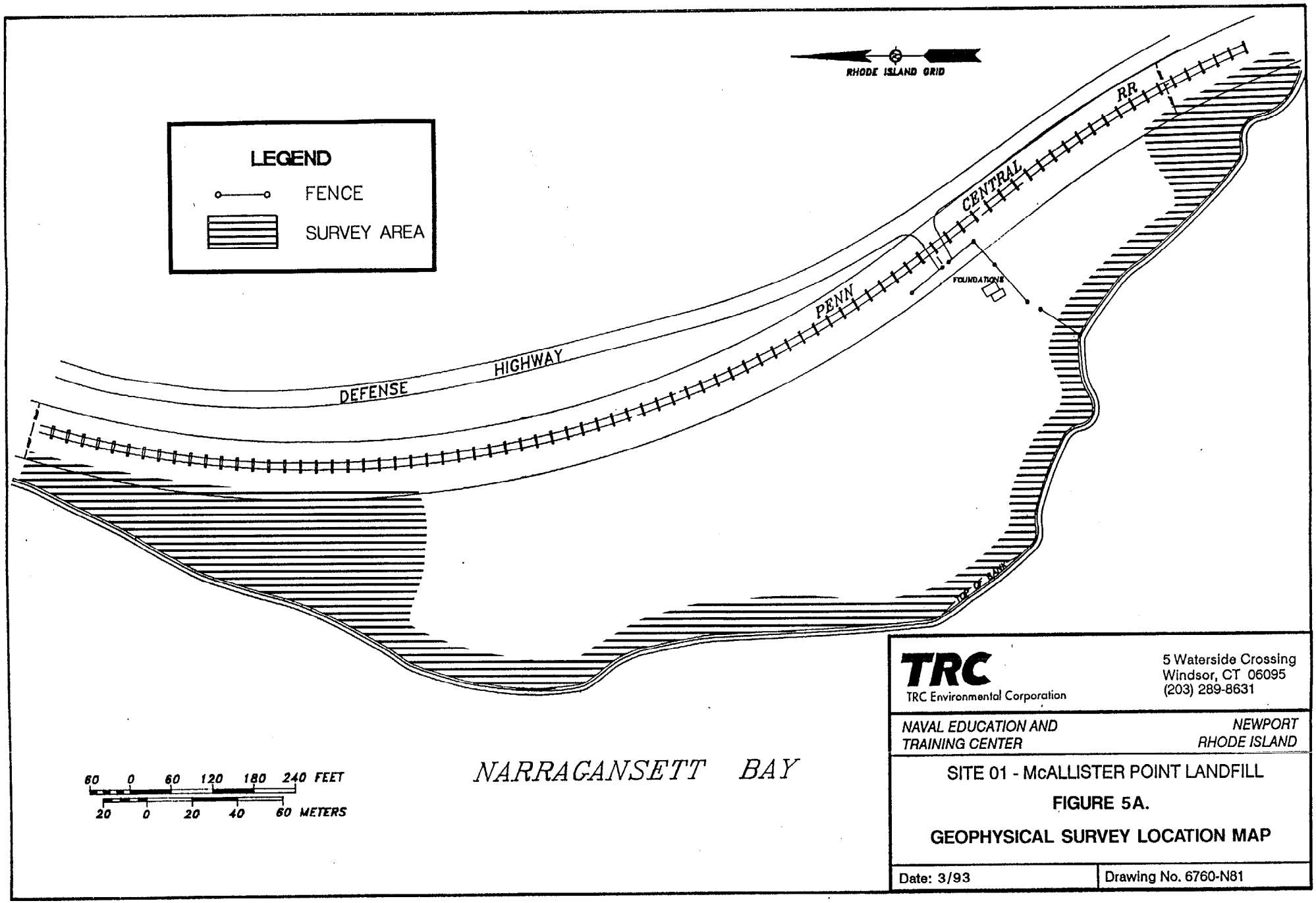
SITE 01 - McALLISTER POINT LANDFILL

FIGURE 5.
PHASE II
INVESTIGATION SUMMARY

Date: 3/93
Drawing No. 6760-N81



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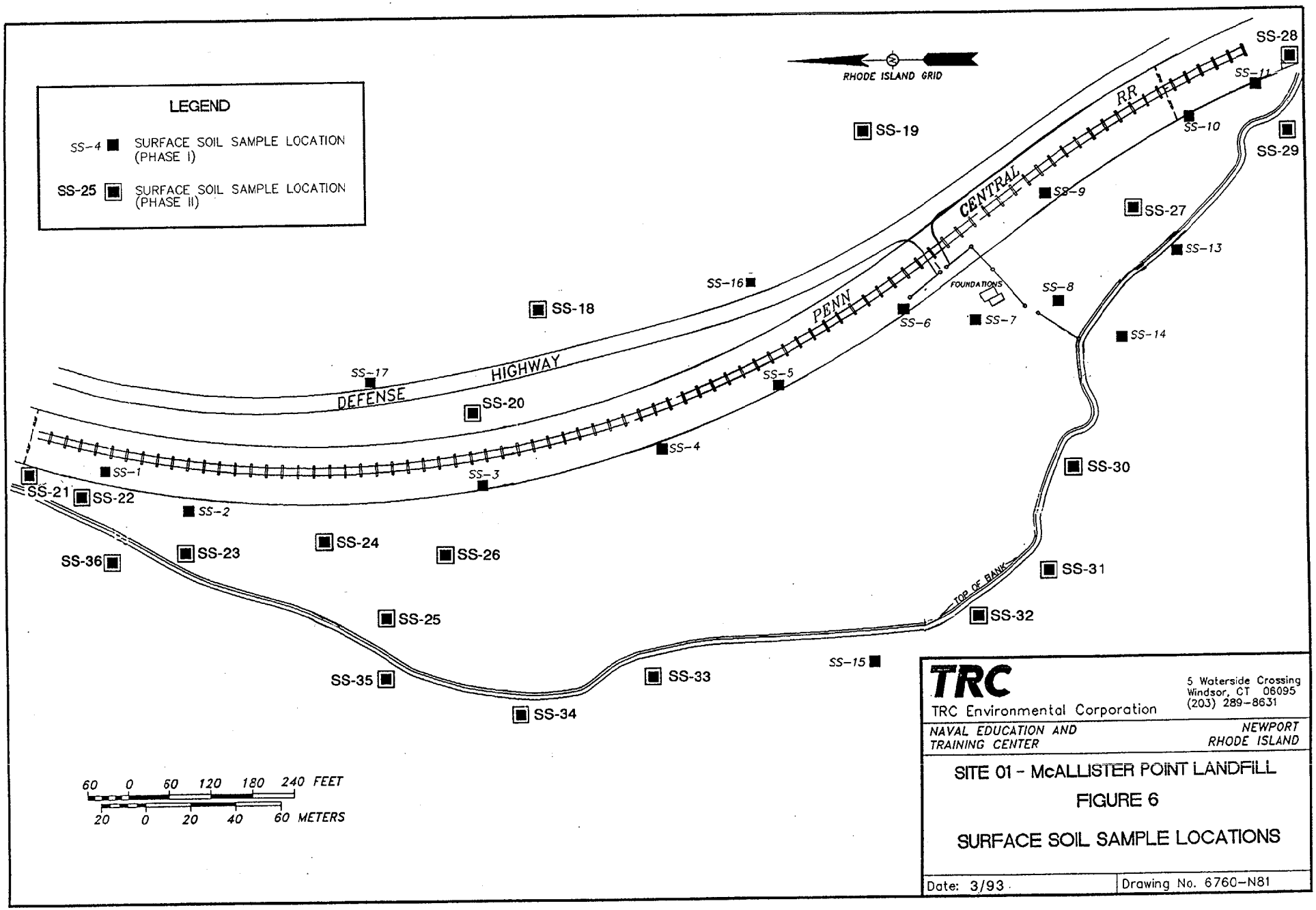
SITE 01 - McALLISTER POINT LANDFILL

FIGURE 5A.

GEOPHYSICAL SURVEY LOCATION MAP

Date: 3/93

Drawing No. 6760-N81



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SITE 01 - McALLISTER POINT LANDFILL

FIGURE 6

SURFACE SOIL SAMPLE LOCATIONS

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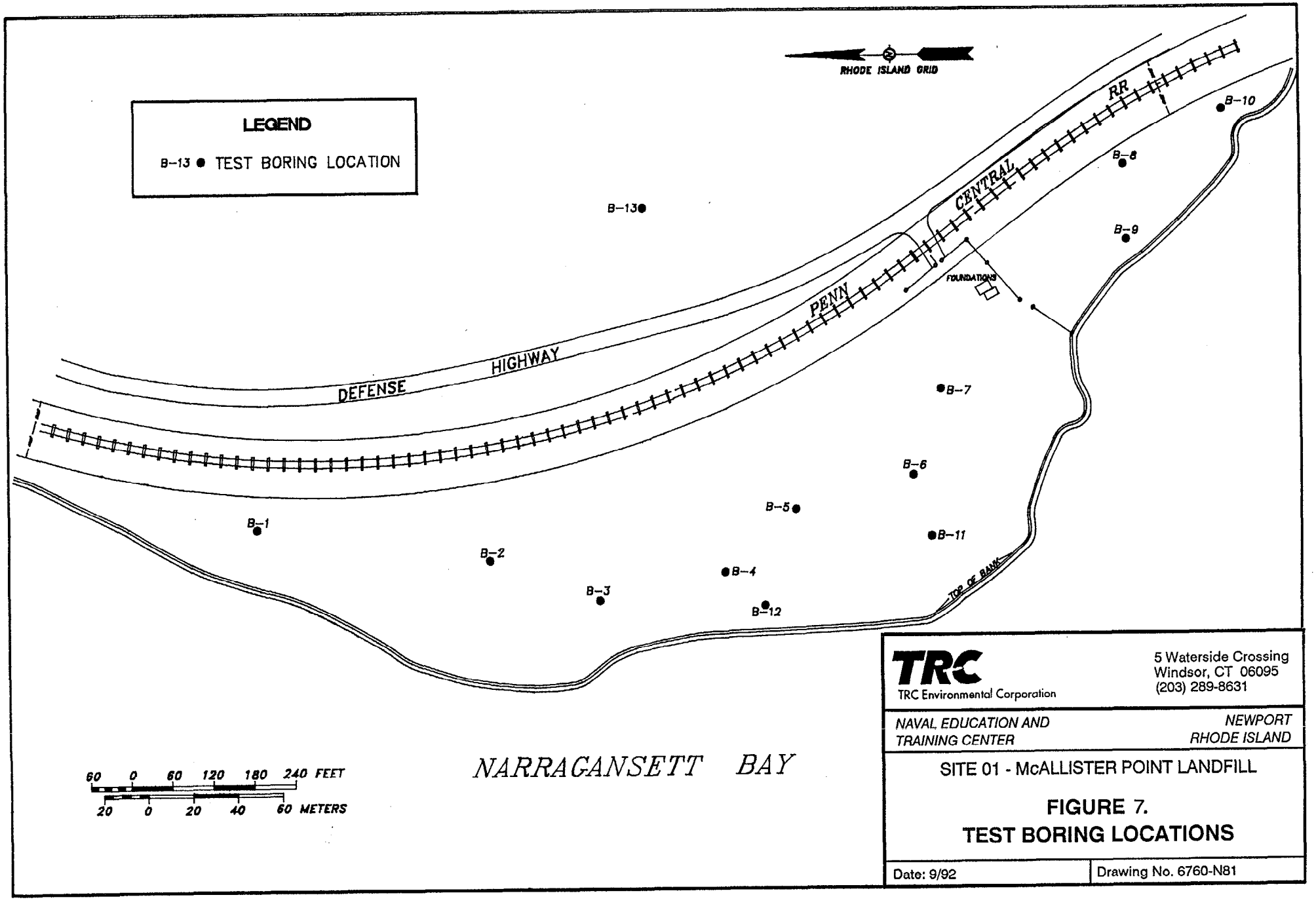
Drawing No. 6760-N81



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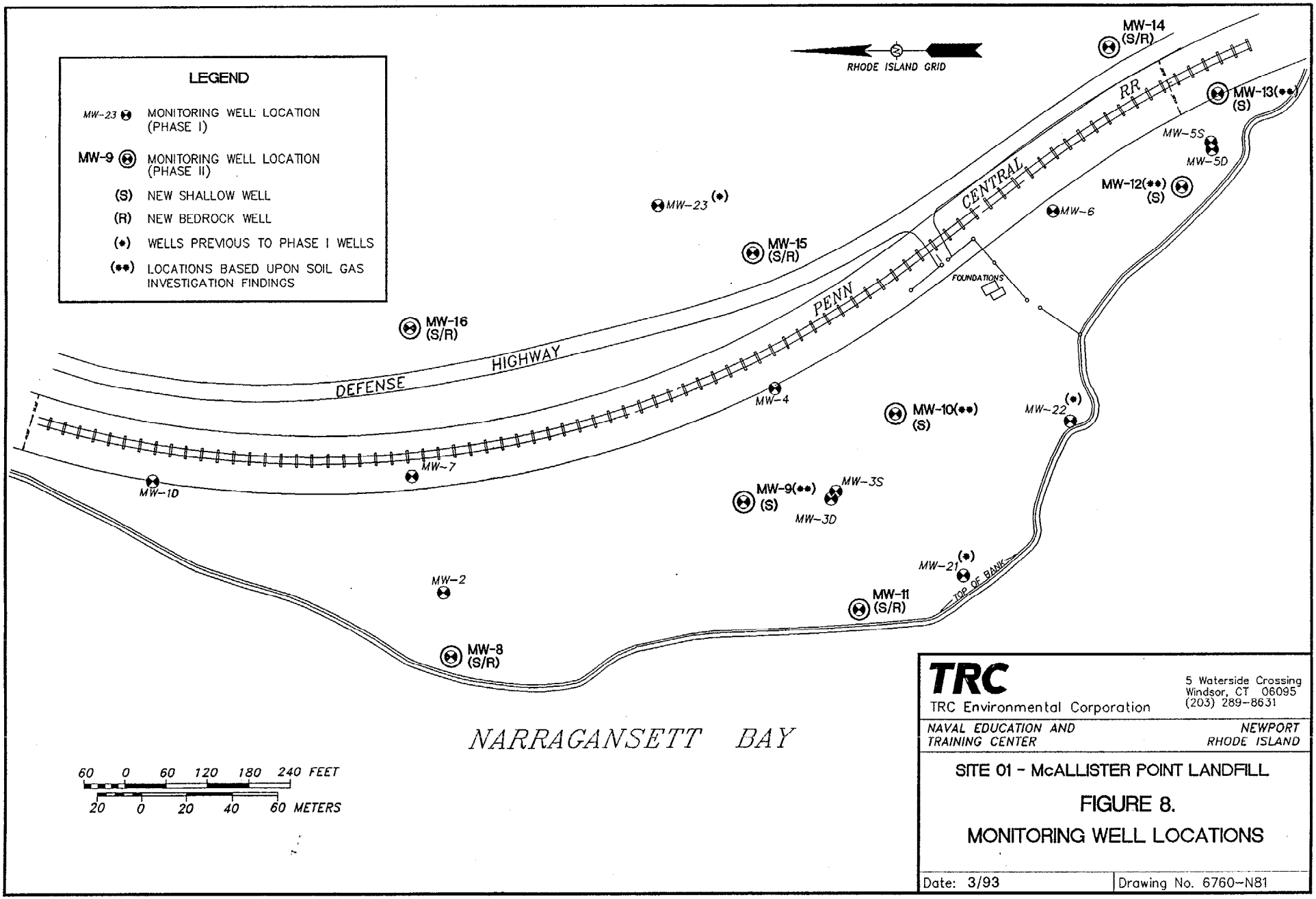
SITE 01 - McALLISTER POINT LANDFILL

FIGURE 7.
TEST BORING LOCATIONS

Date: 9/92

Drawing No. 6760-N81



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SITE 01 - McALLISTER POINT LANDFILL

FIGURE 8.

MONITORING WELL LOCATIONS

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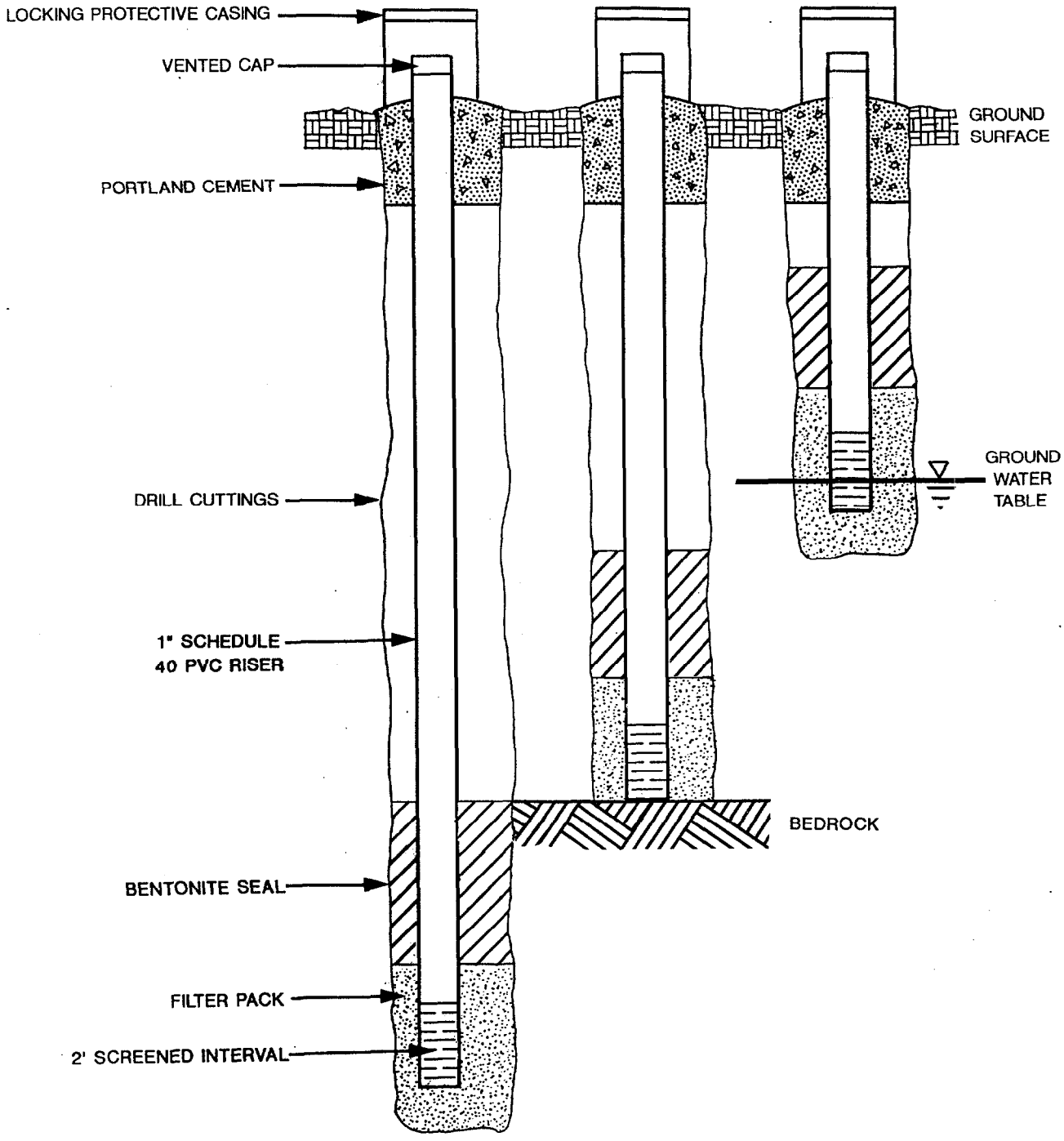

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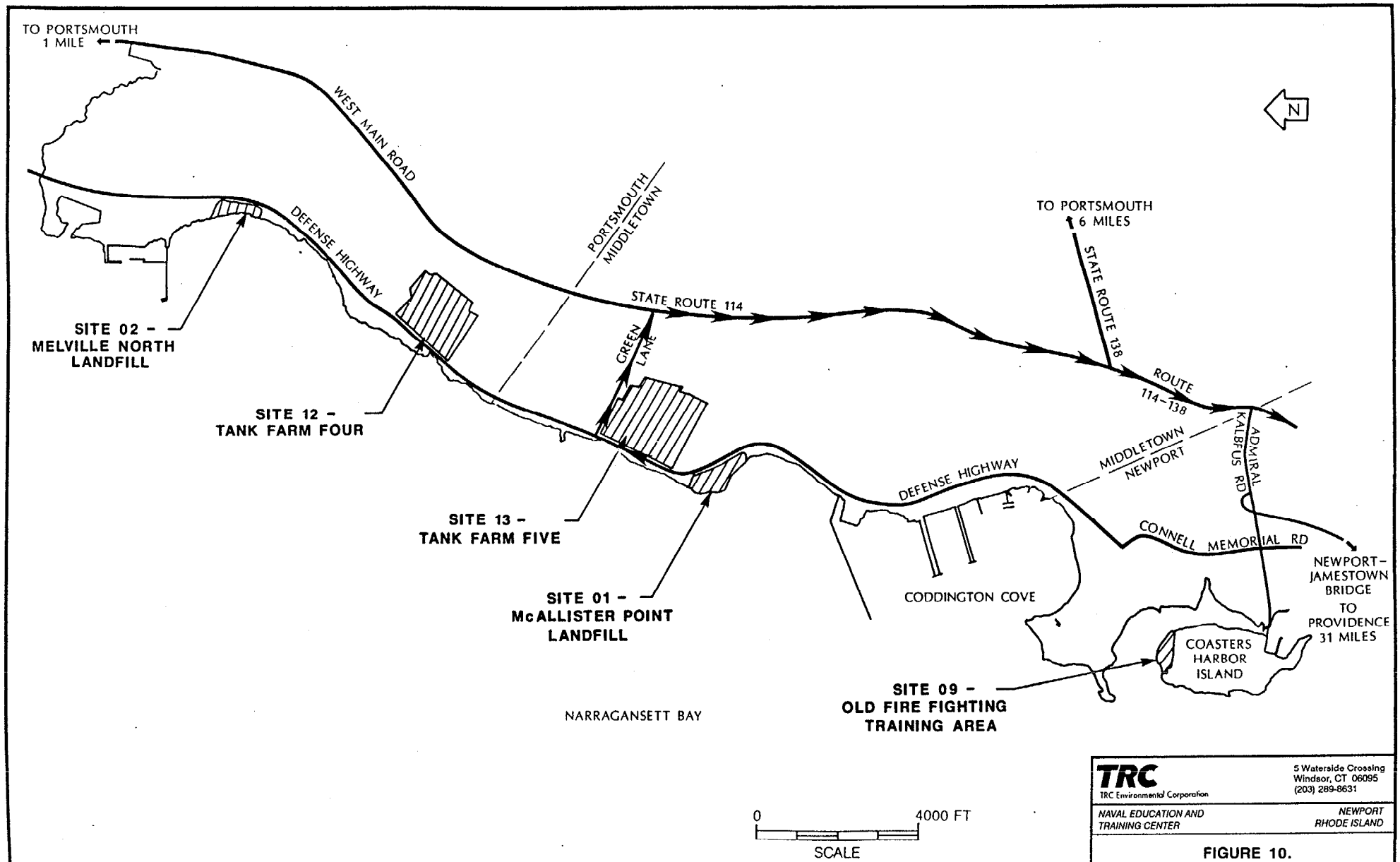
SITE 01 - McALLISTER POINT LANDFILL

FIGURE 9.
PIEZOMETER NEST DIAGRAM

Date: 3/93 | Drawing No. 6760-N81



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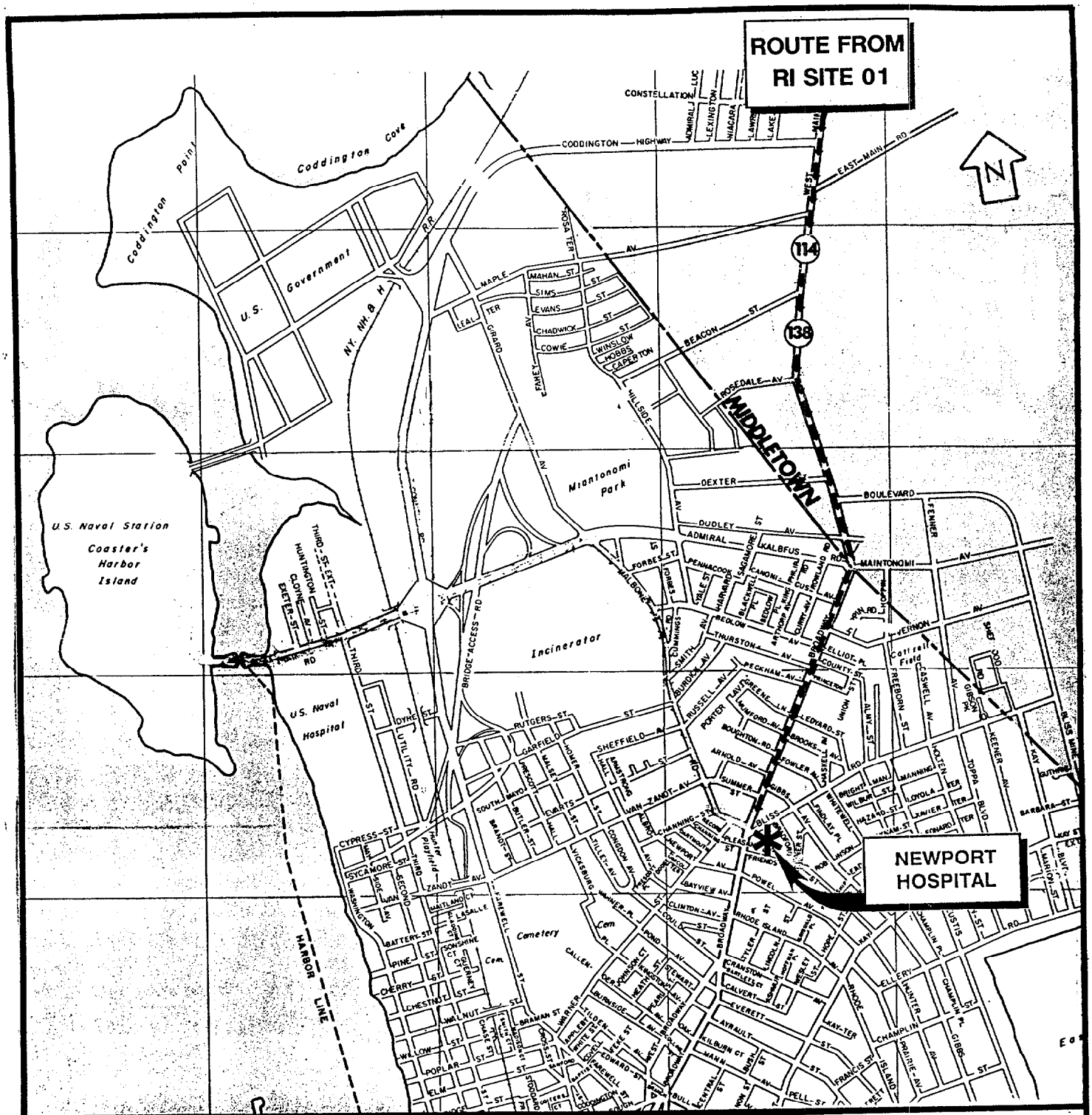
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT RHODE ISLAND

FIGURE 10.

NEWPORT HOSPITAL ROUTE MAP

Date: 3/93
Drawing No. 6760-N81



0 1/4 1/2

SCALE IN MILES

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NEWPORT RHODE ISLAND

FIGURE 10A.

NEWPORT HOSPITAL ROUTE MAP

Date: 3/93

Drawing No. 6760-N81

APPENDIX A

January 1988 ACOE Sediment and Mussel Sampling Report

TRC

Gould Island, McAllister Point & Allen Harbor

Sediment & Mussel Sampling

January 1988

Prepared By
The Water Quality Laboratory
Engineering Division

Department of the Army
New England Division, Corps of Engineers
Hubbardston, Massachusetts

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Introduction

This report discusses the sampling survey, including methods and procedure, which was conducted at the Naval Education Center, Gould Island and McAllister Point, RI, and Allen Harbor, U.S. CBC, Davisville, RI.

Gould Island and McAllister Point were sampled on January 19th and 20th respectively. Allen Harbor was sampled on March 2nd and 3rd.

All sampling was planned and conducted by the U.S. Army Corps of Engineers, New England Division, Water Quality Laboratory personnel.

The original scope of work for this project requested three (3) sediment and three (3) soft shell clam samples from Gould Island, six (6) sediment and six (6) soft shell clam samples from McAllister Point and six (6) sediment and six (6) soft shell clam samples from Allen Harbor. Because of the logistics involved in coordinating transportation to Gould Island, the field personnel decided to take six (6) sediment and clam samples at Gould Island to insure that an adequate amount of material was available to the analyst in the event of future request for more analysis. Seven (7) sediment and clam samples were taken from the McAllister Point locus. Six samples were taken from McAllister Point and one sample, to be used as a control sample, was taken at a distance of 895 feet north of sample #6. Sample point number 7 is outside the immediate area affected by the dump site. Six sediment and clam samples were taken at Allen Harbor.

The total number of sampling points for the three sample locations, Gould Island, McAllister Point and Allen Harbor, is nineteen (19). Weather conditions during the sampling effort are recorded on Table 3.

Purpose

The purpose of this sampling effort was to fulfill the request by the Dept. of the Navy, Naval Education Center, Newport, RI. For an interim study of Gould Island, McAllister Point and Allen Harbor. The interim study is to be utilized to assist in the characterization of chemical and biological conditions in the above mentioned locations.

Gould Island and McAllister Point, Sediment Sampling

Well defined sedimentary deposits could not be found at Gould Island and McAllister Point. The material which was sampled at these locations is considered beach sand. There appears to be a vigorous scouring of the beach at both sites, due to current, wave and tidal action.

Samples were taken in the inter-tidal zone and sampling began approximately one hour before low tide and seized at the approximate time of low tide to one (1) hour after low tide. Refer to Table 1.

At Gould Island seven wooden stakes were set over a linear distance of four hundred and fifty (450') feet. Stake number one (1) being the southern-most stake and stake number seven (7) being the northern-most stake. Stake number one was placed approximately twenty (20) feet north of the abandoned peer, and subsequent stakes were set sixty five feet (65') apart. Stakes were set in the soil east of the winter tidal berm at the toe of the embankment.

At McAllister Point eight (8) wooden stakes were set over a linear distance of eleven hundred (1100) feet. Stake number one was set one hundred and seventy (170) feet Northwest of the fence post on the edge of the embankment. This fence post is the western-most post of the section of fence which runs perpendicular between the beach and the railroad track. Stake number one was set at the toe of the bank, east of the winter tidal berm. All subsequent stakes were set one hundred and fifty (150) feet apart, at the break of the bank or immediately above the riprap, with the exception of stake number eight which was set two hundred (200) feet north of stake number seven (7). Two concrete blocks used as anchors for the utility pole guide wires were used as reference points for sample number seven.

All samples were taken as close to the waters edge as possible during the low tide period (See table 1). A linear distance from the sample hole to two points (stakes) was measured after the sample was taken. Refer to table 2 for distances from sample points to stakes.

The original intent of this sampling survey was to sample a core of sediment from a depth of one (1) foot. However, due to the natural and man made conditions of this site any attempt to obtain a core sample without the facility of an elaborate hydraulic or electric coring device is impractical.

Sample holes were dug with a steel garden shovel and a crow bar. A sample depth of twelve inches was not attainable because of the presence of large stones, boulders, debris from the dump site and water infiltration. All sample material was taken at a depth of four (4) inches to eight (8) inches.

After the sample hole was dug a stainless steel spoon was used to clean out the hole. The inside of the hole was swiped with the spoon from a depth of 4"-8" to obtain the sample. The samples were placed in wide mouth amber glass jars, cleaned to EPA protocols, with teflon lined closures. The jars were appropriately labeled, placed in coolers and iced.

All tools and sampling devices were appropriately washed with hexane after the sampling of each hole. The hexane was collected in a tray, poured off in a teflon bottle and returned to the Water Quality Laboratory for proper disposal.

Allen Harbor, Sediment Sampling

An established sedimentary horizon exists in Allen Harbor in the tidal flats and at the toe of the landfill below mean low water.

A coring device as shown in figure 3 was used to obtain sediment samples, at the required depth of 9"-15", from all six (6) sample locations in Allen Harbor.

Sampling began approximately two (2) hours before low tide and was completed one (1) hour after low tide on March 2, 1988, reference Table 4.

Sample numbers 2 through 6 were taken from a boat and, sample area number 1 was accessed by foot. All samples remained undisturbed in the original tube used to push the core. The tube was immediately cut, capped, and placed in a cooler, on ice. Reference Figure No. 4 for sample site locations.

Allen Harbor, Clam Sampling

Six clam samples were taken from Allen harbor on March 3, 1988. Five of the samples consist of hard shell clams which were raked from the harbor bottom in the areas of sample points 2-6. Soft shell and hard shell clams were taken from the area of sample #1, which is an exposed tidal flat during periods of low tide.

The clams were kept alive in containers filled with seawater from Allen Harbor and transported to the Water Quality Laboratory. Reference Figure No. 4 for sample site locations.

Gould Island and McAllister Point, Mussel Sampling

Mussels were collected by hand within a fifteen (15) to twenty (20) foot radius of the sample hole. All blue mussels collected were approximately 2" in length. Approximately 25-30 mussels were collected from each sample hole area. They were placed (live) in zip lock plastic bags, sealed, placed in coolers and kept on ice until they were returned to the laboratory and froze.

Chain of Custody

A chain of custody record was kept for all samples which were collected on January 19th and 20th. All samples were under the custody of a sample crew member and kept in a locked utility van at all times. Upon arrival at the Water Quality Laboratory, Hubbardston, MA, the samples were immediately placed and locked in the laboratory's walk in cooler and chest freezer. The samples were relinquished to the laboratory's sample custodian on the morning of January 21, 1988. Chain of custody record is enclosed with this report (Appendix A).

Table No. 1
Gould Island Sample Site Locations and Time of Sampling*

Sample Site No.	Stake Numbers	Distance from stake to hole	Compass Direction of sample from stakes	Time of sample
1	1	57'	W N/W	1245
	2	65'	S/W	
2	1	78'	N/W	1256
	2	48'	W	
3	2	69'	N/W	1304
	3	39'	W S/W	
4	3	73'	N/W	1313
	4	26'	W	
5	4	71'	N/W	1324
	5	19'	W S/W	
6	6	50'	W N/W	1357
	7	24'	W S/W	

* Low Tide, January 19th, 1988, 1332 hrs
Tide tables taken from, Tide Tables 1988 East Coast of North America, U.S. Department of Commerce, NOAA

Table No. 2
McAllister Point Sample Site Locations and Time of Sampling*

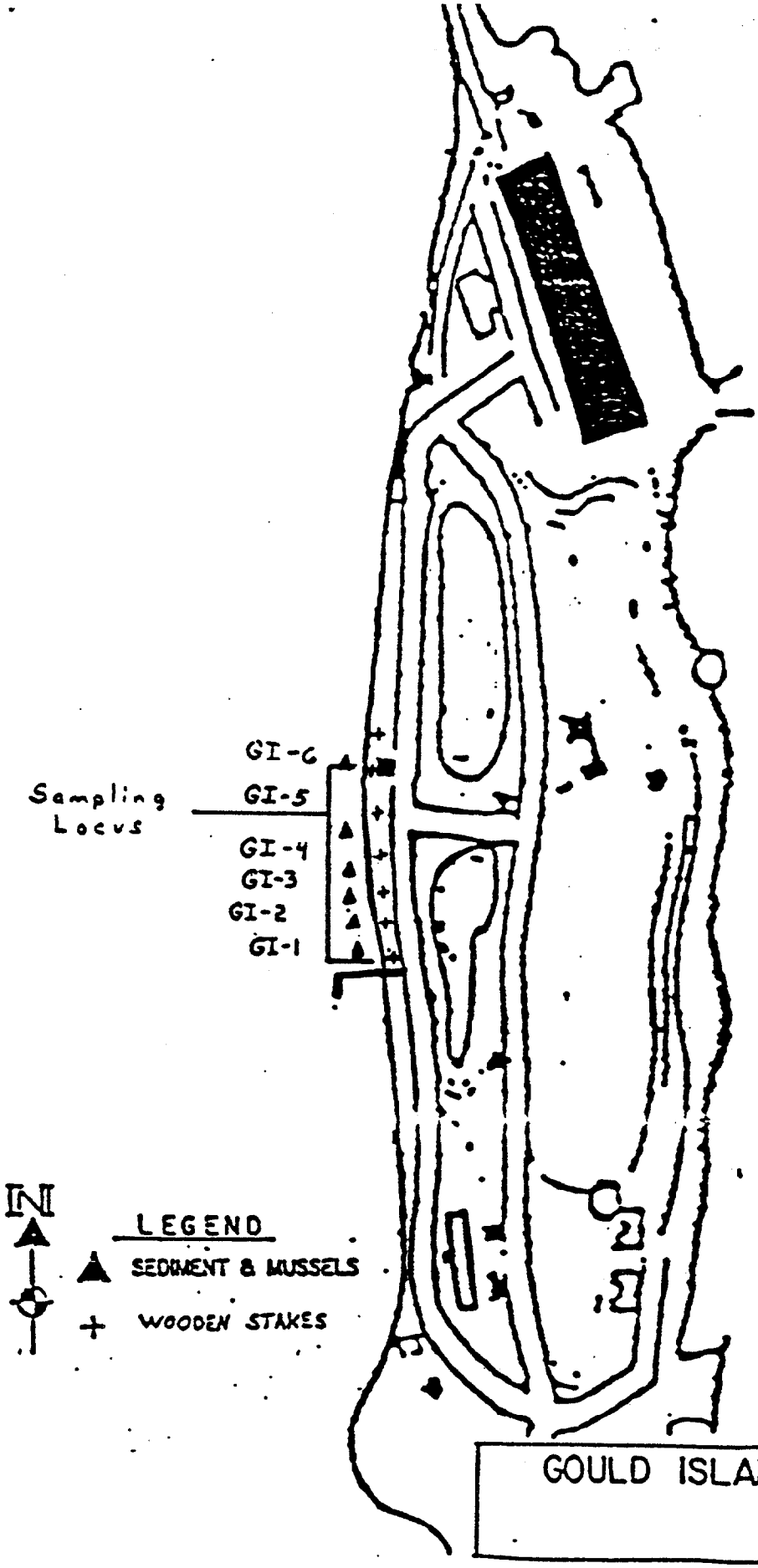
Sample Site No.	Stake Numbers	Distance from stake to hole	Compass Direction of sample from stakes	Time of sample
1	1	67'	W	1530
	Fence Post	207'	N/W	
2	1	150'	N/W	1500
	2	47'	N/W	
3	3	142'	N/W	1440
	4	38'	W	
4	4	122'	N/W	1420
	5	46'	W	
5	5	126'	N/W	1400
	6	49'	S/W	
6	6	146'	N/W	1340
	7	26'	W	
7	Anchors for guide wires	57'	W N/W	1317
		[illegible]	N/W	

* Low tide, January 20th, 1988, 1420 hrs

Table No. 3
Weather Conditions During Sampling Activity

Weather conditions on the sampling dates were as follows:

	Clear	Overcast	Rain	Temp.	Wind Velocity
January 19th	*	-	-	20-30°F	10-15 mph
January 20th	-	*	Heavy	34-38°F	5-10 mph
March 2nd	*	-	-	45°F	$\leq$ 5 mph
March 3rd	-	*	-	45-50°F	0



GOULD ISLAND DISPOSAL AREA

NOT TO SCALE

JAN. 22, 1988

FIG. NO. 1

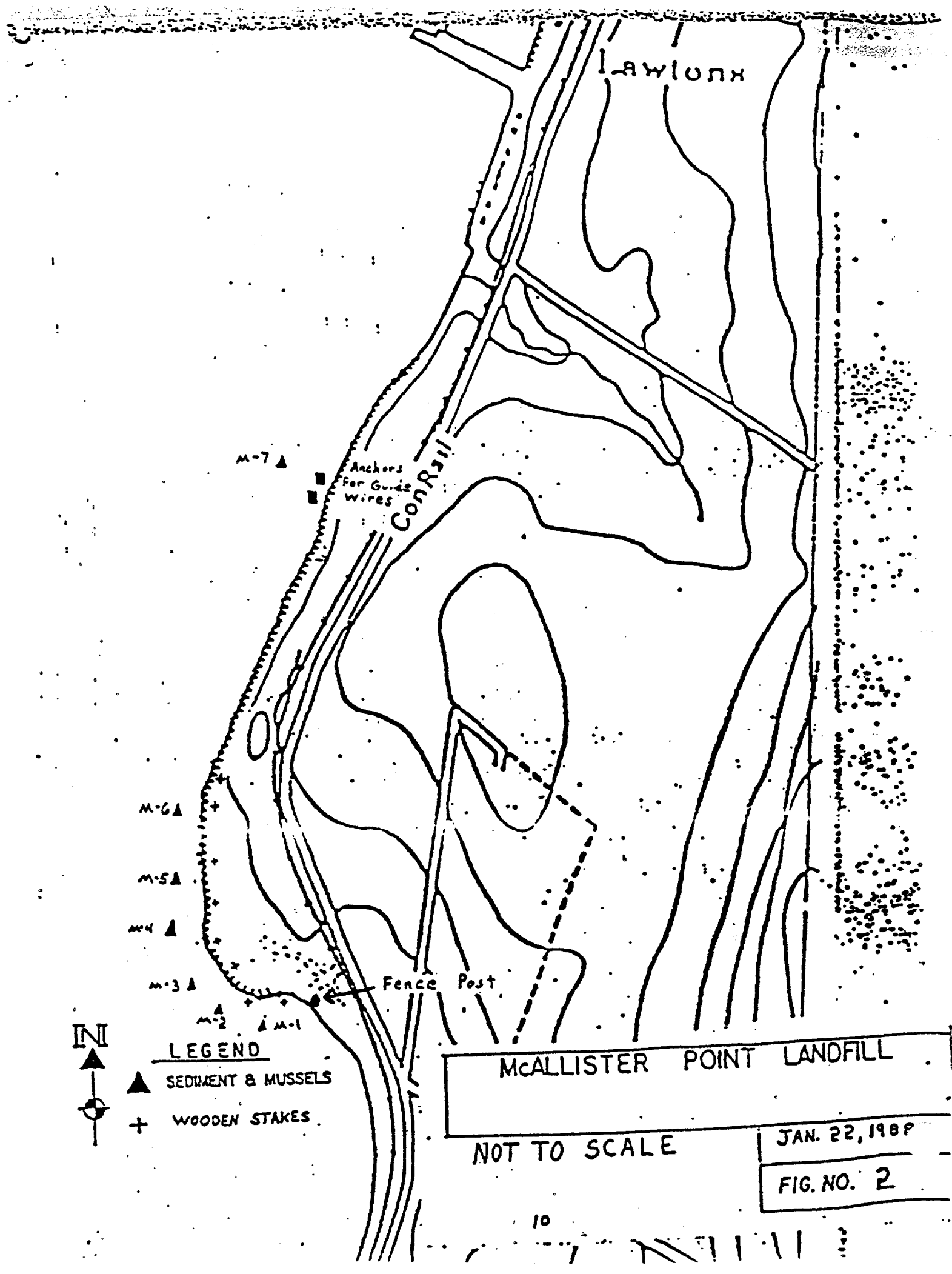
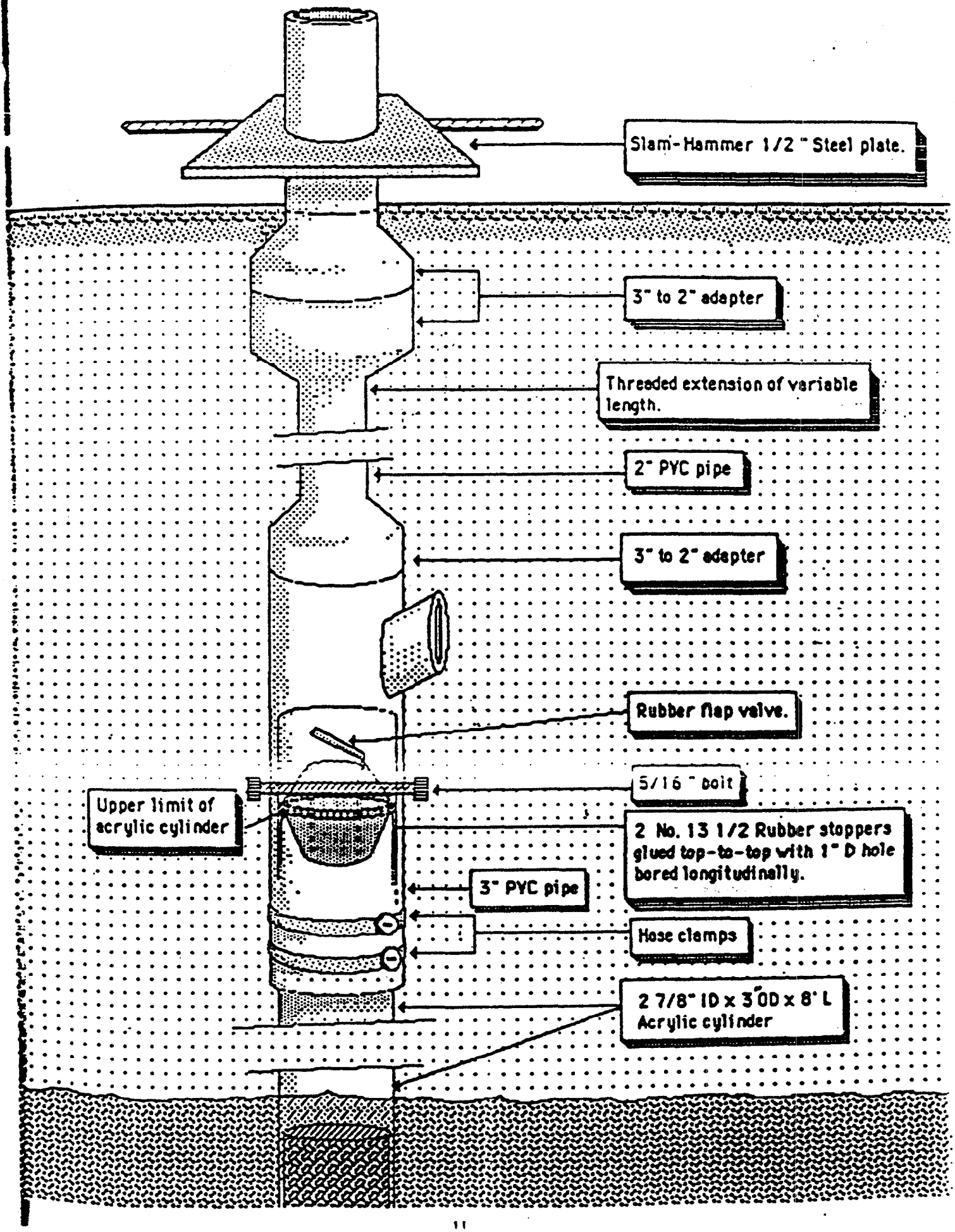
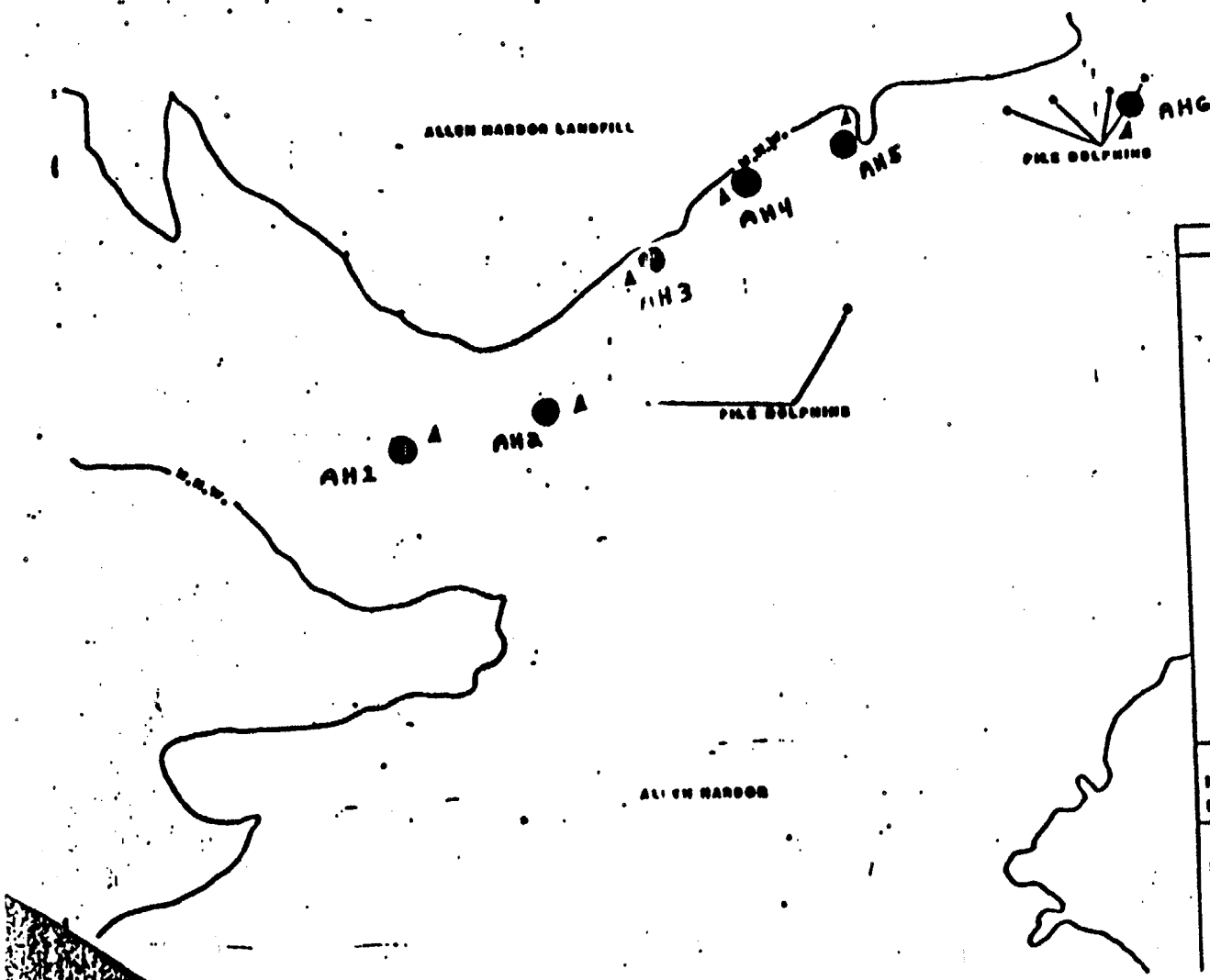

Lawlonx
M-7
Anchors For Guide Wires
ConRail
M-6
M-5
M-4
M-3
M-2
M-1
Fence Post
N
LEGEND
SEDIMENT & MUSSELS
WOODEN STAKES
McALLISTER POINT LANDFILL
NOT TO SCALE
JAN. 22, 1988
FIG. NO. 2

FIGURE 3


Slam-Hammer 1/2 " Steel plate.
3" to 2" adapter
Threaded extension of variable length.
2" PVC pipe
3" to 2" adapter
Rubber flap valve.
5/16 " bolt
Upper limit of acrylic cylinder
2 No. 13 1/2 Rubber stoppers glued top-to-top with 1" D hole bored longitudinally.
3" PVC pipe
Hose clamps
2 7/8" ID x 3"OD x 8' L Acrylic cylinder



LEGEND

▲ SEDIMENT SAMPLE LOCATION

● CLAM SAMPLE LOCATION

NAVAL CONSTRUCTION BATTALION CENTER
DAVISVILLE, RHODE ISLAND

FIGURE 4
SAMPLING LOCATION PLAN
SITE - ALLEN HARBOR LANDFILL

CHAIN OF CUSTODY RECORD

PROJ. NO.

PROJECT NAME: Allen Harbor

SAMPLERS: (Signature) Paul Spano / Nancy L. Amsden

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Metals: Cd, Cr, Cu, Ni, Pb, Zn	PCBs	Total Petroleum Hydrocarbons				REMARKS
AHS #1	3-2-88				Refer to Allen Harbor Sample location Plan	1	✓	✓	✓				1 Tube of sediment
AHS #2	3-2-88				" "	1	✓	✓	✓				" "
AHS #3	3-2-88				" "	1	✓	✓	✓				" "
AHS #4	3-2-88				" "	1	✓	✓	✓				" "
AHS #5	3-2-88				" "	1	✓	✓	✓				" "
AHS #6	3-2-88				" "	1	✓	✓	✓				" "
AHC #1	3-3-88				" "	3	✓	✓	✓				1 doz. soft shell clams "
AHC #1	3-3-88				" "	3	✓	✓	✓				1 doz. Quahogs
AHC #2	3-3-88				" "	4	✓	✓	✓				1 doz. Quahogs
AHC #3	3-3-88				" "	2	✓	✓	✓				" "
AHC #4	3-3-88				" "	2	✓	✓	✓				" "
AHC #5	3-3-88				" "	4	✓	✓	✓				" "
AHC #6	3-3-88				" "	3	✓	✓	✓				" "

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Paul V. Spano	3-4-88 0800	Patricia Gonade			
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

U.S. ARMY CORPS OF ENGINEERS

Appendix II

CHAIN OF CUSTODY RECORD

PROJ. NO.

PROJECT NAME: Gould's Island Point / McAllister Point R.I.

SAMPLERS: (Signature) Paul A. Spanos / Nancy L. Pinsky

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Metals: Cd, Cr, Cu, Ni, Pb, Zn	PCBs	Total Petroleum Hydrocarbons				REMARKS
GI1	01-19-88	1245		✓	Newport Gould's Island #1 (see sample plan)	2	✓	✓	✓				1 bottle of soil, 1 bag of mussels
GI2		1256		✓	" " #2	2	✓	✓	✓				1 bottle of soil, 1 bag of mussels
GI3		1304		✓	" " #3	2	✓	✓	✓				" "
GI4		1313		✓	" " #4	2	✓	✓	✓				" "
GI5		1324		✓	" " #5	2	✓	✓	✓				" "
GI6		1337		✓	" " #6	2	✓	✓	✓				" "
M-1	01-20-88	1530		✓	McAllister Point #1	2	✓	✓	✓				1 bottle of soil, 1 bag of mussels
M-2		1500		✓	" " #2	2	✓	✓	✓				" "
M-3		1440		✓	" " 3	2	✓	✓	✓				" "
M-4		1420		✓	" " 4	2	✓	✓	✓				" "
M-5		1400		✓	" " 5	2	✓	✓	✓				" "
M-6		1340		✓	" " 6	2	✓	✓	✓				" "
M-7		1317		✓	" " 7	2	✓	✓	✓				" "

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Paul A. Spanos	01/21/88 0800	RW Grimaldi			
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

NEW ENGLAND DIVISION WATER QUALITY LABORATORY

REPORT PRODUCED ON 08/24/88 14:07:47

GOULD ISLAND, MCALLISTER POINT AND ALLENS HARBOR
SEDIMENT SAMPLES

Negative values are detection limits and indicate that substance was not detected.

SAMPLE	FIELD DESCRIPTION	Cd (ppm)	Cr (ppm)	Cu (ppm)	Ni (ppm)	Pb (ppm)	Zn (ppm)
3316	GI #1 - SEE PLAN	-2.0	18.0	151.0	-29.0	168.0	126.0
3317	GI #2 - SEE PLAN	3.0	16.0	308.0	-29.0	335.0	253.0
3318	GI #3 - SEE PLAN	6.0	35.0	738.0	31.0	2080.0	251.0
3319	GI #4 - SEE PLAN	3.0	32.0	2270.0	-29.0	1520.0	285.0
3320	GI #5 - SEE PLAN	15.0	34.0	7400.0	37.0	2270.0	515.0
3321	GI #6 - SEE PLAN	-2.0	13.0	160.0	-29.0	126.0	73.0
3322	MP #1 - SEE PLAN	3.0	57.0	1370.0	1340.0	3130.0	2440.0
3323	MP #2 - SEE PLAN	-2.0	69.0	556.0	90.0	814.0	814.0
3324	MP #3 - SEE PLAN	11.0	98.0	25000.0	225.0	4410.0	2410.0
3325	MP #4 - SEE PLAN	12.0	94.0	1220.0	154.0	2290.0	1790.0
3326	MP #5 - SEE PLAN	7.0	2190.0	2810.0	1310.0	587.0	587.0
3327	MP #6 - SEE PLAN	8.0	86.0	3981.0	440.0	3680.0	1760.0
3328	MP #7 - SEE PLAN	-2.0	11.0	16.0	33.0	16.0	67.0
3396	AHS #1 - SEE PLAN	-2.0	10.0	14.0	-30.0	-15.0	39.0
3397	AHS #2 - SEE PLAN	-2.0	10.0	19.0	-30.0	28.0	46.0
3398	AHS #3 - SEE PLAN	3.0	27.0	233.0	42.0	249.0	916.0
3399	AHS #4 - SEE PLAN	5.0	58.0	431.0	106.0	452.0	1290.0
3400	AHS #5 - SEE PLAN	6.0	101.0	299.0	107.0	502.0	1160.0
3401	AHS #6 - SEE PLAN	-2.0	9.0	21.0	-28.0	26.0	2300.0

NEW ENGLAND DIVISION WATER QUALITY LABORATORY

REPORT PRODUCED ON 08/24/88 14:08:47

GOULD ISLAND, MCALLISTER POINT AND ALLENS HARBOR
SEDIMENT SAMPLES

Negative values are detection limits and indicate that substance was not detected.

SAMPLE	FIELD DESCRIPTION	Total PCBs (ppm)	Petroleum Hydrocarbons (ppm)
3316	GI #1 - SEE PLAN	0.02	100.0
3317	GI #2 - SEE PLAN	0.02	100.0
3318	GI #3 - SEE PLAN	0.04	160.0
3319	GI #4 - SEE PLAN	0.30	300.0
3320	GI #5 - SEE PLAN	0.13	230.0
3321	GI #6 - SEE PLAN	0.04	160.0
3322	MP #1 - SEE PLAN	0.49	480.0
3323	MP #2 - SEE PLAN	0.66	300.0
3324	MP #3 - SEE PLAN	2.03	400.0
3325	MP #4 - SEE PLAN	1.58	330.0
3326	MP #5 - SEE PLAN	0.07	170.0
3327	MP #6 - SEE PLAN	0.86	1100.0
3328	MP #7 - SEE PLAN	0.01	30.0
3396	AHS #1 - SEE PLAN	0.02	50.0
3397	AHS #2 - SEE PLAN	0.03	120.0
3398	AHS #3 - SEE PLAN	1.02	290.0
3399	AHS #4 - SEE PLAN	5.26	1800.0
3400	AHS #5 - SEE PLAN	1.16	2100.0
3401	AHS #6 - SEE PLAN	0.08	150.0

NEW ENGLAND DIVISION WATER QUALITY LABORATORY

REPORT PRODUCED ON 08/24/88 14:09:58

GOULD ISLAND, MCALLISTER POINT AND ALLENS HARBOR
TISSUE SAMPLES

Negative values are detection limits and indicate that substance was not detected.

SAMPLE	FIELD DESCRIPTION	Cd (ppm)	Cr (ppm)	Cu (ppm)	Ni (ppm)	Pb (ppm)	Zn (ppm)
3329	GI #1 - SEE PLAN	-0.4	-2.0	2.0	-6.0	-3.0	19.0
3330	GI #2 - SEE PLAN	-0.4	-2.0	1.9	-6.0	-3.0	25.0
3331	GI #3 - SEE PLAN	-0.4	-2.0	2.4	-0.6	-3.0	25.0
3332	GI #4 - SEE PLAN	-0.4	-2.0	4.6	-7.0	-3.0	21.0
3333	GI #5 - SEE PLAN	-0.4	-2.0	3.3	-6.0	-3.0	20.0
3334	GI #6 - SEE PLAN	-0.4	-2.0	2.0	-7.0	-3.0	21.0
3335	MP #1 - SEE PLAN	-0.4	-2.0	1.4	-6.0	-3.0	18.0
3336	MP #2 - SEE PLAN	-0.4	-2.0	2.8	-6.0	-3.0	23.0
3337	MP #3 - SEE PLAN	-0.4	-2.0	1.6	-6.0	-3.0	23.0
3338	MP #4 - SEE PLAN	-0.4	2.0	1.5	-7.0	-3.0	18.0
3339	MP #5 - SEE PLAN	-0.4	-2.0	-1.4	-7.0	-3.0	16.0
3340	MP #6 - SEE PLAN	-0.4	-2.0	-1.4	-6.0	-3.0	14.0
3341	MP #7 - SEE PLAN	-0.4	-2.0	-1.4	-7.0	-3.0	15.0
3402	AHC #1 - SEE PLAN-SS	-0.4	4.9	6.3	-7.0	-3.0	21.0
3403	AHC #1 - SEE PLAN	-0.4	-2.0	2.2	-6.0	-3.0	12.0
3404	AHC #2 - SEE PLAN	-0.4	-2.0	4.3	-6.0	-3.0	19.0
3405	AHC #3 - SEE PLAN	-0.4	-2.0	5.4	-6.0	-3.0	16.0
3406	AHC #4 - SEE PLAN	-0.4	-2.0	4.9	-7.0	-3.0	17.0
3407	AHC #5 - SEE PLAN	-0.4	-2.0	3.5	-6.0	-3.0	19.0
3408	AHC #6 - SEE PLAN	-0.4	-2.0	3.2	-7.0	-3.0	12.0

NEW ENGLAND DIVISION WATER QUALITY LABORATORY

REPORT PRODUCED ON 08/24/88 14:10:53

GOULD ISLAND, MCALLISTER POINT AND ALLENS HARBOR
TISSUE SAMPLES
Negative values are detection limits and indicate that substance was not detected.

SAMPLE	FIELD DESCRIPTION	Total PCBs (ppm)	Petroleum Hydrocarbons (ppm)
3329	GI #1 - SEE PLAN	0.36	
3330	GI #2 - SEE PLAN	0.20	
3331	GI #3 - SEE PLAN	0.15	
3332	GI #4 - SEE PLAN	0.04	
3333	GI #5 - SEE PLAN	0.07	
3334	GI #6 - SEE PLAN	0.14	
3335	MP #1 - SEE PLAN	0.12	
3336	MP #2 - SEE PLAN	0.05	
3337	MP #3 - SEE PLAN	0.01	
3338	MP #4 - SEE PLAN	0.30	
3339	MP #5 - SEE PLAN	0.03	
3340	MP #6 - SEE PLAN	0.05	
3341	MP #7 - SEE PLAN	0.04	
3402	AHC #1 - SEE PLAN-SS	0.03	
3403	AHC #1 - SEE PLAN	0.04	
3404	AHC #2 - SEE PLAN	0.04	
3405	AHC #3 - SEE PLAN	0.02	
3406	AHC #4 - SEE PLAN	0.02	
3407	AHC #5 - SEE PLAN	0.01	
3408	AHC #6 - SEE PLAN	0.02	

U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

VOLUME III-2
-OLD FIRE FIGHTING TRAINING AREA-
SITE 09

PHASE II RI/FS
WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared by:
TRC Environmental Corporation
Windsor, Connecticut

Prepared for:
Northern Division - Naval Facilities
Engineering Command
Lester, Pennsylvania

March, 1993

TRC
TRC Environmental Corporation

TRC-EC Project No. 6760-N81-110
Contract No. N62472-86-C-1282

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1.0 INTRODUCTION

The objective of this volume of the Work Plan is to define the level of Phase II investigation necessary to assess the nature and extent of environmental contamination at Site 09, the Old Fire Fighting Training Area site located on the NETC. This volume of the Work Plan describes site-specific objectives in Section 1.1, summarizes available site background information in Section 2.0, presents the site-specific field sampling activities in Section 3.0, and summarizes site-specific health and safety information in Section 4.0.

1.1 SITE-SPECIFIC INVESTIGATION OBJECTIVES

The general objectives of the RI site investigation are to determine the nature and extent of site contamination, sources of contamination, potential contaminant migration pathways, potential contaminant receptors, and associated exposure pathways. This information is necessary to determine whether, and to what extent, a threat to human health or the environment exists, and to provide the information required to develop and evaluate remedial action alternatives for the site, as necessary.

The scope of the Phase I and Phase II sampling efforts for this site have been developed to meet site-specific RI/FS objectives. The site-specific objectives have been refined based upon the findings of the Phase I RI. Below is a list of the RI objectives for the Old Fire Fighting Training Area site investigation:

- determine the site background soil and ground water quality;
- determine the nature and extent of site surface soil contamination;
- determine the nature and extent of site subsurface soil contamination;
- determine the nature of the soil mounds on the site;
- determine the nature and extent of ground water contamination;
- determine the nature and extent of sediment and biota contamination in the adjacent bay.

The Phase II site investigation is being conducted to address areas of concern discovered under the Phase I investigation and any site investigation data gaps. The Phase II investigation activities will include geophysical surveys, surface soil sampling, soil boring sampling, test pit excavation and sampling, and monitoring well installation and sampling. Soil and ground water samples will be collected from the site and analyzed as described in Section 3.0 of this plan. The initial Phase I investigation of the sediment and biota in the bay adjacent to the site will be conducted prior to this Phase II investigation.

2.0 SITE BACKGROUND INFORMATION

2.1 SITE LOCATION AND DESCRIPTION

The site occupies approximately 5.5 acres at the northern end of Coasters Harbor Island. The location of the site on the NETC is shown on Figure 1. Presently, the site contains a child care facility, picnic area, playground, and baseball field. The only unique topographic features at the site are two soil mounds: one that is approximately 15 feet high located in the center of the site, and another that is approximately 6 feet high located in the western corner of the site. A map of the site is presented on Figure 2 and site topography is shown on Figure 2A.

2.2 SITE HISTORY

This site was used from World War II to 1972 as a fire fighting training area. A 1943 construction drawing for the Fire Fighting Training Area shows how it appeared when operational. The site details from the 1943 drawing are provided on Figure 3. It is believed that the two buildings labeled "Carrier Compartment" had a water/oil mixture injected into them which was set on fire for fire fighting practice. Underground piping carried the water/oil mixture to the buildings and from the buildings to the oil-water separator shown on the figure.

2.2.1 Aerial Photography

Aerial photos and facility maps were reviewed for the period from 1939 through 1988. Activity on the site dates back to 1943, with a site map which indicated the locations of structures and site features associated with fire fighting training exercises. Based on this map and subsequent facility maps, on-site structures included an administration building, hose house, two carrier compartments, smothering pit, separator pit, foam pit, simulated ship structures, suction pumps and oil tanks.

The structure currently used as a day care center was used as "wash and dressing rooms". No significant visible site changes are noted until 1975, when all structures and facilities associated with the fire fighting training area no longer exist, with exception of the hose house and day care center structure. As of 1987, the site appears similar to its current

condition, with soil mounds visible in the central and western portions of the site and a pavilion in the east-central portion of the site.

2.3 PREVIOUS SITE INVESTIGATIONS

This site was not investigated in detail during the IAS and was not studied in the CS. The site was not studied in the CS because the conclusions of the IAS stated that the site did not warrant any further action. It was decided by the Navy to investigate the site further after the discovery of oily subsurface soils during a 1987 geotechnical boring investigation related to the planned expansion of the on-site child care facility.

The Phase I RI site activities included a soil gas survey, geophysical surveys, surface soil sampling, soil boring sampling, and monitoring well installation and sampling. The findings and results of the Phase I site RI are presented below:

Soil Gas Survey - A total of 81 soil gas points were installed on a 50 foot grid system during the Phase I soil gas exploration program. In general, elevated soil gas readings were obtained in the central portion of the site. Subsequent soil gas analysis of two of these points the next day confirmed the elevated readings, although a lesser total VOC concentration was observed.

Soil Assessment - Volatile organic compounds (VOCs), base neutral/acid extractable organic compounds (BNAs), pesticides, polychlorinated biphenyls (PCBs), and inorganics were all detected in on-site soils. The major areas where contaminants were detected in the soils at elevated levels include the following:

- Northern area - VOCs, BNAs, and inorganics;
- Central area - VOCs, and inorganics
- Western area - BNAs;
- Eastern area - BNAs, carcinogenic PAHs, and inorganics; and
- Southern area (off-site) - BNAs.

Significant VOC contamination (i.e., greater than 1 ppm total VOCs) was detected in subsurface soils at the depth of the water table in the central portion of the site (B-6) and in the north central portion of the site (M-2). In the central portion of the site, detected contaminants

were petroleum-related VOCs, while in the northern area, only 2-butanone was detected. Soil samples collected at both of these locations generally exhibited petroleum odors and/or visible oil contamination.

BNAs were detected at elevated levels (i.e., greater than 10 ppm total BNAs) in the northern, western, and eastern portions of the site. The subsurface samples collected from the western portion of the site (at B-7) exhibited a strong petroleum odor. BNAs were also detected at levels greater than 10 ppm at the off-site well boring (M-5). Carcinogenic PAHs were detected at levels greater than 1 ppm, but total BNA concentrations were less than 10 ppm in samples collected from the eastern portion of the site. Pesticides were detected at low levels (i.e., 10's of ppb) in surface soil samples across the site. One surface soil sample (SS-01) exhibited PCBs at 80 ppb, well below the 10 ppm RIDEM PCB soil action level. PCBs were not detected in any other soil samples.

Inorganics were detected at levels exceeding background levels in soil samples collected throughout the central and eastern portions of the site. The highest inorganic levels were generally detected in subsurface soils collected at well location M-2, in the northern portion of the site, although background inorganic levels were also exceeded at boring B-1. A single soil sample (SS-02) collected within the playground area of Building #144 indicated 2 ppb tetrachloroethene, 1,751 ppb total PAHs, 671 ppb total carcinogenic PAHs and pesticides 7.2 ppb (4-4'-DDE) and metals at concentrations consistent with or lower than other surface soils collected at the site. The presence of the PAHs may be due to pieces of roofing paper reported in the sample.

Ground Water Assessment - VOCs, BNAs, and inorganics were detected in site ground water samples. The major areas of the site where contaminants were detected at levels exceeding action levels include the following:

- Northern area - BNAs and inorganics;
- Central area - inorganics;
- Western area - inorganics;
- Eastern area - inorganics; and
- Southern area (off-site) - inorganics.

VOCs were not detected at concentrations exceeding ground water action levels in any of the site ground water samples. However, at well location M-4, elevated soil gas readings in the soil, petroleum odors in the soil and ground water samples, and a sheen on the ground water sample indicate a potential for subsurface VOC contamination in this area. Elevated soil gas readings, petroleum odors and/or sheens were also observed in association with other well locations at this site.

Four BNA compounds were detected above ground water action levels in one well (MW-2) in the northern portion of the site. A strong petroleum odor and sheen were observed during ground water sampling at this well. No pesticides or PCBs were detected in ground water samples.

While inorganic concentrations exceeded ground water action levels in all of the site well samples, including the background well, the highest levels of inorganic analytes were detected in samples from the wells located in the central to northern portions of the site.

2.4 SITE GEOLOGY

A previous geotechnical study conducted on the site, along with soil boring activities completed during the Phase I site RI, provided information on the geology of the site. Previous activities included the drilling of three geotechnical borings on the site near the existing, on-site child care facility.

Subsurface investigation activities conducted under this investigation included the drilling and sampling of six (6) test borings and five (5) well borings. The locations of these Phase I borings and wells are shown on Figure 5.

The overburden materials across a majority of the site consist of fill over till deposits. Fill was encountered over most of the site, generally ranging in thickness from 0 to 4 feet. The fill consists primarily of fine sand and silt and construction-type debris (i.e., brick, concrete, asphalt).

The native overburden deposits at the site can be divided into three general types: a very tight sand and gravel till (encountered across the entire site), a silt and fine sand till (similar to that encountered at the McAllister Point Landfill site and Melville North Landfill site; present at the background well location (MW-5)), and an organic, swampy muck encountered in boring

B-5, completed along the shoreline of Narragansett Bay. The sand and gravel till was present overlying the silt and fine sand layer at the location of well MW-5.

The previous investigation boring logs indicate that bedrock, composed of sandstone, was encountered at depths of 5.5 to 10.2 feet below grade. Bedrock was encountered in only one Phase I RI borings (M-1). Bedrock was present at a depth of 9 feet in this boring and consisted of brown-gray sandstone.

2.5 SITE HYDROLOGY

The following are discussions on the site surface water hydrology and ground water hydrology.

Surface Water Hydrology

No surface water bodies are present on the Old Fire Fighting Training Area site. The general site topography slopes slightly in a southern to northern direction. Narragansett Bay borders the site along its northern edge.

Along the southern edge of the site is a curbed road which likely deters any surface water runoff from flowing onto the site. Surface water runoff (precipitation) from the site either evaporates, infiltrates into the site soils, ponds on-site, or flows directly into the Narragansett Bay.

Small ponded areas were observed on-site during periods of heavy rainfall. The site shoreline is at an elevation slightly higher than the beach along the bay.

Ground Water Hydrology

Ground water levels were measured in the five monitoring wells installed as part of the Phase I site RI in June and September of 1990, and in January of 1991. A representative ground water table contour map for the site is presented as Figure 4. The water level measurements and resulting contour maps indicate that site ground water is flowing to the north.

Single well hydraulic conductivity tests (slug tests) were also performed at two of the monitoring wells at the site (MW-4 and MW-5). Monitoring wells MW-4 and MW-5 are both

screened in the till overburden. The hydraulic conductivities determined for the till were 0.44 ft/day (MW-4) and 0.29 ft/day (MW-5).

- Horizontal Hydraulic Gradients

Horizontal hydraulic gradients were determined from the Phase I site RI water level measurements at the site. Average horizontal gradients ranged from 0.0040 ft/ft (MW-3 to MW-4) to 0.0068 ft/ft (MW-1 to MW-2).

- Average Linear Velocities

The calculated average horizontal hydraulic gradients, along with hydraulic conductivity and effective porosity values, were used to calculate average linear velocity values at the site. A hydraulic conductivity of 0.30 ft/day, an average of the hydraulic conductivities determined by the slug tests performed at the site, was used in the calculations. An effective porosity of 15% was assumed for the till at the site (Driscoll, 1986).

Average linear velocities of the shallow ground water ranged from 0.0080 ft/day (MW-3 to MW-4) to 0.014 ft/day (MW-1 to MW-2). It is important to note that the above calculated average linear velocity values are lower than the "true microscopic velocities" because water particles must travel along irregular paths that are longer than the linearized paths represented by the calculated average linear velocities (Freeze and Cherry, 1979). In addition, the estimated effective porosity value of 15% for the till at the site may be too high or low, causing the linear velocity estimates to be too low or high respectively.

- Tidal Influence

Continuous water level measurements were recorded in all five of the Phase I RI monitoring wells at the site for three days (August 27 to August 30, 1990). Water levels were recorded every 15 minutes during the three-day time period. Tidal influences were seen in monitoring wells MW-2 and MW-4. No tidal effects were exhibited in wells MW-1, MW-3, or MW-5. The maximum fluctuation of the ground water table (0.91 feet) was observed in well MW-2. No gauging station was constructed at the Old Fire Fighting Training Area site to measure the tidal fluctuation in the bay during this time period. Although a six-hour tidal fluctuation was identified in the ground water elevation data.

3.0 SAMPLING PLAN

3.1 INTRODUCTION

The program of investigation described in this section has been developed to achieve both overall and site-specific project objectives. Field sampling methodology for individual investigation activities (e.g., soil gas survey, surface soil sampling) is described in Appendix B. The quality assurance/quality control procedures for field sampling and laboratory analyses are presented in the project Quality Assurance Project Plan (QAPP) provided in Appendix D. A summary of the Phase II Old Fire Fighting Training Area site sampling program is presented in Table 1. The planned Phase II sample locations are shown on Figure 6.

3.2 RECONNAISSANCE SURVEYS

Prior to initiating sampling activities a site walkover will be conducted by field investigation team members to familiarize themselves with the current site conditions. An attempt will be made to conduct this survey during the spring, however, schedule constraints may dictate initiation of the survey at another time of the year. The site will be visually surveyed with respect to any changes in site access restrictions, the Phase I monitoring well locations, and the planned Phase II sampling locations. Site-specific health and safety considerations, including emergency evacuation procedures, will be reviewed during the visit. Pertinent features, such as overhead and subsurface utilities, and other potential hazards will also be reviewed with Navy personnel with respect to affected sampling activities.

During the site walkover survey, a Phase II baseline ambient air survey will be conducted across the site. The ambient air survey will be conducted with either a flame or photo-ionization detector to assess ambient conditions for the presence of volatile organic compounds (VOCs) and establish the Phase II site baseline conditions. The ambient air surveys will be completed using equipment and methods outlined in the Field Sampling Methodology Plan provided as Appendix B of this Work Plan.

3.3 GEOPHYSICAL SURVEYS

Electromagnetic conductivity (EM-31), magnetometer, and seismic refraction surveys are planned at this site. In Phase I, EM and magnetometer surveys were completed on a 50-foot spaced grid across the site. The Phase II follow-up EM and magnetometer surveys will be used to relocated and further define the extent of anomalies detected in the Phase I survey and the extent of any salt water intrusion at the site.

The EM and magnetometer geophysical surveys will be conducted along the 10-foot spaced traverses in the central mounded area and in the small western mounded area of the site and at 50-foot spaced traverses along the shoreline edge of the site. In addition to recording EM readings at grid points and the top of the bank, continuous EM readings will be also observed between grid points. Any EM readings which are observed to significantly deviate from normal (e.g., negatives, highs, lows) between the grid points will also be recorded.

A seismic refraction survey will be conducted across the site to aid in characterizing the bedrock topography beneath the site. The seismic survey will also aid in characterizing the overburden materials. The seismic survey specifications (e.g., spread lengths geophone spacing) will be determined and established by the geophysical subcontractor prior to the survey activities. This information will be forwarded to the EPA and RIDEM prior to the survey for review and comment. The location of planned geophysical surveys is provided on Figure 6A.

The findings of the Phase II geophysical surveys will be reviewed with the EPA and RIDEM to determine the need to modify any of the planned Phase II soil or ground water investigation activities.

3.4 SOIL GAS SURVEY

A soil gas survey is planned at this site to aid in investigating potential upgradient contamination observed in the form of SVOCs in soil at an upgradient boring (MW-5) during Phase I exploration activities. The survey will also investigate the presence of upgradient subsurface petroleum-related contamination reportedly observed in utility trenches in this area. The soil gas survey will be conducted on a 100-foot grid just south of the site. It is estimated that approximately twelve (12) soil gas points will be sampled. The approximate location of soil gas survey points is shown on Figure 6B. As is necessary, additional soil gas survey points will

be completed around points indicating elevated concentrations of soil gas to further locate "hot spots".

The soil gas survey will be conducted with a van-mounted hydraulic probe device and field gas chromatograph. The portable GC will be used to identify the concentrations of individual VOCs and a total VOCs concentration. The soil gas sampling and analysis methodology is presented in the Field Sampling Methodology discussion provided in Appendix B of this Work Plan.

3.5 SOIL SAMPLING

Soil samples will be collected as surface soil samples, test pit samples, and soil boring samples under this site investigation. Below is a discussion on each of the planned soil sampling activities.

3.5.1 Surface Soil Sampling

Surface soil samples will be collected from twelve (12) locations (SS-12 to SS-22) on the site. The planned locations of the surface soil samples are shown on Figure 7. These samples will be collected from the following general locations: around areas of documented Phase I surface soil contamination, surface soil areas not sampled in Phase I, and the site shoreline. The rationale for each of the planned surface soil samples is presented in Table 2.

In addition, three (3) "background" surface soil samples (SS-24, SS-25 and SS-26) will be collected from locations in the park just south of the eastern end of the site. An attempt will be made to select background soil sample locations believed to be representative of site background soil conditions and away from other potential sources of contamination (e.g., roadways). The proposed locations for the background samples will be confirmed with the EPA and RIDEM during a site visit prior to the surface soil sampling activities.

Surface soil sampling will be conducted according to the method described in the Field Sampling Methodology Plan provided in Appendix B of this Work Plan. Surface soil samples will be analyzed for the full organic target compound list (TCL) and inorganic target analyte list (TAL). In addition, shore line samples which may be periodically inundated (SS-19 to SS-23) will also be analyzed for TOC and grain size.

Surface soil samples will also be collected from each of the planned test and well boring locations, as described in Section 3.4.2 of this plan. The 0- to 1-foot portion of the first 2-foot split spoon sample will be collected as the surface soil sample at each boring location consistent with EPA Region I risk assessment requirements. The soil boring samples will also be analyzed for the full TCL/TAL. The VOC fraction of surface soil samples will be collected as a discrete increment from the 0.5 to 1 foot portion of the first split spoon as described in Appendix B. Soil for the remaining analytical fractions will be homogenized prior to filling sampling containers.

3.5.2 Soil Boring Sampling

Test borings will be completed and sampled at eleven (11) locations (B-8 to B-18) across the site. In addition, soil samples will be collected from the Phase II site well borings planned at six (6) different well locations. The planned test boring and monitoring well locations are shown on Figures 8 and 10, respectively.

Test borings are planned to further investigate the characteristics of the soil at the site and the extent of subsurface soil contamination detected in Phase I. The Phase II test boring rationale is presented in Table 3. The well borings are associated with the Phase II ground water monitoring wells planned for the site. The Phase II monitoring well rationale is discussed in Section 3.5 and presented in Table 4.

Soil samples will be collected continuously from the on-site soil borings to the depth of competent bedrock (estimated on-site to be approximately 6 to 10 feet below ground surface). Split spoon soil samples will be screened with an OVA and Hnu immediately upon being opened. A 10-foot Nx (2 63/64" O.D. core) core of the bedrock will be collected at each of the planned four bedrock well locations. Well borings completed at well locations planned for only a shallow well will be tremie backfilled with a cement/bentonite, as necessary, for the placement of a well screen which intercepts the ground water table. A 1/2 to 1 foot sand layer will be placed between the top of the cement/bentonite slurry and bottom of the well screen.

A minimum of two soil samples will be collected from each of the on-site soil borings for the full TCL/TAL analysis. The two soil samples which will be submitted for laboratory analysis will include the soil samples collected from the 0- to 2-foot interval (the 0- to 1-foot

portion for analysis) and from the last sample interval of the observed fill material. If insufficient sample volume is present within the 0 to 1 foot portion of the split spoon (i.e. recovery is low), additional sample volume will be collected using either hand auguring procedures (non-VOC fractions), or from a second split spoon collected immediately adjacent to the first. If signs of potential contamination (e.g., oil, stains, odors) are observed in a boring, a third sample will also be collected from the depth of greatest observed contamination (i.e., most stained or oily, highest OVA/Hnu reading). If no fill material or signs of potential contamination are observed in a boring, only the surface sample and sample from directly above the water table will be submitted for laboratory analysis.

In addition, to the soil samples collected for chemical analyses, a soil sample from just below the depth of the water table (i.e., within the saturated zone) will also be collected from each well location for total organic carbon (TOC) analysis, cation exchange capacity analysis, and grain size determination. The information from these tests will be used in evaluating ground water treatment options.

Geologic descriptions and other sample characteristics (e.g., stains, odors) and observations (e.g., OVA/Hnu readings, depth to water) will be recorded in a field notebook.

3.5.3 Test Pit Sampling

Test pits will be excavated at the site to investigate the characteristics of the soil mounds in the western and central portions of the site. The findings of the Phase I geophysical surveys indicated the presence of significant electromagnetic and magnetic anomalies in or beneath the soil mound located in the central portions of the site. In addition, a magnetic anomaly was detected on a mound in the western corner of the site. The locations of the Phase I geophysical anomalies along with the proposed test pits are shown on Figure 9. As described in Section 3.3, geophysical surveys will again be conducted in Phase II to aid in relocating and further defining the extent of the anomalies.

The findings of the Phase II geophysical survey will be reviewed to determine if the planned test pit locations should be moved or if any other test pits should be excavated at the site. The planned test pits would be moved or additional test pits excavated only if the geophysical surveys indicate the presence of a geophysical anomaly outside of an area already

planned for investigation with a test pit. Significant findings of the geophysical surveys will be reviewed with the EPA and RIDEM to assess the need for any modifications to the test pit program prior to initiation.

The test pits will be excavated with a backhoe. The test pits will be completed to the depth of the observed water table or the encountered source of the anomaly. Ground water is anticipated to be at a depth of approximately five to six feet below the average site grade; however, the depth to water will increase when excavating in the elevated above-grade mound.

One to three soil samples will be collected from each of the five (5) test pit areas (TP-1 to TP-5). If fill or signs of contamination (e.g., odors, staining) are noticed during test pitting operations, three samples will be collected from the area. One sample will be collected from the bottom of the test pit and the other two will be collected from the side walls. If no evidence of contamination is noted, only one sample will be collected from the bottom of the test pit area. If only demolition-like debris material (e.g., concrete, wood, asphalt) is observed in the pit, one sample will be collected of the fill material from the test pit. Test pit soil/fill samples will be analyzed for the full TCL/TAL.

All excavated soils will be segregated as visually clean (or surface) and potentially contaminated (i.e., oily) in separate lined, box roll-off containers. All test pits will backfilled at the completion of each days activities. If potentially contaminated soils (e.g., oily, stained, petroleum odors) are encountered in a test pit, the soils will only be backfilled to within two feet of the surrounding land surface grade. Efforts will be made to remove and contain any soils which are observed to be heavily contaminated during test pit excavation activities. The last two feet of these test pits will be filled and graded with clean topsoil by the Navy. Attempts will also be made to replace the excavated test pit soil in the order in which it was removed (i.e., test pit bottom soils back in the pit first). All completed test pit locations will be fenced off and grass seeded. The rationale for test pit locations is provided as Table 5.

3.6 GROUND WATER SAMPLING

Monitoring wells were installed at five locations in Phase I (MW-1 through MW-5). Shallow ground water table wells were installed at each of the locations.

In Phase II, a total of ten (10) monitoring wells are planned at six (6) new locations. The planned Phase II well locations consist of three (3) shallow ground water table wells and three (3) shallow ground water table wells paired with bedrock wells. In addition, one new bedrock well will be installed at one of the Phase I shallow well locations (MW-2R).

Generally, the monitoring wells are planned to further assess the nature and extent of ground water contamination detected at the site in Phase I. The planned locations of the monitoring wells are shown on Figure 10. In general, the monitoring wells are located to determine the ground water quality upgradient of the site, the ground water quality at the downgradient edges of the site, the extent of site ground water contamination. Completion of upgradient wells will provide information on background ground water metals concentrations and subsurface conditions (geology, hydrogeology). The rationale for each of the planned well locations is provided in Table 4. Ground water samples will be collected from each of the monitoring wells. Wells will be developed after installation. Water levels will be measured in the wells after development and just prior to well purging. The procedures for well development, purging, and sampling are provided in the Field Sampling Methodology Plan provided in Appendix B.

Ground water samples will be analyzed for the full TCL/TAL and total chloride. In addition, the temperature, pH, conductivity, dissolved oxygen, redox potential, and salinity of each ground water sample will be measured in the field immediately following sample collection. Five of the ground water samples (three shallow and two bedrock) will also be field filtered for dissolved metals analysis, and analyzed for BOD, COD, and total suspended solids for ground water treatability information. Field filtering procedures are described in Section 7.5 of Appendix B.

In addition to collecting ground water samples from the monitoring wells and obtaining routine water level measurements, single well hydraulic conductivity testing (i.e., slug tests) will be performed on several of the site monitoring wells. Slug tests will be performed on site monitoring wells to aid in determining the characteristics of the site aquifers. Both rising and

falling head slug tests will be performed on newly installed bedrock wells, or wells which fully penetrate the water table. Rising head slug tests will be performed on wells which are screened across the water table.

3.7 STORM SEWER SAMPLING

To address observations of an oily sheen flowing from an outfall pipe at the northwestern portion of the site into Narragansett Bay two surface water samples (ST-1 and ST-2) will be collected. These samples will be collected from a storm water sewer pipe just upgradient of the site (ST-1) and at its outfall adjacent to the site (ST-2). These locations are shown on Figure 6. These samples will be analyzed for full TCL/TAL parameters.

3.8 LAND SURVEY

Following completion of field sampling activities the site will be surveyed by a State of Rhode Island registered surveyor. The location and elevation of the Phase II sampling points will be determined in the survey. Each sampling location will be referenced to the State of Rhode Island Grid Coordinate System. Completed monitoring wells will be surveyed for elevation at the top of the protective casing, top of the well casing, and adjacent land surface. Elevations will be referenced to mean low water (mlw) and a United States Geological Survey benchmark to the nearest 0.01 foot. The Phase II survey information will be added to the final Phase I site survey map.

4.0 SITE-SPECIFIC HEALTH AND SAFETY SUMMARY

4.1 INTRODUCTION

The purpose of this health and safety discussion is to summarize the site-specific health and safety information. This section describes the nature of wastes or contamination suspected and present at the site, the site access and work zones, and the initial level of personnel protection and monitoring planned for each site investigation activity. In addition, a list of site emergency contacts and maps of the route to the Newport Hospital from the site are provided as Table 6 and Figures 11 and 11A, respectively.

4.2 NATURE OF WASTES

Historical information indicates that the site was used over a period of nearly 30 years for fire fighting training exercises by the Navy. Waste oils were reportedly burned at the site during the training exercises. Historical maps and aerial photos indicate the prior existence of fuel sumps and above-ground tanks on the site.

While conducting a geotechnical soil boring investigation for the expansion of the on-site child day care center, oil was discovered in the site soils at a depth of approximately 5 feet below the surface. The Phase I RI findings indicates the presence of elevated levels of volatile organic compounds, polynuclear aromatic hydrocarbons, and metals in site soils. The highest levels of VOCs, BNAs, and metals were generally detected in the central portion of the site. Oily soils and petroleum-like odors were also observed during the drilling activities in the central portion of the site.

Elevated levels of base neutral/acid extractable organic compounds and metals were detected in the site ground water. Levels of VOCs were also detected in the site ground water, but none at levels exceeding action levels. Petroleum-like odors and sheens were also observed during ground water sampling activities at several of the on-site wells.

4.3 SITE ACCESS/WORK ZONES

This site will not have a permanent support zone, contamination reduction zone, or exclusion zone. Given that this site is currently being used in part as a public park, only the immediate area surrounding each of the subsurface soil investigation activities (e.g., drilling, excavation) will be cordoned off from the rest of the site. During these activities, a minimum distance of 25-feet surrounding each of the drilling and test pit excavation locations will be marked off with caution tape or barricades. Test pit areas will also be surrounded by temporary snow fence to aid in deterring any unauthorized entry into the area.

A contamination reduction station, or personnel decontamination area, will be established adjacent to each of the location-specific exclusion zones. All personnel exiting the exclusion zone (work area) must pass through a decontamination area prior to entering the support zone vehicles or leaving the site. Personnel shall undergo appropriate decontamination, as required by the activity-specific procedures and level of personnel protection. Split spoon decontamination will be conducted in a designated area just south of the site, adjacent to Building 158. Given the relative open public access to the site, a heavy equipment decontamination area will not be constructed on the site. The heavy equipment area established at Site 01 in Phase I will also be used for this investigation.

The support zone for this site will be the company vehicles used by the field investigation crew. The vehicles will be located in the nearby parking areas along the Taylor Drive which borders the site to the south. The vehicles will provide temporary relief from any adverse weather conditions and will store necessary field sampling and safety/emergency equipment (e.g., car phone, first aid kit, drinking water, HASP). The command center for the RI activities will be at a portable field office trailer located on Site 13.

The OSC or alternate will be responsible for keeping nonessential personnel outside of the exclusion zone boundaries during the investigation activities. In the event that authorized visitors are present on the site during field activities, the OSC or designee shall insure that they adhere to site safety requirements and maintain a safe distance outside of the exclusion zone. All personnel allowed to enter the exclusion zone shall be required to follow safety procedures described in the project HASP in Appendix C and directions of the OSC.

Disposal of field-generated materials (e.g., PPE, decon solutions) is described in the Investigation Derived Waste Plan provided in Appendix E of this Work Plan.

4.4 PERSONNEL PROTECTION AND MONITORING

Based on the findings of the Phase I RI and suspected site contaminants, the field investigation activities will be initiated in either Level D or Level C personnel protection (as defined in the HASP in Appendix C). A list of anticipated initial levels of personnel protection for each of the specific investigation activities is presented in Table 6. Levels of personnel protection will be upgraded or downgraded as conditions dictate.

During field sampling activities, continuous monitoring of ambient air will be conducted with an OVA and Hnu. During drilling and test pit excavation activities, continuous ambient monitoring of combustible gas levels will also be conducted with an LEL/O2 meter. Air monitoring will also be performed "downhole" during drilling and directly downwind of the test pits during excavation activities.

TABLES

TABLE 1

SITE 09 – OLD FIRE FIGHTING TRAINING AREA
SITE INVESTIGATION SUMMARY

ACTIVITY / SAMPLE MATRIX	SCOPE OF WORK	NUMBER OF SAMPLES	SAMPLE ANALYSIS
GEOPHYSICS			
EM–31	50' & 10' Spacing	NA	NA
Magnetometer	50' & 10' Spacing	NA	NA
Seismic Refraction	Multiply traverses	NA	NA
SOIL GAS	1 Area	16 Points	Modified 601/602
SURFACE SOIL	15 Locations	15 5	TCL/TAL TOC, Grain Size
TEST BORING SOIL	11 Locations	22 – 33	TCL/TAL
WELL BORING SOIL	6 Borings	12 – 18 6	TCL/TAL TOC, Cation Exchange Grain Size
TEST PIT SOIL	5 Locations	5 – 15	TCL/TAL
GROUND WATER	10 new wells at 6 locations; 6 shallow wells & 4 shallow bedrock wells	10 5	TCL/TAL, Chloride Dissolved TAL, BOD, COD, TSS
	5 existing wells	5	TCL/TAL, Chloride
STORM SEWER	2 Locations	2	TCL/TAL, Chloride

Note: "NA" indicates that activity is not applicable.
TCL indicates sample will be analyzed for Target Compound List.
TAL indicates sample will be analyzed for Target Analyte List.

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TABLE 2

Site 09 - Old Fire Fighting Training Area
Surface Soil Location / Rationale

SAMPLE NUMBER	LOCATION / RATIONALE
SS-12	Characterize surface soil quality near the day care center.
SS-13	Determine extent of Phase I detected PCB contamination of surface soils in the eastern portion of Site 09.
SS-14	Determine extent of Phase I detected PCB contamination of surface soils in the eastern portion of Site 09.
SS-15	Determine extent of Phase I detected PCB contamination of surface soils in the eastern portion of Site 09.
SS-16	Characterize surface soil quality in the southwestern portion of Site 09.
SS-17	Characterize surface soil quality in the southwestern portion of Site 09.
SS-18	Characterize surface soil quality in the northwestern portion of Site 09.
SS-19	Further investigate Site 09 shoreline soil/sediment quality.
SS-20	Further investigate Site 09 shoreline soil/sediment quality.
SS-21	Further investigate Site 09 shoreline soil/sediment quality.
SS-22	Further investigate Site 09 shoreline soil/sediment quality.
SS-23	Further investigate Site 09 shoreline soil/sediment quality.
SS-24	Determine background surface soil quality for Site 09.
SS-25	Determine background surface soil quality for Site 09.
SS-26	Determine background surface soil quality for Site 09.
TOTAL:	12 LOCATIONS 3 BACKGROUND LOCATIONS 15 SAMPLE LOCATIONS

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TABLE 3

Site 09 - Old Fire Fighting Training Area
Test Boring Location / Rationale

BORING NUMBER	LOCATION / RATIONALE
B-8	Characterize subsurface soil/fill mound located at the western end of Site 09.
B-9	Characterize subsurface soil/fill mound located at the western end of Site 09.
B-10	Characterize subsurface soil at the west end (boudary) of Site 09.
B-11	Investigate a Phase I investigation soil gas anomaly.
B-12	Characterize subsurface soil in the west central portion of Site 09.
B-13	Further characterize subsurface soil quality in the north central portion of Site 09.
B-14	Characterize subsurface soil/fill mound located in the central portion of Site 09.
B-15	Characterize subsurface soil/fill mound located in the central portion of Site 09.
B-16	Further characterize subsurface soil quality in the north central portion of Site 09.
B-17	Characterize subsurface soil quality in the day care playground.
B-18	Characterize subsurface soil at the east end (boundary) of Site 09, approximately 40 feet south of Boring B-1 at which low levels of organic and inorganic contamination were observed.
TOTAL:	11 BORING LOCATIONS

TABLE 4

Site 09 - Old Fire Fighting Training Area
Monitoring Well Location / Rationale

WELL NUMBER	LOCATION / RATIONALE
MW-2R	Investigate bedrock ground water quality downgradient (northwest) of the west central portion of Site 09 and at a Phase I shallow ground water contamination location.
MW-6S/R	Further investigate ground water quality upgradient (south) of the site, primarily the SVOC contamination detected at well MW-5 in Phase I.
MW-7S	Investigate ground water quality in the south central upgradient edge of Site 09.
MW-8S	Investigate ground water quality in the south east upgradient edge of Site 09.
MW-9S/R	Further investigate ground water contamination in the central portion of Site 09.
MW-10S	Investigate ground water quality downgradient (north) of the eastern portion of Site 09.
MW-11S/R	Investigate ground water quality at the downgradient (north) edge of the central portion of Site 09.
TOTAL:	6 SHALLOW WELLS 4 ROCK WELLS 10 WELLS

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TABLE 5

Site 09 - Old Fire Fighting Training Area
Test Pit Location / Rationale

TEST PIT NUMBER	LOCATION / RATIONALE
TP-1	Investigate the characteristics of the soil mound in the central portion of the site.
TP-2	Investigate the characteristics of the soil mound in the central portion of the site.
TP-3	Investigate the characteristics of the soil mound in the central portion of the site.
TP-4	Investigate the characteristics of the soil mound in the central portion of the site.
TP-5	Investigate the characteristics of the soil mound in the central portion of the site.
TOTAL:	5 TEST PIT LOCATIONS

TABLE 6

SITE 09 - OLD FIRE FIGHTING TRAINING AREA
SITE EMERGENCY CONTACTS

NETC Emergency Numbers:

Command Duty Officer	841-3456 or 3457
Security Office - Police	841-3241
NETC Fire Protection	841-3333
Public Works Trouble Desk	841-4001

Utilities:

Rhode Island Dig Safe	800-225-4977
NETC Dig Safe	841-2464

Newport Emergency Numbers:

Newport Police Dept.	847-1306
Newport Fire Dept.	846-2211
Newport Hospital	
General Number	846-6400
Emergency Room	846-6400 ext. 1120
Poison Control Center	277-5727

Additional Resources:

Dr. Erdil, or Dr. Stahl - TRC Company Physicians, Immediate Medical Care, Hartford, Connecticut - (203) 296-8330
Mr. James Peronto - TRC Project Manager - (203) 289-8631
Ms. Rachel Marino - NETC Environmental Coord. - (401) 841-3735
Mr. Robert Hanley - NETC Safety Officer - (401) 841-2478

TABLE 7

SITE 09 - OLD FIRE FIGHTING TRAINING AREA PERSONNEL PROTECTION SUMMARY

Activity	*Intitial Level of Protection*
Reconnaissance Survey	*D*
Geophysical Surveys	*D*
Soil Gas Survey	*D*
Surface Soil Sampling	*D*
Test Pit Activities	*C*
Soil Boring	*Mod. D*
Ground Water Sampling	*Mod. D*
Land Survey	*D*

NOTE: *The personnel protection levels will be upgraded or downgraded as conditions warrant according to criteria specified in the project Health and Safety Plan (HASP).*

FIGURES

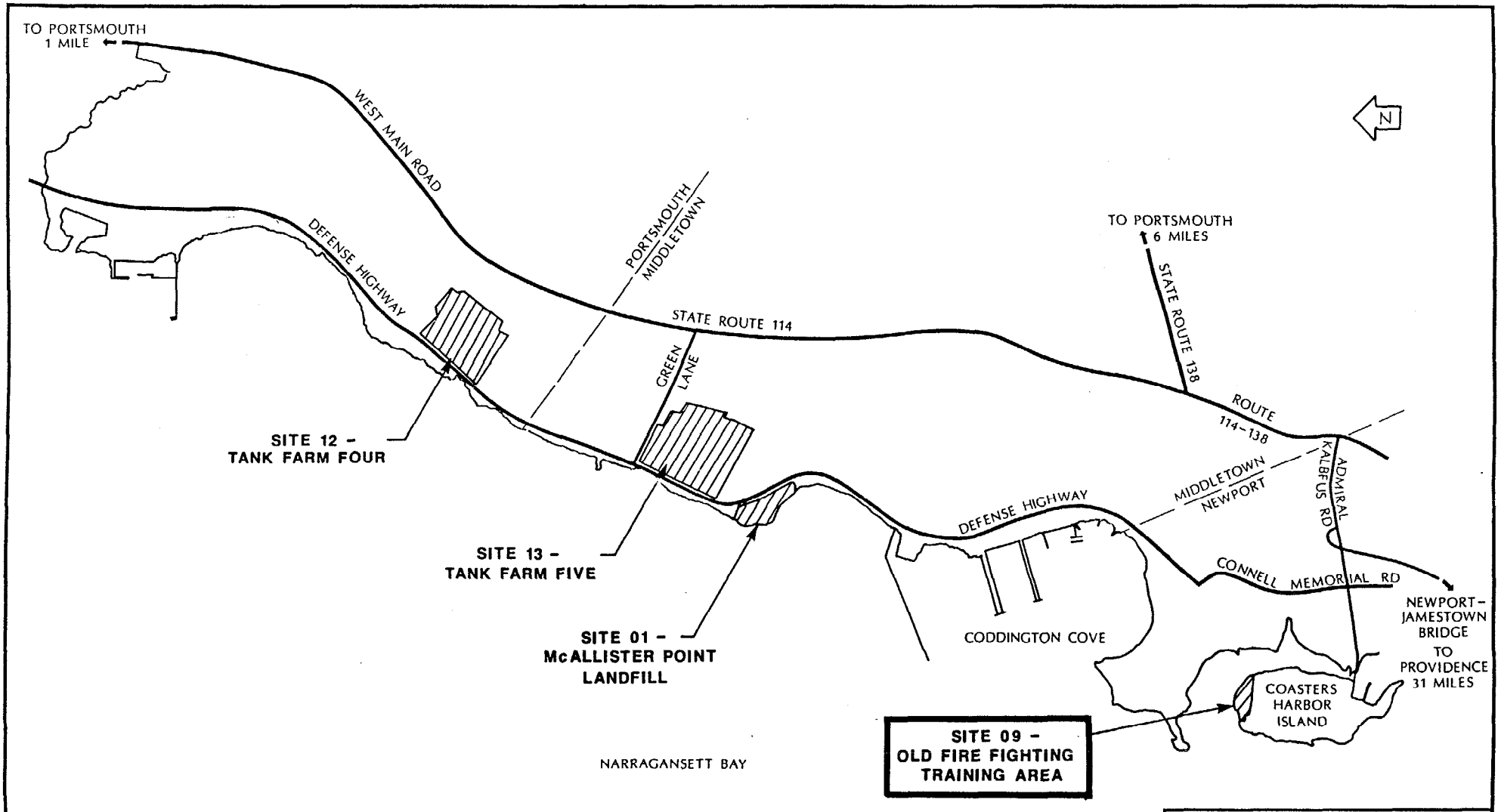

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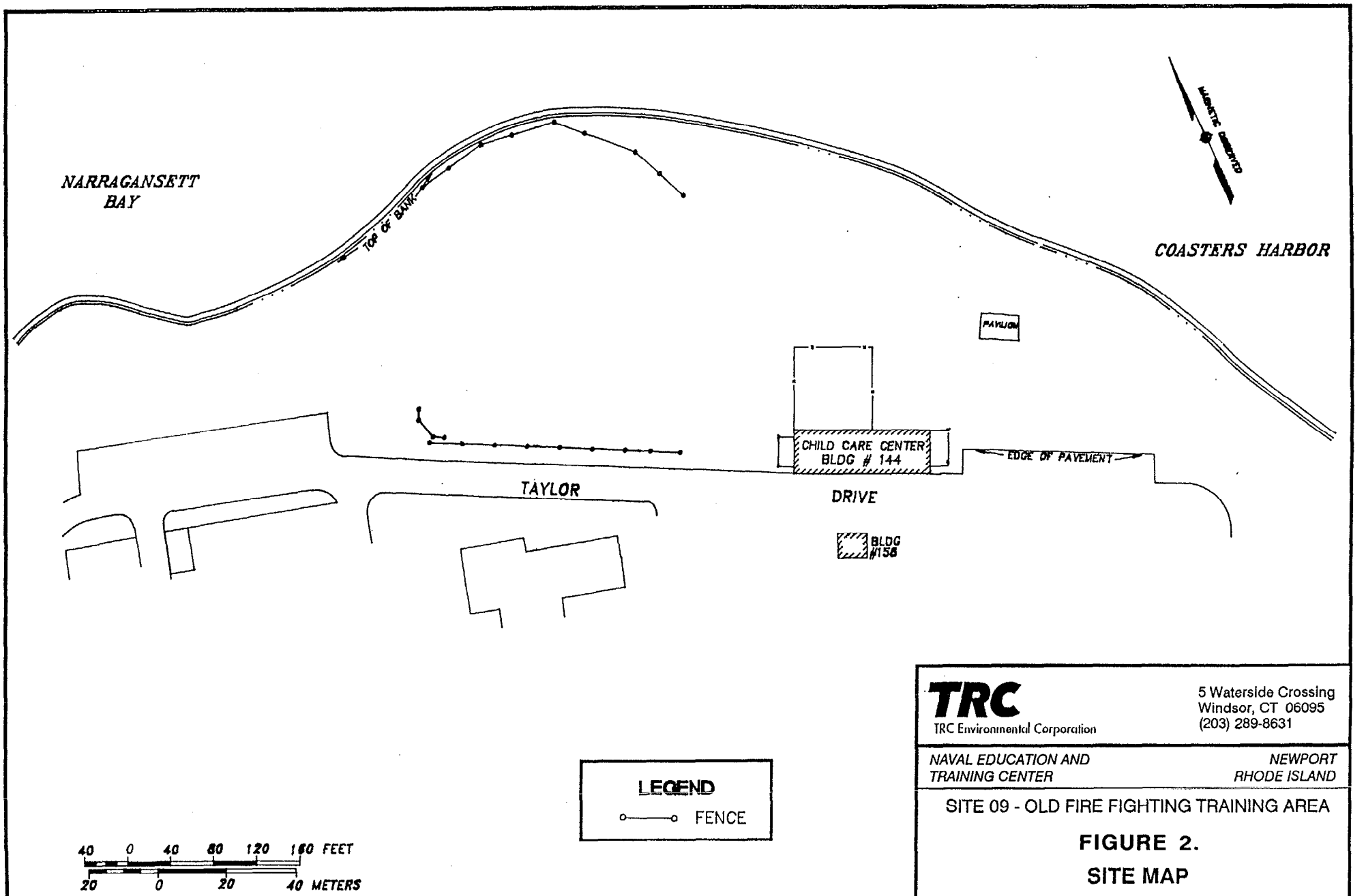
FIGURE 1.

NETC SITE LOCATION MAP

Date: 3/93

Drawing No. 6760-N81



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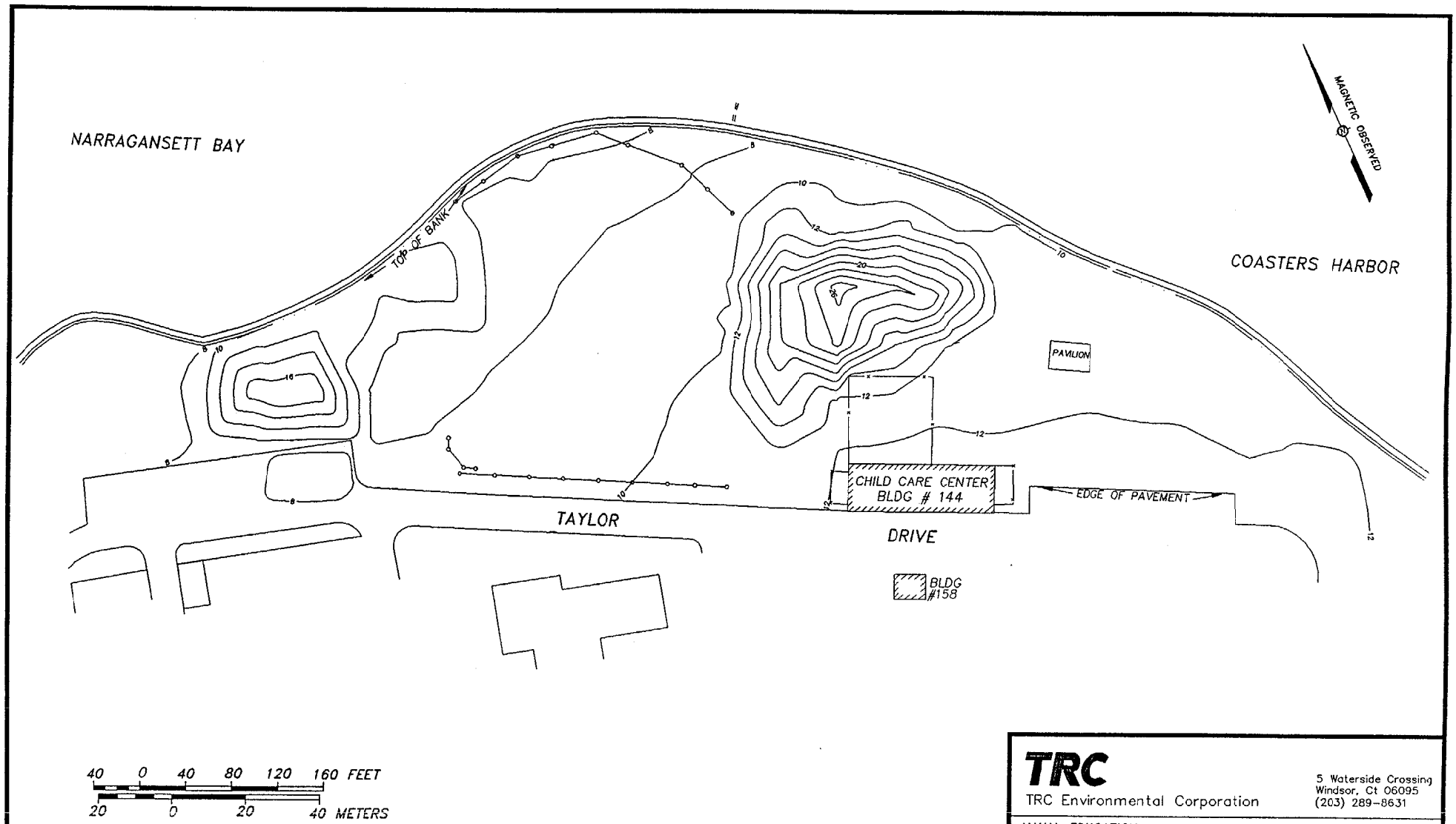
SITE 09 - OLD FIRE FIGHTING TRAINING AREA

FIGURE 2.

SITE MAP

Date: 3/93

Drawing No. 6760-N81



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SITE 09 - OLD FIRE FIGHTING TRAINING AREA

FIGURE 2A.
SITE TOPOGRAPHIC MAP

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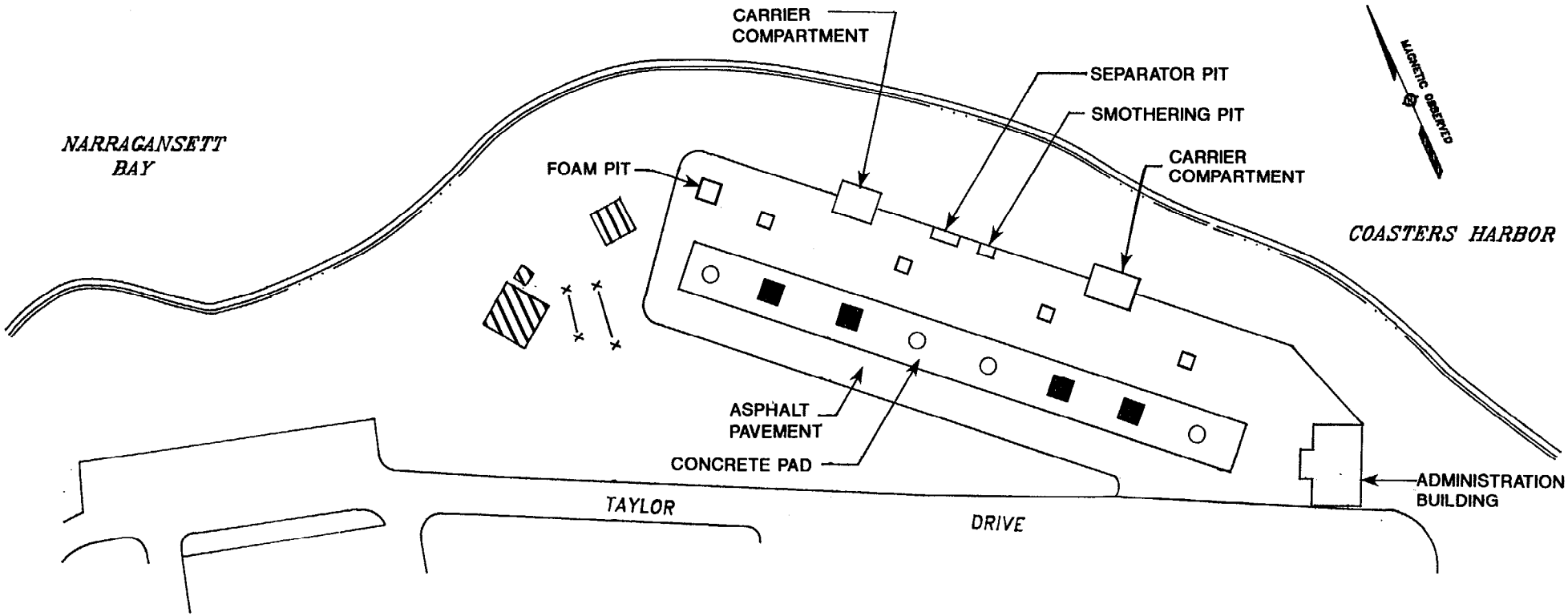
Drawing No. 6760-N81



40 0 40 80 120 160 FEET
20 0 20 40 METERS

SOURCE: FIRE FIGHTERS SCHOOL LOCATION PLAN MAP, PUBLIC WORKS DRAWING NO. 7146-78 (U.S. NAVY, 1943).

LEGEND

- OIL TANK
- CHRISTMAS TREES
- SUCTION PUMP
- WOOD STRUCTURE
- OBSTACLE FENCE

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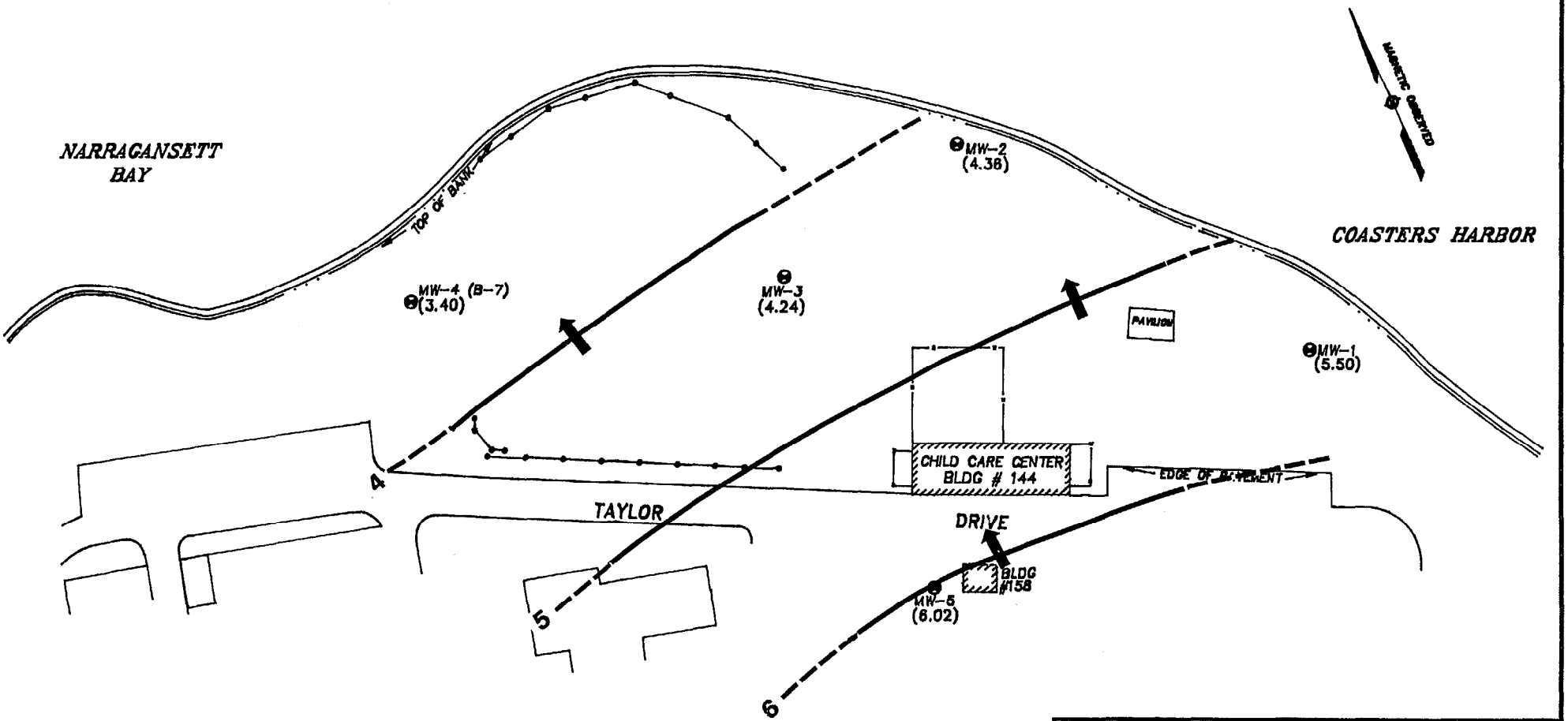
SITE 09 - OLD FIRE FIGHTING TRAINING AREA

FIGURE 3.
1943 FACILITY DESIGN MAP

Date: 3/93 | Drawing No. 6760-N81



LEGEND

MW-3 ●	MONITORING WELL LOCATION
(4.24)	GROUND WATER ELEVATION (feet above mlw)
6 ———	GROUND WATER CONTOUR
⬅	GROUND WATER FLOW DIRECTION

40 0 40 80 120 160 FEET

20 0 20 40 METERS

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SITE 09 - OLD FIRE FIGHTING TRAINING AREA

FIGURE 4.
GROUND WATER TABLE CONTOUR MAP

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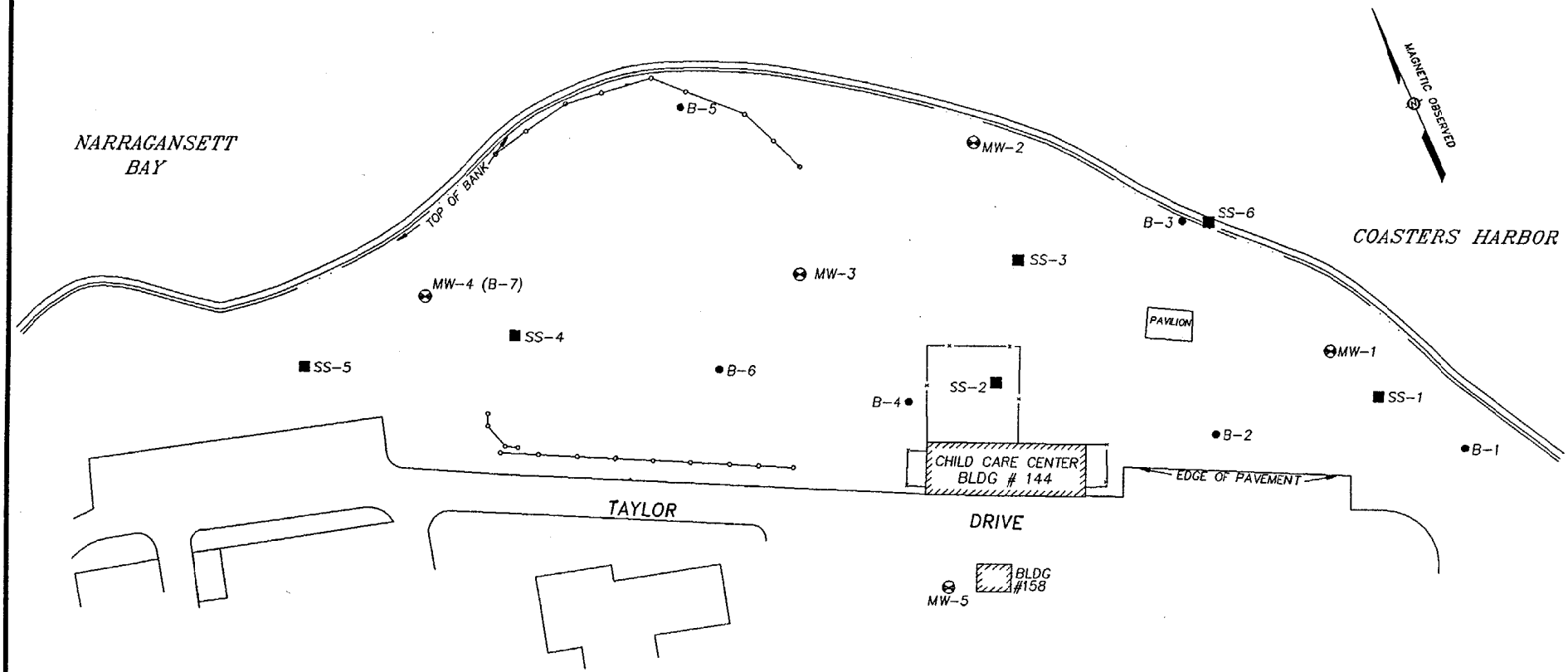

40 0 40 80 120 160 FEET

20 0 20 40 METERS

LEGEND

SS-4 ■ SURFACE SOIL SAMPLE LOCATION

B-2 ● BORING LOCATION

MW-5 ⊗ MONITORING WELL LOCATION

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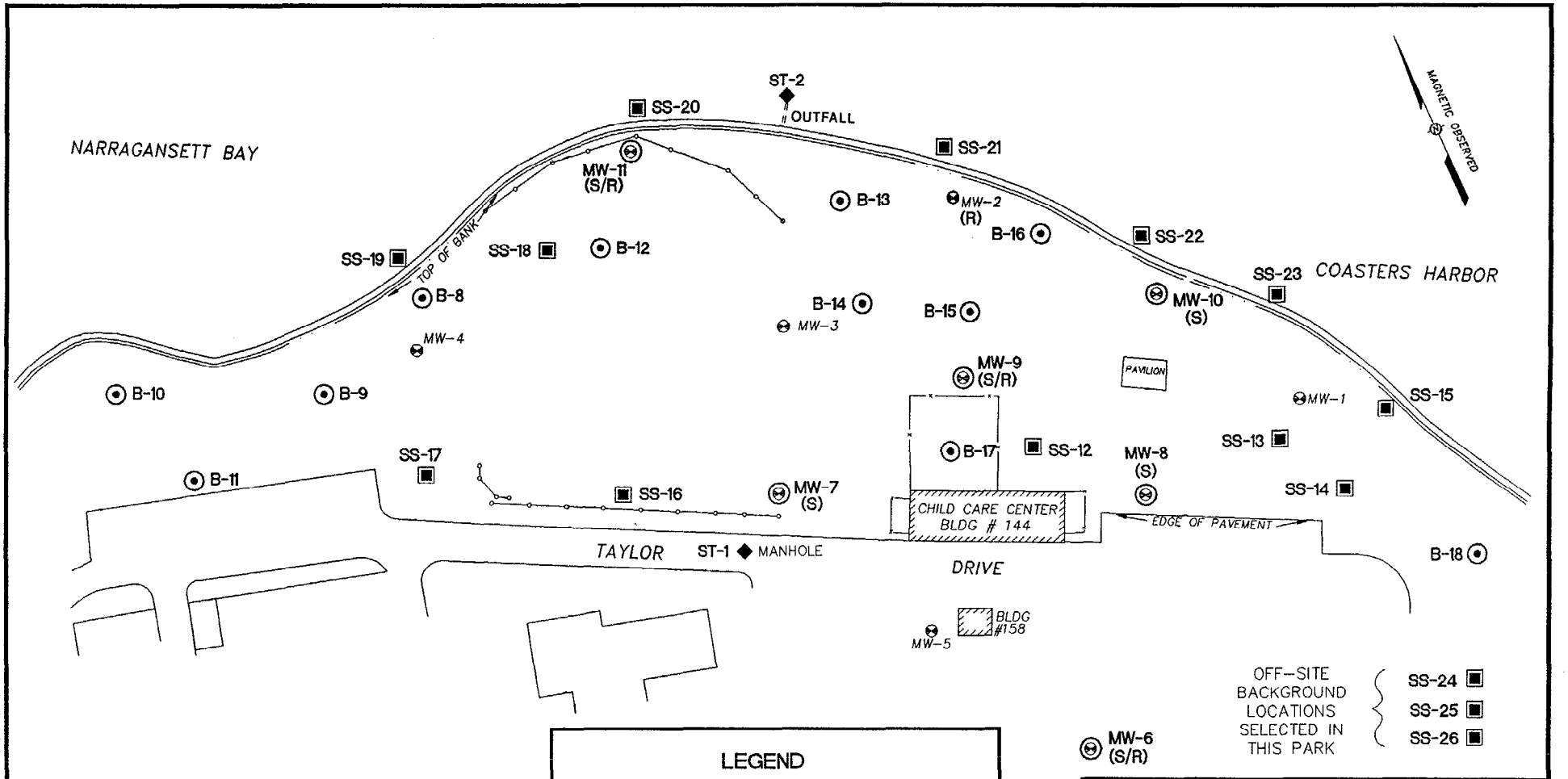
SITE 09 - OLD FIRE FIGHTING TRAINING AREA

FIGURE 5.

PHASE I
INVESTIGATION SUMMARY

Date: 3/93

Drawing No. 6760-N81



LEGEND

SS-27 ■	SURFACE SOIL SAMPLE LOCATION
ST-1 ◆	STORM SEWER SAMPLE LOCATION
MW-11	MONITORING WELL LOCATION
MW-1	EXISTING MONITORING WELL LOCATION
B-20	BORING LOCATION
(S)	NEW SHALLOW WELL
(R)	NEW BEDROCK WELL

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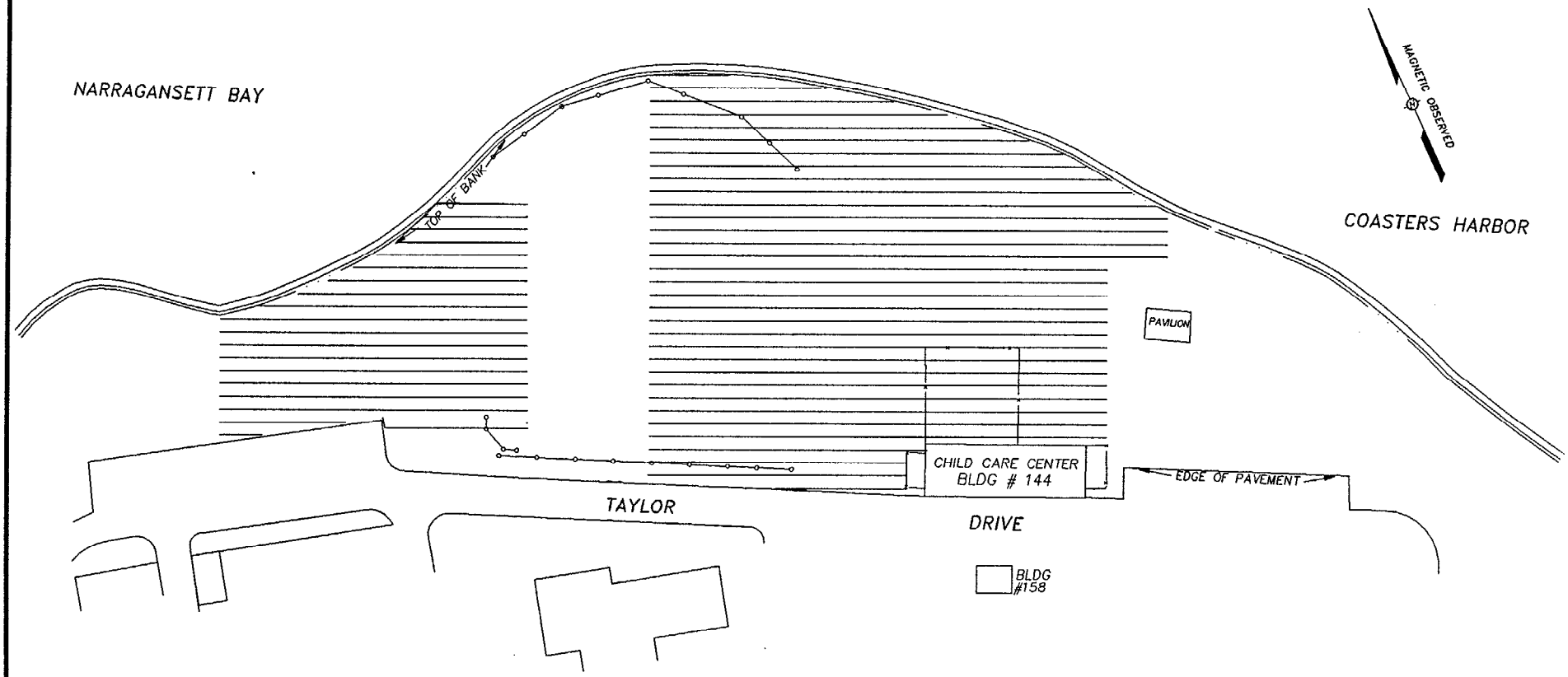
SITE 09 - OLD FIRE FIGHTING TRAINING AREA

FIGURE 6.

PHASE II INVESTIGATION SUMMARY

Date: 3/93 | Drawing No. 6760-N81



40 0 40 80 120 160 FEET

20 0 20 40 METERS

LEGEND

FENCE

SURVEY AREA

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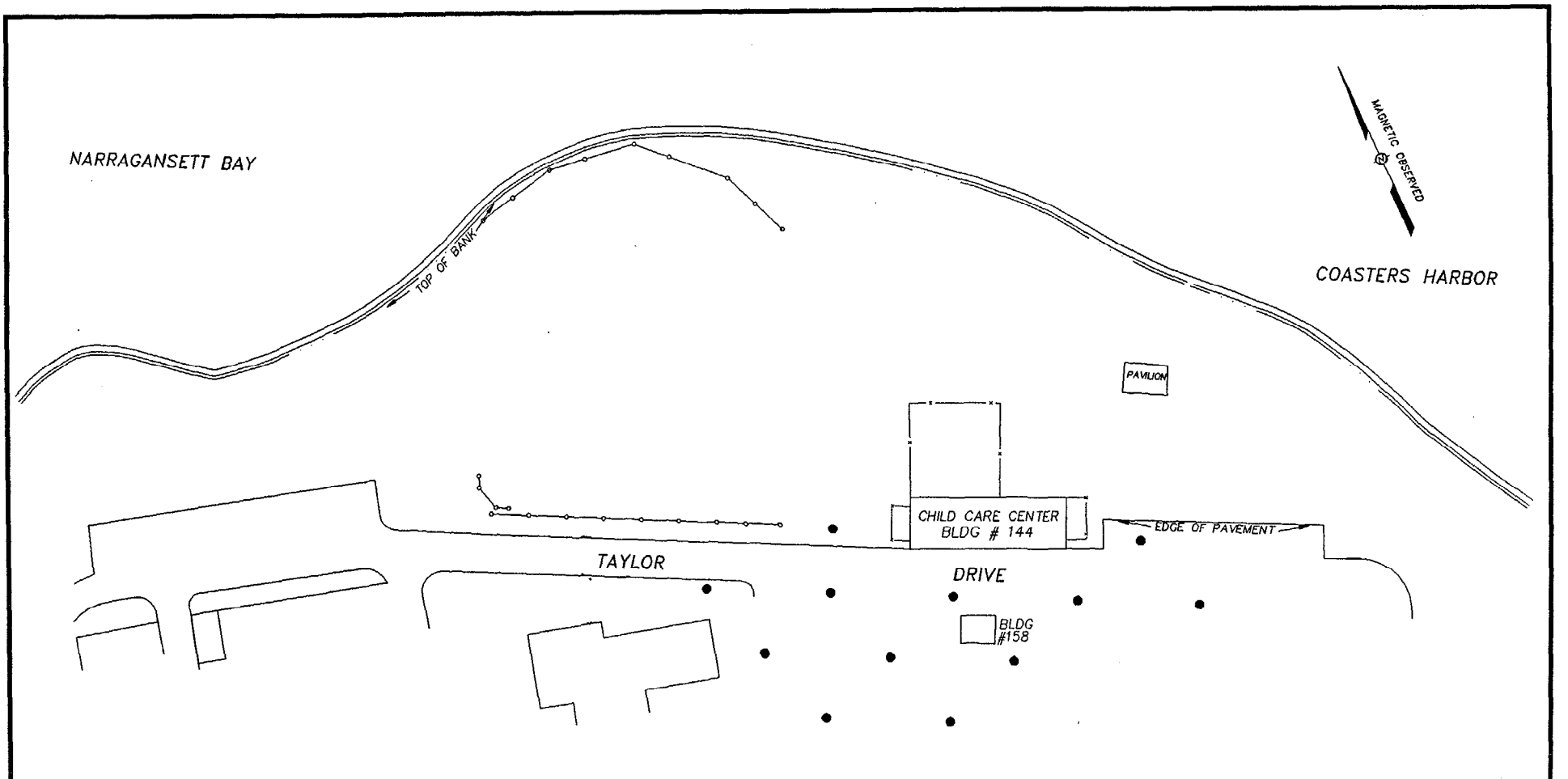
SITE 09 - OLD FIRE FIGHTING TRAINING AREA

FIGURE 6A.

GEOPHYSICAL SURVEY LOCATION MAP

Date: 3/93

Drawing No. 6760-N81



40 0 40 80 120 160 FEET

20 0 20 40 METERS

LEGEND

FENCE

SOIL GAS POINT

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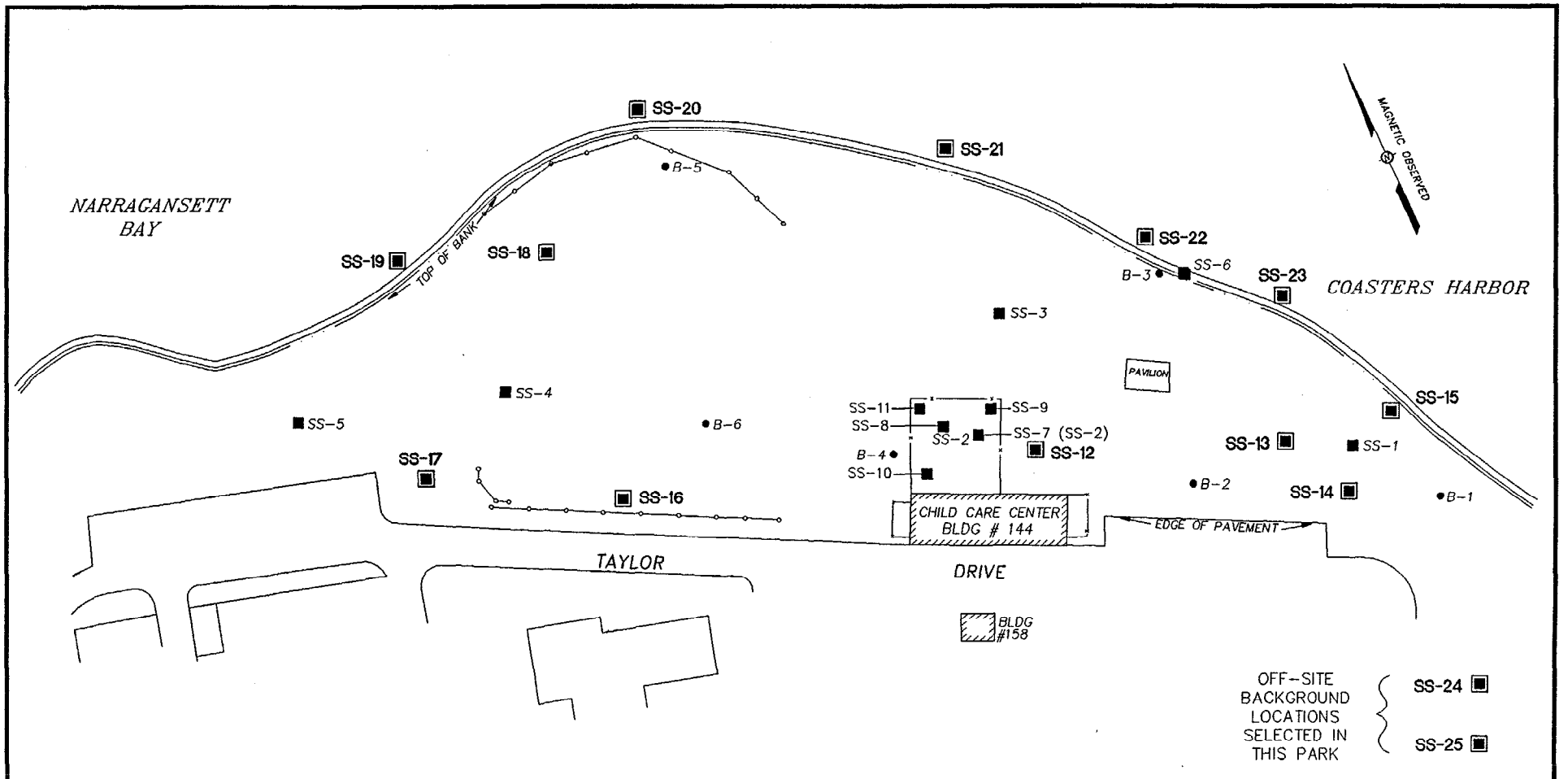
SITE 09 - OLD FIRE FIGHTING TRAINING AREA

FIGURE 6B.

SOIL GAS SURVEY LOCATION MAP

Date: 3/93

Drawing No. 6760-N81



LEGEND

SS-5 ■ SURFACE SOIL SAMPLE LOCATION (PHASE I)

SS-17 ■ SURFACE SOIL SAMPLE LOCATION (PHASE II)

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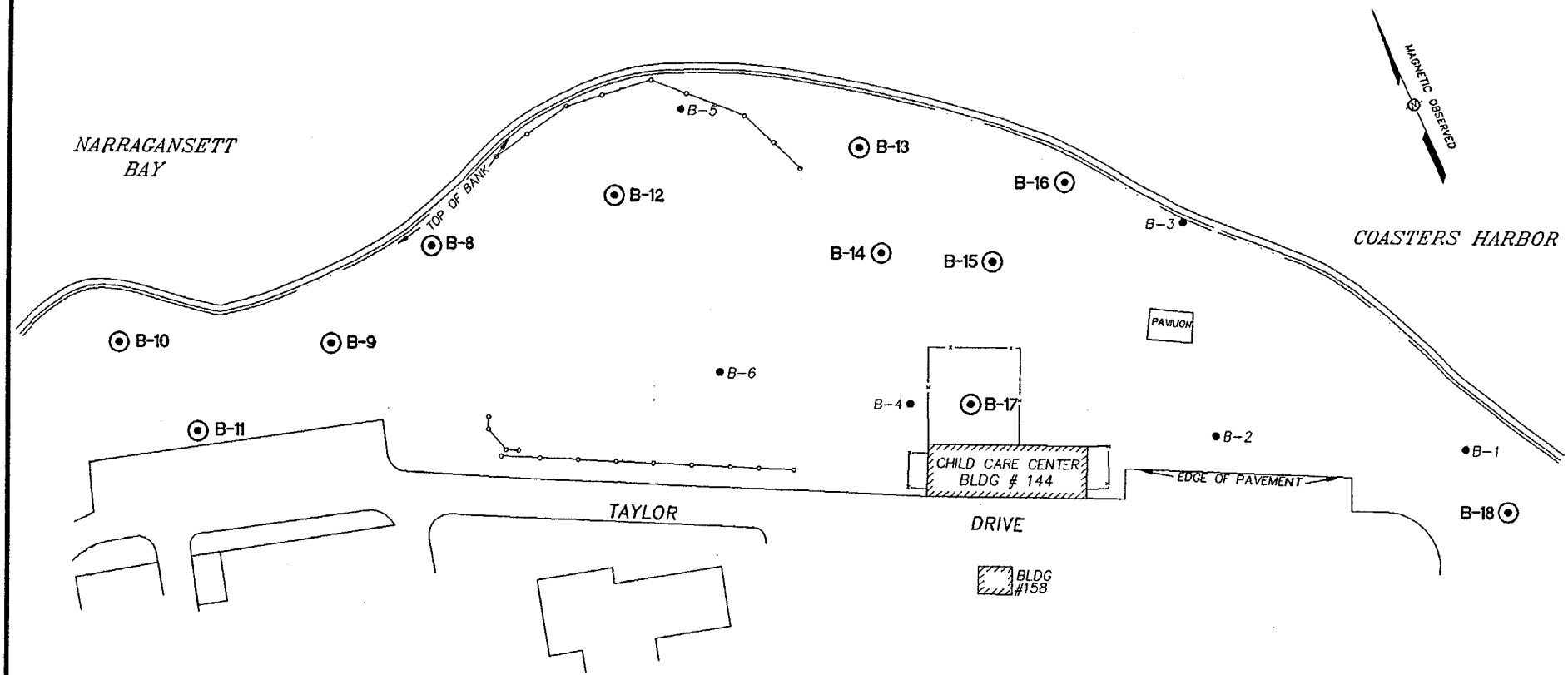
SITE 09 - OLD FIRE FIGHTING TRAINING AREA

FIGURE 7.

SURFACE SOIL SAMPLE LOCATIONS

Date: 3/93 | Drawing No. 6760-N81



40 0 40 80 120 160 FEET

20 0 20 40 METERS

LEGEND

B-4 ● BORING LOCATION (PHASE I)

B-10 ⊙ BORING LOCATION (PHASE II)

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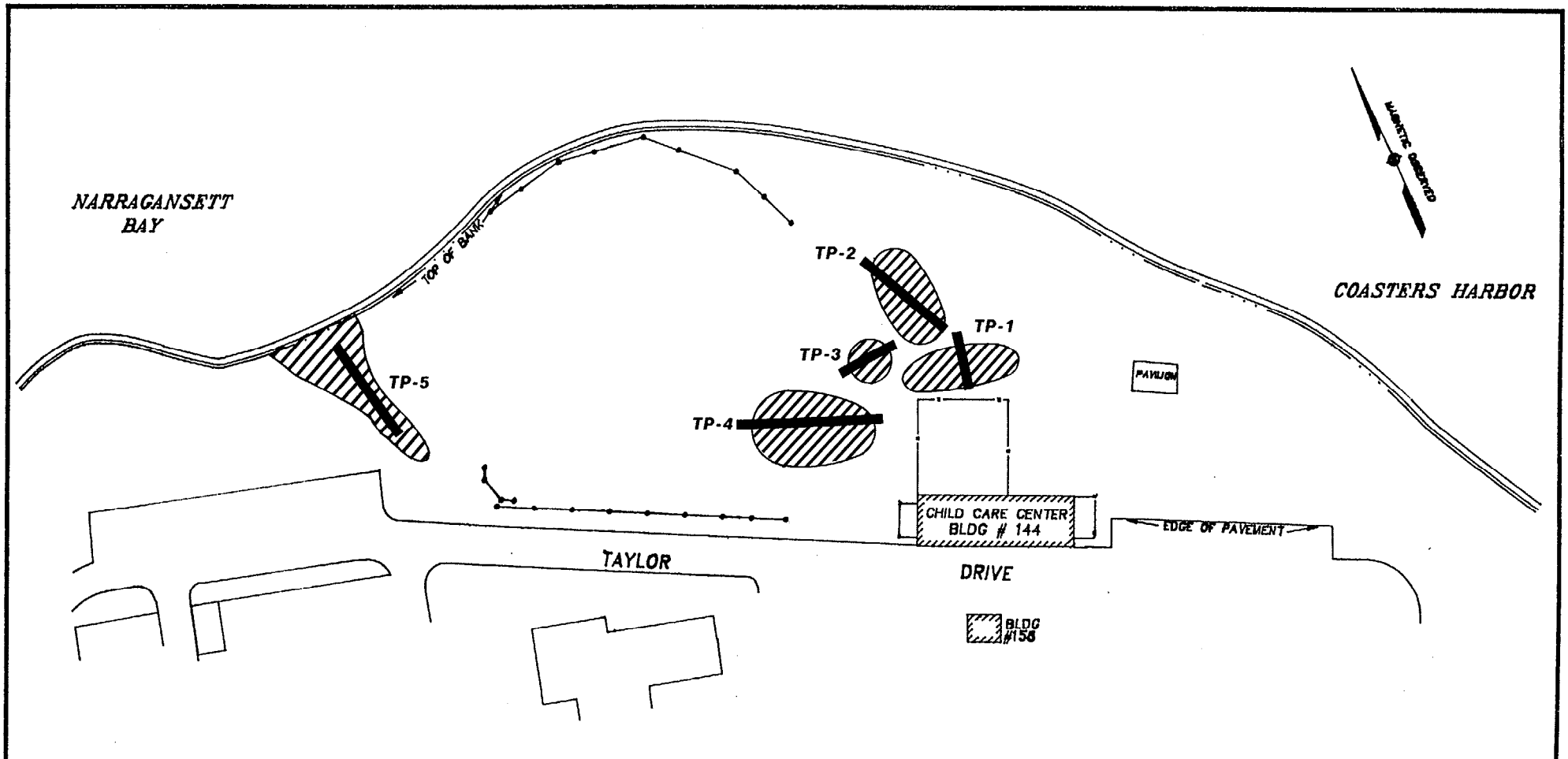
SITE 09 - OLD FIRE FIGHTING TRAINING AREA

FIGURE 8.

TEST BORING LOCATIONS

Date: 3/93

Drawing No. 6760-N81



40 0 40 80 120 160 FEET
20 0 20 40 METERS

LEGEND

- FENCE
- GEOPHYSICAL ANOMALY -PHASE I RI
- TEST PIT LOCATION

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SITE 09 - OLD FIRE FIGHTING TRAINING AREA

FIGURE 9.

TEST PIT LOCATIONS

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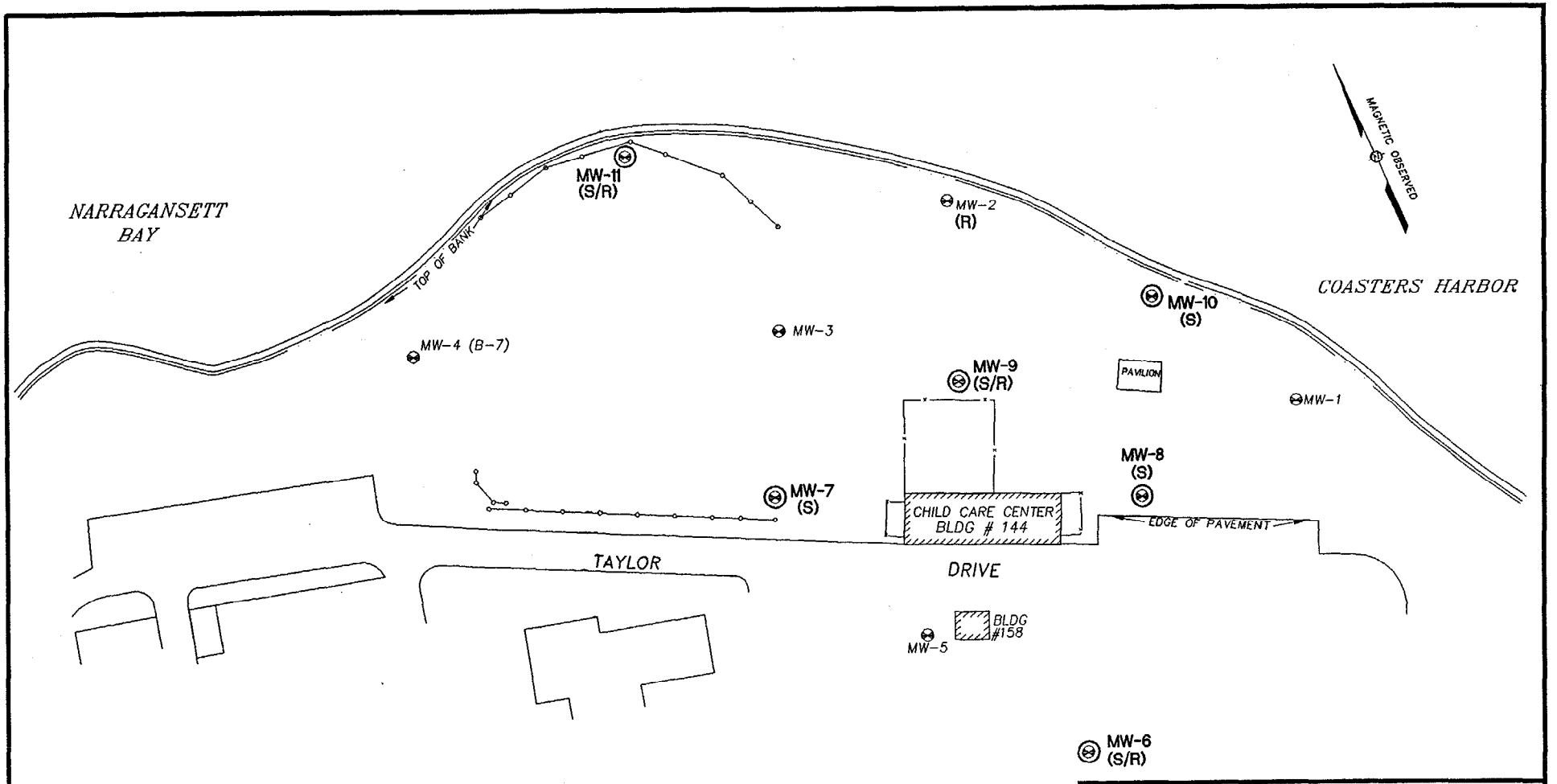

40 0 40 80 120 160 FEET

20 0 20 40 METERS

LEGEND

MW-4	MONITORING WELL LOCATION (PHASE I)
MW-6	MONITORING WELL LOCATION (PHASE II)
(S)	NEW SHALLOW WELL
(R)	NEW BEDROCK WELL

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SITE 09 - OLD FIRE FIGHTING TRAINING AREA

FIGURE 10.
MONITORING WELL LOCATIONS

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Drawing No. 6760-N81

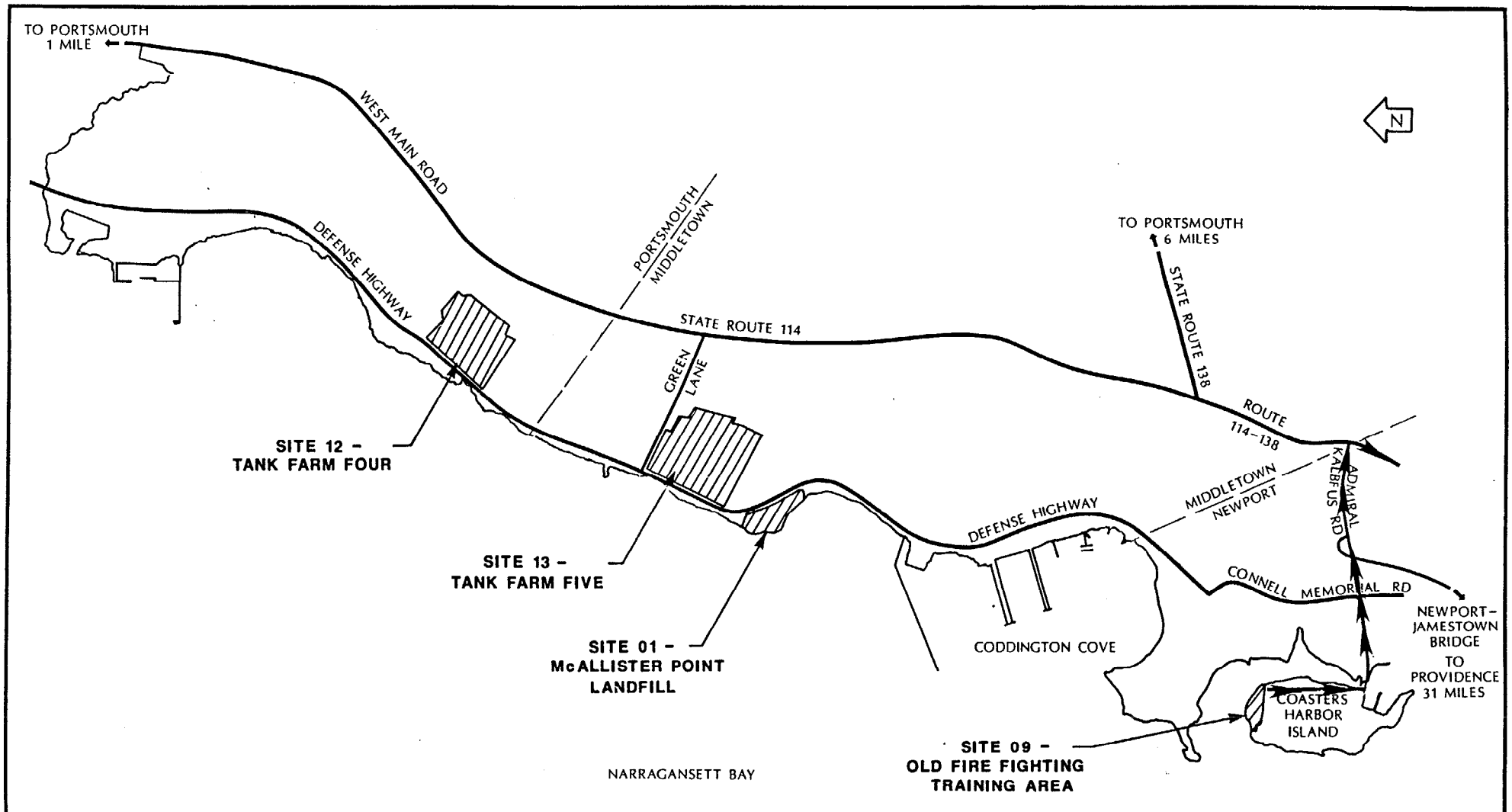

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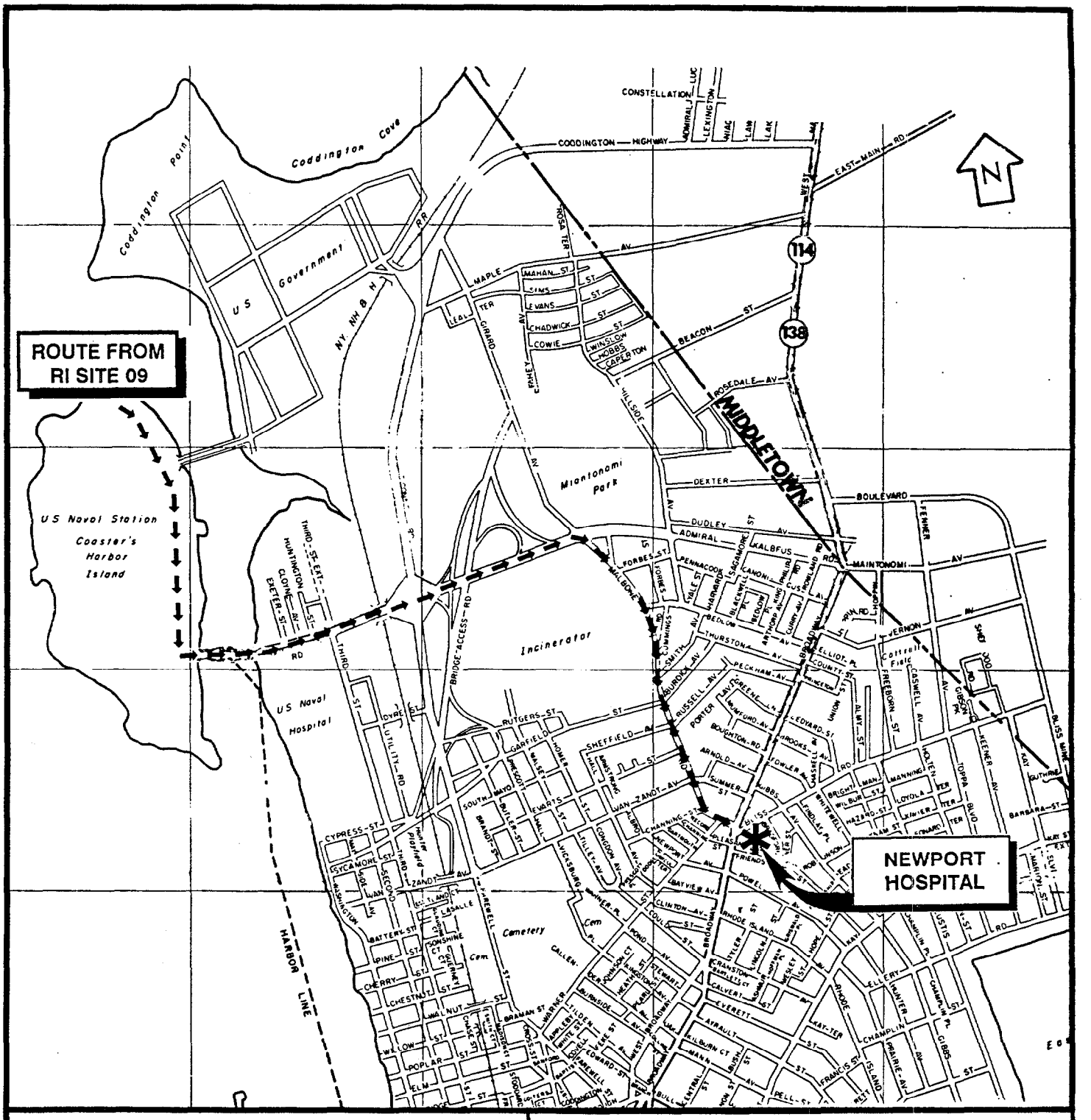
FIGURE 11.

NEWPORT HOSPITAL ROUTE MAP

Date: 3/93

Drawing No. 6760-N81



0 1/4 1/2

SCALE IN MILES

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FIGURE 11A.

NEWPORT HOSPITAL ROUTE MAP

Date: 3/93

Drawing No. 6760-N81

U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

VOLUME III-3
-TANK FARM FOUR-
SITE 12

PHASE II RI/FS
WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared by:
TRC Environmental Corporation
Windsor, Connecticut

Prepared for:
Northern Division - Naval Facilities
Engineering Command
Lester, Pennsylvania

March 1993

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TRC-EC Project No. 6760-N81-110
Contract No. N62472-86-C-1282

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1.0 INTRODUCTION

The objective of this volume of the Work Plan is to define the level of Phase II investigation necessary to assess the nature and extent of environmental contamination at Site 12, the Tank Farm Four site located on the NETC. This volume of the Work Plan describes site-specific objectives in Section 1.1, summarizes available site background information in Section 2.0, presents the site-specific field sampling activities in Section 3.0, and summarizes site-specific health and safety information in Section 4.0.

1.1 SITE-SPECIFIC INVESTIGATION OBJECTIVES

The general objectives of the RI site investigation are to determine the nature and extent of site contamination, sources of contamination, potential contaminant migration pathways, potential contaminant receptors, and associated exposure pathways. This information is necessary to determine whether, and to what extent, a threat to human health or the environment exists, and to provide the information required to develop and evaluate remedial action alternatives for the site, as necessary.

The scope of the Phase I and Phase II sampling efforts for this site have been developed to meet site-specific RI/FS objectives. The site-specific objectives have been refined based upon the findings of the Phase I RI. Below is a list of the RI objectives for the Tank Farm Four site investigation:

- determine the background soil and ground water quality;
- determine the presence and nature of site surface soil contamination;
- determine the presence and nature of any contamination related to past reported on-site sludge disposal/burning activities;
- determine the nature and extent of any site ground water contamination;
- determine the nature and extent of surface water and sediment contamination in the on-site brook;
- determine the physical and chemical characteristics of the underground storage tank contents; and
- determine the presence and nature of contamination in the on-site oil/water separator.

The Phase II site investigation is being conducted to address areas of concern discovered under the Phase I investigation and any site investigation data gaps. The Phase II investigation activities will include surface soil sampling, soil boring sampling, monitoring well installation and sampling, structure sampling, and surface water and sediment sampling. Soil and ground water samples will be collected from the site and analyzed as described in Section 3.0 of this plan.

2.0 SITE BACKGROUND INFORMATION

2.1 SITE LOCATION AND DESCRIPTION

Tank Farm 4 is located in the northern portion of the Newport Naval Base, in the town of Portsmouth. The location of Tank Farm Four on the NETC is shown on Figure 1. The tank farm is approximately 88 acres in size. The site is located just east of Narragansett Bay. Defense Highway borders the western edge of the site. Wooded, undeveloped areas are located just north and south of the site. A residential development is located east of the site. A map of Tank Farm Four is presented on Figure 2 with site topography shown on Figure 2A.

Access to the site is from the west, off of Defense Highway, through a gate and along a paved entrance way which leads to the central portion of the site. The paved road continues through the site in a loop, past all of the underground storage tank locations. Adjacent to each of the UST locations are pump/valve houses for the tanks. At the western side of the tank area is a small metal building which was used as the electrical substation during the operation of the tank farm. In the northeastern corner of the site is a small dirt road which leads to a wooden pole barn currently used for the storage of hay. A concrete structure which was used as an oil-water separator is located at the end of an extension of the paved road, near the entrance to the site.

The site topography generally slopes to the west. The ground elevation generally ranges from 25 feet above mean low water level (mlw) in the western corner of the site to 120 feet above mlw in the eastern corner of the site. In the vicinity of a brook (Normans Brook) which crosses the western corner of the site, the ground elevation falls to mean low water level. The brook flows off-site and into Narragansett Bay.

The site is vegetated with grass, weeds, brush, and some trees. The central portion of the site where the tanks are located is covered with grass and weeds. This portion of the site is routinely cleared of brush for use as grazing land by cows which are kept on the site. The grazing by the cows also keeps the grass down in this area. The remaining portion of the site is covered by dense brush and some trees. The majority of the more mature pine trees are located along the eastern edge of the site.

2.2 SITE HISTORY

Tank Farm Four was studied in both the IAS and the CS. The following site history information was obtained from the IAS report.

> Tank Farm Four was used for the storage of diesel and fuel oil and consists of twelve 60,000-barrel underground storage tanks. Disposal at the site was from World War II until the mid-1970's. The tank bottom sludge, obtained during cleaning operations, was disposed of directly onto the ground in the vicinity of the tank being cleaned. Between 100,000 and 190,000 gallons of oil sludge, which is a hazardous waste in Rhode Island, was disposed of at this site. The sludge is no longer evident on the surface but probably covered the entire Tank Farm. This site is located within one quarter mile of Narragansett Bay. This site is on land which is being excessed by the Navy.
>
> (IAS, pg 2-8)
>
> The Navy has withdrawn its plans to excess the site's land.

2.2.1 Aerial Photography

Aerial photos and facility maps were reviewed for the period from 1938 through 1988. Activity on the site dates back to 1942 blackline photo prints, which show the tank farm under construction. In the early 1950's, two shedlike structures were located along the site access road (near the access road to the oil/water separator) and Norman's Brook was dammed and a reservoir formed at the point where the brook exits the site. A 1965 aerial photo identifies site features similar to the way they exist today. The access road, substation building, pole barn, and oil/water separator are all visible. The site generally remains unchanged through 1988. Figure 2B indicates the approximate location of piping at Tank Farm Four.

2.3 PREVIOUS SITE INVESTIGATIONS

The CS conducted at this site included the collection of a near-surface composite soil sample, a surface water sample (expected to be representative of shallow ground water quality), a stream sediment sample, ground water samples, and water samples from six of the twelve USTs. The near-surface soil sample indicated the presence of oil and grease. Petroleum hydrocarbons were detected in the surface water and sediment samples. The water samples

collected from the USTs exhibited low concentrations of petroleum hydrocarbons and varied levels of total suspended solids and biochemical oxygen demand. The ground water samples indicated the presence of lead and petroleum hydrocarbons in the ground water. The monitoring wells do not appear to be located directly downgradient of the USTs. Therefore, the full impact of the tanks on ground water quality has not been defined.

A Phase I Remedial Investigation (RI) was conducted at the site in 1990. The RI activities included a soil gas survey, surface soil sampling, soil boring sampling, monitoring well installation and sampling, surface water and sediment sampling, tank sampling, and structure sampling. The finding and analytical results of the Phase I RI are presented below for each of the media investigated:

Soil Assessment - VOCs, BNAs, pesticides, and inorganics were detected in on-site soils. In general, minimal soil contamination was detected at the site, with the exception of elevated TPH levels detected in surface soils adjacent to the oil/water separator and in a soil boring sample collected along the site access road.

VOCs were detected in three subsurface soil samples at very low levels (i.e., less than 5 ppb) and are not considered to represent significant subsurface VOC contamination.

BNAs were not detected at levels greater than the contaminant-comparison level (i.e., greater than 10 ppm total BNAs). Only one soil sample exhibited BNAs at a concentration greater that 1 ppm (3.3 ppm) and that concentration consisted entirely of di-n-butylphthalate. Therefore, BNA soil contamination at this site is not considered to be significant.

Pesticides were detected at low levels (i.e., less than 10 ppb) in one surface soil and one subsurface soil sample and are not considered to be significant soil contaminants. No PCBs were detected in soil samples.

Inorganics were generally detected at levels less than or slightly exceeding (1 to 7 ppm above) background levels in soil samples. Therefore, there does not appear to be significant inorganic soil contamination at this site.

Total petroleum hydrocarbons (TPH) analysis of soil samples identified the presence of TPH across the site, ranging in concentration from 3 to 270 ppm. The highest TPH levels were

detected in a subsurface soil sample collected along the site access road (boring M-1) and in a surface soil sample collected from adjacent to the oil/water separator.

Ground Water Assessment - BNAs, and inorganics were detected in ground water samples. Inorganics were detected at levels exceeding action levels in all wells on-site.

VOCs were not detected in any ground water samples, which coincides with their absence in soil samples. One BNA compound, bis(2-ethylhexyl)phthalate (a common laboratory contaminant) was detected in two on-site wells. No ground water action levels were exceeded for BNAs. No pesticides or PCBs were detected in ground water samples. While inorganic concentrations exceeded ground water action levels in both shallow and deep wells, including the background well, the highest levels of inorganic analytes were detected in wells in the northeast to southwest portions of the site.

Surface Water and Sediment Assessment - VOCs, BNAs pesticides and inorganics were detected in sediment samples and VOCs and inorganics were detected in surface water samples. One VOC, carbon disulfide, was detected in one sediment sample at 21 ppb, which is not considered to be a significant level of sediment contamination. Three BNAs were detected in sediment samples, with a maximum total BNA concentration of 780 ppb, well below the contaminant-comparison level of 1 ppm. One pesticide, 4.4'-DDT was detected in three sediment samples at concentrations of 2.8 to 5.9 ppb. No PCBs were detected in sediment samples. Arsenic, cobalt and iron were the only inorganic analytes detected in sediment samples at levels exceeding background. Higher inorganic concentrations were generally detected in the 0-1 foot sediment sample interval than the 1-2 foot interval.

Two VOCs, carbon disulfide and carbon tetrachloride, were detected in surface water samples. No surface water quality criteria for VOCs were exceeded. No BNAs, pesticides, or PCBs were detected in surface water. Cadmium, lead and zinc were the only inorganic analytes detected at levels exceeding surface water quality criteria. The highest levels of inorganic analytes were detected in the surface water sample collected closest to the mouth of Normans Brook, as it enters Narragansett Bay.

Structure Sample Assessment - The distribution of contaminants within the oil/water separator and demolished unknown structure (referred to as the ruins) was as follows:

- Oil/water separator -
  Soil: VOCs, BNAs, and inorganics; and
  Sludge: BNAs, PCBs and inorganics.
- Ruins -
  Soil/sediment: VOCs, BNAs, inorganics; and
  Water: inorganics.

VOCs were detected in the soil/sediment and sludge samples collected from the oil/water separator and from the ruins on-site, although total VOC levels were less than the contaminant-comparison level of 1 ppm. The soil/sediment sample collected from the ruins exhibited the greatest VOC concentration (680 ppb tetrachloroethene). This sample was visibly contaminated (e.g., odor, sheen). BNAs were detected in the soil/sediment and sludge samples.

The sludge sample was the only sample with a total BNA concentration greater than the contaminant-comparison level of 10 ppm and a carcinogenic PAH concentration greater than the contaminant-comparison level of 1 ppm.

No pesticides were detected in soil/sediment or sludge samples. A PCB compound was identified in the sludge sample at a concentration of 12 ppb, well below the RIDEM soil action level of 1 ppm. Cobalt and iron were the only inorganics detected at levels exceeding background levels and were only detected in the ruins sample.

No VOCs, BNAs, pesticides, or PCBs were detected in the surface water sample collected from the ruins. Lead and zinc were the only inorganic analytes which were detected in the water sample at levels exceeding surface water quality criteria.

Tank Contents Assessment - The distribution of contaminants within the oil and water samples collected from the on-site tanks was as follows:

- Oil: VOCs, BNAs, and inorganics; and
- Water: VOCs, BNAs, and inorganics.

VOCs were detected in the oil samples collected from the on-site tanks at very elevated levels. The VOCs consisted of benzene, toluene, ethylbenzene, and xylene. Total VOC levels exceeded 10 ppm in a majority of the tanks.

Extraction Procedure (EP) Toxicity tests of oil samples detected no EP Toxicity analytes; low levels of toluene, ethylbenzene and xylene in a TCL/TAL analysis of the EP Toxicity extraction leachate from one sample. A TCL/TAL analysis of the Toxicity Characteristic Leachate Procedure (TCLP) extraction leachate from the same oil sample detected concentrations of these compounds at levels three orders of magnitude greater than the EP Toxicity results.

BNAs were detected in the oil samples and consisted primarily of PAHs. Total BNA levels in excess of 1,500 ppm were detected in four of the oil samples. Oil samples were not analyzed for pesticides. No PCBs were detected in the oil samples, although detection limits ranged from 12 to 24 ppm.

Iron, lead, and zinc were the only inorganics detected in greater than 50% of the oil samples. TAL metals analysis of EP Toxicity and TCLP oil leachates identified inorganic analytes. The EP Toxicity extract analyses detected silver and arsenic, analytes which were not detected in the CLP method extract.

VOCs were detected in all of the tank water samples, with total VOC concentrations ranging from 13 to 346 ppb. The main VOC compounds detected included the same VOCs detected in the oil samples. BNAs detected in the water samples consisted of PAH compounds, phenols, phthalate esters and dibenzofuran. Total BNA concentrations ranged from 10 to 202 ppb. Tank water samples were not analyzed for pesticides or PCBs.

The inorganics detected in greater than 50% of the tank water samples include barium, calcium, iron, potassium, magnesium, manganese, sodium, lead and zinc. The analyte concentrations in the water samples were typically higher than those detected in the oil samples.

2.4 SITE GEOLOGY

The soil boring activities performed during the Phase I site RI investigation, as well as under previous subsurface investigations, provided information on the site geology. Previous subsurface investigation activities (characterization step of Confirmation Study) included the drilling and sampling of two well borings (MW-10 and MW-11).

The well boring logs indicate that the surficial deposits are mostly silt with sand layers. Although shale chips were recovered in the split spoon samples, neither competent nor weathered shale was encountered in either of the borings.

The Phase I RI subsurface investigation activities included the drilling and sampling of five (5) shallow (M-1 through M-5) and three (3) deep (M-1, M-3, and M-5) monitoring well borings. The locations of these Phase I RI wells are shown on Figure 3.

The overburden deposits on this site consist of a native sand and silt, glacial till. The till was encountered in all of the borings, ranging in thickness from 12 feet (at M-5) to 29 feet (at M-3). No fill was encountered at the this site.

Bedrock was encountered at all of the boring locations. The three deep monitoring wells (M-1, M-3, and M-5) were completed within competent bedrock. At the location of well boring M-3, completed in the central portion of the site, 10 feet of weathered shale was encountered on top of competent rock.

Nx rock cores were collected of competent rock from the screened interval of the three deep monitoring well borings. The rock cores indicate that the bedrock at the site consists of the same shale unit (the Rhode Island Formation) that was encountered at the McAllister Point Landfill. The bedrock is a gray-green to black, carboniferous shale, which varies from highly weathered to competent. The shale exhibits a high degree of fracturing, with quartz and iron-oxide deposits common along fractures. The sites bedrock slopes towards the west.

2.5 SITE HYDROLOGY

The following presents discussions on the site surface water hydrology and ground water hydrology.

Surface Water Hydrology

A perennial stream, Normans Brook, flows through the southwestern corner of the site. The brook is located in a topographically low area of the site and flows into Narragansett Bay. The general site surface topography slopes in a east to west direction, with the steepest surface gradients located near the brook. The central, tank portion of the site is gradually sloping and

well drained. Along the northwestern edge of the site is Defense Highway, beyond which is Narragansett Bay.

Surface water runoff (from precipitation) on the site either evaporates, infiltrates into site soils, ponds on the surface, or flows overland towards the brook and Defense Highway. During periods of heavy rainfall, ponded water was observed both in a small ditch which runs between the site and Defense Highway, and in low lying areas in the northern corner of the site. During rainfall events, overland flow was observed in the western corner of the site towards Normans Brook.

Data from piezometers installed along the banks of Normans Brook, as well as surface water levels recorded in the brook, document that the brook is a "gaining" or effluent stream (i.e., ground water discharges into the stream). Ground water springs have been observed along the land slope just east of the brook. As shown on Figure 4, a typical site ground water contour map, the site ground water flow direction is strongly influenced by Normans Brook.

Ground Water Hydrology

Ground water levels were measured in the eight monitoring wells installed during the Phase I RI in July and September of 1990, and in January of 1991. The water level measurements indicate that the shallow and deep ground water seems is flowing to the southwest. A representative contour map of the ground water table elevation is presented as Figure 4. A representative contour map of the deep piezometric surface is provided as Figure 5.

As shown on the ground water contour maps, the shallow and deep ground water at the site appears to be affected by the presence of Norman's Brook at the southwestern end of the site. The ground water contours also generally reflect the site topography.

Single well hydraulic conductivity tests (slug tests) were performed at two of the shallow monitoring wells (MW-1S and MW-5S) and the three deep monitoring wells (MW-1D, MW-3D, and MW-5D) at the site. The shallow monitoring wells are all screened in the till overburden and the deep wells are all screened in competent bedrock. The hydraulic conductivities determined for the shallow (till) were 0.23 ft/day for both well MW-1S and MW-5S. The hydraulic conductivities determined for the deep (bedrock) wells were 0.059 ft/day (MW-1D),

0.029 ft/day (MW-3D), and 0.042 ft/day (MW-5D). These values indicate that the till is an order of magnitude more conductive than the bedrock at the site.

- Vertical Hydraulic Gradients

Vertical hydraulic gradients were determined at the three sets of nested monitoring wells at the site (MW-1S/D, MW-3S/D, and MW-5S/D). Vertical hydraulic gradients are used to determine whether contamination can migrate downward through an aquifer. For all three of the Phase I ground water elevation measurement dates, a downward, or negative, hydraulic gradient was observed in all three of the well pairs. The vertical gradients ranged from -0.059 ft/ft (MW-3S/D on 7/19/90) to -0.683 ft/ft (MW-5S/D on 9/20/90). This indicates that ground water from above the bedrock surface (in the till overburden) would tend to flow downward into the bedrock at these locations.

- Horizontal Hydraulic Gradients

Horizontal hydraulic gradients were determined from the Phase I RI water level measurements at the site. Representative average horizontal gradients for both the shallow ground water and the deep ground water were determined for several areas on the site. Average horizontal gradients for shallow ground water ranged from 0.041 ft/ft (MW-3S to MW-1S) to 0.187 ft/ft (MW-5S to MW-3S). Deep average horizontal gradients were calculated as 0.052 ft/ft (MW-3D to MW-1D) and 0.162 ft/ft (MW-5D to MW-3D).

- Average Linear Velocities

The calculated average horizontal hydraulic gradients at the site, along with hydraulic conductivity and effective porosity values, were used to calculate average linear velocity values at the site. A hydraulic conductivity of 0.23 ft/day, an average of the hydraulic conductivities determined by the slug tests performed at the shallow wells at the site, was used in the calculations. An effective porosity of 15% was assumed for the till at the site (Driscoll, 1986). A hydraulic conductivity of 0.043 ft/day was used for the bedrock at the site, and is an average of the hydraulic conductivities determined by the slug tests performed on the deep wells at the

site. An effective porosity of 10% was assumed for the shale (bedrock) at the site (Driscoll, 1986).

Average linear velocities of the shallow ground water ranged from 0.063 ft/day (MW-3S to MW-1S) to 0.29 ft/day (MW-5S to MW-3S). The average linear velocities of the deep ground water were calculated as 0.023 ft/day (MW-3D to MW-1D) and 0.070 ft/day (MW-5D to MW-3D). It is important to note that the calculated average linear velocity values are lower than the "true microscopic velocities" because water particles must travel along irregular paths that are longer than the linearized paths represented by the calculated average linear velocities (Freeze and Cherry, 1979). In addition, the estimated effective porosity value of 15% for the till and 10% for shale at the site may be too high or low, causing the linear velocity estimates to be too low or high, respectively.

3.0 SAMPLING PLAN

3.1 INTRODUCTION

The program of investigation described in this section has been developed to achieve both overall and site-specific project objectives. Field sampling methodology for individual investigation activities (e.g., soil gas survey, surface soil sampling) is described in Appendix B. The quality assurance/quality control procedures for field sampling and laboratory analyses are presented in the project Quality Assurance Project Plan (QAPP) provided in Appendix D. A summary of the Phase II Tank Farm Four site sampling program is presented in Table 1. The planned Phase II Tank Farm Four sample locations are shown on Figure 6.

3.2 RECONNAISSANCE SURVEYS

Prior to initiating sampling activities, a site walkover will be conducted by field investigation team members to familiarize themselves with the current site conditions. An attempt will be made to conduct this survey during the spring, however, schedule constraints may dictate initiation of the survey at another time of the year. The site will be visually surveyed with respect to any changes in site access restrictions, the Phase I monitoring well locations, and the planned Phase II sampling locations.

Site-specific health and safety considerations, including emergency evacuation procedures, will be reviewed during the visit. Pertinent features, such as overhead and subsurface utilities, and other potential hazards will also be reviewed with Navy personnel with respect to affected sampling activities.

During the site walkover survey, a Phase II baseline ambient air survey will be conducted across the site. The ambient air survey will be conducted with either a flame or photo-ionization detector to assess ambient conditions for the presence of volatile organic compounds (VOCs) and establish the Phase II site baseline conditions. The ambient air surveys will be completed using equipment and methods outlined in the Field Sampling Methodology Plan provided as Appendix B of this Work Plan.

3.3 SOIL SAMPLING

Soil samples will be collected as surface soil samples and soil boring samples under this site investigation. Below is a discussion on each of the planned soil sampling activities.

3.3.1 Surface Soil Sampling

Surface soil samples will be collected from twenty six (26) locations on the site (SS-5 through SS-24, SS-38, SS-40, SS-41, and SS-45 through SS-47). The planned locations of the surface soil samples are shown on Figure 7. These samples will be collected from the following general locations: around areas of documented Phase I surface soil contamination (oil/water separator), surface soil areas not sampled in Phase I, the drainage ditch along the western edge of the site, at several of the tank locations. The rationale for each of the planned surface soil samples is presented in Table 2.

In addition, three (3) "background" surface soil samples (SS-25, SS-26, and SS-27) will be collected from three locations in the wooded area in the south and southeast portions of the site. An attempt will be made to select background soil sample locations believed to be representative of site background soil conditions and away from other potential sources of contamination (e.g., roadways, houses). The proposed locations for the background samples will be confirmed with the EPA and RIDEM during a site visit prior to the surface soil sampling activities.

Surface soil sampling will be conducted according to the method described in the Field Sampling Methodology Plan provided in Appendix B of this Work Plan. Surface soil samples will be analyzed for the full organic target compound list (TCL) and inorganic target analyte list (TAL).

Surface soil samples will also be collected from each of the planned well boring locations, as described in Section 3.3.2 of this plan. The 0- to 1-foot portion of the first 2-foot split spoon sample will be collected as the surface soil sample at each boring location consistent with EPA Region I risk assessment requirements. The soil boring samples will also be analyzed for the full TCL/TAL. The VOC fraction of surface soil samples will be collected as a discrete increment from the 0.5 to 1 foot portion of the first split spoon as described in Appendix B. Soil for the remaining analytical fractions will be homogenized prior to filling sampling containers.

3.3.2 Soil Boring Sampling

Soil samples will be collected from the Phase II site well borings planned at ten (10) different on-site locations (MW-4D, and MW-6S to MW-14S). The planned monitoring well locations are shown on Figure 8. The well borings are associated with the Phase II ground water monitoring wells planned for the site. The Phase II monitoring well rationale is discussed in Section 3.4 and presented in Table 3.

Soil samples will be collected continuously from ground surface to five feet after which samples will be collected at 5-foot intervals to the depth necessary for installation of the well (i.e., approximately 5 feet past the water table). However, if signs of potential contamination are observed continuous split spoons sampling will be resumed until such signs are no longer present. At the four planned bedrock well locations, split spoon sampling will continue at 5-foot intervals to the depth of competent bedrock (estimated on-site to be approximately 30 feet below ground surface). Split spoon soil samples will be screened with an OVA and Hnu immediately upon being opened. A 10-foot Nx core (2 63/64" O.D.) of the bedrock will be collected at each of the planned four bedrock well locations.

A minimum of two soil samples will be collected from each of the ten (10) shallow well borings for the full TCL/TAL analysis. The two soil samples which will be submitted for laboratory analysis will include the soil samples collected from the 0- to 2-foot interval (the 0- to 1-foot portion for analysis) and from the last sample interval just above the depth of the ground water table. If insufficient sample volume is present within the 0 to 1 foot portion of the split spoon (i.e. recovery is low), additional sample volume will be collected using either hand auguring procedures (non-VOC fractions), or from a second split spoon collected immediately adjacent to the first. If signs of potential contamination (e.g., oil, stains, odors) are observed in a boring, a third sample will also be collected from the depth of greatest observed contamination (i.e., most stained or oily, highest OVA/Hnu reading). If no fill material or signs of potential contamination are observed in a boring, only the surface sample and sample from directly above the water table will be submitted for laboratory analysis.

In addition, to the soil samples collected for chemical analyses, a soil sample from just below the depth of the water table (i.e., within the saturated zone) will also be collected from one well at each location for total organic carbon (TOC) analysis, cation exchange capacity

analysis, and grain size determination. The information from these tests will be used in evaluating ground water treatment options.

Geologic descriptions and other sample characteristics (e.g., stains, odors) and observations (e.g., OVA/Hnu readings, depth to water) will be recorded in a field notebook.

3.4 GROUND WATER SAMPLING

Monitoring wells were installed at five locations in Phase I (MW-1 through MW-5). Shallow ground water table wells were installed at each of the locations, and bedrock wells were installed at three of the locations (MW-1, MW-3, and MW-5).

In Phase II, a total of fourteen (14) monitoring wells are planned at ten (10) new locations. The planned Phase II well locations consist of five (5) shallow ground water table wells (MW-6S, MW-9S, MW-10S, MW-13S, and MW-14S) and four (4) shallow ground water table wells paired with bedrock wells (MW-7S/R, MW-8S/R, MW-11S/R, and MW-12S/R), and one bedrock well (MW-4D).

Generally, the monitoring wells are planned to further assess the presence and nature of ground water contamination at the site. The planned locations of the monitoring wells are shown on Figure 8. In general, the monitoring wells are located to determine the ground water quality in the following areas: at the upgradient edge of the site, in the central tank portion of the site, just downgradient of the central tank portion, and at the downgradient edges of the site. The rationale for each of the planned well locations is provided in Table 3.

Ground water samples will be collected from each of the Phase I and newly installed Phase II monitoring wells. Wells will be developed after installation. Water levels will be measured in the wells after development and just prior to well purging. The procedures for well development, purging, and sampling are provided in the Field Sampling Methodology Plan provided in Appendix B.

Ground water samples from the fourteen (14) proposed Phase II wells and the existing ten (10) wells will be analyzed for the TCL/TAL parameters (less the pesticide/PCB fraction). In addition, the temperature, pH, conductivity, dissolved oxygen, redox potential, turbidity, and salinity of each ground water sample will be measured in the field immediately following sample collection. Five of the ground water samples (three shallow and two bedrock) will also be field

filtered for dissolved metals analysis, and analyzed for BOD, COD, and total suspended solids for ground water treatability information. Field filtering procedures are described in Section 7.5 of Appendix B.

In addition to collecting ground water samples from the monitoring wells and obtaining routine water level measurements, single well hydraulic conductivity testing (i.e., slug tests) will be performed on several of the site monitoring wells. Slug tests will be performed on site monitoring wells to aid in determining the characteristics of the site aquifers. Both rising and falling head slug tests will be performed on newly installed wells which are screened below the water table. Rising head slug tests will be performed on wells which are screened across the water table.

In addition to the installation of monitoring wells for ground water elevation measurements, piezometers were installed in Phase I installed adjacent to the on-site brook at the locations of the surface water/sediment sampling locations discussed in Section 3.5. Two additional piezometers (WP-7 and WP-8) will be installed in Phase II adjacent to the two new off-site upstream brook sample locations as shown on Figure 9. The piezometer and surface water levels measurements are intended to indicate whether the streams and pond are "gaining" or "loosing" surface water bodies. Water levels will be measured from the piezometers and surface water stations at times concurrent with the ground water elevation measurements.

3.5 SURFACE WATER AND SEDIMENT SAMPLING

Surface water and sediment sampling will be conducted in the brook which runs through the western corner of the site, Normans Brook, to further investigate the presence of site-related contamination in the brook. In Phase I, surface water and sediment samples were collected from four locations (SD-1/SW-1, SD-2/SW-2, SD-4/SW-4, and SD-6/SW-6) in the brook, and additional sediment samples were collected at two other locations (SD-3 and SD-5).

Surface water and sediment samples will be collected from twelve (12) locations in the brook; consisting of six (6) on-site locations and six (6) off-site locations. Several of the Phase I surface water and sediment sample locations will be resampled in Phase II. The planned locations of the surface water and sediment samples are shown on Figure 9. The rationale for the Phase II surface water and sediment sample locations is provided in Table 4.

In addition to collecting surface water samples, as in Phase I a water sample (W-2) will be collected from the pipe which flows into the brook between brook sample locations 4 and 5. The pipe water sample will be collected at the time of the surface water sampling.

The surface water samples, sediment samples, and pipe water sample will be analyzed for TCL/TAL parameters less the pesticide/PCB fraction and hardness. In addition, the temperature, pH, conductivity, dissolved oxygen, salinity, total chloride, and turbidity of the surface water at each sample location and the pipe water will be measured in the field. Sediment samples will also be submitted for acid volatile sulfides (AVS) analysis, grain size determination, and total organic carbon (TOC) analysis. The AVS data will provide information which will be useful in evaluating the bioavailability of any metals detected in the sediment samples.

Graduated wooden stakes will also be driven at each of the surface water sample locations from which surface water levels will be referenced at the time of sampling. The elevation and location of the graduated stakes will be surveyed during site land surveying activities. Both surface water and ground water elevation measurements will be obtained concurrently during the site investigation to assess surface water and ground water interactions.

3.6 STRUCTURE SAMPLING

A structure (referred to as "ruins") discovered in the western portion of the site during the Phase I investigation will be further investigated in Phase II. The location of the ruins is shown on all of the site figures just east of Normans Brook. The ruins appears to be a former oil/water separator or similar structure. A soil sample was collected from the ruins in Phase I. A water sample was also collected from a pipe which appeared to be connected to the ruins and opens into Normans Brook near the ruins. As discussed in Section 3.5, the water flowing from this pipe will again be sampled during the Phase II surface water sampling.

The structure was observed to be subgrade structure which is nearly completely buried by railroad ties, soil, and vegetation. The ruins is located in a densely overgrown area with small trees and brush. Portions of the concrete walls of the rectangular structure were visible at the surface, as well as what appeared to be vent pipe similar to that of the on-site oil\water separator. The subgrade structure appears to be divided into several chamber separated by

concrete walls and is partially filled with water. Ground water appeared to be flowing through the structure in an east to west direction.

During Phase II, the top of the structure will be cleared away to allow for access and sampling. The clearing will include the removal of small trees and brush growing in and around the structure and of the railroad ties and soil covering portions of the structure. At the completion of the clearing activities, the structure, will be surrounded with orange caution fencing to deter any accidental entry into the structure.

It is assumed that three chambers are present within the structure, as with the similar on-site oil/water separator. If present, a soil/waste sample will be collected from each chamber. In addition, the ground water flowing into (sample W-3) and out (sample W-4) of the structure will also be sampled. The planned locations of these samples are shown on Figure 9. One sample will be collected from water flowing into the chamber (north end) and the second sample will be collected from water which flows out of the chamber (the south end). These water samples will be collected at the time when the surface water and pipe samples are collected, proceeding downstream to upstream.

Both surface water and soil/waste samples will be analyzed for all TCL/TAL parameters. Surface water and structure water samples will also be laboratory analyzed for hardness. In addition, the temperature, pH, conductivity, dissolved oxygen, salinity, and turbidity of the water at each sample location will be measured in the field. The condition of the interior walls of the electrical substation located on the western portion of the tank farm will be visually surveyed for any signs of leakage from the transformers or evidence of fires. This information will be presented to EPA and RIDEM to further assess the need for investigation of this structure.

3.7 LAND SURVEY

Following completion of field sampling activities the site will be surveyed by a State of Rhode Island registered surveyor. The location and elevation of the Phase II sampling points will be determined in the survey. Each sampling location will be referenced to the State of Rhode Island Grid Coordinate System. Completed monitoring wells will be surveyed for elevation at the top of the protective casing, top of the well casing, and adjacent land surface. Elevations will be referenced to mean low water (mlw) and a United States Geological Survey benchmark to the nearest 0.01 foot. The Phase II survey information will be added to the final Phase I site survey map.

4.0 SITE-SPECIFIC HEALTH AND SAFETY SUMMARY

4.1 INTRODUCTION

The purpose of this health and safety discussion is to summarize the site-specific health and safety information. This section describes the nature of wastes or contamination suspected or known to be present at the site, the site access and work zones, and the initial level of personnel protection and monitoring planned for each site investigation activity. In addition, a list of site emergency contacts and maps of the route to the Newport Hospital from the site are provided as Table 5 and Figures 10 and 10A, respectively.

4.2 NATURE OF WASTES

Historical information indicates that Tank Farm Four was used for the storage of diesel and fuel oil in twelve 60,000 barrel underground storage tanks. Tank bottom sludge was reportedly disposed of on the ground during tank cleaning operations.

The results of the Phase I RI indicate that low levels of total petroleum hydrocarbons are present in on-site surface soils. Metals were detected at elevated levels in site ground water and ground water upgradient of the site. Elevated levels of heavy metals were also detected in sediments and surface water from the on-site brook.

Volatile organic compounds (VOCs) and base neutral/acid organic extractable compounds (BNAs) were detected in samples from the on-site oil/water separator. A low concentration (12 ppb) of PCBs were also detected in a sample from the separator. VOCs and BNAs were detected at very high concentrations in tank samples. Metals were also detected in the tank contents.

4.3 SITE ACCESS/WORK ZONES

Site access is on the western side of the site through a locked gate on a short portion of chain-link fence along Defense Highway. A chain-link fence surrounds all but the western side of the site. On the western side, a barbed-wire fence connects to both sides of the chain-link gate section and runs along this entire side of the site.

This site will not have a permanent support zone, contamination reduction zone, or exclusion zone. Only the immediate area surrounding each of the well drilling activities will be cordoned off as an exclusion zone from the rest of the site. Given that most of the planned drilling activities are planned for densely vegetated areas (thick high brush) which are inherently unaccessible and for which access is easily controlled, the locations will not be surrounded with any flagging or barricades. However, at well drilling locations in open areas (e.g., MW-9), a minimum distance of 25-foot surrounding the drill rig will be marked off with caution tape or barricades.

A contamination reduction station, or personnel decontamination area, will be established adjacent to each of the location-specific exclusion zones. All personnel exiting the exclusion zone (work area) must pass through the decontamination area prior to entering the support zone vehicles or leaving the site. Personnel shall undergo appropriate decontamination, as required by the activity-specific procedures and level of personnel protection. Split spoon decontamination will be conducted at a designated area adjacent to the field office trailer on Site 13. The heavy equipment decontamination area established at Site 01 will also be used for this site investigation.

The support zone for this site will be the company vehicles used by the field investigation crew. The vehicles will either be located near the planned well locations or the central portion of the site. The vehicles will provide temporary relief from any adverse weather conditions and will store necessary field sampling and safety/emergency equipment (e.g., car phone, first aid kit, drinking water, HASP). The command center for the RI activities will be at a portable field office trailer located on Site 13, Tank Farm Five.

The OSC or alternate will be responsible for keeping nonessential personnel outside of the exclusion zone boundaries during the investigation activities. In the event that authorized visitors are present on the site during field activities, the OSC or designee shall insure that they adhere to site safety requirements and maintain a safe distance outside of the exclusion zone. All personnel allowed to enter the exclusion zone shall be required to follow safety procedures described in the project HASP in Appendix C and directions of the OSC.

Disposal of field-generated materials (e.g., PPE, decon solutions) is described in the Investigation Derived Waste Plan provided in Appendix E of this Work Plan.

4.4 PERSONNEL PROTECTION AND MONITORING

Based on the findings of the Phase I RI and suspected site contaminants, the field investigation activities will be initiated in either Level D or Modified Level D personnel protection (as defined in the HASP in Appendix C). A list of anticipated initial levels of personnel protection for each of the specific investigation activities is presented in Table 6. Levels of personnel protection will be upgraded or downgraded as conditions dictate.

During field sampling activities, continuous monitoring of ambient air will be conducted with an OVA and HNu. During drilling activities, continuous ambient monitoring of combustible gas levels will also be conducted with an LEL/O2 meter. Air monitoring will also be performed "downhole" during drilling activities.

TABLES

TABLE 1

SITE 12 – TANK FARM FOUR
SITE INVESTIGATION SUMMARY

ACTIVITY / SAMPLE MATRIX	SCOPE OF WORK	NUMBER OF SAMPLES	SAMPLE ANALYSIS
SURFACE SOIL	29 Locations	29	TCL/TAL
STRUCTURES (water & soil)	3 Chambers, 2 Water Samples	3 Soil & 5 Water	TCL/TAL
WELL BORING SOIL	10 Locations	20 – 30 10	TCL/TAL TOC, Cation Exchange, Grain Size
GROUND WATER	14 new wells at 10 locations (9 shallow wells & 5 shallow bedrock wells)	14 5	TCL/TAL less Pest/PCBs Chloride Dissolved TAL, BOD, COD, TSS
	10 existing wells	10	TCL/TAL less Pest/PCBs
SURFACE WATER	13 Stations	13	TCL/TAL, Hardness
SEDIMENT	12 Stations	12	Sediment List (1)

Note: "NA" indicates that activity is not applicable.
TCL indicates sample will be analyzed for Target Compound List.
TAL indicates sample will be analyzed for Target Analyte List.
(1) Sediment List is composed of TCL, TAL, total organic carbon, grain size, and acid volatile sulfides.

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TABLE 2

Site 12 - Tank Farm Four
Surface Soil Location / Rationale

SAMPLE NUMBER	LOCATION / RATIONALE
SS-5	Characterize surface soil quality around the oil/water separator at Site 12.
SS-6	Characterize surface soil quality around the oil/water separator at Site 12.
SS-7	Characterize surface soil quality around the oil/water separator at Site 12.
SS-8	Characterize surface soil quality around the oil/water separator at Site 12.
SS-9	Characterize surface soil quality around the ruins in the southwestern portion of Site 12.
SS-10	Characterize surface soil quality around the ruins in the southwestern portion of Site 12.
SS-11	Characterize surface soil quality downgradient of the central UST portion of Site 12.
SS-12	Characterize surface soil quality downgradient of the central UST portion of Site 12.
SS-13	Characterize surface soil quality downgradient of the central UST portion of Site 12.
SS-14	Characterize surface soil quality in the central portion of Site 12.
SS-15	Characterize surface soil quality in the central portion of Site 12.
SS-16	Characterize surface soil quality in the central portion of Site 12.
SS-17	Characterize surface soil quality on the eastern portion of Site 12.

TABLE 2
(continued)
Site 12 - Tank Farm Four
Surface Soil Location / Rationale

SAMPLE NUMBER	LOCATION / RATIONALE
SS-18	Characterize surface soil quality in low-lying area located in the northwest portion of Site 12.
SS-19	Characterize surface soil quality in low-lying area located in the northwest portion of Site 12.
SS-20	Characterize surface soil quality in the west central portion of Site 12.
SS-21	Characterize surface soil quality in the drainage ditch along the western border of Site 12.
SS-22	Characterize surface soil quality in the drainage ditch along the western border of Site 12.
SS-23	Characterize surface soil quality in the drainage ditch along the western border of Site 12.
SS-24	Characterize surface soil quality in the drainage ditch along the western border of Site 12 to assess potential site runoff considerations.
SS-25	Assess background surface soil quality for Site 12.
SS-26	Assess background surface soil quality for Site 12.
SS-27	Assess background surface soil quality for Site 12.
SS-38	Assess soil conditions on top of Tank 38 where TPH contamination was identified in Phase I.
SS-40	Assess soil conditions on top of Tank 40 where TPH contamination was identified in Phase I.
SS-41	Assess soil conditions on top of Tank 41 where TPH contamination was identified in Phase I.

TABLE 2
(continued)
Site 12 - Tank Farm Four
Surface Soil Location / Rationale

SAMPLE NUMBER	LOCATION / RATIONALE
SS-45	Assess soil conditions on top of Tank 45 where TPH contamination was identified in Phase I.
SS-46	Assess soil conditions on top of Tank 46 where TPH contamination was identified in Phase I.
SS-47	Assess soil conditions on top of Tank 47 where TPH contamination was identified in Phase I.
TOTAL:	26 LOCATIONS 3 BACKGROUND LOCATIONS 29 SAMPLE LOCATIONS

TABLE 3

Site 12 - Tank Farm Four
Monitoring Well Location / Rationale

WELL NUMBER	LOCATION / RATIONALE
MW-4R	Further investigate ground water quality within bedrock near Normans Brook.
MW-6S	Further investigate ground water quality upgradient of the central portion of Site 12.
MW-7S/R	Investigate ground water quality upgradient of the south central portion of Site 12.
MW-8S/R	Investigate ground water quality upgradient of the north central portion of Site 12.
MW-9S	Further investigate ground water quality in the central portion of Site 12.
MW-10S	Investigate ground water quality downgradient of the north central portion of Site 12, near and slightly downgradient of the tanks.
MW-11S/R	Further investigate ground water quality downgradient of the central portion of Site 12.
MW-12S/R	Investigate ground water quality downgradient of the southwest central portion of Site 12, and downgradient of the tanks.
MW-13S	Investigate ground water quality downgradient of the southern portion of Site 12, and downgradient of the tanks.
MW-14S	Investigate ground water quality at the western downgradient edge of Site 12.
TOTAL:	9 SHALLOW WELLS 5 ROCK WELLS 14 WELLS

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TABLE 4

Site 12 - Tank Farm Four
Surface Water & Sediment Location / Rationale

STATION NUMBER	LOCATION / RATIONALE
SW-1A/SD-1A	Station is located at a depositional area just east of station SW-1/SD-1 and directly west of the overhead railroad bridge.
SW-2A/SD-2A	Station is located in a depositional area at the downstream edge of the site just upstream of Defence Highway. This station is also just downstream of Phase I station SW-2/SD-2.
SW-3A/SD-3A	Station is located in a depositional area just downstream of Phase I station SW-4/SD-4.
SW-4/SD-4	Station is located in a depositional area just downstream of the discharge pipe. This is also a Phase I sample station.
SW-5A/SD-5A	Station is located in a depositional area just upstream of the discharge pipe and downstream of Phase I station SW-5/SD-5.
SW-6A/SD-6A	Station is located in a depositional area just on-site and downstream of station SW-6/SD-6.
SW-6/SD-6	Station is located just upstream of the site and is a Phase I sample station.
SW-7/SD-7	Station is located in a depositional area approximately 400 feet upstream of the site and station SW-6/SD-6.
SW-8/SD-8	Station is located in a depositional area approximately 900 feet from the site and upstream of station SW-6/SD-6.
SW-9/SD-9	Station is located at the confluence of Normans Brook and Narragansett Bay.
SW-10/SD-10	Station is located north of the confluence of Normans Brook and Narragansett Bay.

TABLE 4
(continued)
Site 12 - Tank Farm Four
Surface Water & Sediment Location / Rationale

STATION NUMBER	LOCATION / RATIONALE
SW-11/SD-11	Station is located south of the confluence of Normans Brook and Narragansett Bay.
W-2	Sample of water at outlet of concrete pipe between surface water stations SW-4 and SW-5A.
W-3	Sample of water entering "ruins".
W-4	Sample of water exiting "ruins".
TOTAL:	15 WATER SAMPLES 12 SEDIMENT SAMPLES

TABLE 5

SITE 12 - TANK FARM FOUR
SITE EMERGENCY CONTACTS

NETC Emergency Numbers:

Command Duty Officer	841-3456 or 3457
Security Office - Police	841-3241
NETC Fire Protection	841-3333
Public Works Trouble Desk	841-4001

Utilities:

Rhode Island Dig Safe	800-225-4977
NETC Dig Safe	841-2464

Newport Emergency Numbers:

Newport Police Dept.	847-1306
Newport Fire Dept.	846-2211
Newport Hospital	
General Number	846-6400
Emergency Room	846-6400 ext. 1120
Poison Control Center	277-5727

Additional Resources:

Dr. Erdil, or Dr. Stahl - TRC Company Physicians, Immediate Medical Care, Hartford, Connecticut - (203) 296-8330
Mr. James Peronto - TRC Project Manager - (203) 289-8631
NETC Environmental Coord. - (401) 841-3735
Mr. Robert Hanley - NETC Safety Officer - (401) 841-2478

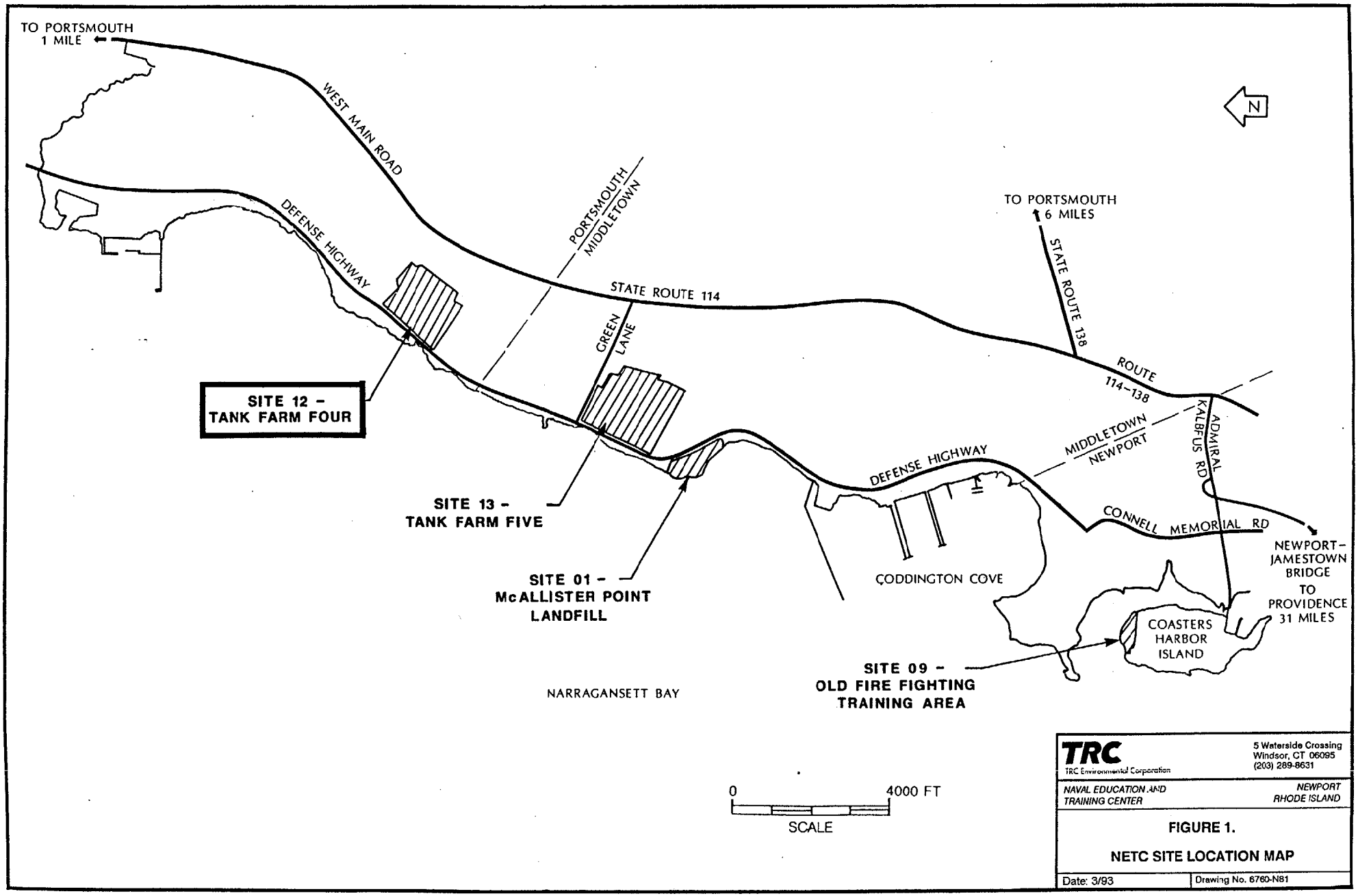
TABLE 6

SITE 12 - TANK FARM FOUR
PERSONNEL PROTECTION SUMMARY

Activity	*Intitial Level of Protection*
Reconnaissance Survey	*D*
Soil Gas Survey	*D*
Surface Soil Sampling	*D*
Well Boring	*Mod. D*
Ground Water Sampling	*Mod. D*
Surface Water & Sediment Sampling	*D*
Structure Sampling	*Mod. D*
Land Survey	*D*

NOTE: *The personnel protection levels will be upgraded or downgraded as conditions warrant according to criteria specified in the project Health and Safety Plan (HASP).*

FIGURES


TO PORTSMOUTH
1 MILE
WEST MAIN ROAD
DEFENSE HIGHWAY
PORTSMOUTH
MIDDLETOWN
STATE ROUTE 114
GREEN LANE
TO PORTSMOUTH
6 MILES
STATE ROUTE 138
ROUTE 114-138
SITE 12 -
TANK FARM FOUR
SITE 13 -
TANK FARM FIVE
SITE 01 -
McALLISTER POINT
LANDFILL
DEFENSE HIGHWAY
MIDDLETOWN
NEWPORT
ADMIRAL KALBFUS RD
CONNELL MEMORIAL RD
NEWPORT-
JAMESTOWN
BRIDGE
TO
PROVIDENCE
31 MILES
CODDINGTON COVE
COASTERS
HARBOR
ISLAND
SITE 09 -
OLD FIRE FIGHTING
TRAINING AREA
NARRAGANSETT BAY
N
0
4000 FT
SCALE
TRC
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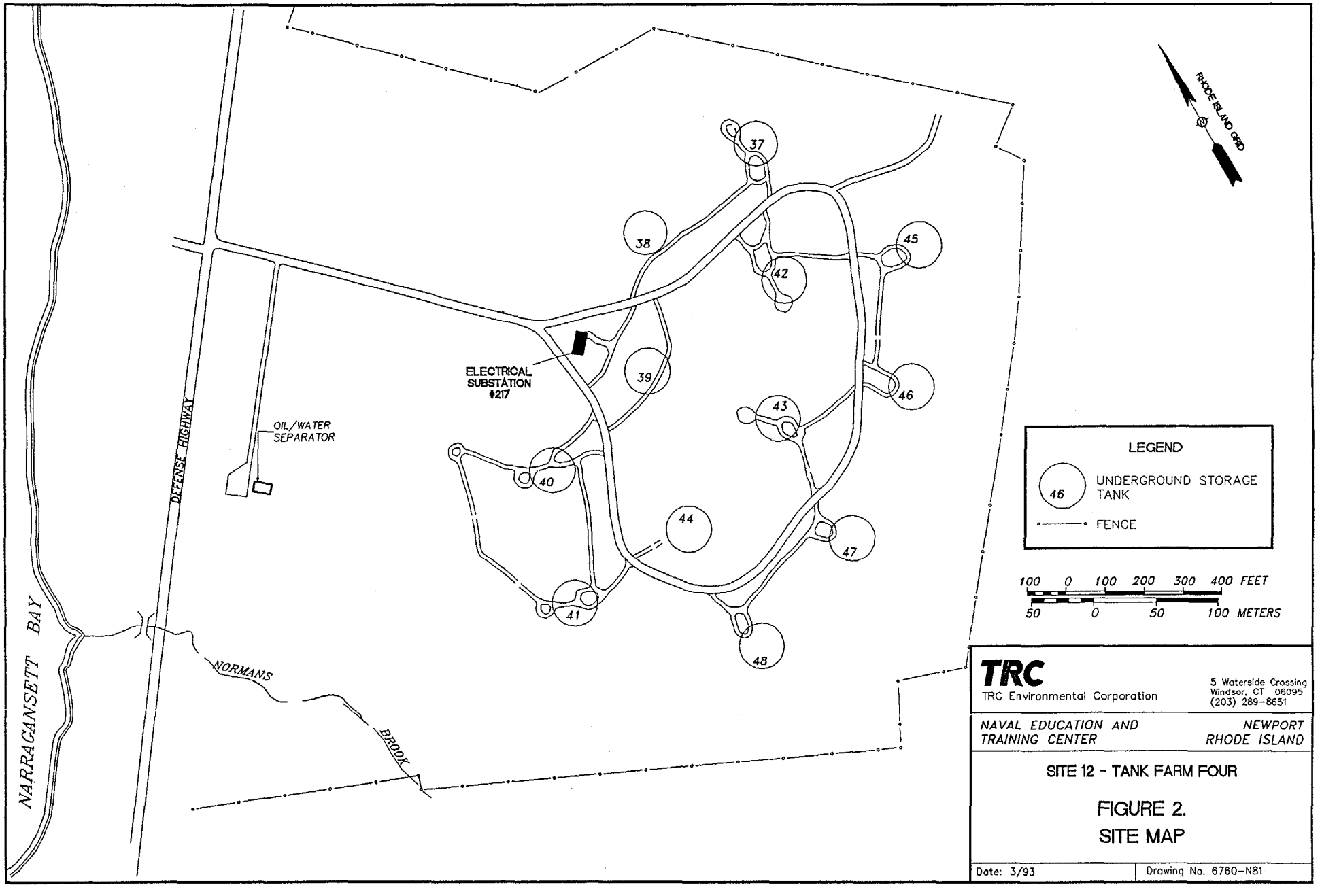
5 Waterside Crossing
Windsor, CT 06095
(203) 289-8631
NAVAL EDUCATION AND
TRAINING CENTER
NEWPORT
RHODE ISLAND
FIGURE 1.
NETC SITE LOCATION MAP
Date: 3/93
Drawing No. 6760-N81


RHODE ISLAND GRID
37
38
39
40
41
42
43
44
45
46
47
48
ELECTRICAL SUBSTATION #217
OIL/WATER SEPARATOR
DEFENSE HIGHWAY
NARRAGANSETT BAY
NORMANS BROOK
LEGEND
46 UNDERGROUND STORAGE TANK
FENCE
100 0 100 200 300 400 FEET
50 0 50 100 METERS
TRC
TRC Environmental Corporation
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Windsor, CT 06095
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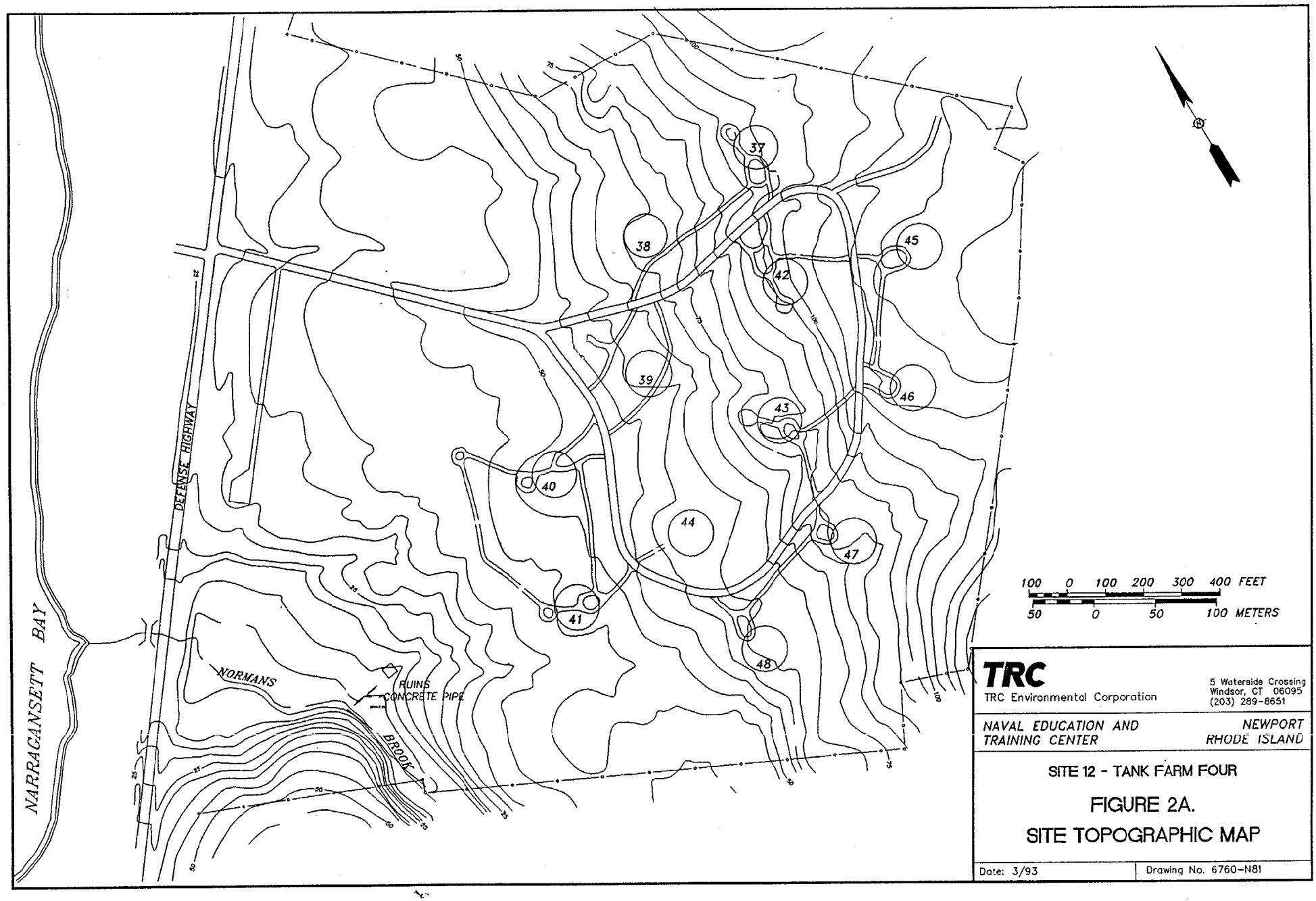
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT RHODE ISLAND
SITE 12 - TANK FARM FOUR
FIGURE 2.
SITE MAP
Date: 3/93
Drawing No. 6760-N81


NARRAGANSETT BAY
DEFENSE HIGHWAY
NORMANS
BROOK
RUINS
CONCRETE PIPE
37
38
39
40
41
42
43
44
45
46
47
48
100 0 100 200 300 400 FEET
50 0 50 100 METERS
TRC
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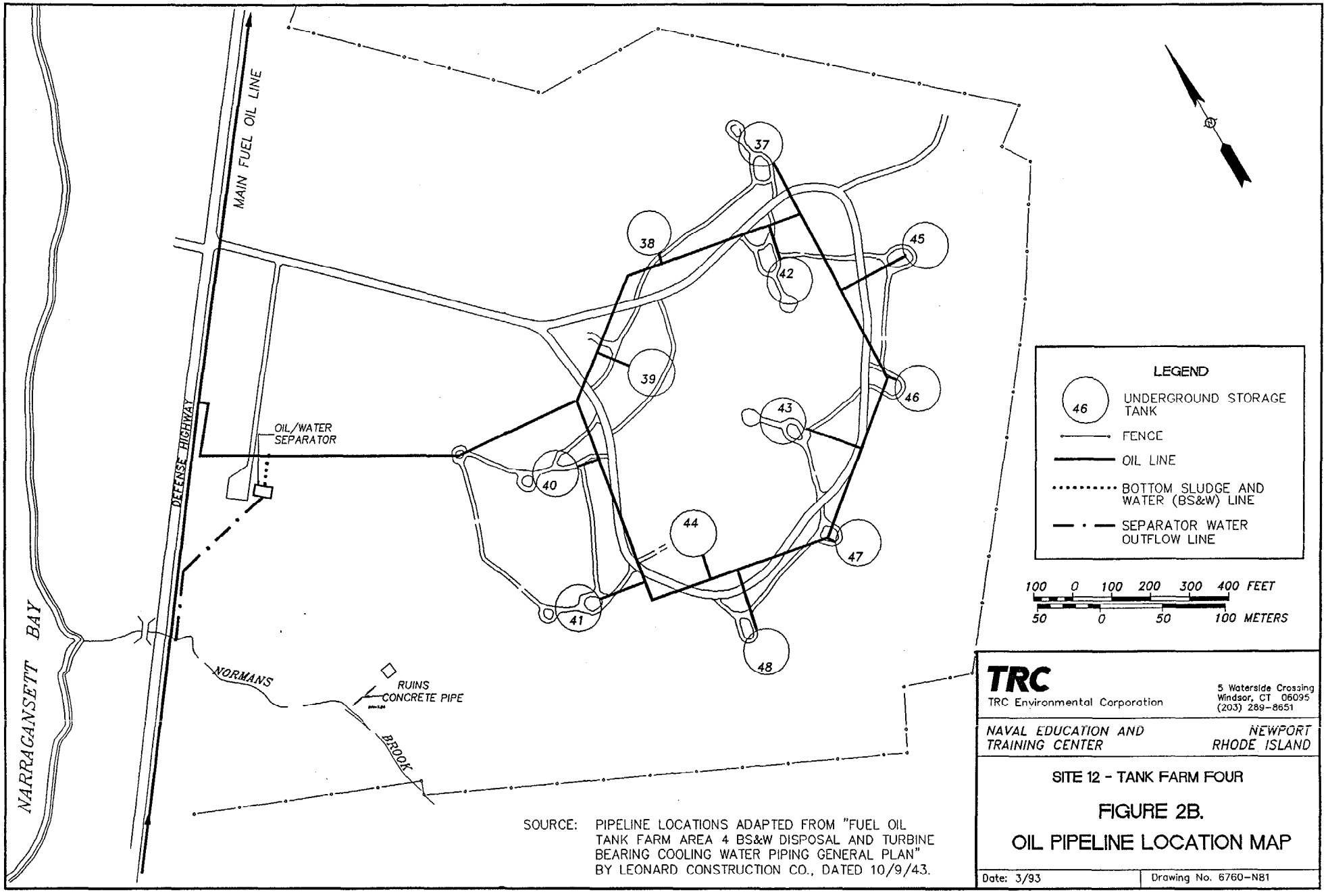
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT RHODE ISLAND
SITE 12 - TANK FARM FOUR
FIGURE 2A.
SITE TOPOGRAPHIC MAP
Date: 3/93
Drawing No. 6760-N81



SOURCE: PIPELINE LOCATIONS ADAPTED FROM "FUEL OIL TANK FARM AREA 4 BS&W DISPOSAL AND TURBINE BEARING COOLING WATER PIPING GENERAL PLAN" BY LEONARD CONSTRUCTION CO., DATED 10/9/43.

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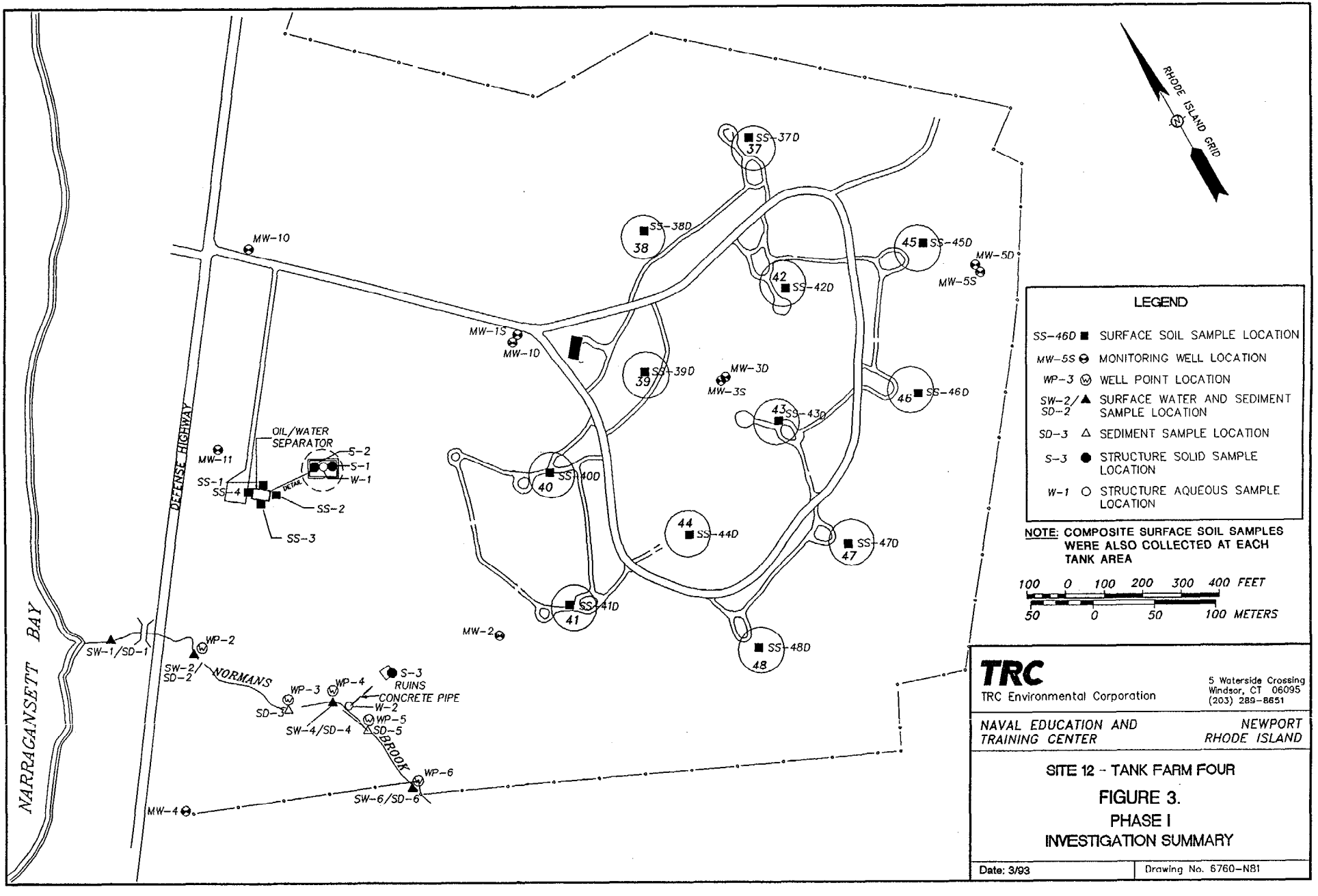
SITE 12 - TANK FARM FOUR

FIGURE 2B.

OIL PIPELINE LOCATION MAP

Date: 3/93
Drawing No. 6760-N81


RHODE ISLAND GRID
LEGEND
SS-46D SURFACE SOIL SAMPLE LOCATION
MW-5S MONITORING WELL LOCATION
WP-3 WELL POINT LOCATION
SW-2/SD-2 SURFACE WATER AND SEDIMENT SAMPLE LOCATION
SD-3 SEDIMENT SAMPLE LOCATION
S-3 STRUCTURE SOLID SAMPLE LOCATION
W-1 STRUCTURE AQUEOUS SAMPLE LOCATION
NOTE: COMPOSITE SURFACE SOIL SAMPLES WERE ALSO COLLECTED AT EACH TANK AREA
100 0 100 200 300 400 FEET
50 0 50 100 METERS
NARRAGANSETT BAY
DEFENSE HIGHWAY
NORMANS BROOK
OIL/WATER SEPARATOR
DETAIL
S-2
S-1
W-1
SS-1
SS-4
SS-2
SS-3
MW-11
MW-10
MW-1S
MW-1D
MW-2
MW-3D
MW-3S
MW-4
MW-5D
MW-5S
SS-37D
37
SS-38D
38
SS-39D
39
SS-40D
40
SS-41D
41
SS-42D
42
SS-43D
43
SS-44D
44
SS-45D
45
SS-46D
46
SS-47D
47
SS-48D
48
SW-1/SD-1
WP-2
SW-2/SD-2
WP-3
WP-4
SD-3
SW-4/SD-4
S-3
RUINS
CONCRETE PIPE
W-2
WP-5
SD-5
WP-6
SW-6/SD-6
TRC
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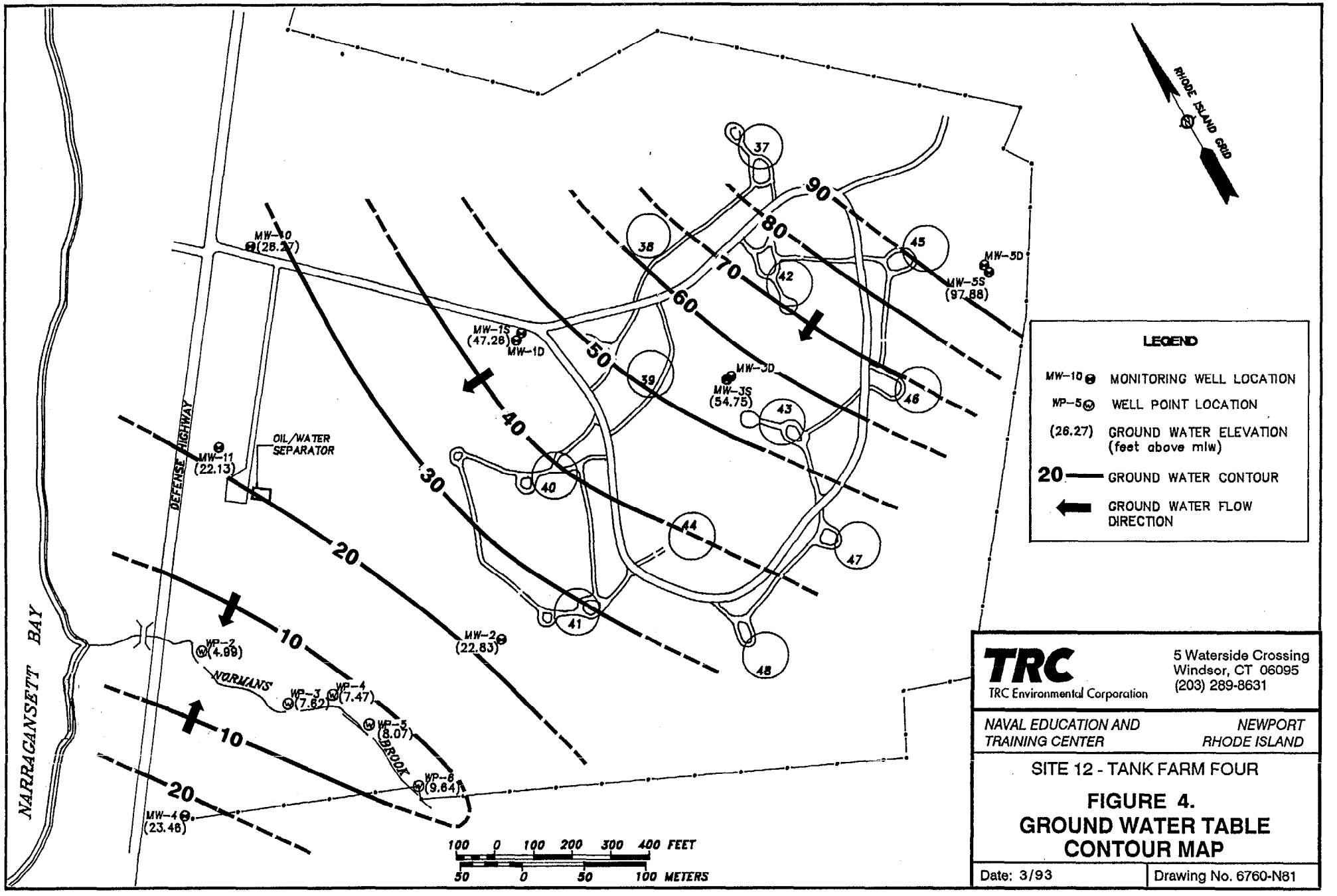
SITE 12 - TANK FARM FOUR
FIGURE 3.
PHASE I
INVESTIGATION SUMMARY
Date: 3/93
Drawing No. 6760-N81


NARRAGANSETT BAY
DEFENSE HIGHWAY
OIL/WATER SEPARATOR
NORMANS BROOK
MW-10 (26.27)
MW-11 (22.13)
MW-1S (47.26)
MW-1D
MW-2 (22.83)
MW-3D
MW-3S (54.75)
MW-4 (23.46)
MW-5D
MW-5S (97.88)
WP-2 (4.99)
WP-3 (7.62)
WP-4 (7.47)
WP-5 (8.07)
WP-6 (9.64)
10
20
30
40
50
60
70
80
90
37
38
39
40
41
42
43
44
45
46
47
48
100 0 100 200 300 400 FEET
50 0 50 100 METERS
RHODE ISLAND GRID
LEGEND
MW-10 MONITORING WELL LOCATION
WP-5 WELL POINT LOCATION
(26.27) GROUND WATER ELEVATION (feet above mlw)
20 GROUND WATER CONTOUR
GROUND WATER FLOW DIRECTION
TRC
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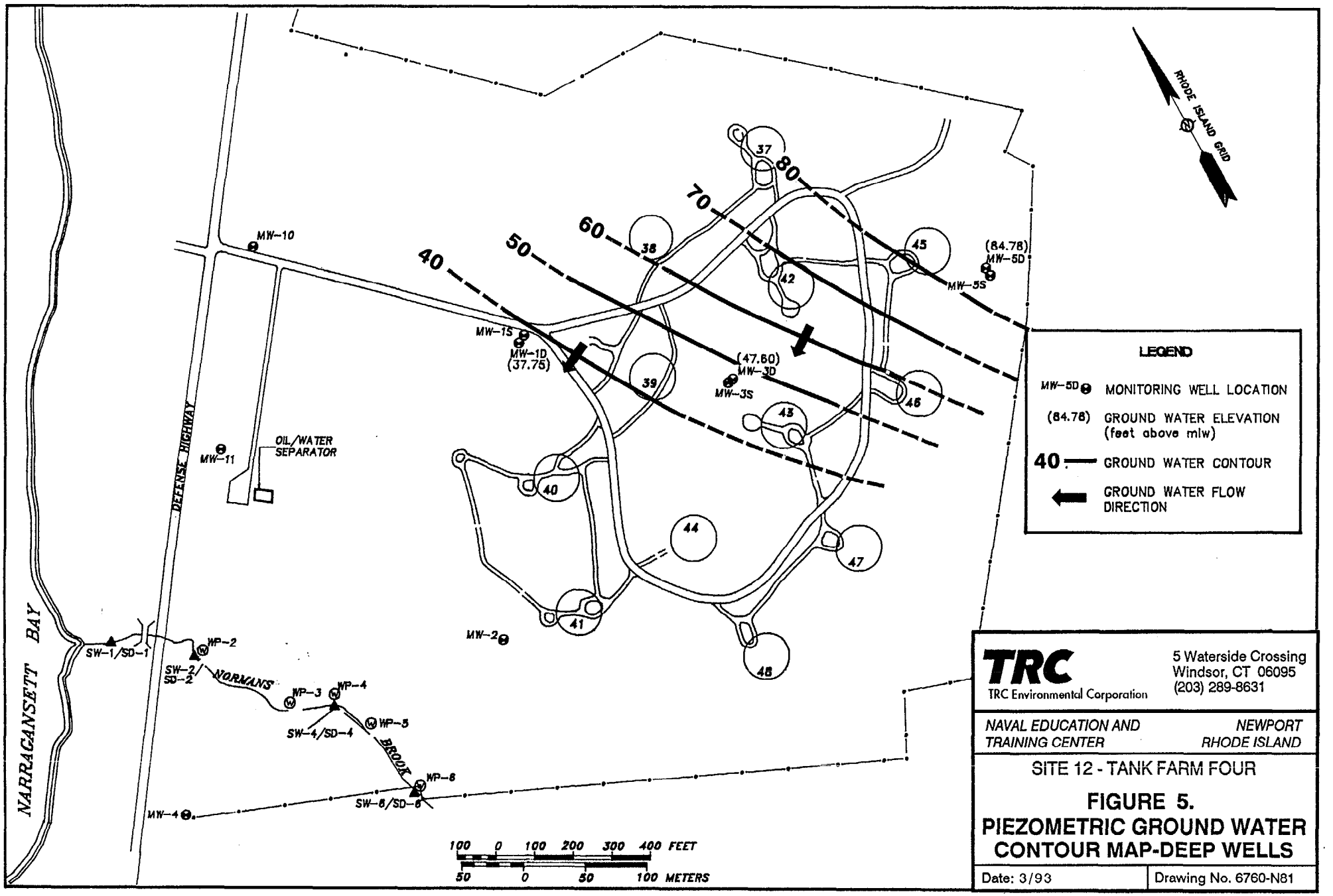
NEWPORT RHODE ISLAND
SITE 12 - TANK FARM FOUR
FIGURE 4.
GROUND WATER TABLE CONTOUR MAP
Date: 3/93
Drawing No. 6760-N81



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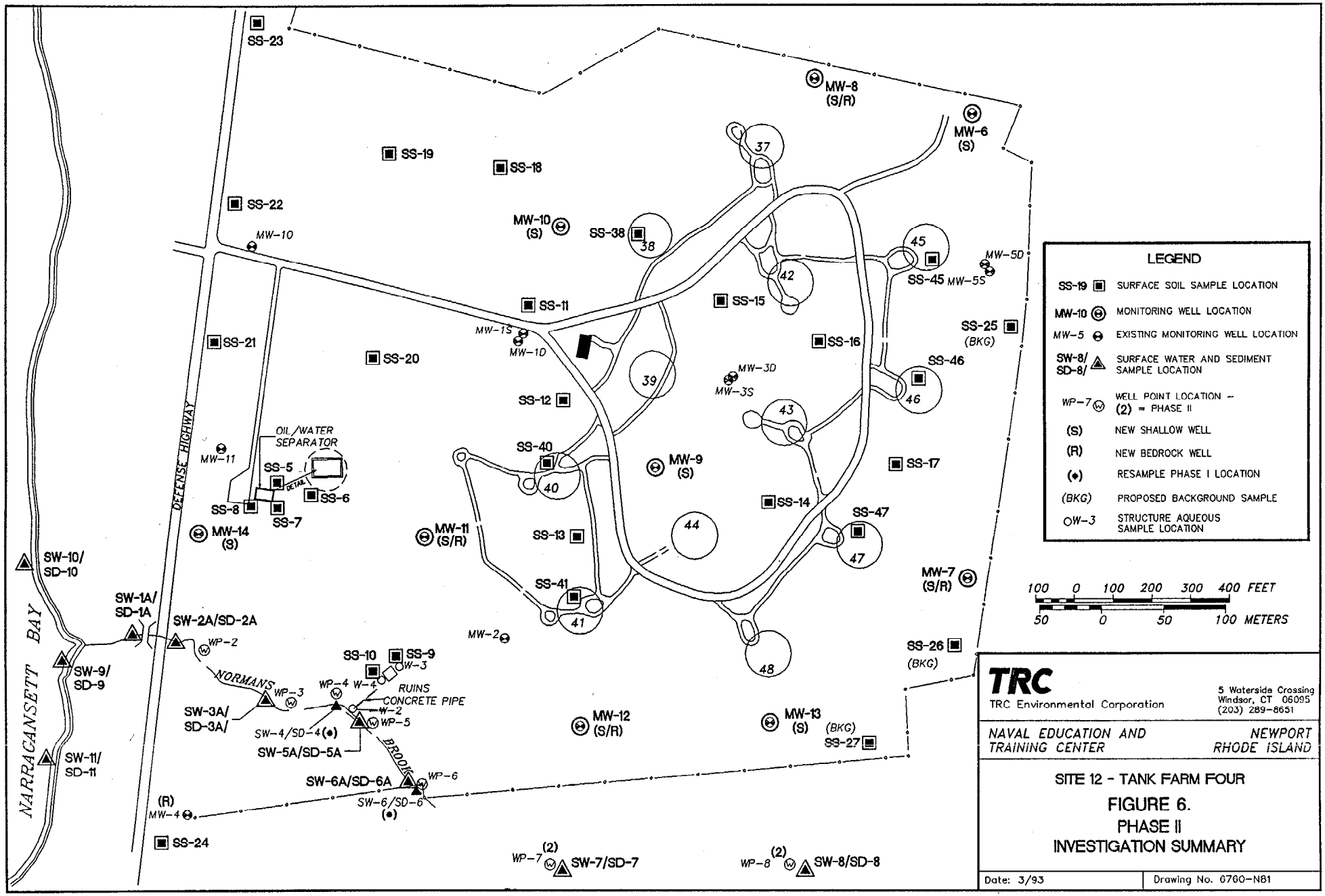
SITE 12 - TANK FARM FOUR

FIGURE 5.
PIEZOMETRIC GROUND WATER CONTOUR MAP-DEEP WELLS

Date: 3/93 | Drawing No. 6760-N81



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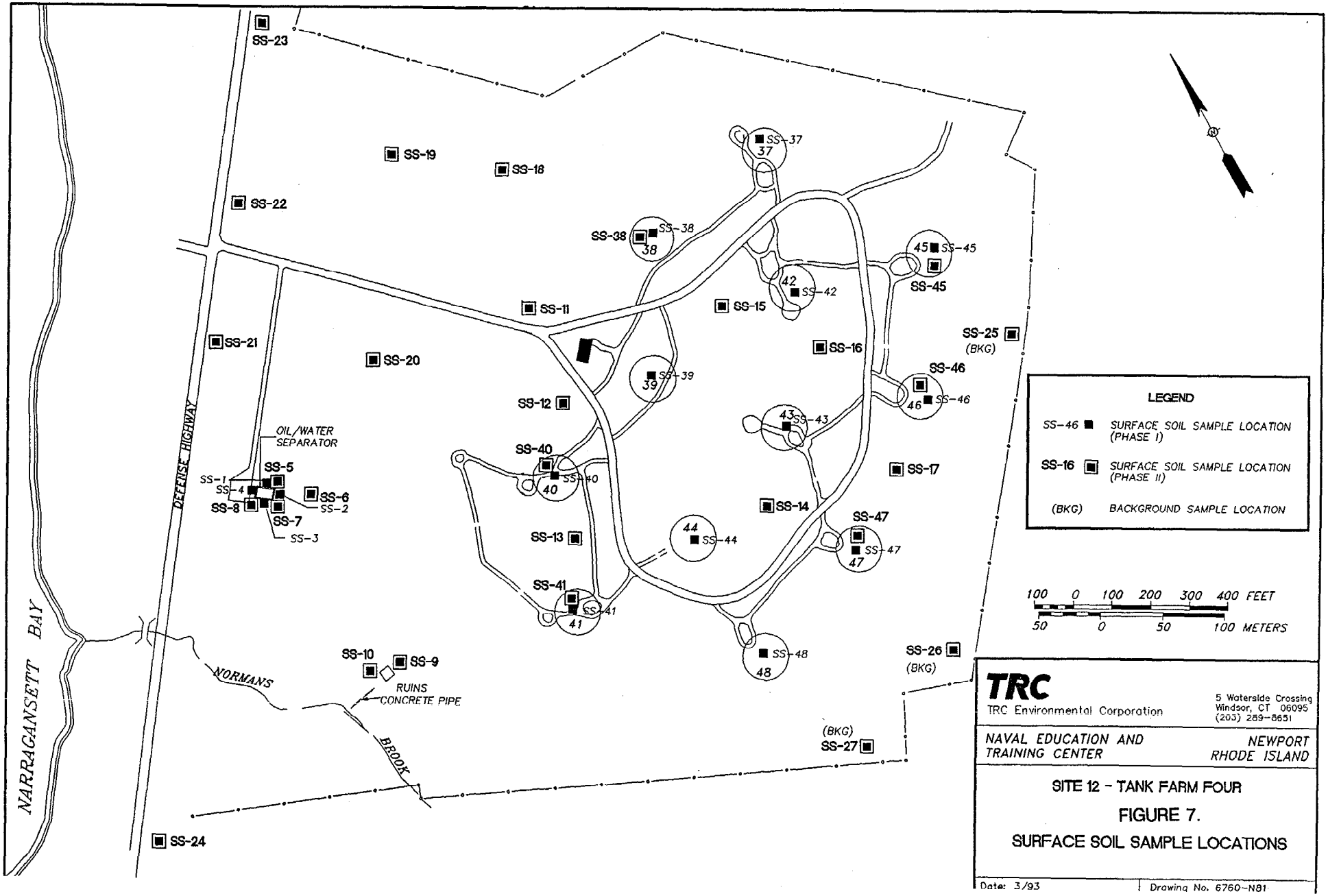
SITE 12 - TANK FARM FOUR

FIGURE 6.
PHASE II
INVESTIGATION SUMMARY

Date: 3/93 | Drawing No. 6760-N81


SS-23
SS-19
SS-18
SS-22
SS-37
37
SS-38
38
SS-45
45
SS-42
42
SS-11
SS-15
SS-21
SS-20
SS-16
SS-25
(BKG)
SS-46
46
SS-39
39
SS-12
SS-43
43
OIL/WATER SEPARATOR
SS-40
40
SS-5
SS-1
SS-4
SS-6
SS-2
SS-8
SS-7
SS-3
SS-17
SS-14
SS-47
47
SS-44
44
SS-13
SS-41
41
DEFENSE HIGHWAY
NARRAGANSETT BAY
NORMANS
BROOK
SS-10
SS-9
RUINS
CONCRETE PIPE
SS-48
48
SS-26
(BKG)
(BKG)
SS-27
SS-24
LEGEND
SS-46 SURFACE SOIL SAMPLE LOCATION (PHASE I)
SS-16 SURFACE SOIL SAMPLE LOCATION (PHASE II)
(BKG) BACKGROUND SAMPLE LOCATION
100 0 100 200 300 400 FEET
50 0 50 100 METERS
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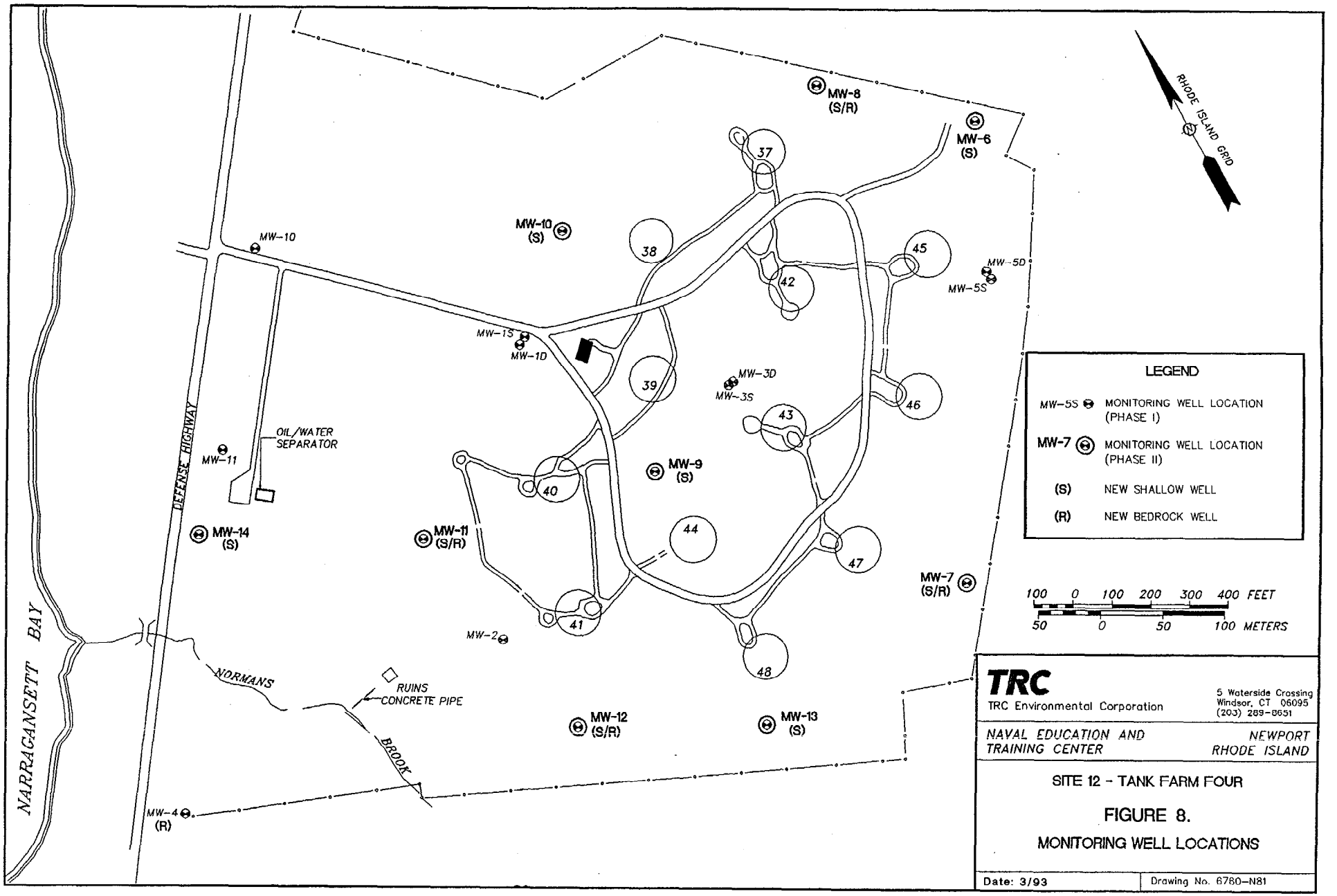
SITE 12 - TANK FARM FOUR
FIGURE 7.
SURFACE SOIL SAMPLE LOCATIONS
Date: 3/93
Drawing No. 6760-N81


NARRAGANSETT BAY
DEFENSE HIGHWAY
NORMANS BROOK
RUINS
CONCRETE PIPE
OIL/WATER SEPARATOR
MW-10
MW-11
MW-14 (S)
MW-11 (S/R)
MW-2
MW-4 (R)
MW-12 (S/R)
MW-13 (S)
MW-7 (S/R)
MW-9 (S)
MW-10 (S)
MW-8 (S/R)
MW-6 (S)
MW-1S
MW-1D
MW-3D
MW-3S
MW-5D
MW-5S
37
38
39
40
41
42
43
44
45
46
47
48
RHODE ISLAND GRID
LEGEND
MW-5S MONITORING WELL LOCATION (PHASE I)
MW-7 MONITORING WELL LOCATION (PHASE II)
(S) NEW SHALLOW WELL
(R) NEW BEDROCK WELL
100 0 100 200 300 400 FEET
50 0 50 100 METERS
TRC
TRC Environmental Corporation
5 Waterside Crossing
Windsor, CT 06095
(203) 289-8651
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT RHODE ISLAND
SITE 12 - TANK FARM FOUR
FIGURE 8.
MONITORING WELL LOCATIONS
Date: 3/93
Drawing No. 6760-N81

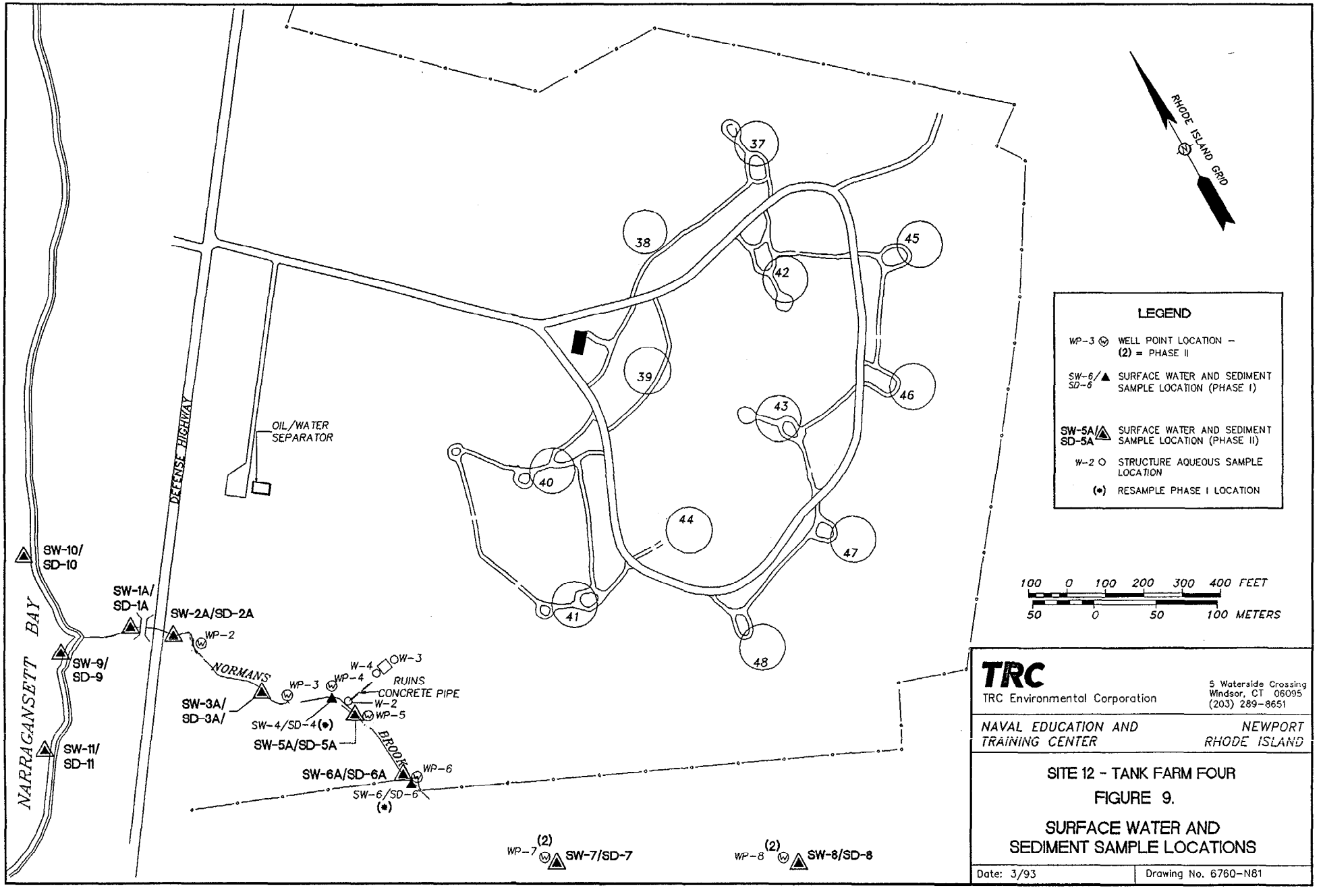

RHODE ISLAND GRID
LEGEND
WP-3 WELL POINT LOCATION – (2) = PHASE II
SW-6/SD-6 SURFACE WATER AND SEDIMENT SAMPLE LOCATION (PHASE I)
SW-5A/SD-5A SURFACE WATER AND SEDIMENT SAMPLE LOCATION (PHASE II)
W-2 STRUCTURE AQUEOUS SAMPLE LOCATION
(*) RESAMPLE PHASE I LOCATION
100 0 100 200 300 400 FEET
50 0 50 100 METERS
37
38
39
40
41
42
43
44
45
46
47
48
OIL/WATER SEPARATOR
DEFENSE HIGHWAY
NARRAGANSETT BAY
NORMANS BROOK
SW-10/SD-10
SW-9/SD-9
SW-11/SD-11
SW-1A/SD-1A
SW-2A/SD-2A
WP-2
SW-3A/SD-3A/
WP-3
WP-4
W-4
OW-3
RUINS
CONCRETE PIPE
W-2
WP-5
SW-4/SD-4(*)
SW-5A/SD-5A
SW-6A/SD-6A
WP-6
SW-6/SD-6 (*)
WP-7 (2) SW-7/SD-7
WP-8 (2) SW-8/SD-8
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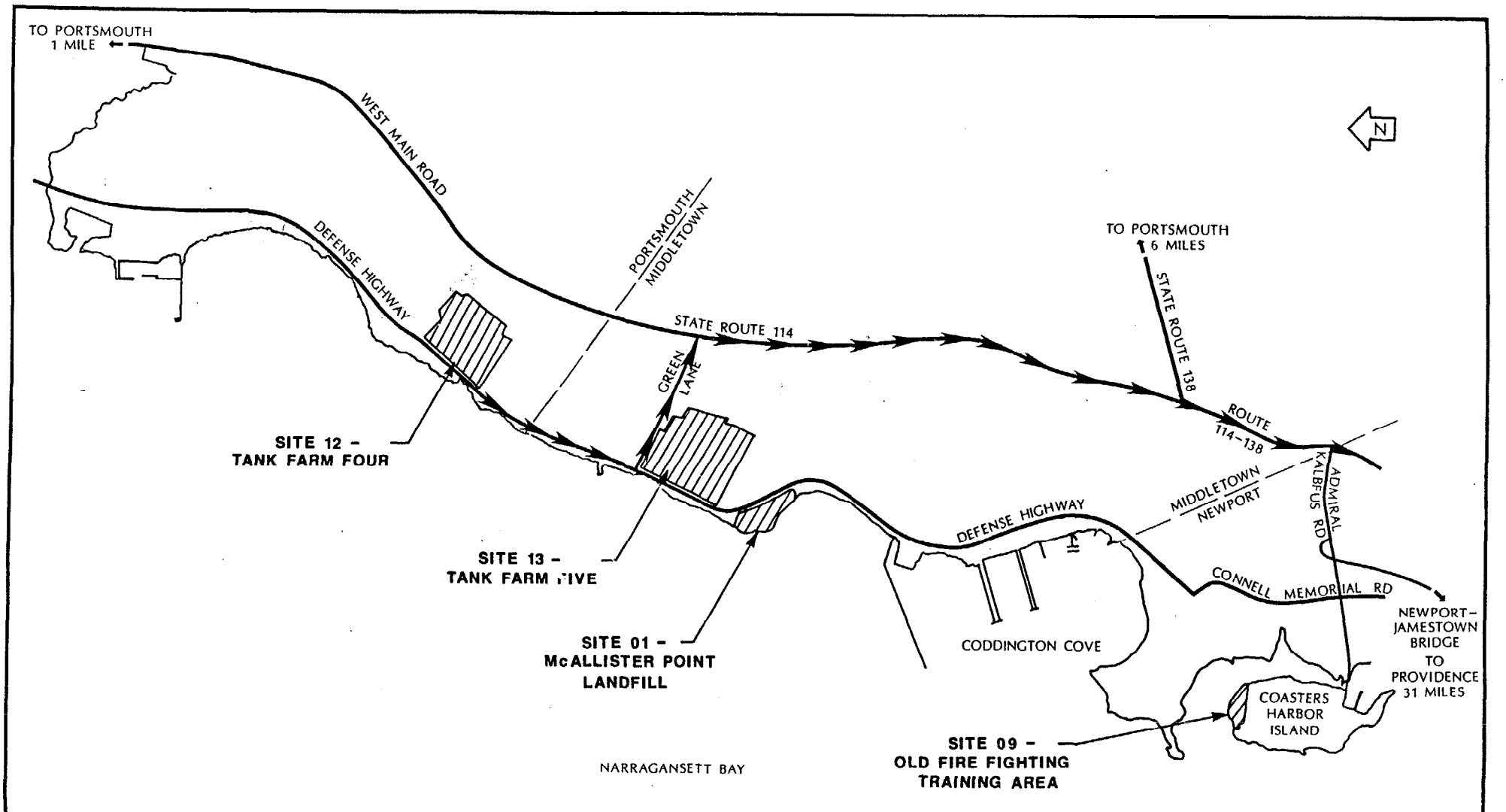
FIGURE 9.
SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS
Date: 3/93
Drawing No. 6760-N81



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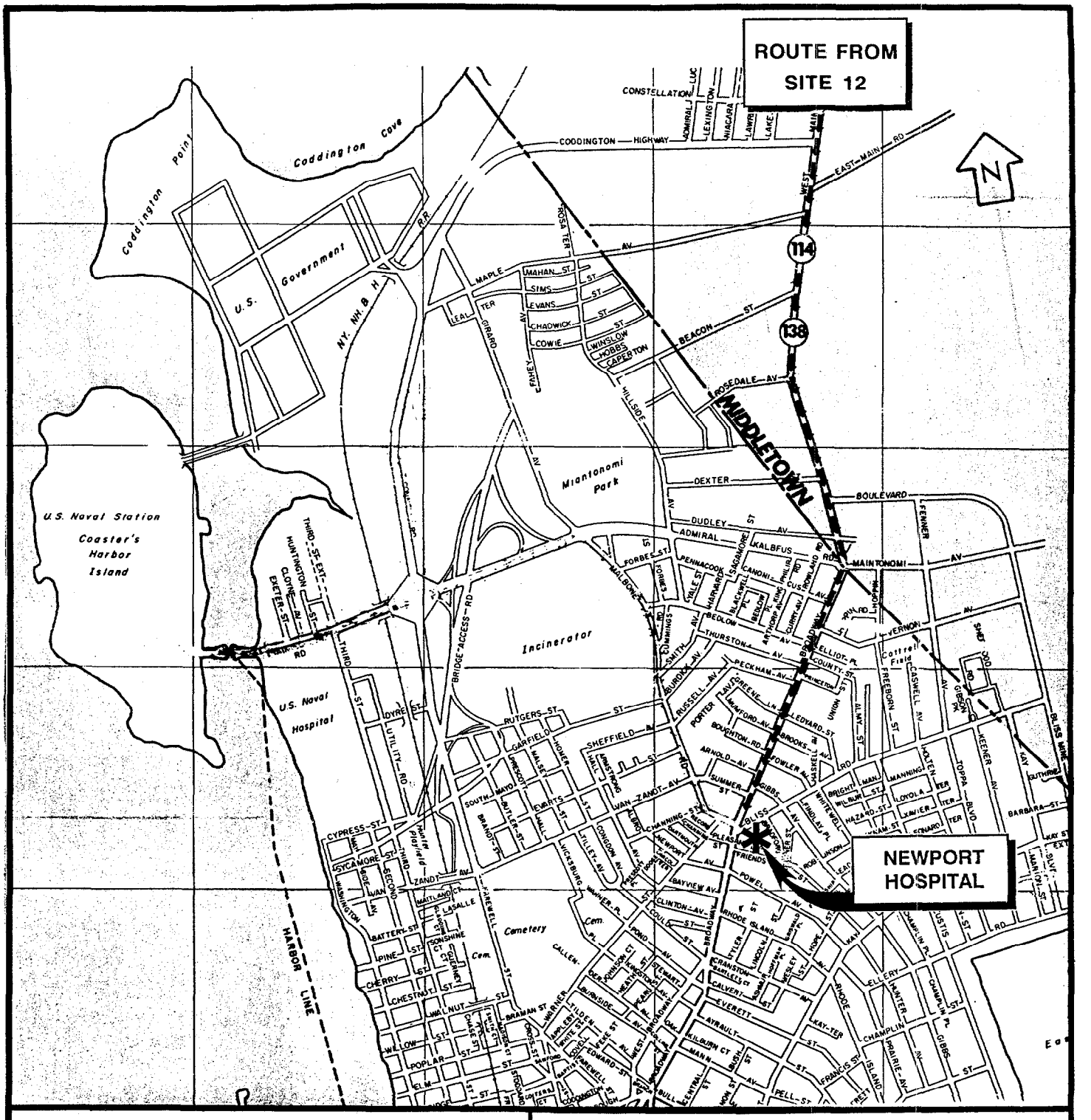
NEWPORT RHODE ISLAND

FIGURE 10.

NEWPORT HOSPITAL ROUTE MAP

Date: 3/93

Drawing No. 6760-N81



0 1/4 1/2
SCALE IN MILES

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FIGURE 10A.

NEWPORT HOSPITAL ROUTE MAP

Date: 3/93

Drawing No. 6760-N81

U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

VOLUME III-4
-TANK FARM FIVE-
SITE 13

PHASE II RI/FS
WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared by:
TRC Environmental Corporation
Windsor, Connecticut

Prepared for:
Northern Division - Naval Facilities
Engineering Command
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March, 1993

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1.0 INTRODUCTION

The objective of this volume of the Work Plan is to define the level of Phase II investigation necessary to assess the nature and extent of environmental contamination at Site 13, the Tank Farm Five site located on the NETC. This volume of the Work Plan describes site-specific objectives in Section 1.1, summarizes available site background information in Section 2.0, presents the site-specific field sampling activities in Section 3.0, and summarizes site-specific health and safety information in Section 4.0.

1.1 SITE-SPECIFIC INVESTIGATION OBJECTIVES

The general objectives of the RI site investigation are to determine the nature and extent of site contamination, sources of contamination, potential contaminant migration pathways, potential contaminant receptors, and associated exposure pathways. This information is necessary to determine whether, and to what extent, a threat to human health or the environment exists, and to provide the information required to develop and evaluate remedial action alternatives for the site, as necessary.

The scope of the Phase I and Phase II sampling efforts for this site have been developed to meet site-specific RI/FS objectives. The site-specific objectives have been refined based upon the findings of the Phase I RI. Below is a list of the RI objectives for the Tank Farm Five site investigation:

- determine the site background soil and ground water quality;
- determine the presence and nature of site surface soil contamination;
- determine the presence and nature of any contamination related to past reported on-site sludge burning activities;
- determine the nature and extent of any site ground water contamination;
- determine the nature and extent of surface water and sediment contamination in the on-site brook;
- determine the physical and chemical characteristics of the underground storage tank contents; and
- determine the presence and nature of contamination in the on-site oil/water separator.

The Phase II site investigation is being conducted to address areas of concern discovered under the Phase I investigation and any site investigation data gaps. The Phase II investigation activities will include surface soil sampling, soil boring sampling, monitoring well installation and sampling, and surface water and sediment sampling. Soil and ground water samples will be collected from the site and analyzed as described in Section 3.0 of this plan.

2.0 SITE BACKGROUND INFORMATION

2.1 SITE LOCATION AND DESCRIPTION

Tank Farm 5 is located in the north-central portion of the Newport Naval Base in the town of Middletown. The location of Tank Farm Five on the NETC is shown on Figure 1. The tank farm is approximately 73 acres in size. The site is located just east of Narragansett Bay. Defense Highway borders the western edge of the site. A road (Greene Lane) borders the site to the northeast. East of the site is a residential development. To the south is a wooded area and cemetery. A map of Tank Farm Five is presented on Figure 2 with site topography shown on Figure 2A.

Access to the site is from the west, off of Defense Highway through a gate and along a paved entrance way which leads to the central portion of the site. Just inside the entrance and north of the paved road is the new Fire Fighting Training area which occupies approximately 3 acres and is surrounded by a chain link fence. The paved road continues through the site in a loop past all of the underground storage tank locations. Adjacent to each of the UST locations are pump/valve houses for the tanks. At the western side of the tank area is a small metal building which was used as the electrical substation during the operation of the tank farm. A concrete structure which was used as an oil-water separator is located at the end of an extension of the paved road, just northeast of the new Fire Fighting Training Center.

The site topography generally slopes to the north. The ground elevation generally ranges from 25 feet above mean low water level (mlw) in the northern corner of the site to 90 feet above mlw at the southern edge of the site. In the vicinity of the brook (Gomes Brook) which crosses through the northeastern portion of the site, the ground elevations fall to mean low water level. The brook flows off-site and into Narragansett Bay.

The site is vegetated with grass, weeds, brush, and some trees. Most of the site is covered by very dense brush. The area around the new Fire Fighting Training area is open and grassy with new sod. The majority of the more mature trees on the site are located in the northern and southern corners of the site.

2.2 SITE HISTORY

The following is a summary of the history of the site as presented in the IAS report (Envirodyne, 1983).

> The site was used for the storage of diesel and fuel oil and consisted of eleven 60,000-barrel underground storage tanks. Disposal at this site has been from World War II until the mid-1970's. The tank bottom sludge, obtained during cleaning operations, was disposed of in a burning pit. This burning pit had steel sides and a sand bottom.
>
> The sludge was placed in the pit and burned. Between 100,000 and 175,000 gallons of oil sludge were disposed of at this site. This oil sludge is considered a hazardous waste in Rhode Island. This is located within 1,000 feet of Narragansett Bay. With the exception of Tanks 53 and 56, this site is being excessed by the Navy.
>
> (IAS, pg. 2-8)

The former location of the "burning pit" is presently what appears to be an oil/water separator. Design plans for the oil water separator show this unit as being constructed within the pre-existing burning chamber.

The Navy has withdrawn its plans to excess all but 1.75 acres of the site's land. The 1.75 acres of land, located in the eastern corner of the site along Green Lane, was previously sold to the town of Middletown. Figure 2B indicates the approximate location of subsurface piping between the Tank Farm Five tanks.

2.2.1 Aerial Photography

Aerial photos and facility maps were reviewed for the period from 1938 through 1988. Activity on the site dates back to 1942 blackline photo prints which show the tank farm under construction. In a 1963 aerial photo, the site features appear similar to the way they appear today. The tank farm is visible, along with a main access road which encircles the tanks, and two spur, which split off to the north. The oil/water separator is visible to the west of the westernmost spur. A transformer vault is present along the northern side of the main access road. No significant site changes are visible through 1988.

2.3 PREVIOUS SITE INVESTIGATIONS

Tank Farm Five was initially investigated under the Initial Assessment Study (IAS) in 1983. A Confirmation Study (CS) was not performed for the site. However, two of the tanks at the site, Numbers 53 and 56, were examined further previous to the Phase I RI as part of a tank closure study. The tank closure study was conducted from 1985 to 1986 by Environmental Resource Associates (ERA) of Warwick, Rhode Island. In addition, Tibbets Engineering Corporation (Tibbets) of New Bedford, Massachusetts, sampled the contents of all of the tanks at Tank Farm Five in 1983.

It was reported in the IAS report (Envirodyne, 1983) that tank bottom sludge from the tanks on this site was disposed of in a burning pit, constructed with steel sides and a sand bottom. Given the possibility of surface soil and ground water contamination at this site, this site was listed as requiring further action in the IAS. However, due to the similarity of this site to the other tank farm sites, it was recommended in the IAS that the findings of the investigation of one of the other tank farms (Tank Farms One and Four were addressed in the CS) be used to direct any investigation at Tank Farm Five. Thus, a CS was not conducted on Tank Farm Five.

As referenced previously, two studies were conducted at Tank Farm Five in relation to two of the on-site underground storage tanks (USTs); a 1983 study on the contents of two of the USTs at the site, and a 1985-86 study required by the RIDEM for the closure of the same two tanks. These two tanks were used for waste oil storage after the use of the other tanks was discontinued. The scope and findings of the tank closure investigation are presented in a report by Environmental Resource Associates, Inc. (ERA, 1988) and are summarized below.

The contents of the two USTs and the ground water quality adjacent to the two USTs were investigated during the tank closure study. Sampling of the tank contents included the collection of water samples, surficial floating oil samples, bottom sludge samples, and samples of an intervening oil-water emulsion (Tanks 53 and 56). The sample results indicated the presence of aromatic and chlorinated compounds and some metals in the oils contained within Tanks 53 and 56. The sludge samples from these two tanks also exhibited high metals levels. Water samples collected from other tanks indicated that tanks which were not used for waste oil

storage also contain water contaminated with chlorinated and aromatic organic compounds, copper and zinc.

During the 1985/1986 study a total of ten (10) ground water monitoring wells were installed at Tank Farm Five. These wells included MW-53E and MW-53W, MW-56E and MW-56W, and well clusters MW-86-1 through MW-86-5 which supplemented existing well GHR on-site. During the Phase I RI a total of six wells (MW-1 through MW-6) were installed on-site. During a 1991 tank closure investigation for Tanks 53 and 56, five (5) new wells (MW-7 to MW-10, and RW-1) were installed on-site. Monitoring wells MW-7 and MW-8 replaced a damaged well cluster MW-86-3S/3D and well GHR respectively. In summary, a total of nineteen (19) wells exist on-site, prior to Phase II explorations.

Ground water samples collected from wells located adjacent to Tanks 53 and 56 indicated the presence of low levels of metals and high levels of volatile organics. Petroleum product was also identified in the ground water around Tank 53. Downgradient migration of contaminants as well as movement of chlorinated contaminants downward through the water column is indicated by the analytical results.

The Phase I site RI activities included surface soil sampling, subsurface soil sampling, monitoring well installation and sampling, surface water and sediment sampling, and tank and structure sampling. The findings and results of the Phase I RI/FS are presented below:

Soil Assessment - VOCs, BNAs, pesticides, and inorganics were detected in on-site soils. In general, minimal soil contamination was detected at the site, with the exception of elevated TPH levels detected in surface soils at four of the tank locations.

VOCs were detected in surface and subsurface soil samples at very low levels (i.e., less than 10 ppb) and are not considered to represent significant subsurface VOC contamination. BNAs were not detected at levels greater than the contaminant-comparison level (i.e., greater than 10 ppm total BNAs). Only two soil samples exhibited BNAs at a concentration greater that 1 ppm (4.6 and 1.3 ppm) and those concentrations consisted entirely of phthalate esters and PAHs, respectively. Therefore, BNA soil contamination at this site is not considered to be significant. Pesticides were detected at low levels (i.e., 10's of ppb) in two surface soil and

one subsurface soil sample and are not considered to be significant soil contaminants. No PCBs were detected in soil samples.

Inorganics were generally detected at levels exceeding background levels in subsurface soil samples. Lead was detected above background in one surface soil sample collected from adjacent to the oil/water separator.

Total petroleum hydrocarbons (TPH) analysis of soil samples identified the presence of TPH across the site, ranging in concentration from 4 to 60,000 ppm. The highest TPH levels were detected in visibly oily samples collected at Tank 50. Significantly elevated levels of TPH (TPH greater than 100 ppm) were detected in surface soil samples collected at Tanks 49, 50, 51 and 55.

Ground Water Assessment - VOCs, BNAs, and inorganics were detected in ground water samples. VOCs and inorganics were detected at levels exceeding ground water action levels.

VOCs were detected at levels exceeding ground water action levels in only one on-site well (MW-53W) and consisted mainly of petroleum-related VOCs. Petroleum product was also observed in wells MW-53W and MW-53E, both located in the ring drain of Tank 53. The presence of low VOC levels in downgradient well MW-4 indicates the potential migration of the ground water contamination observed adjacent to Tank 53.

BNAs were only detected in well MW-53W and consisted entirely of PAHs. Detected levels did not exceed ground water action levels. No pesticides or PCBs were detected in ground water samples.

While inorganic concentrations exceeded ground water action levels in all wells, including the background well, the highest levels of inorganic analytes were detected in wells in the central portion of the site.

Surface Water and Sediment Assessment - Lead and TPH were detected in sediment samples; no PCBs, lead or TPH were detected in surface water.

No PCBs were detected in sediment samples. Lead was detected in all sediment samples but at levels less than background soil levels. TPH was detected in sediment samples at concentrations ranging from 13 to 220 ppm at increasing levels with distance downstream.

However, the two highest TPH levels were detected in the furthest upstream and downstream off-site sediment samples.

Structure Sample Assessment - The distribution of contaminants within the oil/water separator was as follows:

- Soil: VOCs, BNAs, and inorganics; and
- Water: inorganics.

One VOC was detected in one soil sample collected from the oil/water separator at a very low (2 ppb) level. Low levels of two BNAs were detected in one soil sample collected from the oil/water separator. No pesticides or PCBs were detected in soil samples and no inorganics were detected in the soil samples at levels exceeding background levels.

No VOCs, BNAs, pesticides, or PCBs were detected in the surface water sample collected from the oil/water separator. Cadmium was the only inorganic analyte which was detected in the water sample at levels exceeding surface water quality criteria.

Tank Contents Assessment - The distribution of contaminants within the oil and water samples collected from the on-site tanks was as follows:

- Oil: VOCs, BNAs, and inorganics; and
- Water: VOCs, BNAs, and inorganics.

VOCs were detected in the oil samples collected from the on-site tanks at very elevated levels. The VOCs consisted of petroleum-related hydrocarbons and chlorinated hydrocarbons. Total VOC levels exceeded 100 ppm in a majority of the tanks. BNAs were detected in the oil samples and consisted primarily of PAHs and bis(2-ethylhexyl)phthalate. Total BNA levels in excess of 1,000 ppm were detected in six of the oil samples. Only PAHs were detected in the oil sludge sample. Oil samples were not analyzed for pesticides. No PCBs were detected in the oil samples. Iron and lead were the only inorganics detected in greater than 50% of the oil samples. The EP Toxicity extract analysis detected barium at a level which exceeds the EP Toxicity federal standard.

VOCs were detected in all of the tank water samples, with total VOC concentrations ranging from 2 to 4,917 ppb. The main VOC compounds detected included the same VOCs

detected in the oil samples. BNAs detected in the water samples consisted of PAH compounds, phenols, and dibenzofuran. Total BNA concentrations ranged from 31 to 895 ppb. Tank water samples were not analyzed for pesticides or PCBs. The inorganics detected in greater than 50% of the tank water samples include barium, calcium, iron, potassium, magnesium, manganese, and sodium. The analyte concentrations in the water samples were typically higher than those detected in the oil samples.

2.4 SITE GEOLOGY

The Phase I site RI soil boring activities, as well as under previous subsurface investigations, provided information on the site geology. Previous tank closure investigation activities included the drilling and sampling of several well borings around Tanks 53 and 56. Six (6) monitoring wells were installed under the Phase I RI. Five (5) additional monitoring wells were also installed under tank closure investigation activities completed by TRC-EC. The locations of all of these wells are shown on Figure 3.

The overburden deposits on this site consist of a native sand and silt, glacial till, like that encountered at Tank Farm Four. The till was encountered in all of the borings and ranged in thickness from 1 foot (M-3) to 21 feet (M-8). The till directly overlies the bedrock at the site.

The bedrock at the site consists of gray, highly weathered to competent, slightly metamorphosed, shale, with quartz lenses. All of the monitoring well borings completed at the site during this investigation encountered the bedrock surface. Depth to weathered bedrock ranged from 1 foot (at M-3) to 33 feet (in R-1). It is believed that the depth to bedrock encountered in boring R-1 is artificially low due to its proximity to the Tank 53 excavation. The tank excavations reportedly extended into bedrock at the site. Greatest depths to bedrock were encountered at the hilltop on the southern side of the site near Tank 59.

Nx rock cores (2-63/64" O.D.) were collected from several of the well borings completed on the site. The rock cores indicate that the bedrock at the site consists of the same unit (the Rhode Island Formation) which was encountered at the McAllister Point Landfill and at Tank Farm Four. As was observed at Tank Farm Four, a considerable zone of weathered bedrock overlies the competent bedrock at Tank Farm Five. Twenty-two feet of weathered shale was encountered at the location of well boring M-10, which was installed during tank closure

investigation activities. The bedrock surface slopes to the west (to the bay) in the southwestern portion of the site (by Tanks 53 and 56), and towards the north (to the brook) in the northeastern portions of the site.

2.5 SITE HYDROLOGY

Below is a discussion of the surface water and ground water hydrology for the Tank Farm Five site.

Surface Water Hydrology

A perennial stream, Gomes Brook, flows across the northeast side of the site. The brook is generally located in a topographically low area of the site, and flows into Narragansett Bay. The general site topography slopes in a south to north direction, with the steepest surface gradients located near the brook in the northern corner of the site. The central, tank portion of the site is gradually sloping and generally well drained. Along the northwestern edge of the site is Defense Highway, beyond which is Narragansett Bay.

Surface water runoff (from precipitation) on the site either evaporates, infiltrates into site soils, ponds on the surface, or flows overland towards the brook and Defense Highway. The western edge of the site slopes downward to Defense Highway. During periods of heavy rainfall, runoff from the site was observed accumulating at the point where Defense Highway crosses Gomes Brook. During these events, overland flow was also observed in the northeastern portion of the site towards Gomes brook and ponded water was observed in a marshy area in the eastern corner of the site.

Data from piezometers installed along the southern bank of Gomes Brook, as well as surface water levels recorded within the brook, document that the brook is a "gaining" or effluent stream (i.e., ground water discharges into the stream). As shown on a site ground water contour map (see Figure 4), the site ground water flow is strongly influenced by Gomes Brook.

Ground Water Hydrology

A total of nineteen (19) monitoring wells are present on-site. These wells include four wells installed within the ring drains of Tanks 53 (MW-53E and MW-53W) and 56 (MW-56E and MW-56W) in 1985, four wells (MW-86-1, MW-86-2, MW-86-4, and MW-86-5) installed on the southwestern portion of the site in 1986, six wells (MW-1 through MW-6) installed during the Phase I RI in 1990, and five wells (MW-7 through MW-10 and RW-1) installed as part of a closure investigation for Tanks 53 and 56 in 1991. Water level measurements collected from each of these wells, except those within the ring drain of Tanks 53 and 56, on May 6, 1992 are shown on Figure 4, with a representative ground water contour map.

As shown on the contour map, the shallow ground water at the site appears to be affected by the presence of Gomes Brook at the northern end of the site. The ground water contours also generally reflect the site topography. Ground water from the southern end of the site (near tanks 53, 56 and 59) appears to be flowing to the west-northwest (directly toward the bay). Ground water from the northern portion of the site becomes increasingly affected by Gomes Brook and flows to the north (toward the brook).

Single well hydraulic conductivity tests (slug tests) were performed at five of the shallow monitoring wells (MW-1, MW-2, MW-3, MW-5, and MW-6) at the site. All of these monitoring wells were screened in weathered bedrock, except MW-6 which is screened in till (overburden).

The hydraulic conductivities determined for the weathered bedrock ranged from 0.16 ft/day (MW-2) to 0.21 ft/day (MW-3). The hydraulic conductivity determined for the overburden well (MW-6) was 0.25 ft/day. These values indicate that the weathered bedrock at the site is almost as conductive as the overburden at the site.

- Horizontal Hydraulic Gradients

Horizontal hydraulic gradients were determined from the water level measurements at the site. Average horizontal gradients ranged from 0.0128 ft/ft (MW-3 to MW-2) to 0.0398 ft/ft (MW-5 to MW-3).

- Average Linear Velocities

The calculated average horizontal hydraulic gradients, along with hydraulic conductivity and effective porosity values, were used to calculate average linear velocity values at the site. A hydraulic conductivity of 0.20 ft/day, an average of the hydraulic conductivities determined by the slug tests performed at the site, was used in the calculations. An effective porosity of 15% was assumed for the till at the site (Driscoll, 1986).

Average linear velocities of the shallow ground water ranged from 0.017 ft/day (MW-3 to MW-2) to 0.05 ft/day (MW-5 to MW-4). It is important to note that the above calculated average linear velocity values are lower than the "true microscopic velocities" because water particles must travel along irregular paths that are longer than the linearized paths represented by the calculated average linear velocities (Freeze and Cherry, 1979). In addition, the estimated effective porosity value of 15% for the till at the site may be too high or low, causing the linear velocity estimates to be too low or high, respectively.

3.0 SAMPLING PLAN

3.1 INTRODUCTION

The program of investigation described in this section has been developed to achieve both overall and site-specific project objectives. Field sampling methodology for individual investigation activities (e.g., surface soil sampling, surface water sampling) is described in Appendix B. The quality assurance/quality control procedures for field sampling and laboratory analyses are presented in the project Quality Assurance Project Plan (QAPP) provided in Appendix D. A summary of the Phase II Tank Farm Five site sampling program is presented in Table 1. The planned Phase II Tank Farm Five sample locations are shown on Figure 5.

3.2 RECONNAISSANCE SURVEYS

Prior to initiating sampling activities, a site walkover will be conducted by field investigation team members to familiarize themselves with the current site conditions. An attempt will be made to conduct this survey during the spring. However, schedule constraints may dictate the initiation of the survey at another time of the year. The site will be visually surveyed with respect to any changes in site access restrictions, the Phase I monitoring well locations, and the planned Phase II sampling locations.

Site-specific health and safety considerations, including emergency evacuation procedures, will be reviewed during the visit. Pertinent features, such as overhead and subsurface utilities, and other potential hazards will also be reviewed with Navy personnel with respect to affected sampling activities.

During the site walkover survey, a Phase II baseline ambient air survey will be conducted across the site. The ambient air survey will be conducted with either a flame or photo-ionization detector to assess ambient conditions for the presence of volatile organic compounds (VOCs) and establish the Phase II site baseline conditions. The ambient air surveys will be completed using equipment and methods outlined in the Field Sampling Methodology Plan provided as Appendix B of this Work Plan.

3.3 SOIL SAMPLING

Soil samples will be collected as surface soil samples and soil boring samples under this site investigation. Below is a discussion on each of the planned soil sampling activities.

3.3.1 Surface Soil Sampling

Surface soil samples will be collected from thirty-three (33) locations (SS-1 through SS-30, SS-49 through SS-51) on the site. The planned locations of the surface soil samples are shown on Figure 6. These samples will be collected from the following general locations: at and around areas of documented Phase I surface soil contamination (oil/water separator and tanks), surface soil areas not sampled in Phase I, and at several of the tank locations. The rationale for each of the planned surface soil samples is presented in Table 2.

In addition, two (2) "background" surface soil samples (SS-31 and SS-32) will be collected from two (2) locations in the wooded area in the south and southeast portions of the site. An attempt has been made to select background soil sample locations believed to be representative of site background soil conditions and away from other potential sources of contamination (e.g., roadways, houses). The proposed locations for the background samples will be confirmed with the EPA and RIDEM during a site visit prior to the surface soil sampling activities. To assess conditions in the former on-site burning pit, now an oil/water separator, the four phase I surface soil sample locations (SS-1 to SS-4) will be re-sampled and analyzed for dioxin/furans only.

Surface soil sampling will be conducted according to the method described in the Field Sampling Methodology Plan provided in Appendix B of this Work Plan. Surface soil samples will be analyzed for the full organic target compound list (TCL) and inorganic target analyte list (TAL), except samples SS-1 through SS-4 which will be analyzed for only dioxins/furans.

Surface soil samples will also be collected from each of the planned well boring locations, as described in Section 3.3.2 of this plan. The 0- to 1-foot portion of the first 2-foot split spoon sample will be collected as the surface soil sample at each boring location consistent with EPA risk assessment requirements. The soil boring samples will also be analyzed for the full TCL/TAL. The VOC fraction of surface soil samples will be collected as a discrete

increment from the 0.5 to 1 foot portion of the first split spoon as described in Appendix B. Soil for the remaining analytical fractions will be homogenized prior to filling sampling containers.

3.3.2 Soil Boring Sampling

Soil samples will be collected from the Phase II site well borings planned at six (6) different on-site locations. The planned monitoring well locations are shown on Figure 7. The well borings are associated with the Phase II ground water monitoring wells planned for the site. The Phase II monitoring well rationale is discussed in Section 3.4 and presented in Table 3.

Soil samples will be collected continuously from ground surface to five feet after which samples will be collected at 5-foot intervals to the depth necessary for installation of the well (i.e., approximately 5 feet past the water table). However, if signs of potential contamination are observed continuous split spoons sampling will be resumed until such signs are no longer present. Soil sampling associated with the bedrock well at the existing Phase I shallow well MW-5S, will begin at the completed depth of the Phase I well. At the four planned bedrock well locations, split spoon sampling will continue to the depth of competent bedrock (estimated on-site to be approximately 30 to 45 feet below ground surface). Split spoon soil samples will be screened with an OVA and HNu immediately upon being opened. A 10-foot Nx core (2 63/64" O.D. core) of the bedrock will be collected at each of the planned four bedrock well locations.

A minimum of two soil samples will be collected from each of the six new well boring locations (i.e., not including MW-5R) for the full TCL/TAL analysis. The two soil samples which will be submitted for laboratory analysis will include the soil samples collected from the 0- to 2-foot interval (the 0- to 1-foot portion for analysis) and from the last sample interval just above the depth of the ground water table. If insufficient sample volume is present within the 0 to 1 foot portion of the split spoon (i.e. recovery is low), additional sample volume will be collected using either hand auguring procedures (non-VOC fractions), or from a second split spoon collected immediately adjacent to the first. If signs of potential contamination (e.g., oil, stains, odors) are observed in a boring, a third sample will also be collected from the depth of greatest observed contamination (i.e., most stained or oily, highest OVA/HNu reading). If no

fill material or signs of potential contamination are observed in a boring, only the surface sample and sample from directly above the water table will be submitted for laboratory analysis.

In addition, to the soil samples collected for chemical analyses, a soil sample from just below the depth of the water table (i.e., within the saturated zone) will also be collected from each well location for total organic carbon (TOC) analysis, cation exchange capacity analysis, and grain size determination. The information from these tests will be used in evaluating ground water treatment options.

Geologic descriptions and other sample characteristics (e.g., stains, odors) and observations (e.g., OVA/HNu readings, depth to water) will be recorded in a field notebook.

3.4 GROUND WATER SAMPLING

Monitoring wells were installed at five (5) locations in Phase I (MW-1 through MW-5). Shallow ground water table wells were installed at each of the locations. In addition, fourteen (14) other wells were installed in the western portion of the site under a tank closure investigation for Tanks 53 and 56.

In Phase II, nine (9) monitoring wells are planned at five (5) new locations. In addition, one new bedrock well (MW-5R) will be installed at an existing Phase I well location (MW-5) for a total of ten (10) new monitoring wells. The planned Phase II well locations consist of three (3) shallow ground water table wells, three (3) shallow ground water table wells paired with bedrock wells, and one (1) bedrock well with an existing shallow well.

Generally, the monitoring wells are planned to further assess the presence and nature of ground water contamination at the site. The planned locations of the monitoring wells are shown on Figure 7. In general, the monitoring wells are located to determine the ground water quality in the following areas: at the upgradient edge of the site, in the central tank portion of the site, just downgradient of the central tank portion, and at the downgradient edges of the site. The rationale for each of the planned Phase II well locations is provided in Table 3.

Ground water samples will be collected from each of the Phase I, the newly installed Phase II monitoring wells, and all of the other preexisting site wells. All of the new Phase II wells will be developed after installation. Water levels will be measured in the wells after development and just prior to well purging. The wells will be sampled immediately after

purging. The procedures for well development, purging, and sampling are provided in the Field Sampling Methodology Plan provided in Appendix B.

Five of the eight pre-RI wells (MW-86-1, MW-86-2 (if water present), MW-86-5, MW-53W (if water present), MW-56W or MW-56E (whichever has water)), all six of the Phase I RI wells which contain water (MW-1 through MW-6), one or two of the tank closure wells (MW-8 (if water present), and RW-1 (only if no water in MW-53W)), will be sampled and analyzed for TCL VOCs and TAL metals. Each of the ten (10) Phase II wells will be sampled and analyzed for TCL/TAL parameters less the pesticide/PCB fraction, and total chloride. In addition, the temperature, pH, conductivity, dissolved oxygen, redox potential, and salinity of each ground water sample will be measured in the field immediately following sample collection. Five of the ground water samples (three shallow and two bedrock) will also be field filtered for dissolved metals analysis, and analyzed for BOD, COD, and total suspended solids for ground water treatability information. Field filtering procedures are described in Section 7.5 of Appendix B. Any non-aqueous phase liquids (NAPL) observed within the wells will also be sampled and analyzed for TCL VOCs and petroleum GC fingerprint identification. Given previous data which has indicated a lack of adequate ground water within several wells, most notably MW-86-2, MW-53W, and MW-56E and W, and MW-4, an attempt will be made to collect the Phase II ground water samples outside of any long dry spells. In addition, a ground water sample will first be collected from each of these wells without purging the well. This sample will be discarded and the well resampled if the well recovers enough after purging. However, if these procedures still result in insufficient sample volume for analysis, the planned analysis will not be completed.

In addition to collecting ground water samples from the monitoring wells and obtaining routine water level measurements, single well hydraulic conductivity testing (i.e., slug tests) will be performed on several of the site monitoring wells. Slug tests will be performed on site monitoring wells to aid in determining the characteristics of the site aquifers.

In addition to the installation of monitoring wells for ground water elevation measurements, piezometers were installed in Phase I installed adjacent to the on-site brook at the locations of the surface water/sediment sampling locations discussed in Section 3.5. The piezometer and surface water levels measurements are intended to indicate whether the stream

and pond are "gaining" or "loosing" surface water bodies. Water levels will be measured from the piezometers and surface water stations at times concurrent with the ground water well level measurements.

3.5 SURFACE WATER AND SEDIMENT SAMPLING

Surface water and sediment sampling will be conducted in the brook which runs through the western corner of the site, Gomes Brook, to further investigate the presence of site-related contamination in the brook. In Phase I, surface water and sediment samples were collected from five locations in the brook.

Surface water and sediment samples will be collected from a total of thirteen (13) locations. These locations include seven (7) stations within Gomes Brook on-site, 2 on-site locations within feeder streams to Gomes Brook, and four (4) locations off-site. Several of the Phase I surface water and sediment sample locations will be resampled in Phase II. The planned locations of the surface water and sediment samples are shown on Figure 8. The rationale for the Phase II surface water and sediment sample locations is provided in Table 4.

Both surface water and sediment samples will be analyzed for all TCL/TAL parameters. The hardness of each surface water sample will be determined through laboratory analysis. In addition, the temperature, pH, conductivity, dissolved oxygen, salinity, and turbidity of the surface water at each sample location will be measured in the field. Sediment samples will also be submitted for acid volatile sulfides (AVS) analysis, grain size determination, and total organic carbon (TOC) analysis.

Graduated wooden stakes will also be driven at each of the surface water sample locations from which surface water levels will be referenced at the time of sampling. The elevation and location of the graduated stakes will be surveyed during site land surveying activities. Both surface water and ground water elevation measurements will be obtained concurrently during the site investigation to assess surface water and ground water interactions.

3.6 LAND SURVEY

Following completion of field sampling activities the site will be surveyed by a State of Rhode Island registered surveyor. The location and elevation of the Phase II sampling points will be determined in the survey. Each sampling location will be referenced to the State of Rhode Island Grid Coordinate System. Completed monitoring wells will be surveyed for elevation at the top of the protective casing, top of the well casing, and adjacent land surface. Elevations will be referenced to mean low water (mlw) and a United States Geological Survey benchmark to the nearest 0.01 foot. The Phase II survey information will be added to the final Phase I site survey map.

4.0 SITE-SPECIFIC HEALTH AND SAFETY SUMMARY

4.1 INTRODUCTION

The purpose of this health and safety discussion is to summarize the site-specific health and safety information. This section describes the nature of wastes or contamination suspected or known to be present at the site, the site access and work zones, and the initial level of personnel protection and monitoring planned for each site investigation activity. In addition, a list of site emergency contacts and maps of the route to the Newport Hospital from the site are provided as Table 5 and Figures 9 and 9A, respectively.

4.2 NATURE OF WASTES

Historical information indicates that Tank Farm Five was used for the storage of diesel and fuel oil in eleven 60,000-barrel underground storage tanks. Tank bottom sludge was reportedly disposed of in an on-site burning pit (likely current location of oil/water separator) during tank cleaning operations. Two of the tanks on the site, Tanks 53 and 56, were used for the storage of waste oil after the use of the other tanks was discontinued.

Previous tank closure investigations around Tanks 53 and 56 indicated the tank contents were contaminated with volatile organic compounds (both aromatic and chlorinated hydrocarbons) and heavy metals. The contents of these two tanks were removed and the tank interiors cleaned in 1991. The ground water around and downgradient of Tank 53 has been found to be contaminated with VOCs and metals. Oil and petroleum sheen and odors have also been observed in the ground water from those wells located directly adjacent to Tank 53. Only the subsurface soils immediately adjacent to Tank 53 have been observed to be oily or have petroleum-like odors.

The results of the Phase I investigation indicate that elevated levels (> 100 ppm) of total petroleum hydrocarbons are present in the surface soils at several of the tank locations (Tanks 49, 50, 51, and 55). Oily surface soils are visibly evident at Tank 50. VOCs were detected in the ground water immediately surrounding Tank 53. VOCs, BNAs, and metals were detected in the tank contents samples. No PCBs were detected in any of the site samples. Elevated

levels of metals were detected in the site ground water and in the ground water upgradient of the site.

Exploration activities conducted in the vicinity of Tanks 53 and 56 for a recent soil investigation included a soil gas survey and installation and sampling of soil borings. Preliminary results of this investigation indicate the presence of elevated TPH concentrations (greater than 100 ppm) and elevated total VOC concentrations (greater than 1 ppm) within the ring drain material of Tank 53. No significant TPH (greater than 100 ppm) or VOC (greater than 100 ppb) concentrations were observed in soil near Tank 56.

4.3 SITE ACCESS/WORK ZONES

Site access is on the western side of the site through two gates on the western side of the side along Defense Highway. A chain-link fence surrounds the entire site. Another fence gate is located in the northern corner of the site along Greene Lane.

This site will not have a permanent contamination reduction zone or exclusion zone. Only the immediate area surrounding each of the well drilling activities will be cordoned off as an exclusion zone from the rest of the site. Given that most of the planned drilling activities are planned for densely vegetated areas (thick high brush) which are inherently inaccessible and for which access is easily controlled, the locations will not be surrounded with any flagging or barricades. However, at well drilling locations in open areas (e.g., MW-14), a minimum distance of 25-foot surrounding the drill rig will be marked off with caution tape or barricades.

A contamination reduction station, or personnel decontamination area, will be established adjacent to each of the location-specific exclusion zones. All personnel exiting the exclusion zone (work area) must pass through the decontamination area prior to entering the support zone vehicles or leaving the site. Personnel shall undergo appropriate decontamination, as required by the activity-specific procedures and level of personnel protection. Split spoon decontamination will occur in a designated area adjacent to the office trailer. The heavy equipment decontamination area established at Site 01 will also be used for this site investigation.

The support zone for this site will be the company vehicles used by the field investigation crew and a portable office trailer which will be located in the western corner of the site just

south of Tank 56. The vehicles will either be located near the planned well locations or near the road which passes through the central portion of the site. The vehicles will provide temporary relief from any adverse weather conditions and storage for field communication equipment (e.g., mobile phone, walkie talkie). The office trailer will be the command center and primary location for storing all necessary field sampling and safety/emergency equipment (e.g., telephone, first aid kit, drinking water, HASP, walkie talkie base station).

The OSC or alternate will be responsible for keeping nonessential personnel outside of the exclusion zone boundaries during the investigation activities. In the event that authorized visitors are present on the site during field activities, the OSC or designee shall insure that they adhere to site safety requirements and maintain a safe distance outside of the exclusion zone. All personnel allowed to enter the exclusion zone shall be required to follow safety procedures described in the project HASP in Appendix C and directions of the OSC.

Disposal of field-generated materials (e.g., PPE, decon solutions) is described in the Investigation Derived Waste Plan provided in Appendix E of this Work Plan.

4.4 PERSONNEL PROTECTION AND MONITORING

Based on the findings of the Phase I RI and suspected site contaminants, the field investigation activities will be initiated in either Level D or Modified Level D personnel protection (as defined in the HASP in Appendix C). A list of anticipated initial levels of personnel protection for each of the specific investigation activities is presented in Table 6. Levels of personnel protection will be upgraded or downgraded as conditions dictate.

During field sampling activities, continuous monitoring of ambient air will be conducted with an OVA and HNu. During drilling activities, continuous ambient monitoring of combustible gas levels will also be conducted with an LEL/O2 meter. Air monitoring will also be performed "downhole" during drilling activities.

TABLES

TABLE 1

SITE 13 – TANK FARM FIVE
SITE INVESTIGATION SUMMARY

ACTIVITY / SAMPLE MATRIX	SCOPE OF WORK	NUMBER OF SAMPLES	SAMPLE ANALYSIS
SURFACE SOIL	35 Locations	31 4	TCL/TAL Dioxins/Furans
WELL BORINGS	6 Locations	12 – 18 6	TCL/TAL TOC, Grain Size, Cation Exchange
GROUND WATER	10 wells at 6 locations; 6 shallow wells & 4 shallow bedrock wells	10	TCL/TAL, Less Pest/PCBs
	19 existing wells	19	TCL VOCs/TAL
	5 locations	5	Dissolved TAL, BOD, COD, TSS
SURFACE WATER	13 Stations	13	TCL/TAL, Hardness
SEDIMENT	13 Stations	13	Sediment List (1)

Note: "NA" indicates that activity is not applicable.
TCL indicates sample will be analyzed for Target Compound List.
TAL indicates sample will be analyzed for Target Analyte List.
(1) Sediment List is composed of TCL, TAL, total organic carbon, and acid volatile sulfides.

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TABLE 2

Site 13 - Tank Farm Five
Surface Soil Location / Rationale

SAMPLE NUMBER	LOCATION / RATIONALE
SS-1	Characterize soil quality near the former building pit (Oil/H_2O separator) for dioxins/furans.
SS-2	Characterize soil quality near the former building pit (Oil/H_2O separator) for dioxins/furans.
SS-3	Characterize soil quality near the former building pit (Oil/H_2O separator) for dioxins/furans.
SS-4	Characterize soil quality near the former building pit (Oil/H_2O separator) for dioxins/furans.
SS-5	Characterize surface soil quality around the oil/water separator on Site 13.
SS-6	Characterize surface soil quality around the oil/water separator on Site 13.
SS-7	Characterize surface soil quality around the oil/water separator on Site 13.
SS-8	Further investigate TPH surface soil contamination at Tank 50.
SS-9	Further investigate TPH surface soil contamination at Tank 50.
SS-10	Further investigate TPH surface soil contamination at Tank 50.
SS-11	Further investigate TPH surface soil contamination at Tank 50.
SS-12	Further investigate TPH surface soil contamination at Tank 50.
SS-50	Further investigate TPH surface soil contamination at Tank 50.
SS-13	Further investigate TPH surface soil contamination at Tank 51.
SS-14	Further investigate TPH surface soil contamination at Tank 51.
SS-15	Further investigate TPH surface soil contamination at Tank 51.
SS-16	Further investigate TPH surface soil contamination at Tank 51.

TABLE 2
(continued)
Site 13 - Tank Farm Five
Surface Soil Location / Rationale

SAMPLE NUMBER	LOCATION / RATIONALE
SS-51	Further investigate TPH surface soil contamination at Tank 51.
SS-17	Characterize surface soil quality in the central portion of Site 13.
SS-18	Characterize surface soil quality in the central portion of Site 13.
SS-19	Characterize surface soil quality in the central portion of Site 13.
SS-20	Characterize surface soil quality in the central portion of Site 13.
SS-21	Further characterize surface soil quality at Tank 56.
SS-22	Further characterize surface soil quality at Tank 56.
SS-23	Further characterize surface soil quality at Tank 56.
SS-24	Further characterize surface soil quality at Tank 53.
SS-25	Further characterize surface soil quality at Tank 53.
SS-26	Further characterize surface soil quality at Tank 53.
SS-27	Further characterize surface soil quality at Tank 53.
SS-28	Further characterize surface soil quality at Tank 49.
SS-29	Further characterize surface soil quality at Tank 49.
SS-30	Further characterize surface soil quality at Tank 49.
SS-49	Further characterize surface soil quality at Tank 49.
SS-31	Determine background surface soil quality for Site 13.
SS-32	Determine background surface soil quality for Site 13.
TOTAL:	33 LOCATIONS 2 BACKGROUND LOCATIONS 35 SAMPLING POINTS

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TABLE 3

Site 13 - Tank Farm Five
Monitoring Well Location / Rationale

WELL NUMBER	LOCATION / RATIONALE
MW-5R	Investigate bedrock ground water quality and hydrogeology of the central portion of Site 13.
MW-11S	Investigate ground water quality downgradient of the central tank portion of Site 13.
MW-12S/R	Investigate ground water quality downgradient of the east central tank portion and Tank 50 of Site 13.
MW-13S	Further investigate ground water quality downgradient of the eastern portion of Site 13.
MW-14S/R	Investigate ground water quality at the downgradient edge of Site 13.
MW-15S/R	Investigate ground water quality at the upgradient edge of Site 13.
MW-16S	Investigate ground water quality at the upgradient edge of Site 13.
TOTAL:	6 SHALLOW WELLS 4 ROCK WELLS 10 WELLS

TRC

TABLE 4

Site 13 - Tank Farm Five
Surface Water & Sediment Location / Rationale

STATION NUMBER	LOCATION / RATIONALE
SW-1A/SD-1A	Station is located in a depositional area just east of Phase I station SW-1/SD-1 and directly downstream from railroad bridge.
SW-2A/SD-2A	Station is located in a depositional area just downstream of Phase I station SW-2/SD-2.
SW-2B/SD-2B	Station is located just west of an unpaved roadway approximately 100 feet downstream of station SW-3A/SD-3A.
SW-3A/SD-3A	Station is located in a depositional area 200 feet downstream of Phase I station SW-3/SD-3.
SW-3/SD-3	Station is located 200 feet upstream of station SW-3A/SD-3A and is a Phase I sample station, just upstream of the confluence of a small stream and Gomes Brook.
SW-3B/SD-3B	Station is located 100 feet upgradient of Station SW-3/SD-3, just downstream the confluence of another small unnamed streams and Gomes Brook.
SW-4/SD-4	Station is located 200 feet upstream of the confluence of small stream and Gomes Brook and is a Phase I sample station.
SW-4A/SD-4A	Station is located in a deposional area 200 feet upstream of station SW-4/SD-4.
SW-5/SD-5	Station is located 100 feet upstream of site and is a Phase I sample station.
SW-6/SD-6	Station is located upstream of site in a depositional area (to be selected in the field).

TABLE 4
(continued)
Site 13 - Tank Farm Five
Surface Water & Sediment Location / Rationale

STATION NUMBER	LOCATION / RATIONALE
SW-7/SD-7	Station is located upstream of site in a depositional area (to be selected in the field).
SW-8/SD-8	Station is located at the northernmost on-site portion of a small feeder stream to Gomes Brook.
SW-9/SD-9	Station is located at the northernmost on-site portion of a small feeder stream to Gomes Brook.
TOTAL:	13 SURFACE WATER LOCATIONS 13 SEDIMENT LOCATIONS

TABLE 5

SITE 13 - TANK FARM FIVE
SITE EMERGENCY CONTACTS

NETC Emergency Numbers:

Command Duty Officer	841-3456 or 3457
Security Office - Police	841-3241
NETC Fire Protection	841-3333
Public Works Trouble Desk	841-4001

Utilities:

Rhode Island Dig Safe	800-225-4977
NETC Dig Safe	841-2464

Newport Emergency Numbers:

Newport Police Dept.	847-1306
Newport Fire Dept.	846-2211
Newport Hospital	
General Number	846-6400
Emergency Room	846-6400 ext. 1120
Poison Control Center	277-5727

Additional Resources:

Dr. Erdil, or Dr. Stahl - TRC Company Physicians, Immediate Medical Care, Hartford, Connecticut - (203) 296-8330
Mr. James Peronto - TRC Project Manager - (203) 289-8631
NETC Environmental Coord. - (401) 841-3735
Mr. Robert Hanley - NETC Safety Officer - (401) 841-2478

TABLE 6

SITE 13 - TANK FARM FIVE
PERSONNEL PROTECTION SUMMARY

Activity	*Initial Level of Protection*
Reconnaissance Survey	*D*
Soil Gas Survey	*D*
Surface Soil Sampling	*D*
Well Boring	*Mod. D*
Ground Water Sampling	*Mod. D*
Surface Water & Sediment Sampling	*D*
Land Survey	*D*

NOTE: *The personnel protection levels will be upgraded or downgraded as conditions warrant according to criteria specified in the project Health and Safety Plan (HASP).*

FIGURES

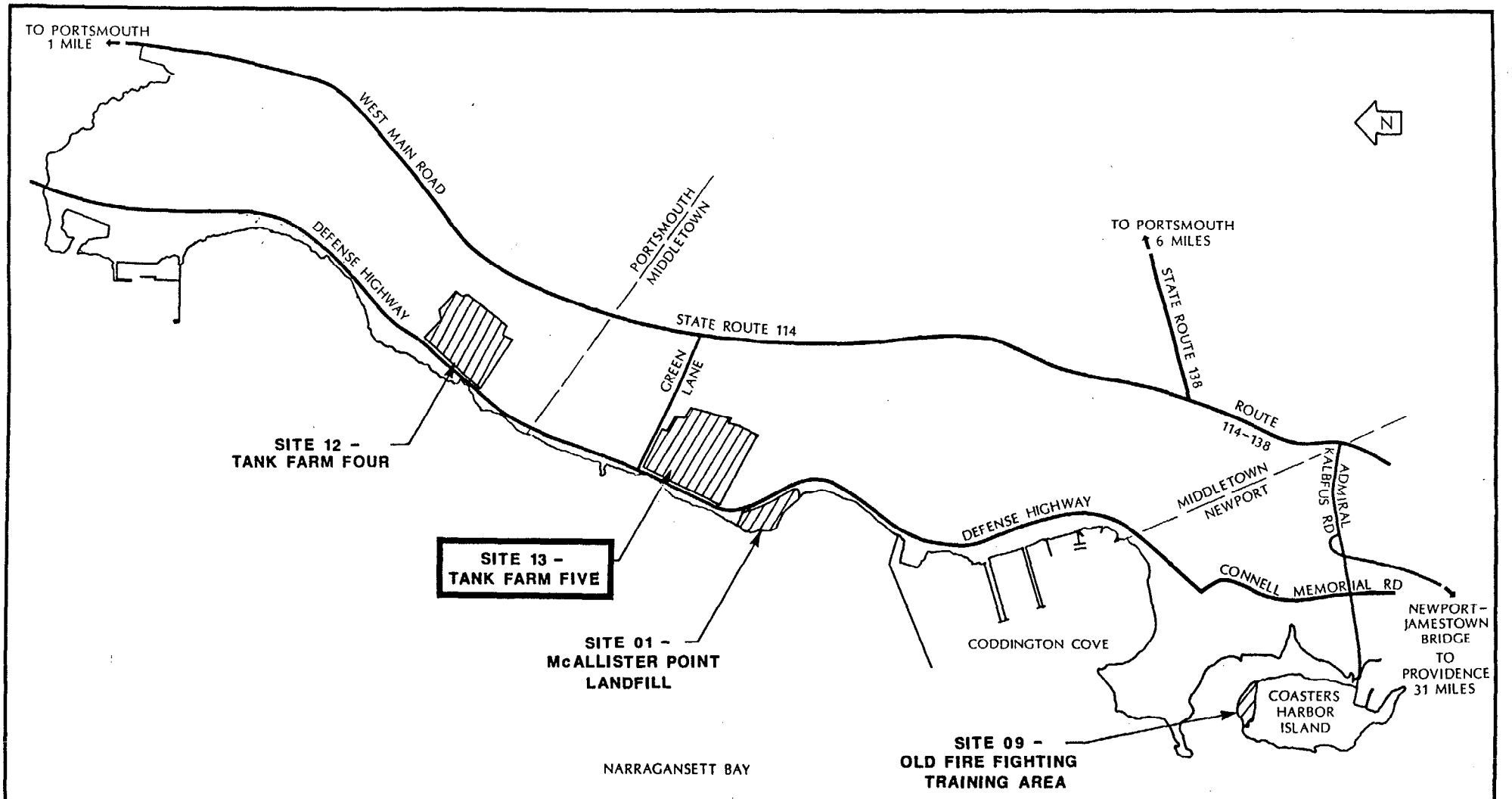

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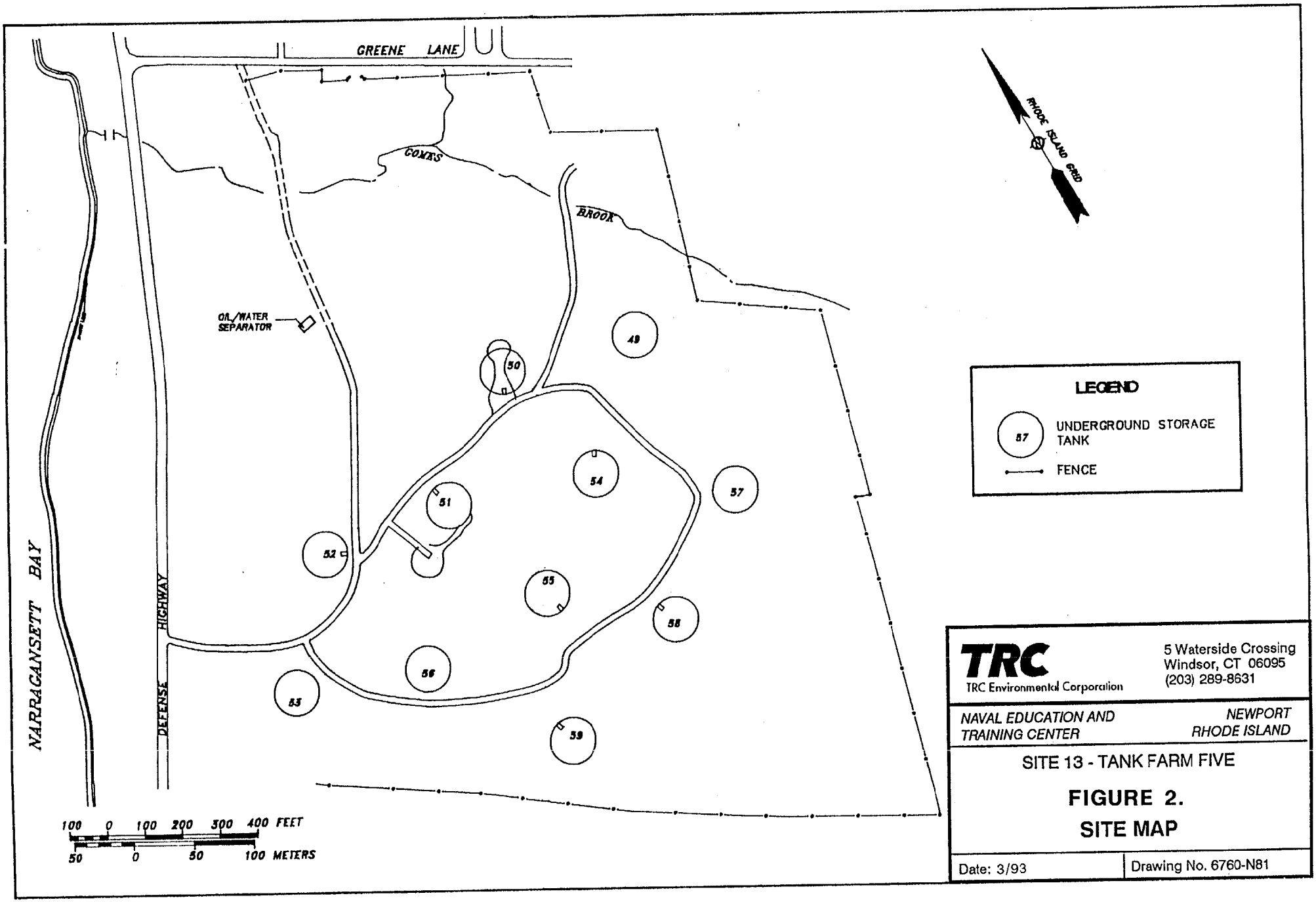
FIGURE 1.

NETC SITE LOCATION MAP

Date: 3/93

Drawing No. 6760-N81


GREENE LANE
COMMS
BROOK
OIL/WATER SEPARATOR
NARRAGANSETT BAY
DEFENSE HIGHWAY
RHODE ISLAND GRID
49
50
51
52
53
54
55
56
57
58
59
LEGEND
57 UNDERGROUND STORAGE TANK
FENCE
100 0 100 200 300 400 FEET
50 0 50 100 METERS
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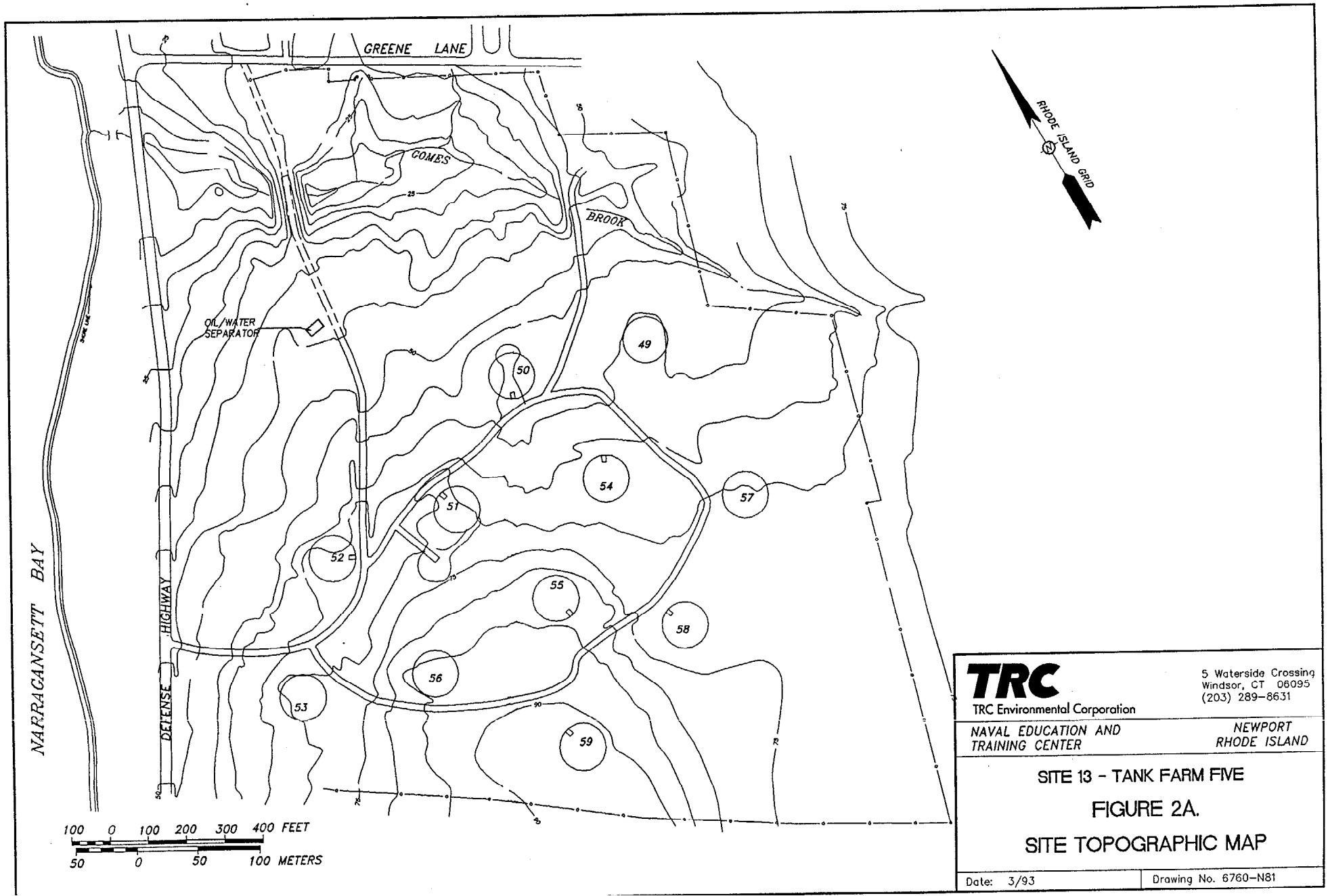
Windsor, CT 06095
(203) 289-8631
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT RHODE ISLAND
SITE 13 - TANK FARM FIVE
FIGURE 2.
SITE MAP
Date: 3/93
Drawing No. 6760-N81


GREENE LANE
COMES
BROOK
OIL/WATER SEPARATOR
NARRAGANSETT BAY
DEFENSE HIGHWAY
RHODE ISLAND GRID
N
49
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57
58
59
100 0 100 200 300 400 FEET
50 0 50 100 METERS
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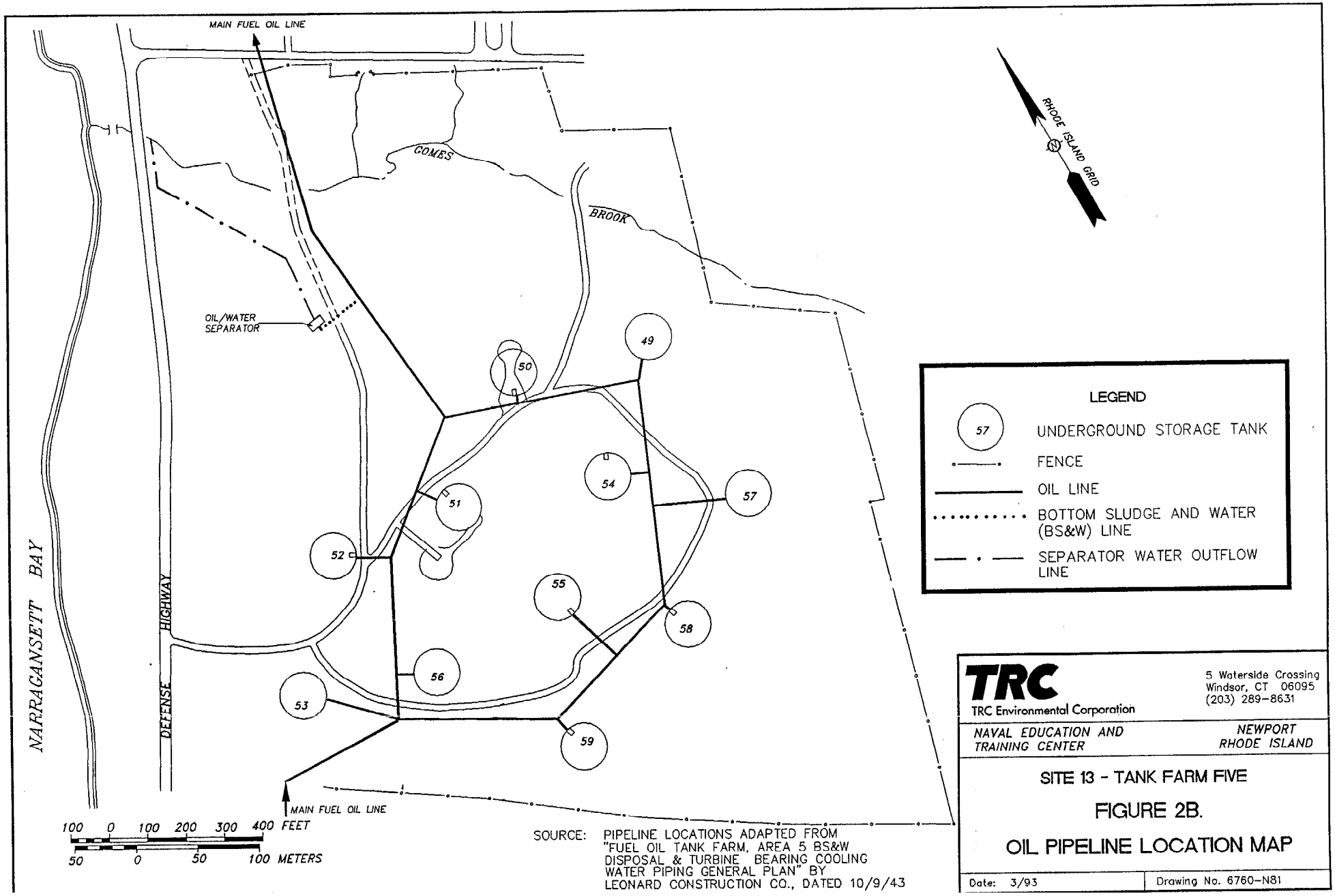
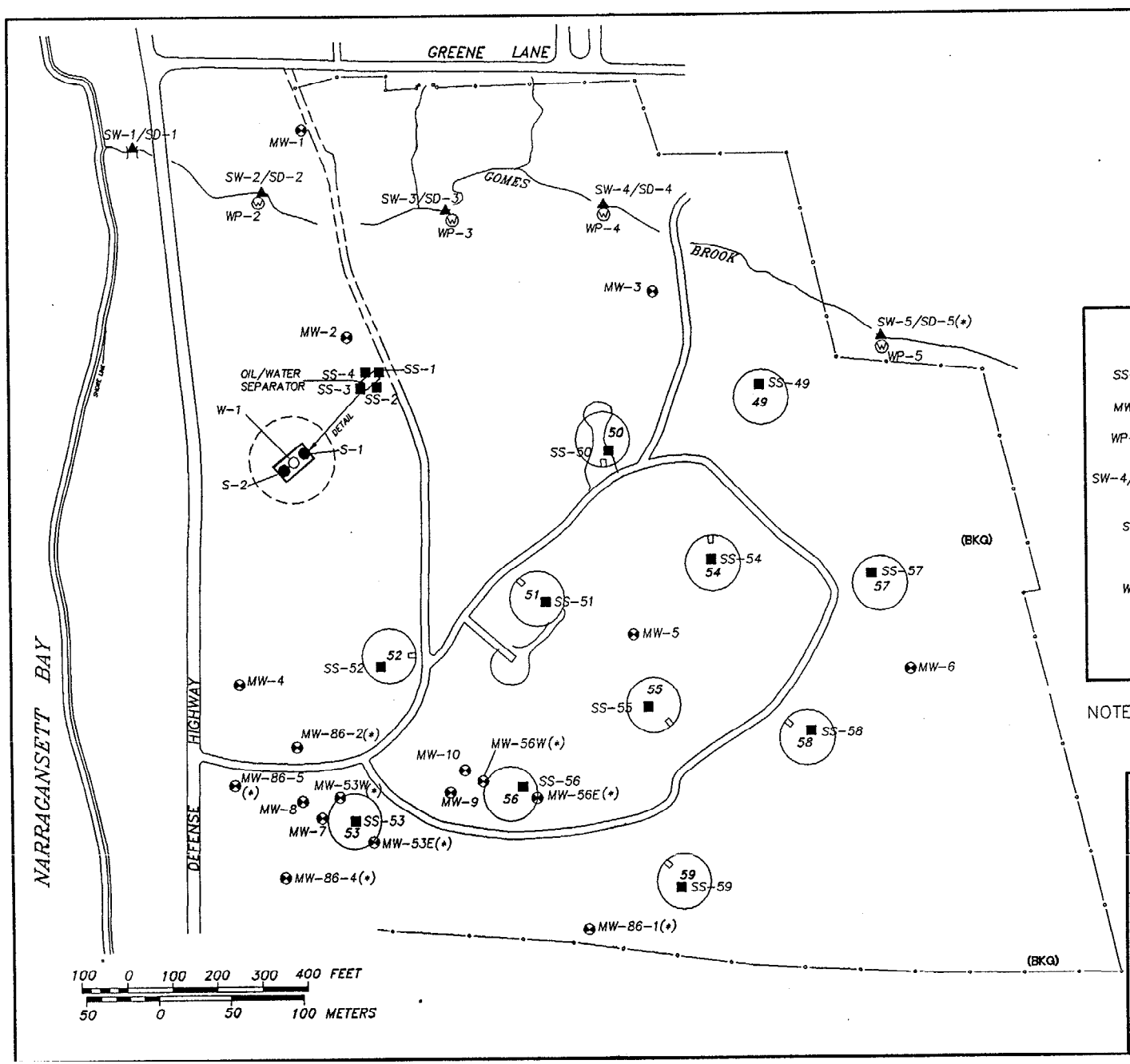
SITE 13 - TANK FARM FIVE
FIGURE 2A.
SITE TOPOGRAPHIC MAP
Date: 3/93
Drawing No. 6760-N81



SOURCE: PIPELINE LOCATIONS ADAPTED FROM "FUEL OIL TANK FARM, AREA 5 BS&W DISPOSAL & TURBINE BEARING COOLING WATER PIPING GENERAL PLAN" BY LEONARD CONSTRUCTION CO., DATED 10/9/43



LEGEND

SS-57 ■	SURFACE SOIL SAMPLE LOCATION
MW-3 ⊖	MONITORING WELL LOCATION
WP-5 Ⓦ	WELL POINT LOCATION
SW-4/SD-4 ▲	SURFACE WATER AND SEDIMENT SAMPLE LOCATION
S-1 ●	STRUCTURE SOLID SAMPLE LOCATION
W-1 ○	STRUCTURE AQUEOUS SAMPLE LOCATION
(*)	WELL INSTALLED PREVIOUS TO PHASE I

NOTE: COMPOSITE SURFACE SOIL SAMPLES ALSO COLLECTED AT EACH TANK LOCATION

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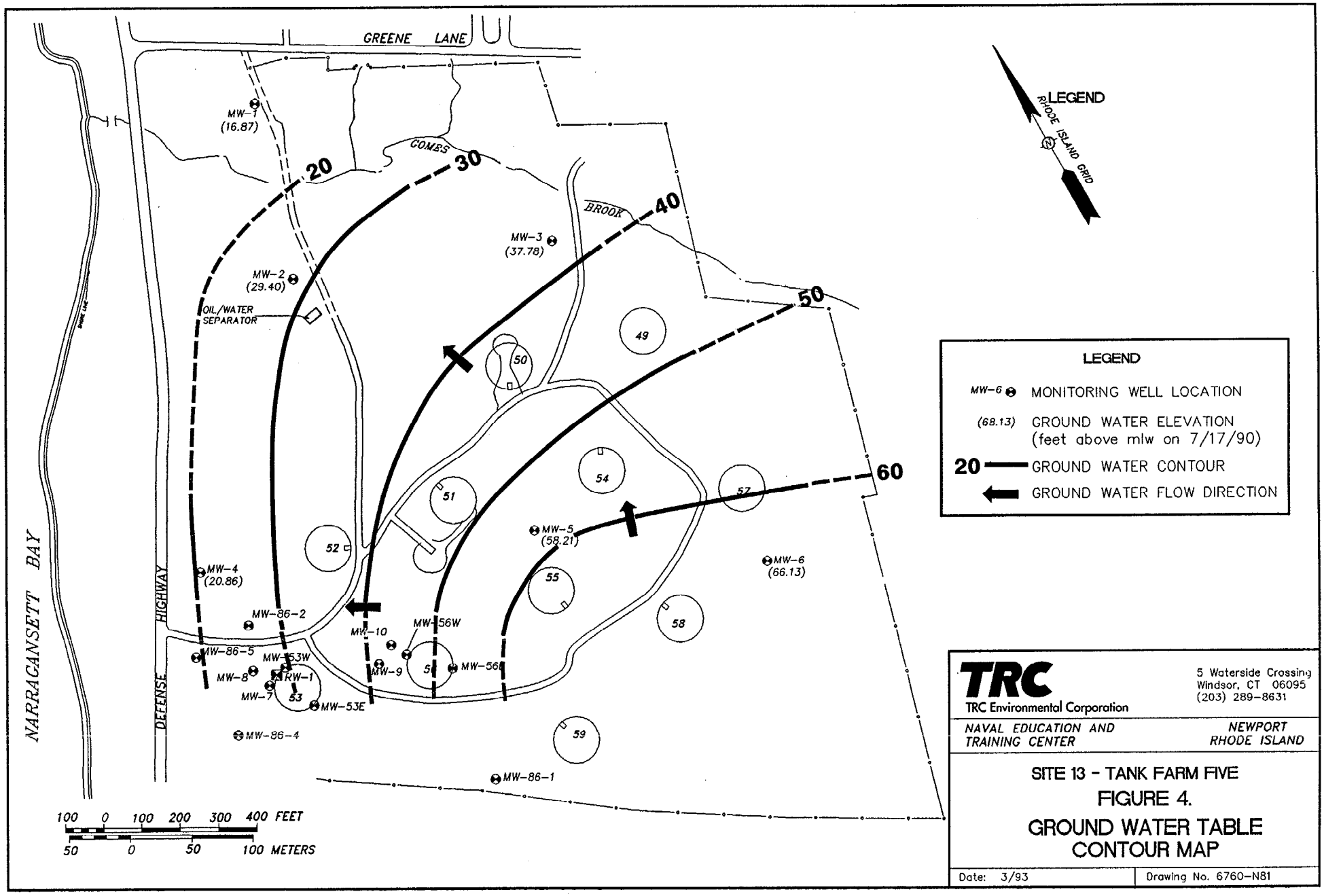
SITE 13 - TANK FARM FIVE
FIGURE 3.
PHASE I INVESTIGATION SUMMARY

Date: 3/93 | Drawing No. 6760-N81


GREENE LANE
COMBS BROOK
NARRAGANSETT BAY
DEFENSE HIGHWAY
MW-1 (16.87)
MW-2 (29.40)
MW-3 (37.78)
MW-4 (20.86)
MW-5 (58.21)
MW-6 (66.13)
MW-86-1
MW-86-2
MW-86-4
MW-86-5
MW-8
MW-7
MW-53W
MW-53E
MW-56W
MW-56E
MW-10
MW-9
OIL/WATER SEPARATOR
20
30
40
50
60
49
50
51
52
53
54
55
57
58
59
LEGEND
RHODE ISLAND GRID
N
100 0 100 200 300 400 FEET
50 0 50 100 METERS
LEGEND
MW-6 MONITORING WELL LOCATION
(68.13) GROUND WATER ELEVATION (feet above mlw on 7/17/90)
20 GROUND WATER CONTOUR
GROUND WATER FLOW DIRECTION
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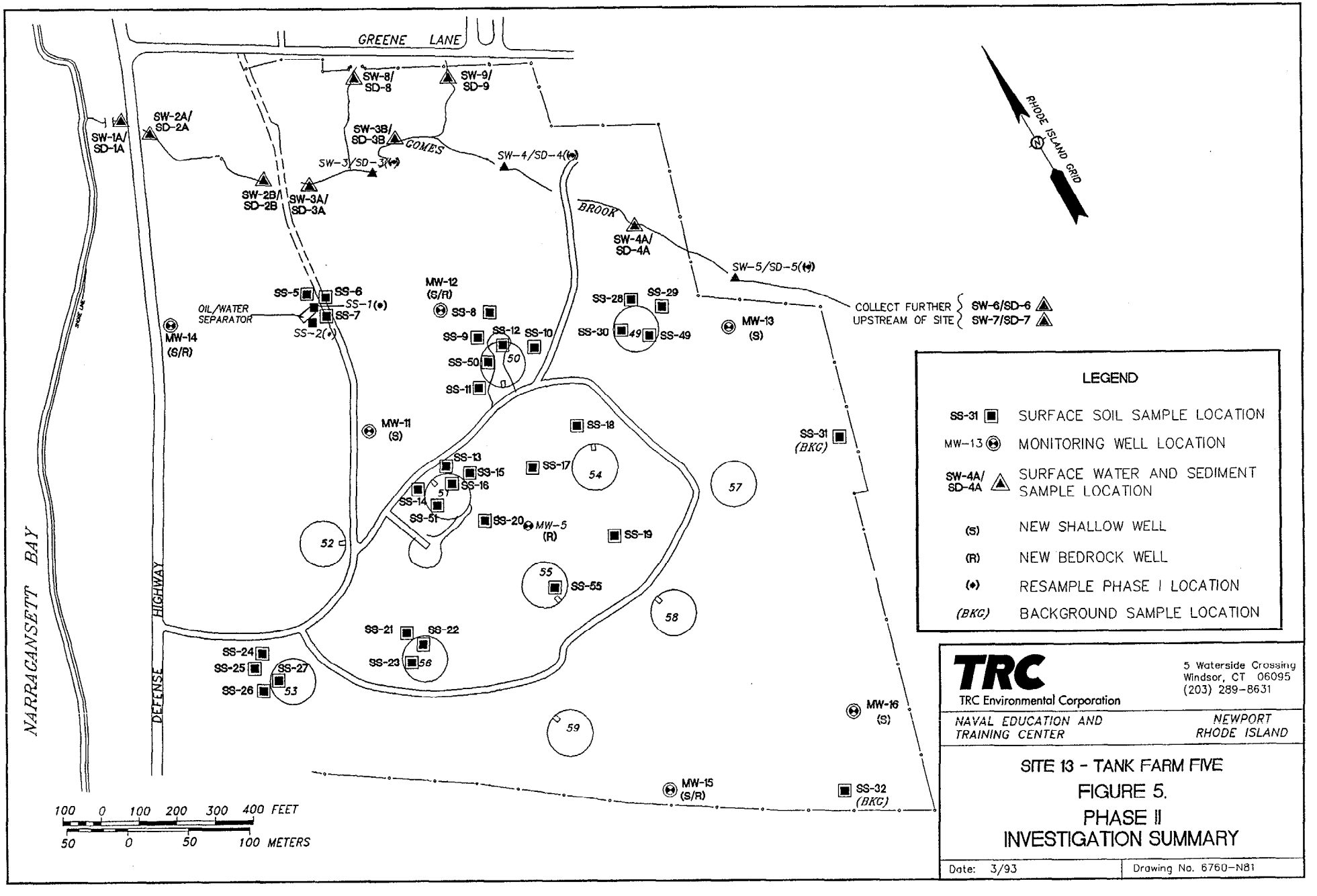
SITE 13 - TANK FARM FIVE
FIGURE 4.
GROUND WATER TABLE CONTOUR MAP
Date: 3/93
Drawing No. 6760-N81


GREENE LANE
NARRAGANSETT BAY
DEFENSE HIGHWAY
GOMES BROOK
RHODE ISLAND GRID
SW-1A/ SD-1A
SW-2A/ SD-2A
SW-2B/ SD-2B
SW-3A/ SD-3A
SW-3B/ SD-3B
SW-3/SD-3(•)
SW-4/SD-4(•)
SW-4A/ SD-4A
SW-5/SD-5(•)
SW-8/ SD-8
SW-9/ SD-9
COLLECT FURTHER UPSTREAM OF SITE
SW-6/SD-6
SW-7/SD-7
OIL/WATER SEPARATOR
SS-1(•)
SS-2(•)
SS-5
SS-6
SS-7
SS-8
SS-9
SS-10
SS-11
SS-12
SS-13
SS-14
SS-15
SS-16
SS-17
SS-18
SS-19
SS-20
SS-21
SS-22
SS-23
SS-24
SS-25
SS-26
SS-27
SS-28
SS-29
SS-30
SS-31 (BKG)
SS-32 (BKG)
SS-49
SS-50
SS-51
SS-55
MW-5 (R)
MW-11 (S)
MW-12 (S/R)
MW-13 (S)
MW-14 (S/R)
MW-15 (S/R)
MW-16 (S)
50
49
51
52
53
54
55
56
57
58
59
100 0 100 200 300 400 FEET
50 0 50 100 METERS
LEGEND
SS-31 SURFACE SOIL SAMPLE LOCATION
MW-13 MONITORING WELL LOCATION
SW-4A/ SD-4A SURFACE WATER AND SEDIMENT SAMPLE LOCATION
(S) NEW SHALLOW WELL
(R) NEW BEDROCK WELL
(•) RESAMPLE PHASE I LOCATION
(BKG) BACKGROUND SAMPLE LOCATION
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NEWPORT RHODE ISLAND
SITE 13 - TANK FARM FIVE
FIGURE 5.
PHASE II
INVESTIGATION SUMMARY
Date: 3/93
Drawing No. 6760-N81

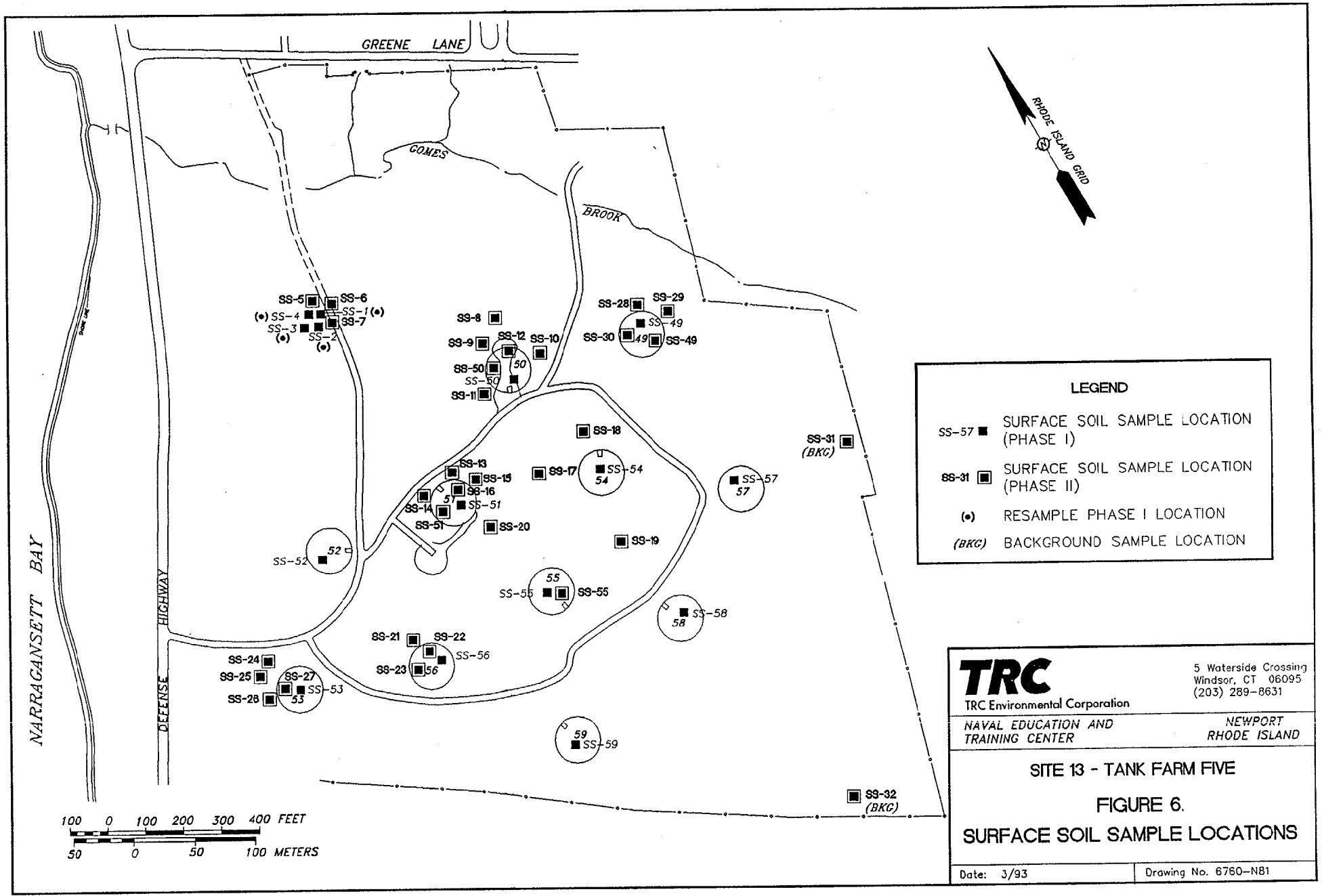
GREENE LANE
GOMES
BROOK
NARRAGANSETT BAY
DEFENSE HIGHWAY
RHODE ISLAND GRID
SS-5
SS-6
(•) SS-4
SS-1 (•)
SS-3
SS-7
(•)
SS-2
(•)
SS-8
SS-9
SS-12
SS-10
SS-50
50
SS-11
SS-28
SS-29
SS-49
SS-30
49
SS-49
SS-18
SS-13
SS-15
SS-17
SS-54
54
SS-16
51
SS-51
SS-14
SS-51
SS-20
SS-19
SS-52
52
SS-55
55
SS-55
SS-57
57
SS-31
(BKG)
SS-58
58
SS-21
SS-22
SS-56
SS-23
56
SS-24
SS-25
SS-27
SS-53
53
SS-26
59
SS-59
SS-32
(BKG)
100 0 100 200 300 400 FEET
50 0 50 100 METERS
LEGEND
SS-57 ■ SURFACE SOIL SAMPLE LOCATION (PHASE I)
SS-31 ■ SURFACE SOIL SAMPLE LOCATION (PHASE II)
(•) RESAMPLE PHASE I LOCATION
(BKG) BACKGROUND SAMPLE LOCATION
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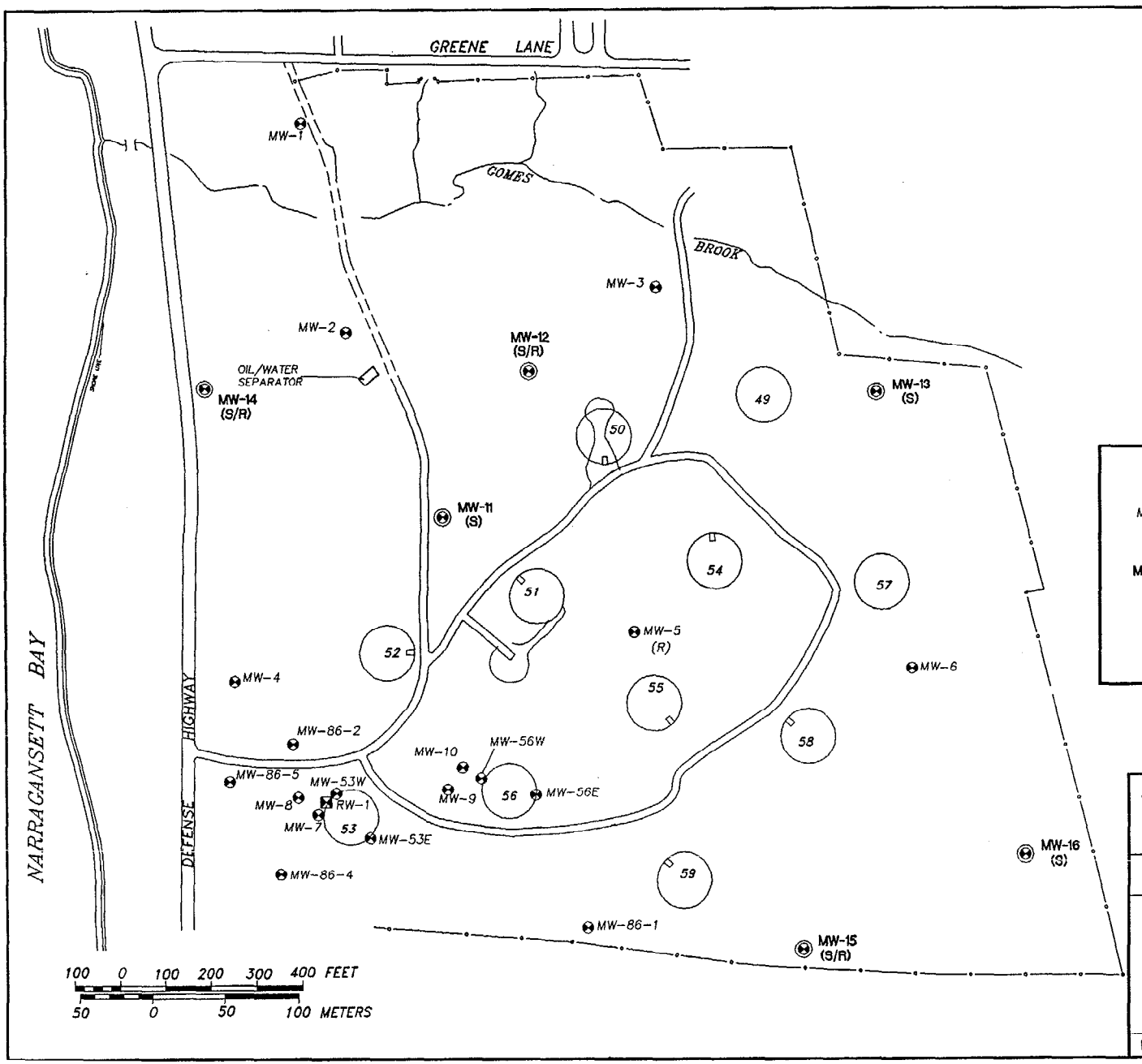
FIGURE 6.
SURFACE SOIL SAMPLE LOCATIONS
Date: 3/93
Drawing No. 6760-N81



LEGEND

MW-6	MONITORING WELL LOCATION (PHASE I)
MW-13	MONITORING WELL LOCATION (PHASE II)
(S)	NEW SHALLOW WELL
(R)	NEW BEDROCK WELL

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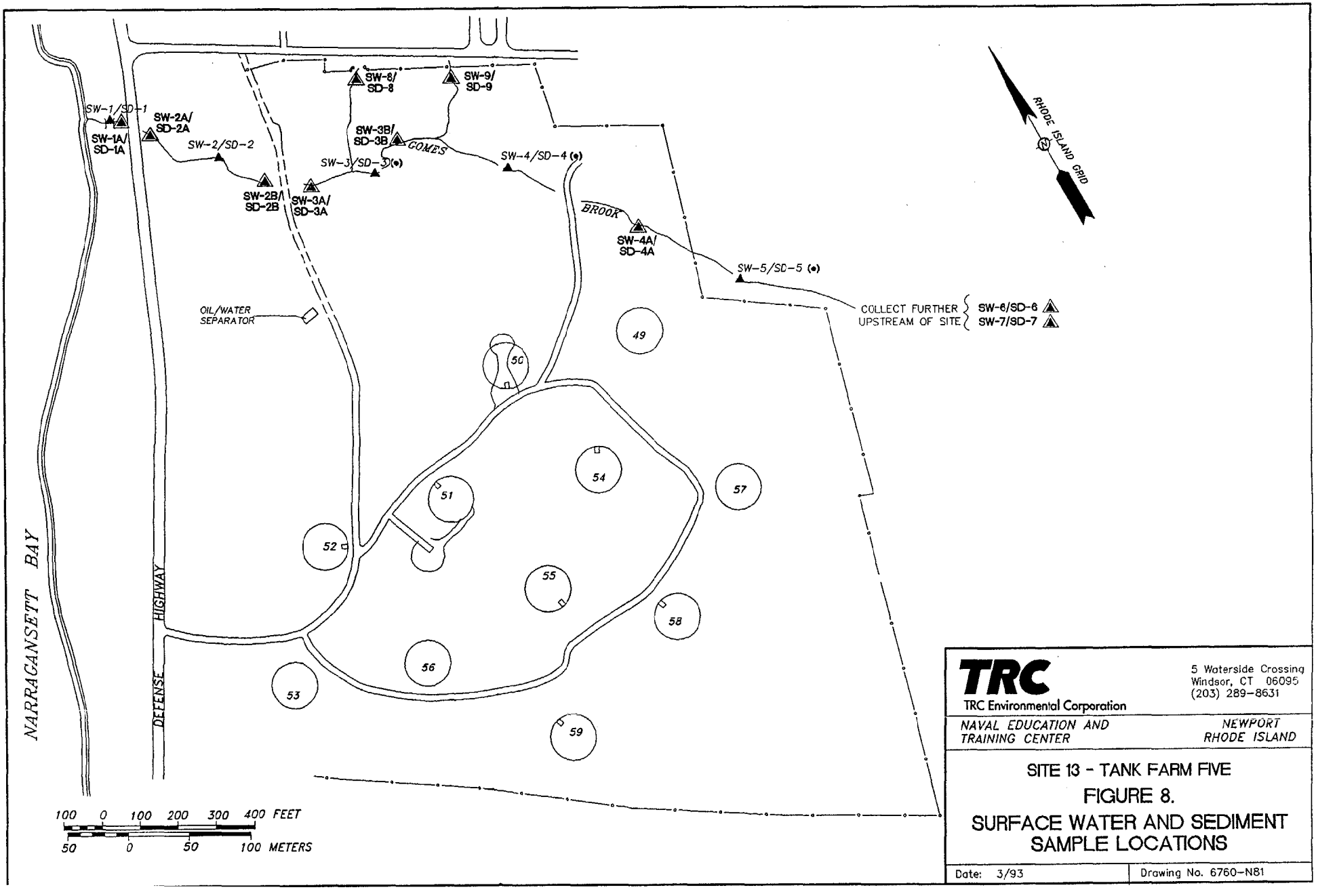
SITE 13 - TANK FARM FIVE

FIGURE 7.

MONITORING WELL LOCATIONS

Date: 3/93

Drawing No. 6760-N81


SW-1/SD-1
SW-1A/
SD-1A
SW-2A/
SD-2A
SW-2/SD-2
SW-2B/
SD-2B
SW-3A/
SD-3A
SW-3/SD-3 (•)
SW-3B/
SD-3B
COMES
BROOK
SW-8/
SD-8
SW-9/
SD-9
SW-4/SD-4 (•)
SW-4A/
SD-4A
SW-5/SD-5 (•)
COLLECT FURTHER
UPSTREAM OF SITE
SW-6/SD-6
SW-7/SD-7
OIL/WATER
SEPARATOR
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50
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59
NARRAGANSETT BAY
DEFENSE HIGHWAY
RHODE ISLAND GRID
N
100 0 100 200 300 400 FEET
50 0 50 100 METERS
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TRAINING CENTER
NEWPORT
RHODE ISLAND
SITE 13 - TANK FARM FIVE
FIGURE 8.
SURFACE WATER AND SEDIMENT
SAMPLE LOCATIONS
Date: 3/93
Drawing No. 6760-N81

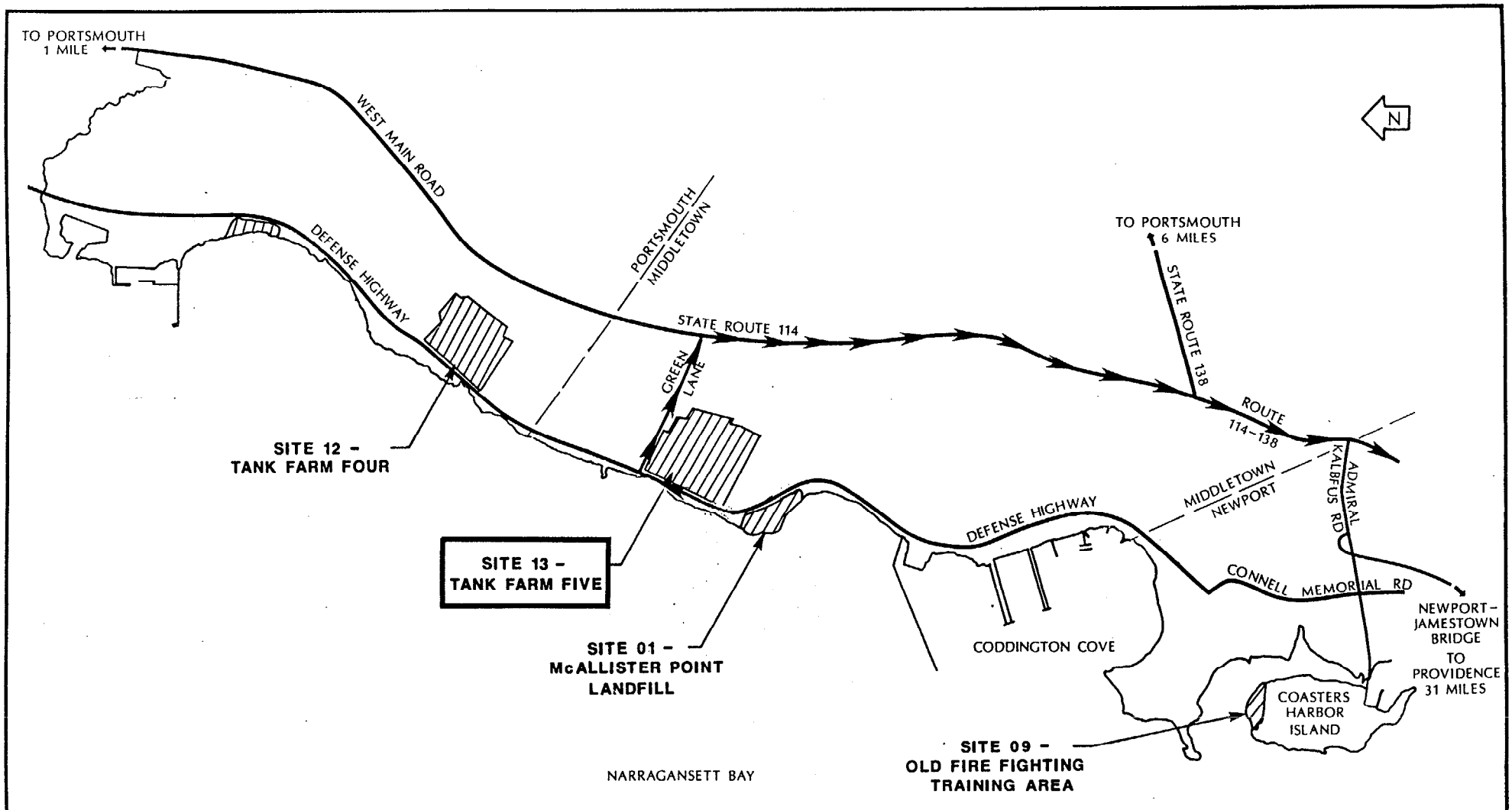

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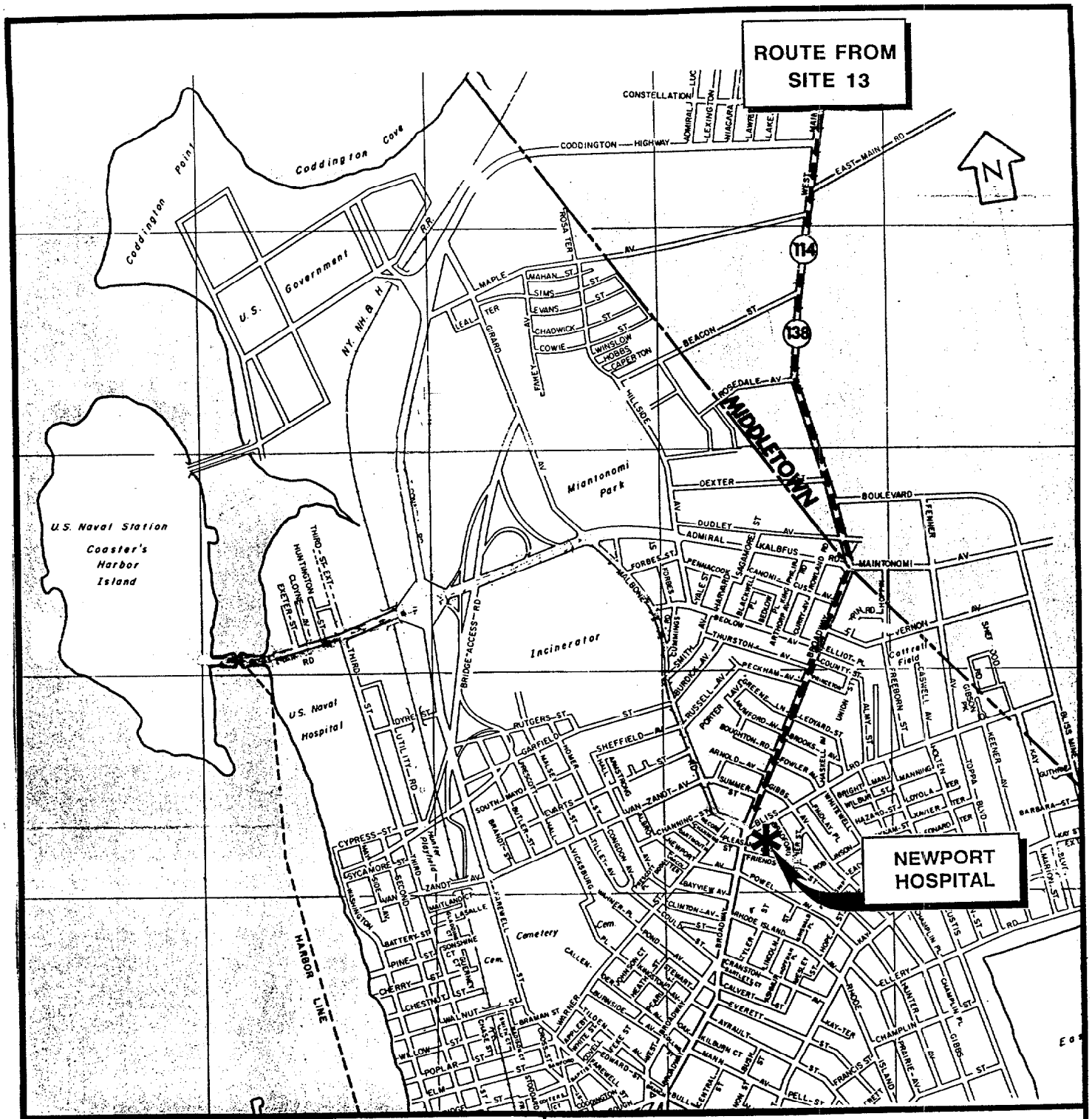
FIGURE 9.

NEWPORT HOSPITAL ROUTE MAP

Date: 3/93

Drawing No. 6760-N81



0 1/4 1/2
SCALE IN MILES

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FIGURE 9A.

NEWPORT HOSPITAL ROUTE MAP

Date: 3/93

Drawing No. 6760-N81

U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

VOLUME III - APPENDICES
FIELD SAMPLING PLANS

PHASE II RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared by:
TRC Environmental Corporation
Windsor, Connecticut

Prepared for:
Northern Division - Naval Facilities
Engineering Command
Lester, Pennsylvania

March 1993

TRC-EC Project No. 6760-N81-110
Contract No. N62472-86-C-1282

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U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

APPENDIX A
REGULATORY INFORMATION

PHASE II RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
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APPENDIX A
REGULATORY INFORMATION

- *RIDEM Ground Water Regulations*
- *RIDEM Surface Water Quality Regulations*

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APPENDIX A
REGULATORY INFORMATION

- *RIDEM Ground Water Regulations*

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STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
Division of Groundwater and Individual Sewage Disposal Systems

Rules and Regulations for GROUNDWATER QUALITY

May 1992

Regulation DEM-GW-01-92, May 92

AUTHORITY: These regulations are adopted in accordance with Chapter 42-35 pursuant to Chapters 46-12, 46-13.1, 23-18.9, 23-19.1, 42-17.6 and 42-17.1 of the Rhode Island General Laws of 1956, as amended.

RECEIVED
MAY 28 1992
SECRETARY OF STATE
ADMINISTRATIVE RECORDS DIV.

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

RULES AND REGULATIONS FOR GROUNDWATER QUALITY

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STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

RULES AND REGULATIONS FOR GROUNDWATER QUALITY

Section 1. PURPOSE

It is the purpose of these regulations to protect and restore the quality of the state's groundwater resources for use as drinking water and other beneficial uses, and to assure protection of the public health and welfare and the environment.

Section 2. LEGAL AUTHORITY

These rules and regulations are promulgated pursuant to the requirements and provisions of Chapter 46-12, Water Pollution; Chapter 46-13.1, Groundwater Protection; Chapter 23-18.9, Refuse Disposal; Chapter 23-19.1, Hazardous Waste Management Act; Chapter 42-17.1, Environmental Management; Chapter 42-17.6, Administrative Penalties for Environmental Violations; in accordance with Chapter 42-35, Administrative Procedures, of the Rhode Island General Laws of 1956, as amended.

Section 3. LIBERAL APPLICATION

The terms and provisions of these rules and regulations shall be liberally construed to allow the Department to effectuate the purposes of state and federal laws, goals, and policies.

Section 4. SEVERABILITY

If any provision of these rules and regulations or the application thereof to any person or circumstances is held invalid by a court of competent jurisdiction, the remainder of the rules and regulations shall not be affected thereby. The invalidity of any section or sections or parts of any section or sections shall not affect the validity of the remainder of these rules and regulations.

Section 5. APPLICABILITY

5.01 These regulations apply to all of the groundwaters of the state.

5.02 Persons subject to these regulations may also be subject to other regulations of the Department and may also be subject to federal regulations. Obligations of facility owners and facility operators hereunder shall be joint and several.

5.03 These regulations shall be construed in harmony with other Department regulations and the regulations of federal agencies. Nothing in these regulations shall affect the Director's power and duty to issue or require any form of groundwater monitoring, groundwater remediation, enforcement action or other action pursuant to any other regulatory program administered or

enforced by the Director.

5.05 Individual Sewage Disposal Systems

(a) These regulations apply to all individual sewage disposal systems designed to treat ten thousand (10,000) or more gallons per day. Such systems are subject to the Groundwater Quality Certification requirements of section 17.

(b) Individual sewage disposal systems that are designed to treat less than ten thousand (10,000) gallons per day, that are used solely for the disposal of sanitary sewage (as defined herein), and which are designed, installed and operating in compliance with the Department's Rules and Regulations Establishing Minimum Standards Relating to Location, Design, Construction, and Maintenance of Individual Sewage Disposal Systems, December 1989, and amendments thereto, are exempt from these Rules and Regulations for Groundwater Quality.

5.06 Monitoring Wells: Permanent monitoring wells installed pursuant to these regulations shall be in compliance with the construction standards in Appendix I. A monitoring well is designated permanent if it exists for more than 120 days. The monitoring well abandonment procedures in Appendix I shall apply to all permanent and non-permanent monitoring wells and those piezometers where improper abandonment would result in a reasonable likelihood of groundwater pollution.

5.07 The Director may require any facility owner or operator subject to these regulations to provide any information deemed necessary in order to determine compliance with these regulations. Failure to disclose such information shall be cause for initiating appropriate enforcement action and shall constitute valid cause for denial of any Departmental approvals under these regulations or the suspension of any approval issued hereunder.

5.08 Nothing in these regulations shall affect the Director's power and duty to issue an immediate compliance order or take any other action pursuant to the General Laws of Rhode Island, 1956, as amended.

Section 6. FINDINGS

The legislative findings set forth in the Rhode Island Groundwater Protection Act of 1985, section 46-13.1-2 of the General Laws of Rhode Island, 1956, as amended and which are repeated below in section 6.01 and the additional findings of the Department set forth in section 6.02 are made a basis for these regulations.

6.01 Legislative Findings

(a) Water is vital to life and comprises an invaluable natural resource which is not to be abused by any segment of the state's population or its economy. It is the policy of the state to restore, enhance, and maintain the chemical, physical, and biological integrity of its waters, to protect public health, to safeguard fish and aquatic life and scenic and ecological values, and to enhance the domestic, municipal, recreational, industrial, and other uses of water;

(b) The groundwaters of the state are a critical renewable resource which must be protecte to insure the availability of safe and potable drinking water for present and future need:

(c) It is a paramount policy of the state to protect the purity of present and future drinkin water supplies by protecting aquifers, recharge areas, and watersheds;

(d) It is the policy of the state to restore and maintain the quality of groundwater to a qualit consistent with its use for drinking water supplies and other designated beneficial use without treatment as feasible. All groundwaters of the state shall be restored to the exten practicable to a quality consistent with this policy;

(e) It is the policy of the state not to permit the introduction of pollutants into th groundwaters of the state in concentrations which are known to be toxic, carcinogenic mutagenic, or teratogenic. To the maximum extent practical, efforts shall be made t require the removal of those pollutants from discharges where such discharges are show to have already occurred;

(f) Existing and potential sources of groundwater shall be maintained and protected. Wher existing quality is inadequate to support certain uses, the quality shall be upgraded i feasible to protect the present and potential uses of the resource;

(g) The groundwaters of the state are to be protected for use as agricultural, industrial, an potable water supplies, and other reasonable uses, and as a supplement to surface water for recreation, wildlife, fish and other aquatic life, agriculture, industry, and potable wate supply;

(h) Discharges to groundwater which subsequently discharge into surface waters and which would cause a contravention of surface water quality or standards shall not be permitted

(i) No degradation of the state's groundwaters shall be permitted unless the state chooses t allow lower water quality as a result of the essential, desirable and justifiable economic commercial, industrial, or social development.

6.02 Administrative Findings

(a) Approximately 25% of the population of Rhode Island depends on groundwater for it drinking water supply, and approximately 27 million gallons of groundwater are used ever day in Rhode Island.

(b) Approximately two-thirds of the cities and towns in Rhode Island depend on groundwate for all or a significant portion of their public and private drinking water supply needs.

(c) Three sole source aquifers have been designated in Rhode Island by the United State Environmental Protection Agency.

(d) The groundwater resources of the state with the highest potential yield are located i glacial deposits of stratified drift which underlie about one-third of the state. These groundwater resources are vulnerable to pollution due to the relatively high water table high permeability, and the absence of a confining subsurface layer that would inhibi

movement of pollutants to groundwater.

(e) Most private drinking water supplies and many small public water supply systems a water from fractured bedrock aquifers. Groundwater pollution in bedrock is ext difficult to monitor and remediate.

(f) Groundwater pollution continues to threaten public and private drinking water supplie A significant number of public and private wells in Rhode Island have had pollutants concentrations that have adversely impacted their use.

(g) Groundwater pollution must be prevented wherever possible because of the actual an potential adverse effects on public health and the environment and due to the technic difficulties and economic costs involved in groundwater remediation.

(h) Certain activities that represent a potential threat to groundwater quality are no appropriate in particular areas because of the sensitivity and value to the state of th underlying groundwater resource.

Section 7. DEFINITIONS

"Annular space seal" means the material placed above the top of the filter pack or the filter pack seal u to the ground surface seal and between the well casing and the adjacent formation.

"Aquifer" means a geologic formation, group of formations, or part of a formation that contains su saturated, permeable material to yield significant quantities of water to wells and springs.

"Bedrock" means solid rock, commonly called ledge, that forms the earth's crust, including fracture zone within said rock.

"Best management practices" means schedules of activities, prohibitions of practices, maintenanc procedures, and other management practices designed to prevent or reduce the degradation of the state' groundwater to the maximum extent possible.

"Contaminant" means any physical, chemical, biological, or radiological substance or matter in water whic impairs its intended or feasible use. For purposes of these regulations, contaminants shall includ pollutants.

"Community water system" means a public water system which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

"Degradation" means a deterioration or decline in groundwater quality.

"Department" means the Rhode Island Department of Environmental Management or its successor.

"Director" means the director of the Rhode Island Department of Environmental Management or the Director's designee.

"Discharge to groundwater" means the intentional, negligent, accidental, or other release of any polluta onto or beneath the land surface, in a location where it is likely to enter the groundwater of the state

"Discharge zone" means a departmentally designated, three-dimensional zone within which the polluta concentrations resulting from an active discharge to groundwater are allowed to be greater than t groundwater quality standards.

"Effluent" means liquid that is discharged from a facility.

"Emergency response" means any action undertaken immediately following the discovery of a release order to completely or partially contain, clean up or treat the released material to prevent an immedia and/or substantial threat or risk of acute or chronic adverse effect on human health or to prevent a immediate and/or substantial significant adverse impact to the environment.

"Facility" means any parcel of real estate or a contiguous series or parcels of real estate together with a and all structures, facility components, improvements, fixtures and other appurtenances located there which constitutes a distinct geographic unit.

"Filter Pack" means the sand, gravel, or both placed in direct contact with the well screen.

"Filter pack seal" means the sealing material placed in the annular space above the filter pack and belo the annular space seal to prevent the migration of annular space sealant into the filter pack.

"Groundwater" means water found underground which completely fills the open spaces between particle of sediment and within rock formations.

"Groundwater quality classification" means the categorization of groundwater as usable for particula purposes on the basis of its physical, chemical, and hydrogeologic characteristics; also, the particular cla (GAA, GA, GB, or GC) assigned to a particular volume of groundwater within specific geographi boundaries.

"Groundwater quality standards" means concentrations of specific chemical, biological, and radiologica constituents and/or narrative statements which describe the quality of groundwater which shall be met i a particular groundwater quality classification.

"Groundwater recharge" means the process of adding water to the zone of saturation; or the quantity c water added to the zone of saturation.

"Groundwater reservoirs" means those stratified drift deposits having a saturated thickness greater tha or equal to 40 feet and a transmissivity greater than or equal to 4000 feet squared per day which hav been designated by the Director to be potentially significant sources of water.

"Hazardous material" means any material or combination or mixture of materials containing any hazardou substance in an amount and concentration such that when discharged to groundwater will or ma reasonably be expected to cause acute or chronic adverse effects on human health or the environmen Hazardous material shall also include any material that contains a hazardous waste.

"Hazardous substance" means any substance designated as such pursuant to 40 CFR 300.5.

"Hazardous waste" means hazardous waste as defined in the Rhode Island Department of Environmental Management Rules and Regulations for Hazardous Waste Generation, Transportation, Treatment, Storage and Disposal, 1988, and amendments thereto.

"Hydraulic conductivity" means a measure of the ability of an aquifer to transmit a fluid; it is expre as the volume of water at the existing kinematic viscosity that will move in a unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow.

"Individual sewage disposal system" means any system of piping, tanks, disposal areas, alternative toilets or other facilities designed to function as a unit to convey, store, treat and/or dispose of sanitary sewage by means other than discharge into a public sewer system.

"Licensed solid waste landfill" means any solid waste disposal facility consisting in whole or in part of a landfill, which facility is operating pursuant to a valid department license issued pursuant to a final action of the Director as to which all applicable appeals periods have expired.

"Monitoring well" means a well that is specifically located, designed, constructed, and emplaced to sample groundwater quality; the monitoring well may also be used to measure water table elevations.

"Monitoring well abandonment" means to remove a monitoring well from service in such a manner that vertical movement of water within the well bore and within the annular space surrounding the well casing is effectively and permanently prevented.

"Non-attainment" means groundwater, designated by the Director, that has pollutant concentrations greater than the groundwater quality standards for the classification.

"Operator" means any person or persons having control or having legal responsibility for operati maintaining any facility which is subject to these regulations.

"Owner" means any person who holds exclusive or joint title to, or lawful possession of real or personal property which is subject to these regulations.

"Person" means an individual, trust, firm, joint stock company, corporation (including a quasi-governmental corporation), partnership, association, syndicate, municipality, municipal or state agency, fire district, club, non-profit agency, or any subdivision, commission, department, bureau, agency or department of state or federal government (including quasi-governmental corporation), or any interstate or international body, or any agent or employee thereof.

"Piezometer" means a well with a short screen that allows measurement of the water level at a particular depth in the aquifer.

"Point of compliance" means any location, described by depth and/or distance from a facility, at which the groundwater quality is sampled to determine whether a preventive action limit or groundwater quality standard is met as a result of activities occurring at such facility.

"Pollutant" means any material or effluent which may alter the chemical, physical, biological, or radiological characteristics and/or integrity of water, including but not limited to, dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biolo materials, radioactive materials, heat, wrecked or discarded equipment, cellar dirt or industrial, munic

agricultural, or other waste or material, petroleum or petroleum products, including but not limited to oil.

"Pollution" means the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water.

"Preventive action limit" means a specified percentage of a numerical groundwater quality standard.

"Private well" means a well established for the purpose of meeting all or part of a person's potable water needs provided said well does not supply a public water system.

"Public water system" means a system for the provision to the public of piped water for human consumption, provided such a system has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year; and shall include all sources and facilities involved in collecting, treating, storing, and distributing the water.

"Public well" means a well that serves a public water system.

"Recharge area" means the land surface from which water is added to the zone of saturation. The recharge area for a particular well or aquifer, for instance, is that land surface from which water moves to the well or aquifer or may move to the well or aquifer under certain hydraulic conditions.

"Release" means any spilling, leaking, pumping, pouring, emitting, emptying, injecting, escaping, leaching, dumping, or disposing of any pollutant onto or below the land surface. For purposes of these regulations, release also includes any storage, disposal, or abandonment of any substance or material in a manner which presents a substantial threat of release as herein defined.

"Remediation" means prevention and control of pollutant migration to, within, or from the groundwater and/or the removal of a pollutant from the groundwater.

"Residual zone" means a departmentally designated, three-dimensional zone within which the pollutant concentrations remaining in the groundwater after remediation activities are allowed to be greater than the groundwater quality standards.

"Sanitary sewage" means wastewater associated with human hygiene, routine cleaning and janitorial activities that is discharged from sanitary conveniences (e.g., toilets, sinks, tubs, showers; dishwashers, kitchen sinks; and laundry machines).

"Saturated thickness" means the thickness of an aquifer measured from the water table to an essentially impermeable boundary; such boundary is typically taken to be the top of the bedrock surface.

"Saturated zone" means the subsurface zone in which all open spaces are filled with water.

"Sludge" means residue, whether partially solid or solid, treated or untreated, resulting from the treatment of sewage, including, without limitation, such residues from the cleaning of sewers, by processes, such as settling, flotation, filtration and centrifugation, and shall not meet the criteria for a hazardous waste as found in the Rhode Island Department of Environmental Management Rules and Regulations for Hazardous Waste Generation, Transportation, Treatment, Storage and Disposal, 1988, and amendments thereto.

"Sole source aquifer" means an aquifer designated by the United States Environmental Protection Agenc as the sole or principal source of drinking water for the area above the aquifer and including those land where the population served by the aquifer live; that is, an aquifer which is needed to supply 50% o pr of the drinking water for that area and for which there are no reasonably available alternative s should the aquifer become polluted.

"Solid waste" means solid waste as defined in the Rhode Island Department of Environmenta Management Rules and Regulations for Solid Waste Management Facilities, February 1991, an amendments thereto; and which shall include garbage, refuse and other discarded solid material generated by residential, institutional, commercial, industrial and agricultural sources but does not includ solids or dissolved materials in domestic sewage or sewage sludge, nor does it include hazardous waste Solid waste shall also include non-hazardous liquid, semi-solid, and containerized gaseous waste.

"Static water table" means the water table under natural, non-pumping conditions.

"Stratified drift" means predominantly sorted sediments deposited in layers by meltwater from a glacier

"Till" means predominantly unsorted, unstratified sediments deposited directly by a glacier.

"Transmissivity" means a measure of the ability of an aquifer to transmit a fluid. It can be quantified a the hydraulic conductivity multiplied by the saturated thickness.

"Unconsolidated deposits" means naturally occurring materials in which the particles are loose or loosel cemented, e.g., sand, gravel.

"Underground storage tank" means any one or combination of tanks (including underground connected thereto) which is used to contain an accumulation of petroleum product or hazardous ma al and the volume of which (including the volume of the underground pipes connected thereto) is 10 percen or more beneath the surface of the ground.

"Water table" means the upper surface of the saturated zone in an unconfined aquifer.

"Well" means a bored, drilled, or driven shaft or a dug hole, with a depth that is greater than its larges surface dimension, through which groundwater flows, has flowed, or may flow under natural or induce pressure.

"Wellhead protection area" means a three-dimensional zone, designated by the Director, surrounding a public well or wellfield through which water will move toward and reach such well or wellfield.

Section 8. PROHIBITIONS

8.01 Groundwater shall be maintained at a quality consistent with its classification. No person shall take actions that violate or cause to violate the standards established in these regulations.

8.02 No person shall cause or allow a discharge of any pollutant to groundwater without the approval of the Director pursuant to these and other Department regulations.

8.03 No person shall take action that shall cause or allow groundwater designated non-attai nt

pursuant to section 9.02 to be further degraded.

8.04 No person shall operate or maintain a facility in a manner that is likely to result in a discharge of any pollutant to groundwater without the approval of the Director.

8.05 No person shall discharge hazardous materials to the groundwaters of the state.

8.06 Solid waste landfills and facilities for the disposal of hazardous waste are prohibited in areas where the groundwater is classified GAA.

8.07 No person shall install underground storage tanks in new locations within the wellhead protection area of community water supply wells. This prohibition shall not apply to the replacement or upgrading of existing underground storage tanks installed prior to the effective date of these regulations provided that such activity take place in accordance with all applicable state and federal regulations.

Section 9. GROUNDWATER CLASSIFICATION

9.01 Definitions: The Director shall classify the groundwater resources of Rhode Island using the four classes established in Chapter 46-13.1 of the General Laws of Rhode Island, 1956, as amended and which are further defined below:

(a) Groundwater classified GAA shall be those groundwater resources which the Director has designated to be suitable for public drinking water use without treatment and which are located within the following areas:

(1) Groundwater reservoirs and portions of their recharge areas as delineated by the Department, pursuant to the method described in Policies and Procedures for Mapping Recharge Areas to Groundwater Reservoirs for GAA Classification, Rhode Island Department of Environmental Management, March, 1990;

(2) A 2000 foot radius circle around each community water system well or within the delineation of a wellhead protection area to each well delineated by the Director or another delineation which is accepted by the Director in accordance with the Rhode Island Wellhead Protection Program, Rhode Island Department of Environmental Management, February 1990, and any amendments thereto; and

(3) Groundwater dependent areas, such as Block Island, that are physically isolated from reasonable alternative water supplies and where the existing groundwater supply warrants the highest level of protection.

(b) Groundwater classified GA shall be those groundwater resources which the Director has designated to be suitable for public or private drinking water use without treatment and which are not described in section 9.01(a)(1)-(3).

(c) Groundwater classified GB shall be those groundwater resources which the Director has designated not suitable for public or private drinking water use. Groundwater located beneath the following areas may be classified GB:

(1) Highly urbanized areas of the state with dense concentrations of industrial ar commercial activity;

(2) The waste disposal area at sites of the following facilities:

(i) Inactive landfills and inactive land disposal sites for solid waste, hazardou waste, and sewage sludge;

(ii) Active sites for the land disposal of sewage sludge, unless such disposal sit is associated with a licensed solid waste landfill;

(3) The area immediately surrounding the waste disposal area, which the Director ha determined is not suitable for public or private drinking water use, at the followin inactive and active facilities: landfills, land disposal sites for solid waste, hazardou waste, and sewage sludge.

(d) Groundwater may be classified GC in those areas which, because of present or past lan use or hydrogeological conditions, the Director has determined to be more suitable fo certain waste disposal practices.

(1) Groundwater located beneath the following areas may be classified GC:

(i) At licensed solid waste landfills:

(A) The currently permitted area for waste disposal as establishe valid operating license issued by the Department; and

(B) Areas surrounding the permitted area for waste disposal that th Director determines are potentially suitable for waste disposal base on the hydrogeologic environment, groundwater quality, groundwate use off-site, and surrounding surface water quality and use;

(ii) Areas that have been reclassified pursuant to section 11.08 for solid wast landfills and facilities for the disposal of hazardous waste.

(2) At the point in time when a license for a solid waste landfill or facility for the disposal of hazardous waste has lapsed or the facility is no longer being operated then the Director shall conduct a site-specific evaluation to determine whether the GC classification is appropriate for the site.

9.02 Non-attainment Areas: Non-attainment areas are those areas that have pollutant concentrations greater than the groundwater quality standards for the applicable classification. The Director shall designate such groundwater as "non-attainment" in the following manner: GAA Non-attainment (GAA-NA), GA Non-attainment (GA-NA), or GB Non-attainment (GB-NA).

(a) The goal for non-attainment areas is restoration to the groundwater quality consistent with the standards in section 10 for the applicable class.

(b) The Director shall maintain maps of areas in which groundwater has been designated GAA-NA and GA-NA on file in the Department's Groundwater Section. Groundwater designated GAA-NA and GA-NA shall include, but shall not be limited to, groundwater not classified GB or GC that is located in areas associated with the following activities:

(1) Subsurface disposal of commercial and industrial effluent where the Director has reason to believe such areas are in non-attainment;

(2) Surface impoundments and uncontrolled surface disposal of commercial and industrial wastes where the Director has reason to believe such areas are in non attainment;

(3) At inactive landfills and inactive land disposal sites for solid waste, hazardous waste and sewage sludge:

(i) The entire site at those sites where data is not available for an adequate delineation of the waste disposal area;

(ii) At sites where the waste disposal area has been adequately delineated pursuant to section 9.01(c)(2): the area determined by the Director to be in non-attainment beyond the waste disposal area and beyond the area described in section 9.01(c)(3);

(4) At licensed solid waste landfills and active sites for the land disposal of sewage sludge: the area determined by the Director to be in non-attainment beyond that area described in Section 9.01(d)(1) and 9.01(c)(3);

(5) Road salt storage sites where road salt has not been stored in accordance with best management practices; and

(6) Releases of chemicals or petroleum products where significant volumes are known or presumed to have reached the groundwater.

9.03 Classification Boundary Disputes: In the event that the boundaries of the groundwater classification areas shown on groundwater classification maps produced by the Department are in dispute, the burden of proof shall be on the person disputing the boundary locations as shown on such map to show, pursuant to section 11 that the boundary locations are incorrect. In determining the accuracy of the Director's delineations, the regional hydrogeologic conditions beyond the boundaries of the specific site in question and the seasonal fluctuations in the water table shall be considered.

9.04 Classification Maps: The Director shall prepare and adopt, simultaneously with the adoption of these regulations, groundwater classification maps, which designate groundwater classification pursuant to these regulations. Said groundwater classification maps shall be at a scale of 1:24000, and such maps shall be on file for review at the Rhode Island Department of Environmental Management Groundwater Section, 291 Promenade Street, Providence, RI 02908. Smaller scale, statewide maps may be made available from the Department at the above address. The Director shall establish an appropriate fee for copies of the groundwater classification maps, which shall be based on the costs of map reproduction.

Section 10. GROUNDWATER QUALITY STANDARDS AND PREVENTIVE ACTION LIMITS

10.01 General: The Director shall establish groundwater quality standards and preventive action limits to be used in determining compliance with the groundwater classifications, including, but not limited to, compliance of proposed discharges to groundwater, existing discharges to groundwater, groundwater remediation activities, and other facilities and activities that have an actual or potential adverse impact on groundwater quality. Numerical groundwater quality standards and preventive action limits shall be established only for class GAA and class GA.

10.02 Class GAA and Class GA Groundwater Quality Standards and Preventive Action Limits

Class GAA and class GA groundwater are suitable for drinking water use without treatment, and therefore, both classes are subject to the same groundwater quality standards and preventive action limits, which are defined below. The preventive action limits shall be set at 50% of the numerical groundwater quality standards.

(a) Pollutants shall not be in groundwater classified GAA or GA, except within an approved discharge zone or residual zone (as provided for in sections 13.03 and 13.04 respectively), in any concentration which will adversely affect the groundwater as a source of potable water or which will adversely affect other beneficial uses of the groundwater, to include but not be limited to recreational, agricultural and industrial uses and the preservation of fish and wildlife habitat through the maintenance of surface water quality.

(b) The numerical groundwater quality standards and the preventive action limits for specific substances in class GAA and class GA are listed in Table 1.

(c) Groundwater classified GAA and GA shall be of a quality which the Director determines does not violate or have any reasonable potential to cause a violation of surface water quality standards established by the Rhode Island Water Quality Regulations for Water Pollution Control, October 1988, and amendments thereto.

10.03 Class GB and GC Groundwater Quality Standards

(a) Groundwater classified GB and GC shall be of a quality which the Director determines does not:

(1) Threaten public health and/or the environment;

(2) Violate or have a substantial likelihood to cause a violation of surrounding groundwater quality standards;

(3) Adversely impact or have a substantial likelihood to adversely impact:

(i) Current or proposed uses of the facility;

(ii) Current or proposed uses of groundwater and surface water at or within the facility boundaries;

TABLE 1. Numerical Groundwater Quality Standards and Preventive Action Limits for Class GAA an Class GA.

Substance	Groundwater Quality Standard (milligrams per liter, except as noted)	Preventive Action Limit
A. Inorganic Chemicals		
Arsenic	0.05	0.025
Barium	1	0.5
Cadmium	0.01	0.005
Chromium (hexavalent)	0.05	0.025
Fluoride	4	2
Lead	0.05	0.025
Mercury	0.002	0.001
Nitrate (as N)	10	5
Selenium	0.01	0.005
Silver	0.05	0.025
B. Organic Chemicals		
Aldicarb (Temik)	0.003	0.0015
Aldicarb Sulfone	0.002	0.001
Aldicarb Sulfoxide	0.004	0.002
Endrin	0.0002	0.0001
Lindane	0.004	0.002
Methoxychlor	0.1	0.05
Toxaphene	0.005	0.0025
2,4-D	0.1	0.05
2,4,5-TP (Silvex)	0.01	0.005
Total Trihalomethanes	0.1	0.05
Benzene	0.005	0.0025
Carbon Tetrachloride	0.005	0.0025
p-Dichlorobenzene	0.075	0.0375
1,2-Dichloroethane	0.005	0.0025
1,1-Dichloroethylene	0.007	0.0035
Methyl Tertiary Butyl Ether (MTBE)	0.04	0.02
Tetrachloroethylene	0.005	0.0025
1,1,1-Trichloroethane	0.2	0.1
Trichloroethylene (TCE)	0.005	0.0025
Vinyl Chloride	0.002	0.001

TABLE 1. (continued)

Substance	Groundwater Quality Standard (milligrams per liter, except as noted)	Preventive Action Limit
C. Microbiological		
Total Coliform Bacteria	zero	zero
D. Radionuclides		
Gross Alpha Particle Activity	15 pCi/liter	7.5 pCi/liter
Gross Beta Particle Activity	4 mrem/yr	2 mrem/yr
Radium 226 and Radium 228 combined	5 pCi/liter	2.5 pCi/liter

Note: The numerical groundwater quality standards in these regulations are based primarily on the maximum contaminant levels promulgated by the Rhode Island Department of Health in the Rules and Regulations Pertaining to Public Drinking Water, December 1990, and amendments thereto. As additional or revised maximum contaminant levels are adopted by the Rhode Island Department of Health, the new or revised maximum contaminant levels are incorporated herein by reference as groundwater quality standards for class GAA and class GA.

(iii) Current and future uses of surrounding property, groundwater and surface water;

(4) Violate or have any reasonable potential to cause a violation of surface water quality standards established by the Rhode Island Water Quality Regulations for Water Pollution Control, October 1988, and amendments thereto.

(b) In determining compliance with the groundwater quality standards for class GB and class GC at a facility, the Director may consider the factors below, in addition to other relevant information, provided by the facility owner or operator:

(1) Surrounding groundwater quality;

(2) Groundwater classification surrounding the facility;

(3) Surface water classification within the facility boundaries and surrounding the facility;

(4) Current and proposed future uses of groundwater and surface water at or within the facility boundaries;

(5) Current and proposed future uses of the facility;

(6) Uses of surrounding property, groundwater and surface water;

(7) Hydrogeologic characteristics of the facility and surrounding the facility, including, but not limited to, groundwater flow direction, hydraulic gradient, type of subsurface materials, and depth to bedrock;

(8) Actual and potential routes for human exposure and points of human exposure to the pollutant(s);

(9) Man-made pathways for pollutant movement off-site, e.g., underground utility lines; and

(10) Persistence and mobility of the pollutant(s) in the subsurface and the toxicity of the pollutant(s).

Section 11. REVIEW AND MODIFICATION OF GROUNDWATER CLASSIFICATION

11.01 Groundwater Classification Changes by the Director: The Director may from time to time propose changes in the groundwater classifications as more information becomes available. The changes shall be delineated in a manner consistent with section 9. At such time that the Director proposes a change in the groundwater classification, the Director shall initiate rule-making procedures.

11.02 Public Hearings: The Director may from time to time conduct public hearings to receive comment on the groundwater classifications, groundwater quality standards, and preventive limits.

11.03 Request for Modification of Groundwater Classification

(a) Any person who may be substantially and specifically affected may petition the Directo to modify the classification assigned to particular groundwaters of the state.

(b) The petitioner for a reclassification shall specify the precise boundary in question an prove by clear, convincing and scientifically valid evidence that a reclassification i consistent with sections 11.05, 11.06, 11.07, or 11.08.

11.04 Reclassification Considerations: In evaluating a reclassification petition in accordance wit sections 11.05, 11.06, 11.07, or 11.08, the Director shall consider the factors below, in addition t other relevant information, provided by the facility owner or operator for the location in question

(a) Actual or potential threats to public health and/or the environment;

(b) Surrounding groundwater and surface water quality;

(c) Surrounding groundwater and surface water quality standards;

(d) Current and potential future uses of surrounding property, groundwater, and surface and

(e) Local and regional groundwater flow direction.

11.05 Upgrading Groundwater Classification: Where it has been proven by clear, convincing an scientifically valid evidence that the groundwater quality of an area meets the standards of a higher quality groundwater classification than the current classification or that the classificatio delineation pursuant to section 9.01(b) or 9.01(c)(2) is incorrect, the Director shall initiate rule-making procedures to upgrade the groundwater classification.

11.06 Changing Groundwater Classified GAA to GA: Where it has been proven by clear, convincing and scientifically valid evidence that groundwater classified GAA is not in an area described in section 9.01(a)(1)-(3), then and in that event, the Director shall initiate rule-making procedures for reclassification of such groundwater to GA.

11.07 Downgrading Groundwater Classified GAA or GA to GB: Where it has been proven by clear, convincing and scientifically valid evidence that groundwater classified GAA or GA does not meet the standards in section 10.02, the Director shall initiate rule-making procedures for reclassification of such groundwater to GB, provided that the area in question is located within one of the areas described below:

(a) Contiguous with an existing area classified GB pursuant to section 9.01(c)(1);

(b) Within the permanent waste disposal area at inactive landfills or disposal sites or solid waste, hazardous waste, or sewage sludge; or

(c) The area immediately surrounding the waste disposal area, which the D. ector has designated not suitable for public or private drinking water use, at the following inactive and active facilities: landfills, land disposal sites for solid waste, hazardous waste, and sewage sludge.

11.08 Downgrading of Groundwater Classification to GC

(a) Groundwater reclassification to GC is required for proposed sites for solid waste landfills and proposed sites for hazardous waste disposal facilities. Such facilities are the only uses for which groundwater will be reclassified to GC.

(b) Groundwater reclassification to GC will not be considered until an application for a solid waste disposal license has been filed with the Department pursuant to the Rules and Regulations for Solid Waste Management Facilities, January 1992, and amendments thereto or pursuant to the Rules and Regulations for Hazardous Waste Generation, Transportation, Treatment, Storage and Disposal, October 1988, and amendments thereto.

(c) Groundwater currently classified GA and GB may be reclassified to GC for proposed sites for solid waste landfills and proposed sites for hazardous waste disposal facilities. Groundwater classified GAA or designated GAA Non-attainment shall not be reclassified to GC.

(d) In order to reclassify groundwater to GC, the applicant must submit to the Department a site-specific study which demonstrates by clear, convincing, and scientifically valid evidence that the groundwater quality standards for GC in section 10.03(a) will be met. The study shall include, but not be limited to, the following:

(1) A locus map using the U.S. Geological Survey 7.5 minute quadrangle map;

(2) Site plan at an appropriate scale (minimum scale of one inch equals fifty feet (1"=50')) to adequately show the location on and immediately surrounding the site of the following: property boundaries, buildings and other structures, roads, surface topography, surface water courses and wetlands, wells, water lines, sewer lines, individual sewage disposal systems and other waste disposal areas, and any other significant site features;

(3) Depth to groundwater, water table elevations, hydraulic gradient, groundwater flow direction, groundwater flow velocity, and water table map;

(4) Description of the unconsolidated materials (in both the unsaturated and saturated zones), including permeability, porosity, degree of stratification, and the capacity for pollutant attenuation;

(5) Depth to bedrock and bedrock characteristics, to include, but not be limited to,

weathering, jointing, faulting, fracture orientation and density;

(6) Aquifer characteristics including saturated thickness, hydraulic conductivity, an transmissivity;

(7) Groundwater quality on-site and surrounding the site;

(8) The hydraulic connection between nearby surface waters and groundwater;

(9) Location and distance off-site of the nearest surface water body that will receiv runoff from the site and that surface water body that will receive groundwater flov from the site and the water quality classification of these surface water bodies.

(10) Public and private wells:

(i) Determine the number and location of public wells within three (3) miles o the site and the number and location of private wells within one (1) mile o the site, or the number and location of such wells within alternative distances agreed upon by the Director;

(ii) Determine or estimate the well depths;

(11) Current and most probable future uses of surrounding groundwater and s ce water;

(12) History of site ownership and operation;

(13) Volume and characteristics of the waste to be disposed of on the site;

(14) Specific methods and procedures to be utilized in the construction, operation, and maintenance of the facility necessary to contain or prevent migration of pollutants;

(15) Evaluation of the potential for migration of pollutants from the site and identification of potential impacts to groundwater and associated surface waters from the proposal.

Section 12. DETERMINATION OF COMPLIANCE WITH GROUNDWATER QUALITY STANDARDS AND PREVENTIVE ACTION LIMITS

12.01 General: Compliance with the groundwater quality standards and preventive action limits shall be determined through analytical tests of groundwater quality by the facility owner or operator. Where applicable, the Director may also require analytical tests of the effluent prior to the discharge to the groundwater. The Director may request verification of any test data or collect separate samples if it is deemed necessary.

(a) Groundwater samples and effluent samples shall be collected, stored, transported, an analyzed in accordance with the most recent United States Envirc.mental Protectio Agency approved procedures; the most recent "Standard Methods for the Examination o Water and Wastewater" (American Public Health Association, et al.); or alternativ methods approved by the Director.

(b) Groundwater and effluent sampling frequency and the list of parameters to test for shal be proposed to the Director by the facility owner or operator. The Director' determination of sampling frequency and the parameters to test for shall be made, in par utilizing information provided by the facility owner or operator regarding the type o facility, waste generated, waste disposed of on site, materials stored or utilized on site an any site specific hydrogeologic characteristics that may be required by the Director.

12.02 Groundwater Monitoring Program

(a) All facilities that are required by the Director to monitor groundwater quality pursuant t these regulations and the Underground Injection Control Program Rules and Regulations May 1984, and amendments thereto, shall implement a groundwater monitoring progran approved by the Director. Groundwater monitoring done in compliance with the followin Department regulations and federal programs are exempt from the provisions of sectio 12.02 but shall comply with section 12.03 regarding termination of groundwater monitoring

(1) Rhode Island Oil Pollution Control Regulations, December 1990, and amendment thereto;

(2) Rhode Island Regulations for Underground Storage Facilities Used for Petroleun Products and Hazardous Materials, April 1985, and amendments thereto;

(3) Rhode Island Rules and Regulations Pertaining to the Treatment, Disposa Utilization and Transportation of Wastewater Treatment Facility Sludge, Marc 1991, and amendments thereto;

(4) Rhode Island Rules and Regulations for Solid Waste Management Facilitie February 1991, and amendments thereto;

(5) Rhode Island Rules and Regulations for Hazardous Waste Generatio Transportation, Treatment, Storage and Disposal, October 1988, and amendment thereto;

(6) Rhode Island Rules and Regulations for the Investigation and Remediation c Hazardous Material Releases, as promulgated;

(7) Federal Comprehensive Environmental Response, Compensation and Liability Ac (42 USC 9601 et seq.); and

(8) Federal Resource Conservation and Recovery Act (42 USC 6901 et seq.).

(b) The groundwater monitoring program to be approved by the Director shall inclu[illegible] minimum, the following:

(1) A locus map using the U.S. Geological Survey 7.5 minute quadrangle map;

(2) Site plan at an appropriate scale (minimum scale of one inch equals fifty feet (1"=50')) to adequately show the monitoring well locations, well casing elevations, and the location on and immediately surrounding the site of the following: property boundaries, buildings and other structures, roads, surface topography, surface water courses and wetlands, wells, water lines, sewer lines, individual sewage disposal systems and other waste disposal areas, and any other significant site features;

(3) A sufficient number of wells (minimum of three) at the appropriate locations and depths to permit detection of any pollutants in the groundwater;

(4) Well logs with detailed lithologic and well construction information; and

(5) Sampling schedule pursuant to section 12.01(b).

(c) Monitoring well construction shall be consistent with the standards set forth in Appendix I.

(d) Minimum site monitoring requirements:

(1) The static water table elevation shall be recorded at the time of monitoring; and

(2) A log containing static water table elevations and the sample analyses shall be maintained on-site by the facility owner or operator.

(e) Copies of sample results and water table measurements shall be submitted to the Director within thirty (30) days of the receipt of such information by the facility owner or operator.

(f) An approved groundwater monitoring program shall be valid for a duration specified by the Director.

(g) There shall be no change in a groundwater monitoring program without the approval of the Director. The Director may require a change in an approved monitoring program where such change is necessary to determine compliance with the groundwater quality standards.

(h) Any person transferring ownership or control of a facility having an approved groundwater monitoring program shall notify the Director of such transfer not less than thirty (30) days prior to the effective date of such transfer.

(i) Groundwater monitoring subject to these regulations and the Underground Injec[illegible] Control Program Rules and Regulations, May 1984, and amendments thereto, that w[illegible]

approved by the Director prior to the effective date of these regulations shall comply wit all provisions of this section except for 12.02(b)(3) and (4) and 12.02(c) within one yea

12.03 Termination of Groundwater Monitoring: Groundwater monitoring required by the Director sha not be terminated without the approval of the Director.

(a) A facility owner or operator may petition the Director for termination of groundwate monitoring when one of the following conditions is met:

(1) For discharges to groundwater: The discharge to groundwater has ceased, th discharge system has been closed in accordance with the appropriate state an federal regulations, and there has been no violation of a preventive action limit c groundwater quality standard at the points of compliance for the number of sample and the time period established by the Director;

(2) At sites of groundwater remediation: There has been no violation of th groundwater quality standards at the points of compliance for the number c samples and the time period established by the Director; or

(3) At sites of suspected or potential discharges to groundwater and any other site required by the Director to monitor groundwater quality: There has been n violation of the groundwater quality standards at the points of compliance for th number of samples and the time period established by the Director.

(b) Monitoring wells at sites where groundwater monitoring has been terminated shall b abandoned in accordance with the procedures established in Appendix I.

Section 13. POINTS OF COMPLIANCE

13.01 General: Any point where the groundwater quality is monitored or where groundwater i withdrawn for use, excepting points within a discharge zone or residual zone approved pursuan to this section, may be used to determine compliance with the groundwater quality standards fo the area.

13.02 Facility Points of Compliance for Groundwater Quality Standards and Preventive Action Limits The point or points of compliance to determine if pollutant concentrations are greater than groundwater quality standard or preventive action limit shall be established by the Director at an point within or beyond the property boundary, provided that it is beyond a discharge zone, if suc zone is approved by the Director pursuant to section 13.03, and provided it is beyond a residua zone, if such zone is approved by the Director pursuant to section 13.04.

13.03 Discharge Zone: In determining compliance with the groundwater quality standards an preventive action limits in these regulations for an active discharge to groundwater, the Directo may approve, deny, or modify a discharge zone proposed by a facility owner or operator. A groundwater monitoring program or revised groundwater monitoring program prepared pursuan to section 12.02 shall be submitted to the Director at the same time that a discharge zone i

proposed.

(a) Within this discharge zone, the pollutant concentrations in groundwater are allowed to b greater than the groundwater quality standards. Acceptable pollutant concentrations in th groundwater within a discharge zone shall be determined by the Director on a case-by-cas basis. The Director may require that the groundwater quality within the discharge zon be monitored.

(b) The facility owner or operator proposing a discharge zone shall provide the Director wit information on the site's hydrogeology and the characteristics of the discharge t groundwater.

(c) Prior to approval of a discharge zone, the facility owner or operator shall demonstrate b clear, convincing, and scientifically valid evidence that:

(1) All practical alternatives to a discharge to groundwater have been evaluated an no technically or economically feasible alternative exists;

(2) Every practical effort has been made to limit the pollutant concentrations in th discharge to groundwater by such means as, but not limited to, reducing th quantity of potentially contaminating substances in use, use of alternativ substances, changes in the operational procedures at the facility, and pretreatmen of the effluent;

(3) The area encompassed by the discharge zone is owned and controlled by the owne or operator of the facility, and the discharge zone is limited to the smallest area that is technically and economically feasible;

(4) The discharge to groundwater and the resulting groundwater quality in the discharge zone do not represent a threat to public health or the environment;

(5) There will be no violation of the groundwater quality standards established in section 10 beyond the discharge zone as a result of the proposed discharge;

(6) There will be no adverse impact on existing public or private drinking water wells as a result of the proposed discharge; and

(7) The groundwater within the discharge zone will not cause a violation of the surface water quality standards established by the Rhode Island Water Quality Regulations for Water Pollution Control, October 1988, and amendments thereto as a result of the proposed discharge.

13.04 Residual Zone: In determining compliance with the groundwater quality standards and preventive action limits in these regulations for groundwater remediation activities, the Director may approve, deny, or modify the designation of a residual zone proposed by the facility own r operator.

(a) Within this residual zone, the pollutant concentrations in groundwater are allowed to b greater than the groundwater quality standards. Acceptable pollutant concentrations in th groundwater within a residual zone shall be determined by the Director on a case-by-cas basis. The Director may require that the groundwater quality within the residual zone b monitored.

(b) Prior to approval of a residual zone, the facility owner of operator shall demonstrate b clear, convincing and scientifically valid evidence that:

(1) Every practical effort has or will have been made to decrease the pollutan concentrations in the residual zone;

(2) The area encompassed by the residual zone is owned and/or effectively controlle by the owner or operator of the facility, and the residual zone is limited to th smallest area that is technically and economically feasible;

(3) The pollutant concentrations in the groundwater within the residual zone do not o will not represent a threat to the public health or the environment;

(4) There will be no adverse impact on existing public or private drinking water well as a result of the residual zone;

(5) At the conclusion of the remediation activities, there will be no violation of th groundwater quality standards established in section 10 beyond the residual zone and

(6) The groundwater within the residual zone will not cause a violation of the surfac water quality standards established by the Rhode Island Water Quality Regulation for Water Pollution Control, October 1988, and amendments thereto.

(c) Residual zones approved pursuant to this section shall be designated non-attainment area pursuant to section 9.02.

Section 14. NOTIFICATION TO DEM OF VIOLATIONS OF PREVENTIVE ACTION LIMITS AND GROUNDWATER QUALITY STANDARDS

14.01 Exemptions from Provisions of This Section:

(a) Owners or operators of facilities which, prior to the effective date of these regulations, discovered groundwater quality at their facility does not comply with the groundwater quality standards in these regulations, provided that such information was previously reported to the Department; and

(b) Persons with knowledge of analytical test results from private wells that serve properties used exclusively for residential purposes.

14.02 Owners or operators of facilities that did not previously report to the Department the disc v, prior to the effective date of these regulations, of groundwater quality at their facility that s not comply with the groundwater quality standards in these regulations, must comply with e notification provisions of these regulations, provided that the conditions requiring notification still exist after the effective date of these regulations.

14.03 Notification: Facility owners and/or operators that discharge to groundwater or have had a discharge or release to groundwater shall notify the Department when:

(a) A preventive action limit has not been met at any point of compliance at a facility that is required by the Director to monitor groundwater quality and where the groundwater is classified GAA or GA;

(b) A groundwater quality standard has not been met at any point of compliance at a facility in any groundwater classification;

(c) An alternative notification level established under a groundwater monitoring program approved by the Director pursuant to section 12 or other groundwater monitoring program approved by the Director pursuant to other regulations of the Department or the federal government has not been met; or

(d) The facility owner or operator has reasonable cause to believe that a discharge or release has occurred which may result in the violation of a preventive action limit a r groundwater quality standard. Persons reporting spills of chemical and/or petro products to the Department pursuant to the immediate notification requirements of o state or federal laws and regulations are exempt from provisions of this section.

14.04 Immediate Notification: Nothing in these regulations shall exempt facility owners or operators from immediate notification requirements as set forth in other Department regulations.

14.05 Notification Deadlines

(a) Notification required in section 14.02 shall be made to the Department in writing within six (6) months of the effective date of these regulations.

(b) Notification required in section 14.03 shall be made to the Department in writing within fifteen (15) days after discovery of the occurrence requiring notification.

14.06 Notification Contents: Notification shall include, but not be limited to, the following:

(a) Name, address, telephone number of person notifying the Department and of the facility owner or operator;

(b) Date and time of the discovery and the circumstances surrounding the discovery of the occurrence requiring notification;

(c) Groundwater classification of the site;

(d) Location of the occurrence and a legal description of the site (plat and lot);

(e) Concentration of the pollutant(s) identified in the groundwater when notification i pursuant to section 14.03(a)-(c);

(f) Identification of the pollutant(s) in the discharge or release when notification is pursuar to section 14.03(d);

(g) Initial determination of the source of the pollutant(s) and an estimate of the extent c pollution; and

(h) Measures taken or proposed to be taken at the time of notification.

14.07 Certification Requirements: The notification shall include a statement signed by the facilit owner or operator, or an authorized representative, that is responsible for the preparation an submittal of the notification certifying, to the best of their knowledge, that the notification : complete and accurate.

Section 15. FACILITY OWNER OR OPERATOR RESPONSES TO VIOLATIONS OF PREVENTIV ACTION LIMITS AND GROUNDWATER QUALITY STANDARDS

15.01 Violation of a Preventive Action Limit: When a preventive action limit has not been met, th facility owner and operator are responsible for taking actions, which shall be subject to th approval of the Director, to meet the following objectives at the point of compliance:

(a) Minimize the concentration of the pollutant in the groundwater where technically ar economically feasible;

(b) Regain and maintain compliance with the preventive action limit, unless the Direct determines that it is not technically or economically feasible to attain the preventive actic limit concentration, in which case the owner or operator shall achieve compliance with tl lowest possible concentration that is technically and economically feasible; and

(c) Ensure that the groundwater quality standard is met at any point of compliance.

15.02 Violation of a Groundwater Quality Standard: When a groundwater quality standard has n been met, the facility owner and operator are responsible for taking actions, which shall be subje to the approval of the Director, to regain and maintain compliance with the groundwater quali standard at the point of compliance.

15.03 Potential for Violation of Preventive Action Limit and/or Groundwater Quality Standard: Whe the Director has reason to believe that a discharge or release has occurred which is likely to ent the groundwaters of the state and result in the violation of a preventive action limit and/ groundwater quality standard, the Director is authorized to require the facility owner or operat to take action pursuant to section 15.04.

15.04 Responses to Violation of a Preventive Action Limit or a Groundwater Quality Standa T responses the Director may require of the facility owner or operator when a preventive .i limit or groundwater quality standard is not met at a point of compliance or a discharge or relea is suspected that may result in the violation of a preventive action limit or groundwater qual standard at a point of compliance include, but are not limited to, the responses listed below. T. Director may require more than one response.

(a) Resample groundwater quality at the point of compliance.

(b) Collect and submit additional data on groundwater quality on site or surrounding the sit hydrogeologic characteristics, and/or facility practices.

(c) Arrange for the sampling of drinking water wells which may be adversely affected.

(d) Install and sample monitoring wells. Such wells shall be in compliance with th construction standards in Appendix I, unless otherwise approved by the Director.

(e) Require the establishment of a groundwater monitoring program pursuant to section 1 or other groundwater monitoring program approved by the Director pursuant to othe regulations of the Department or the federal government, or require a change in a existing groundwater monitoring program.

(f) Require a revision of the operational procedures at the facility.

(g) Require a change in the design or construction of the facility.

(h) Require an alternate method of waste treatment or disposal.

(i) Require the facility owner or operator to conduct a groundwater assessment and prepar a report pursuant to section 15.06, or another report pursuant to other applicabl Department regulations, that is subject to the Director's review and approval. Based on th results of this report, the Director may require further investigation.

(j) Require cessation of any prohibited discharges to groundwater.

(k) Require prohibition of an activity.

(l) Require the facility owner or operator to provide drinking water to those persons that do not have a potable water supply (for violation of groundwater quality standard only).

(m) Require the facility owner or operator to conduct a groundwater investigation and prepare a report pursuant to section 15.07, or another report pursuant to other applicable Department regulations, to adequately assess the nature and extent of pollution. Such report shall be subject to the Director's review and approval.

(n) Require remedial action to restore groundwater quality to levels established l ie Director pursuant to section 16.

15.05 Determination of the Response: In evaluating a violation of a preventive action limit or groundwater quality standard, and in determining the appropriate response required of the facility owner or operator pursuant to section 15.04, the Director may consider the following information provided by the facility owner or operator, in addition to all other relevant information:

(a) Surrounding groundwater quality;

(b) Geographic extent of pollutant migration;

(c) Hydrogeologic conditions;

(d) Present and future uses of the groundwater on-site and in the surrounding area;

(e) Reliability of sampling data;

(f) Performance of the activities at the facility;

(g) Water quality standards established by the Rhode Island Water Quality Regulations for Water Pollution Control, October 1988, and amendments thereto, for those surface waters receiving groundwater from the site; and

(h) Other known or suspected sources in the area of the substance that is identified as in violation of the preventive action limit or groundwater quality standard.

15.06 Groundwater Assessment Report

(a) The groundwater assessment report shall be prepared by a person with appropriate qualifications, and it shall include, but not be limited to, the following information, unless otherwise specified by the Director:

(1) All information previously reported to the Director pursuant to section 14 and/or information reported to the Director in accordance with emergency response procedures of other applicable state and federal laws and regulations. The facility owner or operator may elaborate and expand on any and all information found in previous reports. The facility owner or operator shall correct any incorrect information or interpretations contained in previous reports as part of the site characterization;

(2) A locus map using the U.S. Geological Survey 7.5 minute quadrangle map;

(3) Description of past and present activities on the site, including a list of past owners and operators of the site and approximate time periods of occupancy;

(4) A compliance history of the site including any and all past environmental enforcement actions and documentation of any past discharges or releases;

(5) Site plan at an appropriate scale (minimum scale of one inch equals fifty feet

(1"=50')) to adequately show the location on and immediately surrounding th of the following: property boundaries, buildings and other structures, roads, surface topography, surface water courses and wetlands, wells, water lines, groundwater monitoring wells, materials storage areas (including underground storage tanks), sewer lines, individual sewage disposal systems and other waste disposal areas;

(6) Names and addresses of the owners and tenants of all properties that abut the site;

(7) Description of the site's hydrogeology, including, but not limited to, depth to groundwater, groundwater flow direction, and a description of the unconsolidated materials, including soil characteristics;

(8) Location and distance off-site of the nearest surface water body that will receive runoff from the site and the water quality classification of this surface water;

(9) Location of public wells within three (3) miles of the site or within an alternative distance of the site agreed upon by the Director;

(10) Information regarding private water supply as follows:

(i) Location of private wells on those properties that are wholly or partially within 500 feet of the site or a greater distance specified by the Dire

(ii) A description of the water supply sources and services available beyond 500 feet from the site and up to one mile from the site. The Director may require more specific detail.

(11) Identification of the pollutant(s) and an estimate of the geographic extent and volume of the affected area;

(12) A description of evidence of possible groundwater pollution, including, but not limited to, free liquids, stained soil, stressed vegetation, and the presence and volume of excavated materials.

(13) Results of any analytical testing of groundwater or soil on the site, including identification of methods used and sampling protocols;

(14) Recommendations for further groundwater investigation, groundwater remediation, or other actions; and

(15) Any other factors that the Director has reason to believe are necessary for an adequate groundwater assessment.

(b) Monitoring wells installed to collect groundwater quality data shall be in compliance h the construction standards in Appendix I, unless otherwise approved by the Directo

(c) The groundwater assessment report and any associated progress reports shall include the

following statements signed by an authorized representative of the party specified:

(1) A statement signed by an authorized representative of the person who prepared the groundwater assessment report certifying, to the best of their knowledge, the accuracy of the information contained in the report; and

(2) A statement signed by the facility owner or operator responsible for the submittal of the groundwater assessment report certifying, to the best of their knowledge, that the report is a complete and accurate representation, and that it includes all known facts about the discharge to groundwater or the release that has, or may result in the violation of a preventive action limit or groundwater quality standard.

15.07 Groundwater Investigation Report

(a) The groundwater investigation report shall be prepared by a person with appropriate qualifications, and it shall include all the elements of a groundwater assessment report described in section 15.06, and it shall also include, but not be limited to, the following information:

(1) Complete description of the site's hydrogeology, including, but not limited to, the following:

(i) Depth to groundwater, water table elevations, hydraulic gradient groundwater flow direction, groundwater flow velocity, and water table map

(ii) Description of the unconsolidated materials (in both the unsaturated and saturated zones), including permeability, porosity, degree of stratification and the capacity for pollutant attenuation;

(iii) Depth to bedrock and bedrock characteristics;

(iv) Aquifer characteristics including saturated thickness, hydraulic conductivity and transmissivity;

(v) The presence and effects of both natural and man-made barriers to and conduits for pollutant migration;

(vi) Surrounding groundwater quality;

(2) Description of the pollutant source and the events that caused the pollution;

(3) Extent of soil pollution;

(4) Extent of groundwater pollution;

(5) Map showing lines of equal pollutant concentrations in the groundwater; and

(6) Conclusions based on the site data and recommendations for grou. at remediation.

(b) Monitoring wells installed to collect groundwater quality data shall be in compliance wi the construction standards in Appendix I, unless otherwise approved by the Director.

(c) The groundwater investigation report and any associated progress reports shall include t following statements signed by an authorized representative of the party specified:

(1) A statement signed by an authorized representative of the person who prepared t groundwater investigation report certifying, to the best of their knowledge, t accuracy of the information contained in the report; and

(2) A statement signed by the facility owner or operator responsible for the submitt of the groundwater investigation report certifying, to the best of their knowledg that the report is a complete and accurate representation, and that it includes a known facts about the discharge to groundwater or the release that has, or m result in, the violation of a preventive action limit or groundwater quality standar

Section 16. GROUNDWATER REMEDIATION

16.01 General: When groundwater remediation is required by the Director pursuant to sectio 0 the facility owner and operator are jointly and severally responsible for designi implementing efforts to remediate the groundwater to achieve pollutant concentrations establisne by the Director.

16.02 Exemptions

(a) Groundwater remediation activities and groundwater remediation plans approved i writing by the Director prior to the effective date of these regulations are exempt from th provisions of section 16.06.

(b) Groundwater remediation plans prepared in accordance with the Department regulation and federal programs listed below are exempt from the provisions of section 16.06.

(1) Rhode Island Regulations for Underground Storage Facilities Used for Petroleu Products and Hazardous Materials, April 1985, and amendments thereto;

(2) Rhode Island Rules and Regulations for the Investigation and Remediation o Hazardous Material Releases, as promulgated;

(3) Federal Comprehensive Environmental Response, Compensation and Liability Ac (42 USC 9601 et seq.); and

(4) Federal Resource Conservation and Recovery Act (42 USC 6901 et seq.).

16.03 Groundwater Quality Certification: Groundwater remediation plans, including those prepared pursuant to these regulations and the regulations and programs specified in section 16.02(b)(1)-(4), are subject to the requirements of groundwater quality certification in section 17.

16.04 Groundwater Remediation Objectives: Groundwater remediation activities shall be designed to meet the following objectives:

(a) Protect public health and the environment;

(b) Ensure compliance with the groundwater quality standards for the classification assigned to the groundwater of concern;

(c) Eliminate or contain the source of groundwater pollution and minimize the impacted area;

(d) Achieve pollutant concentrations that are consistent with proposed and anticipated future uses of the site;

(e) Prevent an adverse impact on surrounding uses of property, groundwater and surface water;

(f) Prevent the violation of surrounding groundwater quality standards; and

(g) Prevent the groundwater at the remediation site from causing a violation of the surface water quality standards established by the Rhode Island Water Quality Regulations for Water Pollution Control, October 1988, and amendments thereto.

16.05 Considerations for Remediation Decisions: The determination by the Director of remediation actions required of an owner or operator, the suitability of proposed remediation techniques, and the acceptable pollutant concentrations that may remain in groundwater after remediation may be based on, but not limited to, a consideration of:

(a) Relative threat to public health and the environment from the facility;

(b) The physical and chemical characteristics of the pollutant(s), including toxicity, persistence and potential for migration;

(c) Hydrogeologic characteristics of the site and surrounding the site;

(d) Current and potential future uses of groundwater and surface water at the site and surrounding the site;

(e) Groundwater classification at the site and surrounding the site;

(f) Other state and federal program priorities;

(g) Relative potential for adverse impacts on surrounding uses of property, groundwater and surface water;

(h) Relative potential for violation of surrounding groundwater quality standards;

(i) Relative potential for the groundwater at the remediation site to cause a violation surface water quality standards established by the Rhode Island Water Quality Regulatior for Water Pollution Control, October 1988, and amendments thereto; and

(j) Reliability and technical feasibility of the proposed technologies for groundwate remediation.

16.06 Groundwater Remediation Plan: Where required by the Director, a groundwater remediatio plan shall be prepared by the facility owner or operator.

(a) The groundwater remediation plan shall consist of, at minimum, the following:

(1) Groundwater assessment report pursuant to section 15.06, groundwater investigatio report pursuant to section 15.07 (if such report was required), and any additiona information the Director shall require;

(2) Proposed method for remediation, to include, but not be limited to, the following

(i) Justification of the ability of the method to meet the remediation objectives

(ii) Design standards and technical specifications for the design and constru-tior of any equipment necessary for the proposed remediation;

(iii) Diagrams of any piping routes, instrumentation, and process flows;

(iv) Proposed plans for the disposal of any products or by-products from the remediation activities;

(3) Proposed schedule for implementation of the remediation plan; and

(4) Proposed groundwater monitoring program pursuant to section 12.

(b) The groundwater remediation plan and any associated progress reports shall include the following statements signed by an authorized representative of the party specified:

(1) A statement signed by an authorized representative of the person who prepared the groundwater remediation plan certifying, to the best of their knowledge, the accuracy of the information contained in the plan; and

(2) A statement signed by the facility owner or operator responsible for the preparation and submittal of the groundwater remediation plan certifying, to the best of their knowledge, that the plan is complete and accurate.

16.07 Approval of Groundwater Remediation: Groundwater remediation activities shall be pro d and implemented by the facility owner or operator, and they shall be done in a manner appr

by the Director through the issuance of an order of approval unless otherwise specified by the Director. Emergency response procedures at sites of groun water pollution or the th-eat of pollution are exempt from the provisions of this section, and such procedures shall be conducted in accordance with other applicable state and federal laws and regulations.

(a) Upon review of the groundwater remediation plan, the Director shall approve the plan, approve the plan with conditions, require revisions to the plan, or deny approval of the plan based on a determination of the plan's ability to meet the groundwater remediation objectives in section 16.04.

(b) Orders of approval for groundwater remediation shall be valid for a time period specified by the Director.

(c) Any person transferring ownership or control of a facility having an approved groundwater remediation plan shall notify the Director of such transfer not less than thirty (30) days prior to the effective date of such transfer.

(d) Implementation of remedial activities approved by the Director does not discharge or otherwise release the facility owner or operator from responsibility for any adverse impacts to public health and the environment caused by pollutants in the groundwater at the site.

Section 17. GROUNDWATER QUALITY CERTIFICATION

17.01 Applicability: In order to determine compliance with groundwater classification, groundwater quality certification is required for proposed facilities and activities that have an actual or potential adverse impact on groundwater quality, including certain facilities and activities with no designed discharge to groundwater. Groundwater quality certification by the Department's Groundwater Section shall be a requirement for final Department approval of the applications or requests for the approvals, licenses, certifications, etc. below:

(a) Department approvals for groundwater remediation plans (including, but not limited to, remediation pursuant to: Rhode Island Regulations for Underground Storage Facilities Used for Petroleum Products and Hazardous Materials, April 1985, and amendments thereto; Rhode Island Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases, as promulgated; federal Comprehensive Environmental Response, Compensation and Liability Act (42 USC 9601 et seq.); and federal Resource Conservation and Recovery Act (42 USC 6901 et seq.));

(b) Solid waste disposal licenses (Rhode Island Rules and Regulations for Solid Waste Management Facilities, February 1991, and amendments thereto);

(c) Hazardous waste treatment, storage, and disposal licenses (Rhode Island Rules and Regulations for Hazardous Waste Generation, Transportation, Treatment, Storage and Disposal, October 1988, and amendments thereto);

(d) Department approvals for land disposal, land application, and composting of sewage sludge

(Rhode Island Rules and Regulations Pertaining to the Treatment, Disposal, Util. and Transportation of Wastewater Treatment Facility Sludge, March 1991, amendments thereto);

(e) Department approvals for individual sewage disposal systems designed to treat ten thousand (10,000) gallons or more per day (Rhode Island Rules and Regulations Establishing Minimum Standards Relating to Location, Design, Construction, and Maintenance of Individual Sewage Disposal Systems, December 1989, and amendments thereto);

(f) Water quality certification for upland dredge disposal (Rhode Island Water Quality Regulations for Water Pollution Control, October 1988, and amendments thereto); and

(g) Any other department approval, license, certification, etc. for an industrial, commercial or institutional facility which has a reasonable potential for adversely impacting groundwater quality as determined by the Director.

17.02 Groundwater Quality Certification Review

(a) The applicant or, at the Department's discretion, a division of the Department shall notify the Department's Groundwater Section in writing of applications or requests for the Department approvals, licenses, certifications, etc. in section 17.01(a)-(g).

(b) The applicant shall provide information necessary for groundwater quality certification review. The review of proposals for groundwater quality certification will initially depend on the information provided to the Department division or section that received the application or request for the approvals, licenses, certifications, etc. listed in section 17.01(a)-(g). Additional information may be required in order to adequately review a proposal for groundwater quality certification.

(c) After reviewing a proposal, the groundwater quality certification shall be approved, denied, or approved with conditions and forwarded to the applicant and the Department division or section that received the application or request for the approval, license, certification, etc. listed in section 17.01(a)-(g).

(d) Failure to obtain groundwater quality certification shall be independent and sufficient grounds for Department denial of the application or request for the approvals, licenses, certifications, etc. listed in section 17.01(a)-(g).

17.03 Criteria for Groundwater Quality Certification Approvals: Facility owners or operators that are requesting groundwater quality certification must show by clear, convincing and scientifically valid evidence that:

(a) There is no substantial likelihood for violation of the groundwater quality standards in section 10, except within an approved discharge zone or residual zone pursuant to section 13 as a result of the proposed project requiring groundwater quality certification; a

(b) There is no substantial likelihood for groundwater impacted by the proposed project requiring groundwater quality certification to cause a violation of surface water quality standards established by the Rhode Island Water Quality Regulations for Water Pollution Control, October 1988, and amendments thereto.

17.04 Groundwater Quality Certification for Groundwater Remediation: Groundwater quality certification shall be required for all proposed groundwater remediation plans prepared pursuant to these and other state and federal regulations. Groundwater remediation activities and groundwater remediation plans approved by the Director in writing prior to the effective date of these regulations are exempt from the requirement to obtain groundwater quality certification.

(a) The Director's review of proposed groundwater remediation plans for groundwater quality certification shall be based on the ability of the remediation activities to meet the groundwater remediation objectives in section 16.04.

(b) Proposed termination of groundwater remediation activities and proposed changes in an active groundwater remediation plan that are deemed significant will require groundwater quality certification. Significant changes are defined as:

(1) Establishment of a residual zone pursuant to section 13;

(2) Any change in the operation of remediation activities that will result in pollutant concentrations in groundwater greater than that concentration proposed in the original or most recent groundwater remediation plan; and

(3) Any change in the operation of remediation activities that will result in groundwater quality achieving the desired pollutant concentrations over a longer period than what was proposed in the original or most recent groundwater remediation plan.

Section 18. WELLHEAD PROTECTION AREAS

18.01 Delineation of Wellhead Protection Areas: The Director shall delineate wellhead protection areas for the public water system wells in Rhode Island. This delineation shall be done in accordance with the requirements of the "Rhode Island Wellhead Protection Program," Rhode Island Department of Environmental Management, February 1990, and any amendments thereto.

18.02 Wellhead Protection Area Maps: The wellhead protection areas shall be delineated on 1:24000 scale maps. The 1:24000 scale maps shall be on file for review at the Rhode Island Department of Environmental Management, Groundwater Section, 291 Promenade Street, Providence, RI 02908. Smaller scale maps may be made available from the Department at the above address. The Director shall establish an appropriate fee, which shall be based on the costs of map reproduction, for copies of the wellhead protection area maps.

Section 19. VARIANCES

19.01 Variance Requests: A facility owner or operator may submit a written request to the Director for a variance from any of the provisions of these regulations. Such request for a variance shall include at a minimum:

(a) Name and address of the facility owner or operator, and the name and location of the facility for which the owner or operator seeks a variance;

(b) A list of the names and addresses of the owners and tenants of all properties that abut the facility;

(c) Identification of the specific section or sections of the regulations from which a variance is requested;

(d) A statement of the reasons for which the facility owner or operator seeks a variance. This statement shall specify the reasons that the facility owner or operator is unable to comply with these regulations, why a variance is necessary, and the reasons why a hardship is alleged. The person seeking the variance should separately and by number list each reason and any other mitigating factors he believes the Director should consider; and

(e) An explanation that the alternative procedures requested are substantially equivalent to the regulations herein in achieving protection of the public health and the environment.

19.02 Variance Decisions

(a) The Director may issue a variance under this rule when the facility owner or operator proves by clear, convincing and scientifically valid evidence that:

(1) Compliance with these rules would cause unreasonable or undue hardship;

(2) The issuance of the variance will have no adverse effect on public health and the environment; and

(3) The alternative procedures requested are substantially equivalent to the regulations herein in achieving protection of the public health and the environment.

(b) If the Director determines that there is widespread public interest or that the variance request raises major issues that could affect other facilities, then the Director may schedule a public hearing to solicit public comment prior to rendering a decision on the variance request.

(c) The Director's decision to grant or deny a variance shall be in writing and may, as a condition of granting the variance, impose appropriate requirements necessary to protect the public health and the environment.

Section 20. APPEALS

20.01 Where a groundwater quality certification constitutes a requirement for a license, permit or approval referenced in other rules and regulations promulgated by the Department, all appeals of such groundwater quality certification decisions shall be initiated following and in conjunction with a decision on the pending license, permit or approval.

20.02 Any person affected by a decision of the Director pursuant to these regulations may, in accordance with the Administrative Rules of Practice and Procedure for the Department of Environmental Management, file a claim for an adjudicatory hearing to review the decision. The party appealing a Department decision bears the burden of proving that their application complies with all requirements of the rules and regulations herein.

Section 21. SUPERSEDED REGULATIONS

On the effective date of these regulations, section 9.03 (Monitoring Well Abandonment) of the Rules and Regulations Governing the Enforcement of Chapter 46-13.2 Relating to the Drilling of Drinking Water Wells, filed with the Secretary of State December 15, 1989, is hereby revoked and superseded by section 9.0 of Appendix I of the regulations herein.

Section 22. PENALTIES

Penalties will be assessed in accordance with the Department's Rules and Regulations for the Assessment of Administrative Penalties for any violation of these regulations.

The foregoing regulations are hereby approved for filing with the Secretary of State in accordanc[illegible] Chapters 42-35, 42-17.1, 42-17.6, 46-12, 46-13.1, 23-18.9, and 23-19.1 of the General Laws of Rhode Is[illegible] 1956, as amended.

Attest a true copy.

ENVIRONMENTAL STANDARDS BOARD

Barbara DeBuono
Director of Health

5/27/92
Date

Harry J. Baird
Director of Administration

5-22-92
Date

Louise Durfee
Director of Environmental Management

5/21/92
Date

The foregoing "Rules and Regulations for Groundwater Quality", after due notice and hearing, are hereby adopted and filed with the Secretary of State, this 29th day of May 1992, to become effective twenty (20) days thereafter, in accordance the provisions of Chapters 42-35, 42-17.1, 42-17.6, 46-12, 46-13.1, 23-18.9, and 23-19.1 of the General Laws of Rhode Island, 1956, as amended.

Louise Durfee

Louise Durfee, Director
Department of Environmental Management

Notice given on: March 20, 1992

Public hearing held: April 7, 1992

Filing date: May 29, 1992

Effective date: June 18, 1992

RECEIVED
MAY 29 1992
SECRETARY OF STATE
ADMINISTRATIVE RECORDS DIV.

I hereby certify that the enclosed is a true and accurate copy of the regulations being filed with the Secretary of State on the 29th day of May, 1992.

Alan T. Gates

NOTARY PUBLIC
My commission expires:
June 30, 1993

APPENDIX I

Monitoring Well Construction Standards and Abandonment Procedures

1.0 Applicability: The monitoring well construction standards herein apply to all permaner monitoring wells installed pursuant to these regulations. A monitoring well is designate permanent if it exists for more than 120 days. Section 9 of this appendix on monitoring we abandonment applies to all permanent and non-permanent monitoring wells,and it applies t those piezometers where improper abandonment would result in a reasonable likelihood c groundwater pollution. Additional requirements may be specified by the Director. Any exceptio to these standards requires prior approval by the Director.

2.0 Prevention of Groundwater Pollution: During well construction, every appropriate precautio shall be taken to prevent introducing pollutants into the groundwater, to include, but not b limited to, steam cleaning and washing of drilling rigs and proper cleaning and storage of wel casing. Only potable water shall be used in well construction unless otherwise approved by th Director.

3.0 Well Casing: All permanent groundwater monitoring wells shall be constructed of PVC wel casing material. All casing shall have a minimum inside diameter of 2.0 inches. Monitoring well constructed in unconsolidated material less than 100 feet in depth shall be constructed v a minimum of schedule 40 PVC. Wells greater than 100 feet shall be constructed using a mir m of schedule 80 PVC.

3.1 Assembly and Installation: All casing shall be constructed of flush threaded joints o threaded coupling joints. All joints shall be fitted with an "O" ring or wrapped with teflo tape. Solvent welded joints are not permissible without prior written permission of the Director.

3.2 Exceptions: The Director may allow alternate well casing material if the pollutan concentrations or geologic setting require an alternative construction. Alternative materials include but are not limited to: (a) Teflon; (b) stainless steel; or (c) uncoated or galvanized steel.

4.0 Well Screen: The well screen slot size shall retain at least 90% of the grain size of a filter pack or at least 60% of the grain size of the collapsed formation. Well screens on water table wells shall not exceed 15 feet in length. Well screens for piezometers shall not exceed 5 feet in length. Well screens shall be factory slotted. A bottom cap and sump sediment trap shall be installed.

5.0 Filter Pack: The filter pack shall be chemically inert, well rounded and well sorted glass beads or silica-based sand or gravel of uniform grain size. The filter pack must minimize the amount of fine material entering the well, and it must not inhibit the flow of water into the well. The filter pack shall extend no more than 5 feet above the well screen. The filter pack sha ot pollute groundwater.

6.0 Sealing Requirements

6.1 Filter Pack Seal: All monitoring wells installed with a filter pack shall be constructed wit a top of filter pack seal.

6.2 Annular Space Seal: All monitoring wells shall be installed with an annular space seal tha has a permeability of 1×10^{-7} centimeters per second or less.

6.3 Ground Surface Seal: All monitoring wells shall be constructed with a continuous pou concrete ground surface seal. The ground surface seal shall extend to a minimum of 4 inches below the land surface and shall be flared such that the diameter at the top i greater than the diameter at the bottom. The top of the ground surface seal shall b sloped away from the well casing and shall be imprinted with the designation of th monitoring well.

7.0 Protective Cover Pipe: The protective pipe shall consist of a minimum 4 inch diameter meta casing with locking cap. The protective pipe shall extend from the bottom of the ground surface seal to a minimum of 24 inches above the land surface. There shall be no more than 4 inches between the top of the well casing and the top of the protective pipe. The monitoring well designation shall be indicated clearly on the protective cover pipe. A gas vent and a drain hole shall be installed. A high visibility guard post to prevent destruction of the well may be required. The Director may request additional protective devices as necessary. "Road boxes" will be acceptable in locations where protective cover pipes are not suitable. All road boxes shall be locking and water tight.

8.0 Well Development: Development of all monitoring wells shall be performed no earlier than 48 hours after installation and before the initial water quality samples are taken. The goal of well development is to produce water free of fine sand and coarser material, all drill cuttings, and drilling fluids.

9.0 Monitoring Well and Piezometer Abandonment:

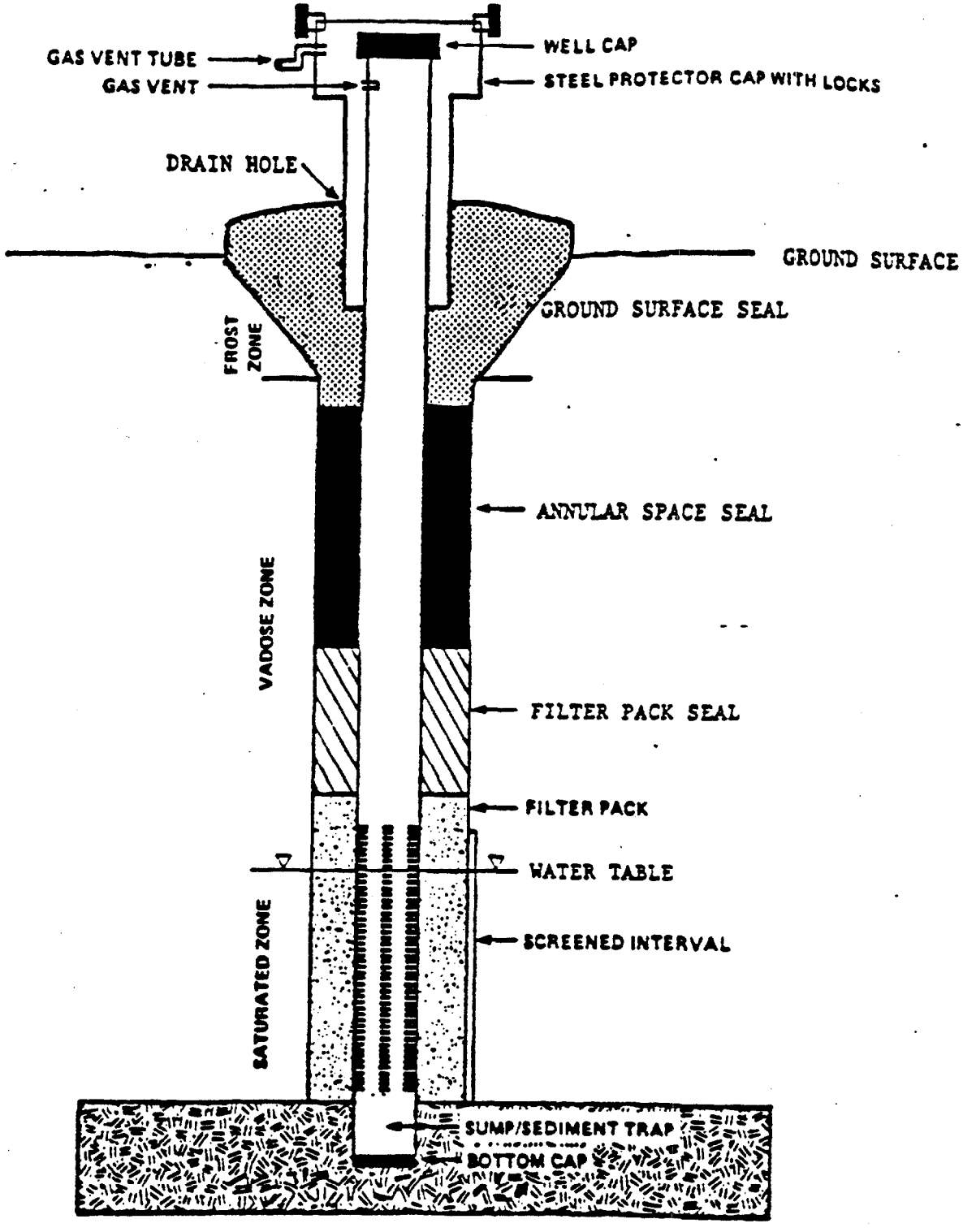
9.1 General: All monitoring wells and applicable piezometers as described in section 1.0 of this appendix that are no longer used to gather information on geologic or groundwater properties shall be abandoned pursuant to the provisions of section 9.2 of this appendix within 60 days after its use has been terminated, unless written approval is received from the Director for continued use.

9.2 Abandonment Procedures: The well shall be checked from the land surface through the entire depth of the well before it is sealed to ensure against the presence of any obstructions that will interfere with sealing operations.

(a) Wells constructed with an annular seal shall be abandoned by cutting off the casing a minimum of 4 feet below land surface. The remaining casing shall be completely filled with a neat cement grout or bentonite-cement grout. The remaining hole volume shall be backfilled with natural material, with the following exception: where backfilling with natural material would result in a grout plug less than 4 feet

long, the hole shall be filled to approximately one foot from the ground surface wit the neat cement grout or bentonite-cement grout.

(b) Wells not known to be constructed with an impermeable annular seal sh abandoned by completely removing the well casing and sealing with neat cemen or bentonite-cement grout to approximately one foot from the ground surface. I the casing cannot be removed during the abandonment of a well, the casing shal be thoroughly ripped or perforated from top to bottom, except that perforations wil not be required over intervals of the well that are sealed with cement. Th screened portion of the well and the annular space between the casing and th drillhole wall shall be effectively and completely filled with cement or bentonite cement grout applied under pressure.



CROSS-SECTION OF TYPICAL MONITORING WELL

After US EPA, 1986, RCRA Groundwater Monitoring Technical Enforcement Guidance Document

APPENDIX II

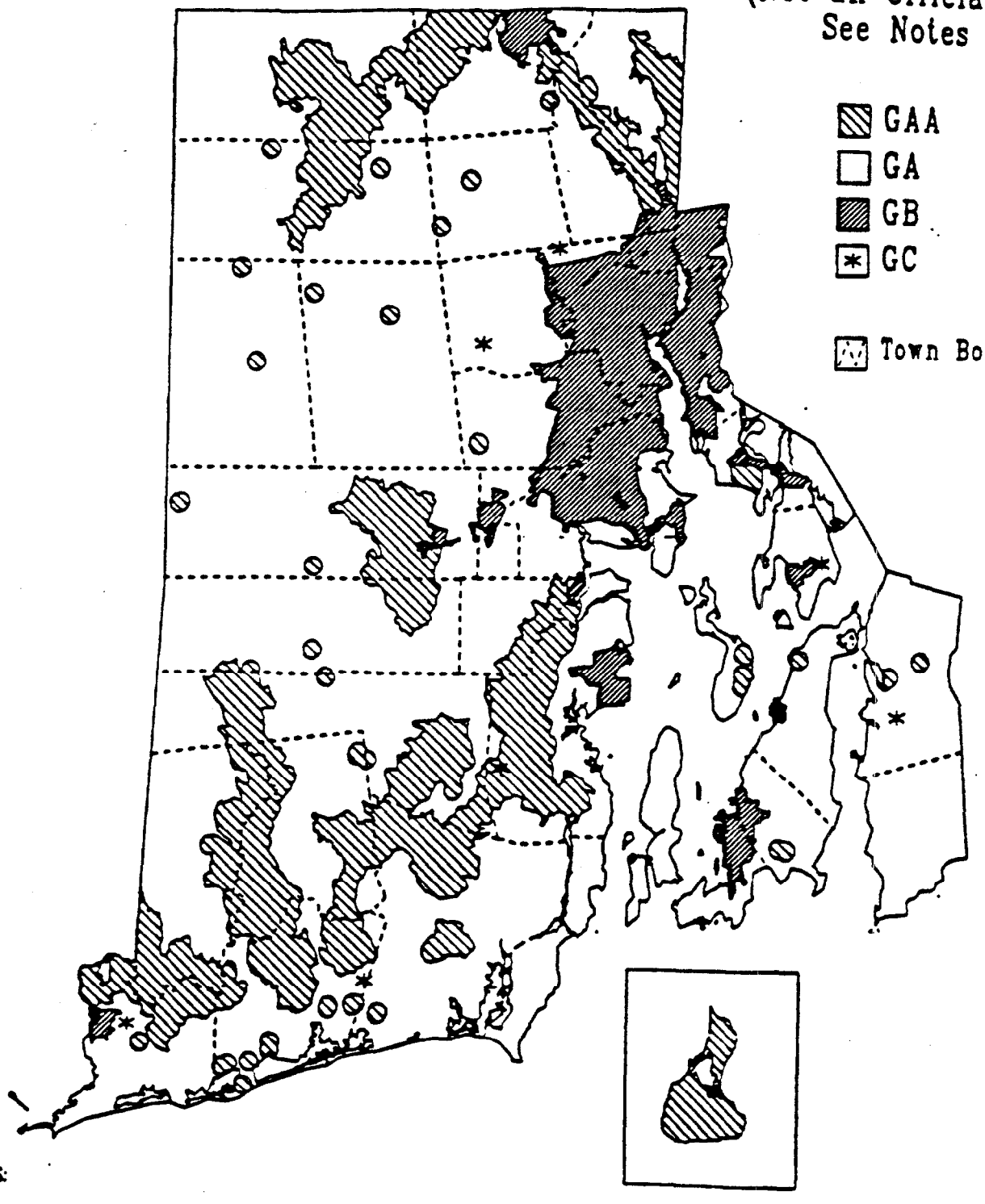
Groundwater Classification Map
(8.5" x 11")

Note: This is a generalized, unofficial map of the groundwater classifications. The official delineations were done at the 1:24,000 scale using the United States Geological Survey 7.5 minute quadrangle maps. These delineations are on file at the office of the Department's Groundwater Section.

GROUNDWATER CLASSIFICATION

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

(Not an Official Map-
See Notes Below)



Scale 1:42

NOTES:

Groundwater classifications were delineated on 1:24,000 scale U.S. Geological Survey quadrangle maps. Refer to these maps at the Groundwater Section, RIDEM, for the official delineation of the groundwater classifications.

Small areas of groundwater classified GB are not evident on above map.

Within the groundwater classified GAA and GA on the above map are areas where RIDEM has determined that the groundwater does not meet the standards for GAA and GA. These areas are called GAA Non-attainment and GA Non-attainment, and the long-term goal is restoration to GAA and GA standards. Refer to the larger scale maps produced by RIDEM for the delineation of these nonattainment areas.

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(c) [illegible]
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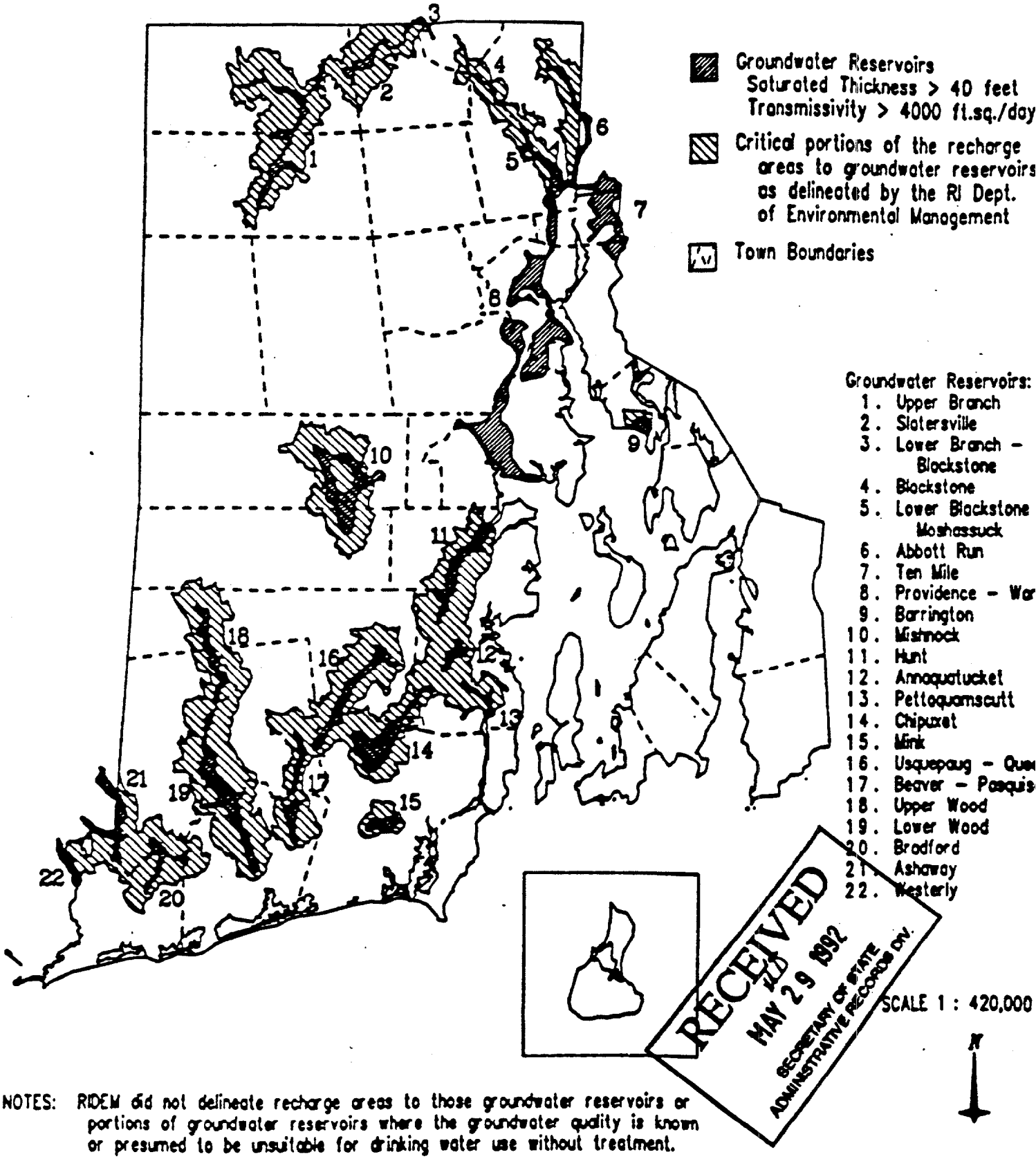
APPENDIX III

Map of Groundwater Reservoirs and the Critical Portions of Their Recharge Areas (8.5" x 11")

RECEIVED
MAY 29 1992
SECRETARY OF STATE
ADMINISTRATIVE RECORDS DIV.

GROUNDWATER RESERVOIRS AND THE CRITICAL PORTIONS OF THEIR RECHARGE AREAS



RECEIVED
MAY 29 1992
SECRETARY OF STATE
ADMINISTRATIVE RECORDS DIV.

NOTES: RIDEM did not delineate recharge areas to those groundwater reservoirs or portions of groundwater reservoirs where the groundwater quality is known or presumed to be unsuitable for drinking water use without treatment.

The groundwater reservoirs were initially delineated by the R.I. Water Resources Board. Three groundwater reservoirs (#12, 14, 19) were modified by DEM using data from the U.S. Geological Survey.

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APPENDIX A
REGULATORY INFORMATION

- *Proposed Amendments to RIDEM Ground Water Regulations*

TRC

Rhode Island Department of Environmental Management
Division of Groundwater and ISDS
Groundwater Section

February 1993

PROPOSED AMENDMENTS TO THE
RULES AND REGULATIONS FOR GROUNDWATER QUALITY
Sections and Subsections as Proposed

The Groundwater Section of the Rhode Island Department of Environmental Management has proposed amendments to the DEM "Rules and Regulations for Groundwater Quality"(May 1992). The proposed amendments include additions and deletions to the original text of the regulations. The following sections and/or subsections of the regulations are proposed to read as follows:

Section 5. APPLICABILITY

5.06 Monitoring Wells: Permanent monitoring wells installed pursuant to these regulations shall be in compliance with the construction standards in Appendix I. A monitoring well is designated permanent if it exists for more than 180 days. The monitoring well abandonment procedures in Appendix I shall apply to all permanent and non-permanent monitoring wells and those piezometers where improper abandonment would result in a reasonable likelihood of groundwater pollution.

Section 7. DEFINITIONS

"Community water supply well" means a well that serves a community water system.

"Non-community water system" means a public water system that is not a community water system; as is defined in the Rhode Island Department of Health Rules and Regulations Pertaining to Public Drinking Water, September 1977, and amendments thereto.

"Non-community water supply well" means a well that serves a non-community water system.

"Refined wellhead protection area" means a wellhead protection area which is approved and designated by the Director based upon a delineation submitted to the Director which was prepared using more sophisticated methods and/or additional data than that used in the Director's initial delineation. The refined wellhead protection area must be prepared in a manner consistent with the criteria and criteria thresholds in the Rhode Island Wellhead Protection Program approved by the US Environmental Protection Agency.

"Wellhead protection area" means the critical portion of a three-dimensional zone surrounding a public well or wellfield through which water will move toward and reach such well or wellfield as designated by the Director.

Section 8. PROHIBITIONS

8.06 The establishment of new solid waste landfills and facilities for the disposal of hazardous waste are prohibited in areas where the groundwater is classified GAA.

8.07 The establishment of new solid waste landfills and facilities for the disposal of hazardous waste shall be prohibited within areas designated by the Director to be wellhead protection areas for community water supply wells.

8.08 Owners and operators of existing solid waste landfills and facilities for the disposal of hazardous waste licensed at the date of promulgation of this rule and located within the wellhead protection area of a community water supply well, shall be prohibited from expanding the areal extent of the waste disposal area and shall not institute modifications to practices under its operating license without prior approval of the Director. Facility modifications which pose an increased risk of introducing pollutants to the groundwater shall be prohibited.

8.09 Disposal of solid waste s prohibited at facilities which lack a valid DEM solid waste disposal facility license or at such facilities whose licenses have expired or lapsed pursuant to Rhode Island Rules and Regulations for Solid Waste Management Facilities, February 1991, and amendments thereto.

8.10 No person shall install underground storage tanks in new locations within the wellhead protection area of community water supply wells. This prohibition shall not apply to the replacement or upgrading of existing underground storage tanks installed prior to the effective date of the regulations provided that such activity take place in accordance with all applicable state and federal regulations.

8.11 Any action taken in violation of the above prohibitions shall be deemed a violation of these Rules and Regulations for Groundwater Quality. For violations that are of a continuing nature, each and every day that the violation exists shall constitute a separate and distinct violation.

Section 9. GROUNDWATER CLASSIFICATION

9.01 Definitions: The Director shall classify the groundwater resources of Rhode Island using the four classes established in Chapter 46-13.1 of the General Laws of Rhode Island, 1956, as amended and which are further defined below:

(a)

(2) Wellhead protection areas for community water supply wells, as described below:

(i) Within the delineation of a wellhead protection area to each community water supply well as designated by the Director or another delineation which is accepted by the Director in accordance with the Rhode Island Wellhead Protection Program, Rhode Island Department of Environmental

Management, February 1990, and any amendments thereto and in accordance with section 18.00;

(ii) Where a delineation of a wellhead protection area for a community water supply well in accordance with 9.01(a)(2)(i) above is not available, the wellhead protection area shall be a 2000 foot radius circle surrounding the well, until such time that a delineation in accordance with 9.01(a)(2)(i) above is available.

(d) Groundwater may be classified GC in those areas which, because of present or past land use or hydrogeological conditions, the Director has determined to be more suitable for certain waste disposal practices than for development as a drinking water supply.

(1) Groundwater located beneath the following areas may be classified GC:

(i) At licensed solid waste landfills:

(A) The currently permitted area for waste disposal as established in a valid operating license issued by the Department, including a license issued pursuant to a court order; and

(2) The classification of a site as GC shall be limited to the waste disposal activities and other site specific conditions prescribed for the facility in the valid DEM solid waste or hazardous waste disposal facility license which was in effect on the effective date of these regulations. Any change in the design, construction or operation of such facilities, including changes in the types of waste accepted at the facility, which the Director has reason to believe may affect the potential for groundwater contamination at the site, shall be subject to the groundwater quality certification requirements of section 17;

(3) At the point in time when a license for a solid waste landfill or facility for the disposal of hazardous waste has lapsed or the facility is no longer being operated, then by definition the site shall be considered reclassified to GB, unless the Director determines that the GC classification is appropriate for the site.

Section 10. GROUNDWATER QUALITY STANDARDS AND PREVENTIVE ACTION LIMITS

TABLE 1. Numerical Groundwater Quality Standards and Preventive Action Limits for Class GAA a Class GA.

Substance	Groundwater Quality Standard	Preventive Action Limit
	(milligrams per liter, except as noted)	
A. Inorganic Chemicals		
Arsenic	0.05	0.025
Asbestos	7 million fibers/l	3.5 million fibers/l
Barium	2	1
Cadmium	0.005	0.0025
Chromium (total)	0.1	0.05
Fluoride	4	2
Lead	0.015	0.007
Mercury	0.002	0.001
Nitrate (as N)	10	5
Nitrite (as N)	1	0.5
Nitrate/Nitrite (total)	10	5
Selenium	0.05	0.025
Silver	0.05	0.025
B. Organic Chemicals		
Alachlor	0.002	0.001
Aldicarb (Temik)	0.010	0.005
Atrazine	0.003	0.0015
Benzene	0.005	0.0025
Carbofuran	0.04	0.02
Carbon Tetrachloride	0.005	0.0025
Chlordane	0.002	0.001
Chlorobenzene	0.1	0.05
2,4-D	0.07	0.035
Dibromomchloropropane (DBCP)	0.0002	0.0001
Dichlorobenzene o-	0.6	0.3
Dichlorobenzene m-	0.6	0.3
Dichlorobenzene p-	0.075	0.0375

TABLE 1. (continued)

Substance	Groundwater Quality Standard	Preventive Action Limit
	(milligrams per liter, except as noted)	
Dichloroethane (1,2-)	0.005	0.0025
Dichloroethylene (1,1-)	0.007	0.0035
Dichloroethylene (cis-1,2-)	0.07	0.035
Dichloroethylene (trans-1,2-)	0.1	0.05
Dichloropropane (1,2-)	0.005	0.0025
Endrin	0.0002	0.0001
Ethylbenzene	0.7	0.35
Ethylene dibromide (EDB)	0.00005	0.000025
Heptachlor	0.0004	0.0002
Heptachlor epoxide	0.0002	0.0001
Lindane	0.0002	0.0001
Methoxychlor	0.04	0.02
Methyl tertiary butyl ether (MTBE)	0.04	0.02
Pentachlorophenol	0.001	0.0005
Polychlorinated biphenyls (PCBs)	0.0005	0.00025
Styrene	0.1	0.05
Tetrachloroethylene	0.005	0.0025
Toluene	1	0.5
Toxaphene	0.003	0.0015
2,4,5-TP (Silvex)	0.05	0.025
Trichlorethane (1,1,1-)	0.2	0.1
Trichloroethylene (TCE)	0.005	0.0025
Trihalomethanes (total)	0.1	0.05
Vinyl Chloride	0.002	0.001
Xylenes	10	5

C. Microbiological

Total Coliform Bacteria	zero	zero

TABLE 1. (continued)

Substance	Groundwater Quality Standard (milligrams per liter, except as noted)	Preventive Action Limit
D. Radionuclides		
Gross Alpha Particle Activity	15 pCi/liter	7.5 pCi/liter
Gross Beta Particle Activity	4 mrem/yr	2 mrem/yr
Radium 226 and Radium 228 combined	5 pCi/liter	2.5 pCi/liter

Note: The numerical groundwater quality standards in these regulations are based primarily on the maximum contaminant levels promulgated by the Rhode Island Department of Health in the Rules and Regulations Pertaining to Public Drinking Water, December 1990, and amendments thereto. As additional or revised maximum contaminant levels are adopted by the Rhode Island Department of Health, the n or revised maximum contaminant levels are incorporated herein by reference as groundwater quality standards for class GAA and class GA.

Section 11. REVIEW AND MODIFICATION OF GROUNDWATER CLASSIFICATION

11.08 Downgrading of Groundwater Classification to GC

(c) Groundwater currently classified GA and GB that does not lie within the wellhead protection area of a community water supply well as designated by DEM may be reclassified to GC for proposed sites for solid waste landfills and proposed sites for hazardous waste disposal facilities. Groundwater classified GAA or designated GAA Non-attainment shall not be reclassified to GC.

Section 12. DETERMINATION OF COMPLIANCE WITH GROUNDWATER QUALITY STANDARDS AND PREVENTIVE ACTION LIMITS

12.02 Groundwater Monitoring Program

(c) Monitoring well construction shall be in compliance with the standards set forth in Appendix I.

Section 14. NOTIFICATION TO DEM OF VIOLATIONS OF PREVENTIVE ACTION LIMITS AND GROUNDWATER QUALITY STANDARDS

14.03 Notification: Facility owners and/or operators that discharge to groundwater or have had a discharge or release to groundwater shall notify the Department when:

(a) A preventive action limit has not been met at any point of compliance at a facility that has a discharge to groundwater approved by DEM where the groundwater is classified GAA or GA;

Section 16. GROUNDWATER REMEDIATION

16.03 Groundwater Quality Certification: Groundwater remediation plans, including those prepared pursuant to these regulations and the regulations and programs specified in section 16.02(b)(1)-(4), are subject to the requirements of groundwater quality certification in section 17, except where limited by constraints of federal laws.

Section 17. GROUNDWATER QUALITY CERTIFICATION

17.01 Applicability: In order to determine compliance with groundwater classification, groundwater quality certification is required for proposed facilities and activities that have an actual or potential adverse impact on groundwater quality, including certain facilities and activities with no designed discharge to groundwater. Groundwater quality certification by the Department's Groundwater Section shall be a requirement for final Department approval of the applications or requests to grant, renew or substantially modify the approvals, licenses, certifications, etc. below:

(a) Department approvals for groundwater remediation plans (including, but not limited to, remediation pursuant to: Rhode Island Regulations for Underground Storage Facilities Used for Petroleum Products and Hazardous Materials, April 1985, and amendments thereto; Rhode Island Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases, as promulgated; federal Comprehensive Environmental Response, Compensation and Liability Act (42 USC 9601 et seq.); and federal Resource Conservation and Recovery Act (42 USC 6901 et seq.)); except where limited by constraints of federal laws.

Section 18. WELLHEAD PROTECTION

18.01 Delineation of Wellhead Protection Areas: Wellhead protection areas for each public well or wellfield in Rhode Island shall be established by the Department in accordance with one of the following:

(a) Wellhead protection areas shall be delineated by the Department in accordance with the requirements of the "Rhode Island Wellhead Protection Program," Rhode Isl Department of Environmental Management, February 1990, and any amendments there.

(b) A refined wellhead protection area delineated by the Director, or accepted by the Director in accordance with section 18.02;

(c) Where a delineation of a wellhead protection area for a community water supply well in accordance with 18.01(a) or (b) above is not available, the interim wellhead protection area shall be a 2000 foot radius circle surrounding the well, until such time that a delineation in accordance with 18.01(a) or (b) is available; or

(d) Where a delineation of a wellhead protection area for a non-community water supply well in accordance with 18.01(a) or (b) above is not available, the wellhead protection area shall be a 1750 foot radius circle surrounding the well, until such time that a delineation in accordance with 18.01(a) or (b) is available.

18.02 Refined Wellhead Protection Areas: Refined wellhead protection areas shall be delineated in accordance with the "Rhode Island Wellhead Protection Program," Rhode Island Department of Environmental Management, February 1990, and any amendments thereto. The delineation criteria and criteria thresholds, as described in the "Rhode Island Wellhead Protection Program," shall be adhered to unless otherwise approved by the Director.

(a) Requests for approval of refined wellhead protection areas shall be submitted in writ to the Director and shall include, at minimum:

(1) A map of the well location and proposed refined wellhead protection area using the United States Geological Survey 7.5 minute quadrangle map (scale of 1:24000);

(2) Detailed description of the mapping methodology;

(3) List of data sources;

(4) Detailed description of field methods and results for such activities as pump tests and water table measurements;

(5) Detailed description of modelling method and results, principal model input and output values; and

(6) Water table map at a scale of 1:24000 used in the refined wellhead protection area mapping;

(b) Written requests to the Director to designate a refined wellhead protection area shall be accepted from the following entities:

(1) Mayor, council president, manager or administrator of the municipality that is the owner of the well;

(2) Owner or the chief executive officer, chairman of the board or president of the entity that is the owner of a non-municipal well.

(c) Additional information may be required by the Director in order to adequately review a proposed refined wellhead protection area.

(d) After reviewing the proposed refined wellhead protection area, the Director shall accept it, deny it, or accept it with conditions. An accepted refined wellhead protection area delineation will be incorporated into the official wellhead protection map in accordance with section 18.03(b) and shall replace the Director's initial wellhead protection area delineation.

18.03 Wellhead Protection Area Maps:

(a) The wellhead protection areas shall be delineated on 1:24000 scale maps. The 1:24000 scale maps shall be on file for review at the Rhode Island Department of Environmental Management, Groundwater Section, 291 Promenade Street, Providence, RI 02908. Smaller scale maps may be made available from the Department at the above address. The Director shall establish an appropriate fee, which shall be based on the costs of map reproduction, for copies of the wellhead protection area maps.

(b) The Director shall periodically initiate rule-making procedures to update the wellhead protection maps to incorporate additional wellhead protection areas and/or delete certain wellhead protection areas.

18.04 Deletions of Wellhead Protection Areas: Wellhead protection area delineations will be deleted from the Department's wellhead protection area map when the Director has determined that the well is no longer serving the purpose of a public well and it is not likely to serve such purpose in the foreseeable future.

18.05 Wellhead Protection Program Roles and Responsibilities: Consistent with the "Rhode Island Wellhead Protection Program," Rhode Island Department of Environmental Management, February 1990, and any amendments thereto, the Wellhead Protection Program roles and responsibilities shall be assigned as follows:

(a) The Department of Environmental Management shall:

(1) Provide water suppliers and the municipalities with wellhead protection area delineations;

(2) Provide water suppliers and the municipalities with technical assistance on conducting inventories of known and potential sources of groundwater

contamination and assistance in the development of local wellhead protection plans;

(3) Review and approve, deny, or approve with conditions the inventories of known a. potential sources of groundwater pollution and the local wellhead protection plans;

(4) Ensure that the local wellhead protection plans are implemented and updated as required.

(b) Water suppliers that have a groundwater source(s) of supply and which are subject to the Department's "Rules and Regulations for Water Supply Management Planning," August 1992, and amendments thereto, shall:

(1) Conduct an inventory of known and potential sources of groundwater contamination within their wellhead protection areas in accordance with section 18.06; and

(2) Prepare a wellhead protection plan in accordance with section 18.07.

(c) Municipalities that have wellhead protection areas within their boundaries shall:

(1) Conduct an inventory of known and potential sources of groundwater contamination within the wellhead protection areas in accordance with section 18.06, except for those wellhead protection areas addressed by the water suppliers in section 18.05(b); and

(2) Prepare a wellhead protection plan in accordance with section 18.07.

(d) In carrying out the tasks described above, the Director encourages suppliers and municipalities to coordinate their efforts and where practical to conduct regional inventories and prepare regional wellhead protection plans.

(e) Each supplier or municipality required to conduct a wellhead protection area inventory and prepare a wellhead protection plan shall designate a committee or individual responsible for such inventory and plan and shall notify the Director of this designation by July 1, 1993.

18.06 Wellhead Protection Area Inventories of Known and Potential Sources of Pollution: Inventories are required to identify known and potential sources of groundwater pollution within the wellhead protection area. The results of the inventory will then be used in the determination of the most appropriate management strategies to include in the wellhead protection plan described in section 18.07.

(a) The inventory should be done in accordance with the Rhode Island Department of Environmental Management Guidance Document: "Inventory of Potential Sources of Groundwater Contamination in Wellhead Protection Areas," December 1992, and amendments thereto.

(b) The results of the wellhead protection area inventory shall be submitted to the Groundwater Section on maps and in a summary report in accordance with the following schedule:

(1) Water suppliers that have a groundwater source(s) of supply and which are subject to the Department's "Rules and Regulations for Water Supply Management Planning," August 1992, and amendments thereto, shall submit wellhead protection inventories in accordance with the schedule for the water supply management plans promulgated in the "Rules and Regulations for Water Supply Management Planning." This schedule is reiterated below:

Pawtucket Water Supply Board	October 1, 1993
Wakefield Water Company	October 1, 1993
Kingston Water District	November 1, 1993
South Kingstown (town of)	November 1, 1993
North Kingstown (town of)	November 1, 1993
Rhode Island Port Authority	November 1, 1993
Kent County Water Authority	February 1, 1994
Lincoln Water Commission	March 1, 1994
Cumberland (town of)	March 1, 1994
Bristol County Water Authority	April 1, 1994
Pascoag Fire District	April 1, 1994
Harrisville Fire District	April 1, 1994
Westerly (town of)	June 1, 1994

(2) Municipalities with wellhead protection areas shall submit wellhead protection inventories to the Department by October 31, 1994.

(3) Individual requests for a six month extension of this deadline will be considered by the Director.

(c) Once an inventory is submitted to the Director, the Director shall approve it, deny it or approve it with conditions. In order for an inventory to be approved by the Director, the Director must determine that the methods used to conduct the inventory and the resulting maps and summary reports have sufficiently identified and characterized the threats to groundwater quality within the wellhead protection area.

18.07 Wellhead Protection Plans:

(a) Wellhead protection plans, prepared in accordance with the "Rhode Island Wellhead Protection Program," February 1990, and any amendments or guidance documents thereto, shall be developed to identify workable management strategies to protect groundwater quality within the wellhead protection areas. These plans shall be submitted to the Department's Groundwater Section by:

(1) Water suppliers that have a groundwater source(s) of supply and which are subject to the Department's "Rules and Regulations for Water Supply Manageme Planning," August 1992, and amendments thereto, shall prepare a plan outlinin strategies under their authority to protect groundwater quality within their wellhead protection areas.

(2) Municipalities that have wellhead protection areas within their municipal boundaries, as designated on the map referenced in section 18.02, shall submit wellhead protection plans that address all of the wellhead protection areas within the municipality, including the following:

(i) Wellhead protection areas for wells of water suppliers that have a groundwater source(s) of supply and which are subject to the Department's "Rules and Regulations for Water Supply Management Planning," August 1992, and amendments thereto; and

(ii) Wellhead protection areas for all other community and non-community public water systems that are wholly or partially within the boundaries of the municipality.

(b) The wellhead protection plans shall be submitted to the Department in accordance with the following schedule:

(1) Water suppliers as described above in section 18.07(a)(1) shall submit a wellhe protection plan within one year after the date specified in section 18.06(b)(1) fo submission of the inventory.

(2) Municipalities shall submit wellhead protection plans by October 31, 1995.

(3) Individual requests for a six month extension of this deadline will be considered by the Director.

(c) The wellhead protection plans shall, at minimum, consist of:

(1) A description of past efforts to protect groundwater quality, both regulatory and non-regulatory (e.g., public education, land acquisition);

(2) An evaluation of the groundwater quality within the wellhead protection area based on available groundwater quality data from the well and any other locations in the wellhead protection area and based on the presence of known and potential sources of pollution as identified in the inventory required in section 18.06;

(3) Identification of the management approaches determined to be most appropriate for protecting groundwater quality within the wellhead protection area, given the unique circumstances of the municipality and/or the supplier;

(4) Implementation strategies for each management approach identified above in 18.07(c)(3), including, but not limited to, problems that may be encountered and how they will be resolved; and

(5) Five year schedule of activities for implementing the wellhead protection plan.

(6) Identification of the approach that will be taken to update the wellhead protection plan.

(d) Prior to submission of the wellhead protection plan to the Director, the plan shall be approved and endorsed by:

(1) The town or city council for a municipal wellhead protection plan; or

(2) The governing body of a non-municipal water supplier for a supplier prepared wellhead protection plan.

(e) Once a wellhead protection plan is submitted to the Director, the Director shall approve it, deny it or approve it with conditions. In order for a plan to be approved by the Director, the Director must determine that:

(1) There is a substantial likelihood that implementation of the plan will result in an increased level of groundwater protection in the wellhead protection area; and

(2) The pollution sources identified in the inventory required in section 18.06 will be addressed in a manner that will minimize the threat they pose to groundwater quality in the wellhead protection area.

(f) The wellhead protection plans shall be updated at least once every five years.

Section 20. ENFORCEMENT

20.01 Where the Director has reason to believe that a violation of any part of the regulations herein has occurred, the Director may issue a notice of violation and/or immediate compliance order pursuant to Chapter 42-17.1 of the Rhode Island General Laws of 1956, as amended.

20.02 For violations that are of a continuing nature, each and every day that the violation exists shall constitute a separate and distinct violation.

Section 21. APPEALS

Any person affected by a decision of the Director pursuant to these regulations may, in accordance with the Administrative Rules of Practice and Procedure for the Department of Environmental Management, file a claim for an adjudicatory hearing to review the decision. The party appealing a Department decision bears the burden of proving that their application complies with all requirements of the rules and regulations herein.

Section 22. SUPERSEDED REGULATIONS

22.01 On the effective date of these regulations, section 9.03 (Monitoring Well Abandonment) of the Rules and Regulations Governing the Enforcement of Chapter 46-13.2 Relating to the Drilling of Drinking Water Wells, filed with the Secretary of State December 15, 1989, is hereby revoked and superseded by section 9.0 of Appendix I of the regulations herein.

22.02 In accordance with the filing with the Office of the Secretary of State and effective twenty (20) days thereafter, the following sections and subsections of these regulations are hereby amended: 5.06, 7, 8, 9.01, 10.02, 11.08, 12.02, 14.03, 16.03, 17.01, 18, 20, 21, 22, 23.

Section 23. PENALTIES

Penalties will be assessed in accordance with the Department's Rules and Regulations for the Assessn of Administrative Penalties for any violation of these regulations.

APPENDIX I

Required Monitoring Well Construction Standards and Abandonment Procedures

1.0 Purpose: to provide minimum standards for; (a) the procurement of samples representative of groundwater; and (b) abandonment procedures for removing the vertical conduit to groundwater.

2.0 Applicability: The monitoring well construction standards herein apply to all permanent monitoring wells installed pursuant to these regulations. Pursuant to Section 12.02 of these regulations, wells installed at the direction of other programs are exempt from Sections 4.0 through 12.0 of this Appendix. A monitoring well is designated permanent if it exists for more than 180 days. Section 13 of this appendix on monitoring well abandonment applies to all permanent and non-permanent monitoring wells subject to these regulations. Section 13 also applies to those piezometers where improper abandonment would result in a reasonable

likelihood of groundwater pollution. Additional requirements may be specified by the Director.

3.0 Prevention of Groundwater Pollution: During well construction and abandonment, every appropriate precaution shall be taken to prevent introducing pollutants into the groundwater. This shall include, but not be limited to, steam cleaning and washing of drilling equipment and proper cleaning and storage of well casing. Only potable water shall be used in well construction and abandonment unless otherwise approved by the Director.

4.0 Construction and Abandonment Standards: The procedures described in this Appendix incorporate minimum standards. The Director may waive the requirements and allow deviation from these procedures where such deviations are necessary to procure representative groundwater samples. All deviations from the procedures shall be documented and provided to the Director. If the Director determines that the deviation from these procedures will not or does not result in the procurement of samples representative of groundwater, the Director may require the installation of a new monitoring well.

5.0 Well Casing: All permanent groundwater monitoring wells shall be constructed of PVC well casing material. All casing shall have a minimum inside diameter of 2.0 inches. Monitoring wells constructed in unconsolidated material less than 100 feet in depth shall be constructed using a minimum of schedule 40 PVC. Wells greater than 100 feet shall be constructed using a minimum of schedule 80 PVC.

5.1 Assembly and Installation: All casing shall be constructed of flush threaded joints or threaded coupling joints. All joints shall be fitted with an "O" ring or wrapped with teflon tape. Solvent welded joints are not permissible without prior written permission of the Director.

5.2 Exceptions: The Director may allow alternate well casing material if the pollutant concentrations or geologic setting require an alternative construction. Alternative materials include but are not limited to: (a) Teflon; (b) stainless steel; or (c) uncoated or galvanized steel.

6.0 Well Screen: The well screen slot size shall retain at least 90% of the grain size of a filter pack or at least 60% of the grain size of the collapsed formation. Well screens on wells and piezometers shall not exceed the length necessary to collect a representative groundwater sample or to determine water table elevation. Well screens shall be factory slotted. A bottom cap and sump sediment trap shall be installed.

7.0 Filter Pack: The filter pack shall be chemically inert, well rounded and well sorted glass beads or silica-based sand or gravel of uniform grain size. The filter pack must minimize the amount of fine material entering the well and shall not inhibit the flow of water into the well. The filter pack shall extend a minimum of one foot , but no more than 5 feet above the well screen. The filter pack shall not pollute groundwater.

8.0 Sealing Requirements:

8.1 Filter Pack Seal: All monitoring wells installed with a filter pack shall be constructed w. a filter pack seal, such as bentonite flakes or pellets . The seal shall extend to approximately one foot above the filter pack and shall be properly hydrated.

8.2 Annular Space Seal: All monitoring wells shall be installed with an annular space seal that has a permeability of 1 x 10^{-7} centimeters per second or less. Materials that meet this criterion include but are not limited to neat cement grout and cement-bentonite grout. The annular space seal shall extend to the ground surface seal, except where a road box meeting the requirements of Section 10.0 is used.

8.3 Ground Surface Seal: All monitoring wells shall be constructed with a continuous pour concrete ground surface seal. To avoid frost heaving and to anchor the well, the ground surface seal shall extend to a minimum of 40 inches below the land surface, unless the well meets one of the requirements of the exemption described in Section 8.4. The ground surface seal shall be flared such that the diameter at the top is greater than the diameter at the bottom. The top of the ground surface seal shall be sloped away from the well casing and shall be imprinted with the designation of the monitoring well.

8.4 Exemption from 40 Inch Ground Surface Seal Requirement: As stated in Section 8.3, the ground surface seal shall extend at least 40 inches down the hole from the land surface. Exemptions from the rule are limited to the following circumstances: 1) where the seal would interfere with proper placement or functioning of the well screen; and 2) where a road box is us and sand is placed inside and directly below the road box in such a way as to ensure that a. seepage into the road box drains away from the well.

9.0 Protective Cover Pipe: The protective pipe shall consist of a minimum 4 inch diameter metal casing with locking cap. The protective pipe shall extend from the bottom of the ground surface seal to a minimum of 24 inches above the land surface. There shall be no more than 4 inches between the top of the well casing and the top of the protective pipe. The monitoring well designation shall be indicated clearly on the protective cover pipe. A gas vent and a drain hole shall be installed. A high visibility guard post to prevent destruction of the well may be required. The Director may request additional protective devices as necessary.

10.0 Road Box: Road boxes are acceptable in locations where protective cover pipes are not suitable. All road boxes shall be secured and water tight and prevent easy access to the well. The well shall be fitted with a locking, water tight cap. The ground surface seal for the road box shall be competent such that vehicle traffic will not cause it to fail. The annular space seal shall extend upward to within one foot of the ground surface seal. One or two feet of permeable material may be emplaced between the ground surface seal and the annular space seal in order to allow for the drainage of runoff which may leak into the road box from the ground surface.

11.0 Well Development: Development of all monitoring wells shall be performed no earlier than 48 hours after completion and before the initial water quality samples are taken. The goal of well

development is to produce water free of fine sand, coarser material, drill cuttings, and drilling fluids. The formation shall be allowed to stabilize for at least 24 hours before groundwater sampling.

12.0 Innovative Well Installation: Innovative wells including but not limited to Microwells or Geoprobes, that are small-diameter and are non-destructive to the formation, and which are capable of providing samples representative of groundwater, need not meet the construction requirements set forth in Sections 4.0 through 11.0 of this appendix.

13.0 Monitoring Well and Piezometer Abandonment:

13.1 General:

(a): All monitoring wells and applicable piezometers as described in section 1.0 of this appendix that are no longer used to gather information on geologic or groundwater properties shall be abandoned pursuant to the provisions of section 13.2 of this appendix. Well abandonment shall take place within 60 days after its use has been terminated, unless a written exemption is received from the Director for continued use.

(b) Innovative wells: Innovative wells as described in Section 12.0 of this Appendix shall be abandoned at the end of use in order to remove the conduit to groundwater. Abandonment of innovative wells shall consist of removal of the well and grouting of the borehole. Innovative wells are exempted from the abandonment procedures described in Section 13.2 of this Appendix.

13.2 Abandonment Procedures: The well shall be inspected from the land surface through the entire depth of the well before it is sealed to ensure against the presence of any obstructions that will interfere with sealing operations.

(a) Wells constructed with an impermeable annular seal shall be abandoned by cutting off the casing a minimum of 4 feet below land surface. The remaining casing shall be completely filled with a neat cement grout or bentonite-cement grout. The remaining hole volume shall be backfilled with natural material, with the following exception: where backfilling with natural material would result in a grout plug less than 4 feet long, the hole shall be filled to approximately one foot from the ground surface with the neat cement grout or bentonite-cement grout.

(b) Wells not known to be constructed with an impermeable annular seal shall be abandoned by completely removing the well casing and sealing with neat cement or bentonite-cement grout to approximately one foot from the ground surface. If the casing cannot be removed during the abandonment of a well, the casing shall be thoroughly ripped or perforated from top to bottom. except that perforations will not be required over intervals of the well that are sealed with cement. The screened portion of the well and the annular space between the casing and the

drillhole wall shall be effectively and completely filled with cement or bentonite-cement grout applied under pressure.

Additional documents available from RI DEM:

* A Summary of the Proposed Amendments to the "Rules and Regulations for Groundwater Quality," February 1993.
* A Summary of the "Rules and Regulations for Groundwater Quality," May 1992.
* Groundwater Classification Changes in the Proposed Amendments to the "Rules and Regulations for Groundwater Quality," February 1993.
* A Summary of the RI Wellhead Protection Program, December 1992.
* Wellhead Protection Area Delineation Methodology for Public Drinking Water Wells in RI, March 1993.

For more information on the proposed amendments to the "Rules and Regulations for Groundwater Quality" or the state's Groundwater Protection Program, please contact the Groundwater Section at (401) 277-2234, or write to the Groundwater Section, RI DEM, 291 Promenade St., Providence, RI 02908.

APPENDIX A
REGULATORY INFORMATION

- *RIDEM Surface Water Quality Regulations*

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RHODE ISLAND WATER QUALITY STANDARDS

(Rhode Island Department of Environmental Management, Division of Water Resources; Rhode Island Water Quality Regulations for Water Pollution Control, Section 6 — Water Quality Standards; Adopted December 20, 1984, Effective January 9, 1985; Amended effective October 28, 1988)

6.1 Purpose. A water quality standard defines the water quality goals of a water body, or portion thereof, by designating the use or uses to be made of the water and by setting criteria necessary to protect the uses. Water quality standards are intended to protect public health or welfare, enhance the quality of water and serve the purposes of the Clean Water Act (the Act) and Chapter 46-12 of the General Laws of Rhode Island. "Serve the purposes of the Act" (as defined in Section 101(a)(2) and 303(c) of the Clean Water) means that water quality standards should, whenever attainable, provide water quality for the protection and propagation of fish, shellfish and wildlife and for recreation in and on the water and take into consideration their use and value of public water supplies, propagation of fish, shellfish, and wildlife, recreation in and on the water and agricultural, industrial, and other purposes including navigation.

Such standards serve the dual purposes of establishing the water quality goals for a specific water body and serve as the regulatory basis for the establishment of water-quality-based-treatment controls and strategies beyond the technology-based levels of treatment required by Sections 301(b) and 306 of the Clean Water Act.

6.2 Water Use Classification — The waters of the State shall be assigned to one of the classes listed below. Each class is defined by the most sensitive, and therefore governing, uses which it is intended to protect:

6.21 Freshwater —

Class A — (drinking) water supply

Class B — public water supply with appropriate treatment
— agricultural uses
— bathing, other primary contact recreational activities
— fish and wildlife habitat

Class C — boating, other secondary contact recreational activities
— fish and wildlife habitat
— industrial processes and cooling

*Class D — migration of fish
— good aesthetic value

*Class E — Nuisance conditions; uses limited to:
— certain industrial processes and cooling
— power
— navigation

* Classes D and E shall be used to describe an existing condition only, and shall not be considered an acceptable goal for classification of any water.

6.22 Sea Water —

Class SA — bathing and contact recreation
— shellfish harvesting for direct human consumption
— fish and wildlife habitat

Class SB — shellfish harvesting for human consumption after depuration
— bathing, other primary contact recreational activities
— fish and wildlife habitat

Class SC — boating, other secondary contact recreational activities
— fish and wildlife habitat
— industrial cooling
— good aesthetic value

6.3 Water Quality Criteria — The following physical, chemical and biological criteria are parameters of minimum water quality necessary to support the water use classifications of subsection 6.2 and shall be applicable to all waters of the State.

6.31 General Criteria — The following minimum criteria are applicable to all waters of the State, unless criteria specified for individual classes are more stringent:

1. At a minimum, all waters shall be free of pollutants in concentrations or combinations that will:

(a) Adversely affect the composition of a bottom aquatic life;

(b) Adversely affect the physical or chemical nature of the bottom;

(c) Interfere with the propagation of fish and shellfish; or,

(d) Undesirably alter the qualitative and quantitative character of the biota.

2. Aesthetics — all waters shall be free from pollutants in concentrations or combinations that:

(a) Settle to form objectionable deposits;

(b) Float as debris, scum or other matter to form nuisances;

(c) Produce objectionable odor, color, taste or turbidity; or,

(d) Result in the dominance of nuisance species.

3. Radioactive substances - The level of radioactive materials in all waters shall not be in concentrations or combinations which would be harmful to human, animal or aquatic life, or result in concentrations in organisms producing undesirable conditions.

4. Nutrients - Nutrients shall not exceed the site-specific limits necessary to control accelerated or cultural e

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Best Management Practices shall be used to control sedimentation and erosion.

5. Thermal Mixing Zones - In the case of thermal discharges into tidal rivers or estuaries, or fresh water streams or estuaries, where thermal mixing zones are allowed by the Director, the mixing zone will be limited to no more than 1/4 of the cross sectional area and/or volume of river flow, stream or estuary, leaving at least 3/4 free as a zone of passage. In wide estuaries and oceans, the limits of mixing zones will be established by the Director.

6. Non-thermal Mixing Zones - In applying these standards the Director may recognize, where appropriate, a limited mixing zone or zone of initial dilution on a case-by-case basis. The locations, size and shape of these zones shall provide for the maximum protection of aquatic resources. At a minimum, mixing zones must:

(a) Meet the criteria for aesthetics;

(b) Be limited to an area or volume that will minimize interference with the designated uses in the segment;

(c) Allow an appropriate zone of passage for migrating fish and other organisms; and

(d) Not result in substances accumulating in sediments, aquatic life or food chains to exceed known or predicted safe exposure levels for the health of humans or aquatic life.

6.32 Class-Specific Criteria - Fresh Waters

Criterion	Class A*	Class B	Class C	Class D
Dissolved oxygen	75% saturation, 16 hours/day, but not less than 5 mg/l at any place or time except as naturally occurs.	75% saturation, 16 hours/day, but not less than 5 mg/l at any place or time except as naturally occurs.	Minimum 5 mg/l any place or time, except as naturally occurs. Normal seasonal and diurnal variations above 5 mg/l will be maintained.	A minimum of 2 mg/l at any place or time, except as naturally occurs.
Sludge deposits-solid refuse-floating solids-oils-grease-scum	None Allowable.	None Allowable.	Sludge deposits, floating solids oils, grease and scum shall not be allowed except for such small amounts that may result from the discharge of appropriately treated sewage or industrial waste effluents.	
Color and turbidity	None other than of natural origin. Not to exceed 5NTU over background when the background is 50 NTU or less or have more than a 10% increase in turbidity when the background is more than 50 NTU.	None in such concentrations that would impair any usages specifically assigned to this Class. Not to exceed 10 NTU over background when the background is 50 NTU or less, or have more than a 20% increase in turbidity when the background is more than 50 NTU.	None in such concentrations that would impair any usages specifically assigned to this Class. Not to exceed 10 NTU over background when the background is 50 NTU or less, or have more than a 20% increase in turbidity when the background is more than 50 NTU.	None in such concentrations that would impair any usages specifically assigned to this Class.
Total Coliform bacteria/100 ml	Not to exceed a median value of 100 and not more than 10% of the samples shall exceed a value of 500.	Not to exceed a median value of 1,000 and not more than 20% of the samples shall exceed a value of 2,400.	None in such concentrations that would impair any usages specifically assigned to this Class.	None in such concentrations that would impair any usages specifically assigned to this this Class.
Fecal coliform bacteria/100 ml	Not to exceed a median value of 20 and not more than 10% of the samples shall exceed a value of 200.	Not to exceed a median value of 200, and not more than 20% of the samples shall exceed a value of 500.	Not applicable.	Not applicable.
Taste and odor	None other than of natural origin.	None in such concentrations that would impair any usages specifically assigned to this Class nor cause taste and odor in edible portions of fish.	None in such concentrations that would impair any usages specifically assigned to this Class nor cause taste and odor in edible portions of fish.	None in such concentrations that would impair any usages specifically assigned to this Class.

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Criteria	Class A*	Class B	Class C	Class D
pH	As naturally occurs.	6.5 - 8.0 or as naturally occurs.	6.0 - 8.5***	6.0 - 9.0
Allowable temperature increase	None other than of natural origin.	Only such increases that will not impair any usages specifically assigned to this Class.**	Only such increases that will not impair any usages specifically assigned to this Class or cause the growth of unfavorable species of biota.	None except where the the increase will not exceed the recommended limits on the most sensitive water use and in no case exceed 90°F.
9. Chemical	a. Waters shall be free from chemical constituents in concentrations or combinations which could be harmful to human, animal, or aquatic life for the appropriate most sensitive and governing water class use or unfavorably alter the biota. b. If an aquatic toxicity value has not been established in the R.I. DEM Ambient Water quality Guidelines (see Appendix B), then the level of any "priority pollutant" (see Appendix H) shall not exceed the "detection limits" in the ambient water unless the discharger demonstrates to the satisfaction of the Director that a higher concentration will not adversely effect the most sensitive use of the water body. c. The ambient concentration of a pollutant in a water body designated as suitable for fish and/or wildlife habitat shall not exceed the Ambient Water Quality Guidelines, (see Appendix B) for the protection of aquatic organisms from chronic effects, unless the chronic guideline is modified by the Director based on results of bioassay tests conducted in accordance with the terms and conditions provided in Appendix C. d. The limits prescribed by the United States Environmental Protection Agency will be used where not superseded by more stringent State requirements.			The ambient concentration of a pollutant in a water body designated as suitable for fish mitigation shall not exceed the R.I. DEM Ambient Water Quality Guidelines (see Appendix B) for the protection of aquatic organisms from acute effects, unless the the acute guideline is modified by the Director based on results of bioassay tests conducted in in accordance with the terms and conditions provided in Appendix C.
Phosphorus	None in such concentration that would impair any usages specifically assigned to said Class. New discharges of wastes containing phosphates will not be permitted into or immediately upstream of lakes or ponds. Phosphates shall be removed from existing discharges to the extent that such removal is or may become technically and reasonably feasible.			

* Class A waters used for drinking water supply may be subject to restricted use by State and local authorities.

* The temperature increase shall not raise the temperature of the receiving waters above the recommended limit on the most sensitive receiving water use and in no cases exceed 83 degrees F. In no case shall the temperature of the receiving water be raised more than 4 degrees F. Heated discharges into designated coldwater habitats shall not raise the temperature above 68 degrees F outside an established thermal mixing zone.

* In accordance with 40 CFR, Part 133.102 (c), those facilities achieving the level of effluent quality attainable through the application of secondary or equivalent treatment may discharge an effluent pH of 6.0 to 9.0 (S.U.) standard units.

6.33 Class-Specific Criteria - Sea Waters

Criterion	Class SA	Class SB	Class SC
Dissolved oxygen	Not less than 6.0 mg/l at any place or time, except as naturally occurs.	Not less than 5.0 mg/l at any place or time, except as naturally occurs.	Not less than 5 mg/l during at least 16 hours of any 24-hour period not less than 4 mg/l at any place or time, except as naturally occurs.
Sludge deposits-solid refuse-floating solids-oils-grease-scum	None allowable	None allowable	None except that amount that may result from the discharge from a waste treatment facility providing appropriate treatment
Color and turbidity	None in such concentrations that would impair any usages specifically assigned to this Class. Not to exceed 5 NTU over background when the background is 50 NTU or less or have more than a 10% increase in turbidity when the background is more than 50 NTU.	None in such concentrations that would impair any usages specifically assigned to this Class. Not to exceed 10 NTU over background when the background is 50 NTU or less, or have more than a 20% increase in turbidity when the background is more than 50 NTU.	None in such concentrations that would impair any usages specifically assigned to this Class. Not to exceed 10 NTU over background when the background is 50 NTU or less, or have more than a 20% increase in turbidity when the background is more than 50 NTU.
Total Coliform bacteria per 100 ml	Not to exceed a median MPN of 70 and not more than 10% of the samples shall ordinarily exceed an MPN of 330 for a 3-tube decimal dilution.	Not to exceed a median value of 700, and not more than 10% of the samples shall exceed a value of 2300.	None in such concentrations that would impair any usages specifically assigned to this Class.
Fecal Coliform bacteria/100 ml	Not to exceed a median value of 15 and not more than 10% of the samples shall exceed a value of 50.*	Not to exceed a median value of 50, and not more than 10% of the samples shall exceed a value of 500.	None in such concentrations that would impair any usages specifically assigned to this Class.
Taste and odor	None allowable	None in such concentrations that would impair any usages specifically assigned to this Class and none that would cause taste and odor in edible portions of fish or shellfish.	None in such concentrations that would impair any usages specifically assigned to this Class and none that would cause taste and odor in edible portions of fish or shellfish.

Criterion	Class SA	Class SB	Class SC
pH	6.8 - 8.5	6.8 - 8.5	6.5 - 8.5**
Temperature increase:	None except where the increase will not exceed the recommended limit on the most sensitive receiving water use and in no case exceed 83 degrees F or in any case raise the normal temperature more than 1.6 degrees F, 16 June through September and not more than 4 degrees F from October through 16 June. All measurement shall be made at the boundary of such mixing zones as is found to be reasonable by the Director.		
Chemical constituents	a. None in concentrations or combinations which would be harmful to human, animal or aquatic life or which would make the waters unsafe or unsuitable for fish or shellfish or their propagation, impair the palatability of same, or impair the waters for any other uses.		
	b. None in concentrations or combinations which would be harmful to human, animal or aquatic life or which would make the waters unsafe or unsuitable for fish or shellfish or their propagation, or impair the water for any other usage assigned to this class. The ambient concentration of a pollutant in a water body designated as suitable for fish and/or wildlife habitat shall not exceed the R.I. DEM Ambient Water Quality guidelines (see Appendix B) for the protection of aquatic organisms from chronic effects, unless the chronic guideline is modified by the Director based on results of bioassay tests conducted in accordance with the terms and conditions provided in Appendix C.		
	c. None in concentrations or combinations which would be harmful to human, animal or aquatic life or which would make the waters unsafe or unsuitable for fish or shellfish or their propagation, or impair the water for any other usage assigned to this class.		

If an aquatic toxicity value has not been established in the R.I. DEM Ambient Water Quality Guidelines (see Appendix B), then the level of any "priority pollutant" (see Appendix H) shall not exceed the "detection limits" in the ambient water unless the discharger demonstrates to the satisfaction of the Director that a higher concentration will not adversely effect the most sensitive use of the water body.

Guide, pending further research.

In accordance with 40 CFR, Part 133.102(c), those facilities achieving the level of effluent quality attainable ough the application of secondary or equivalent treatment may discharge an effluent pH of 6.0 to 9.0.

6.4 Water Quality Standards — All waters of the State have been categorized according to the water use classification of subsection 6.2 based on considerations of public health, recreation, propagation and protection of fish, shellfish, and wildlife, and economic and social development. The waters of the State are classified according to the list of water segments in Appendix A.

All small streams tributary to Class A waters shall be Class A. All other small streams where the classification is not indicated shall be Class B. All other fresh waters not classified shall be considered to be Class A until classified. All sea waters not classified shall be considered to be Class SA until classified.

6.41 Applicable Conditions — These water quality standards apply under the most adverse conditions, as determined by the Director according to sound engineering and scientific practices. For fresh water, most adverse conditions shall include a minimum average daily flow for seven consecutive days that can be expected to occur once in ten years. For tidal waters, most adverse conditions shall mean when the most unfavorable hydrographic and pollution conditions occur at the particular point of evaluation.

6.42 Federal Approval — These water quality standards are subject to approval by the administrator pursuant to subsection 303(c)(2) of the Clean Water Act.

6.43 Periodic Review - The Water Quality Standards shall be reviewed periodically and amended as necessary pursuant to section 18 of these regulations.

6.5 Low Quality Water — Any water whose quality falls below any of the criteria of subsection 6.3 corresponding to its classification as designated in subsection 6.2 shall be considered in violation of its water quality standard and unsatisfactory for the uses indicated for that class, except for any designated uses which the Director determines are not affected by the particular criterion which is violated. Classes D and E shall be used to describe an existing condition, and shall not be considered an acceptable goal for classification of any water. Freshwaters falling below any criterion for Class D shall be considered to be in a nuisance condition. Waters in their natural hydraulic condition may fail to meet their assigned water quality criteria from time to time due to natural causes, without necessitating the modification of assigned water use classifications.

6.6 Symbolic Representative of Water Quality Standards. — The Director shall issue maps from time to time which indicate assigned water use classification.

Appendix A: Water Quality Classification Descriptions

The chart used to delineate the seawater conditions and classification zones is the National Oceanic and Atmospheric Administration — U.S. Department of Commerce, United States, East Coast, Rhode Island - Massachusetts, Narragansett Bay. National Chart Catalog No. 1, Panel G, 3rd Ed., May 28, 1983, 13221. True bearings are used in the narrative description of the water bodies.

BLACKSTONE RIVER DRAINAGE BASIN

RIVER SECTION	PRESENT WATER QUALITY CONDITIONS	CLASSIFICATION
Pascoag River, including Burlingame Reservoir and Pascoag Reservoir, and its tributaries to Pascoag Reservoir Dam	B	B
Pascoag River from Pascoag Reservoir Dam to confluence of Clear River	C	B
Chepachet River, including Keech Pond and Smith and Sayles Reservoir, to dam at Chepachet	B	B
Sucker Brook, including Sucker Pond and Steare's Pond, to confluence with Chepachet River, and Spring Grove Brook, including Spring Grove Pond to confluence with Chepachet River	B	B
Chepachet River from dam at Chepachet to confluence with Clear and Branch Rivers	C	B
Tarklin Brook including Tarklin Pond	B	B
Crookfall Brook, including Woonsocket Reservoir to confluence with Blackstone River	A	A
West Sneech Brook to confluence with Blackstone River	C	B
East Sneech Brook, including Sneech Pond, to Pawtucket Reservoir	A	A
Monastery Brook to confluence with Blackstone River	B	B

BLACKSTONE RIVER DRAINAGE BASIN (Cont'd.)

RIVER SECTION	PRESENT WATER QUALITY CONDITIONS	CLASSIFICATION
Peters River from Massachusetts-Rhode Island state line to confluence with Blackstone River	C	B
Abbott Run Brook, including Pawtucket Reservoir and all tributaries to Rhode Island-Massachusetts state line	A	A
Abbott Run Brook from Massachusetts-Rhode Island state line to confluence with Blackstone River	A	A

PAWTUXET RIVER BASIN

RIVER SECTION	Present Water Quality Conditions	Classification
Scituate Reservoir and all tributaries thereto and North Branch Pawtuxet River and Scituate Reservoir to 1/2 mile downstream from dam	A	A
North Branch Pawtuxet River from 1/2 mile downstream of Scituate Reservoir Dam to Fiskeville Dam	B	B
North Branch Pawtuxet River from Fiskeville Dam to the confluence of North and South Branches of the Pawtuxet River at River Point	C	C
Pawtuxet River from confluence of North and South Branches of the Pawtuxet River at River Point to the Pawtuxet Cove Dam at Pawtuxet	C/D	C
Meshanticut Brook to its confluence with Pawtuxet River	B	B
Three Ponds Brook to its confluence with Pawtuxet River	B	B
Pocasset River and its tributaries to Print Works Pond discharge	B	B
Pocasset River from discharge of Print Works Pond to its confluence with Pawtuxet River	C	C
Spectacle Pond	C	B
Mashapaug Brook from Spectacle Pond including Mashapaug Pond and all ponds in Roger Williams Park to its confluence with Pawtuxet River	C	C
Aldrich Brook to its confluence with Pawtuxet River	B	B
Big River and all its tributaries to its entrance into Flat River Reservoir at Harkney Hill Road Highway Bridge	A	A
Flat River Reservoir from Harkney Hill Road to South Main Street Highway Bridge, Washington on the South Branch of Pawtuxet River including all tributaries thereto	B	B
South Branch Pawtuxet River from South Main Street Highway Bridge, Washington to its confluence with Pawtuxet River	C	C
Tiogue Lake	B	B

PAWCATUCK RIVER DRAINAGE BASIN

RIVER SECTION	Present Water Quality Conditions	Classification
White Horn Brook to South of Kingston Road	A	A
White Horn Brook south of Kingston Road to its entrance into Worden Pond	B	B
Chipuxet River to Yawgoo Mill Pond Dam	A	A
Brook tributary to Chipuxet River just below Yawgoo Mill Pond	A	A
Chipuxet River from Yawgoo Mill Pond Dam to its entrance to Worden Pond, including Hundred Acre Pond	B	B
Chickasheen Brook to Yawgoo Pond	A	A
Chickasheen Brook from its entrance to Yawgoo Pond to its confluence with Usquepaug River	B	B
Fisherville Brook and Socom Brook to its confluence with Queen River	A	A
Queens Fort Brook to 3/4 mile below Victory Highway	A	A
Queens Fort Brook from 3/4 mile below Victory Highway to confluence with Queen River	B	B
Queen River to entrance to Bear Swamp	A	A
Queen River from entrance to Bear Swamp to confluence of Queens Fort Brook	C	C
Queen River from confluence of Queens Fort Brook including Glen Rock Reservoir and Usquepaug River to confluence with Pawcatuck River	B	B
Pasquiset Pond and Pasquiset Brook	A	A
Beaver River to its confluence with Pawcatuck River	A	A
Meadow Brook to its confluence with Pawcatuck River	A	A
Indian Cedar Swamp and Brook	B	B
Roaring Brook to its confluence with Wood River	B	B
Wood River including Breakheart Brook, Acid Factory Brook, Flat River, Fall River and Parris Brook to the confluence of Roaring Brook	A	A
Wood River from confluence of Roaring Brook to dam at Wyoming	B	B
Wood River from dam at Wyoming to 3/4 mile downstream from confluence of Moscow Brook	C	C
Wood River from 3/4 mile downstream from confluence of Moscow Brook to confluence with Pawcatuck River	B	B
Brushy Brook to Sawmill Road	A	A
Grassy Pond and Grassy Brook to its entrance to Winchest Pond	A	A

PAWCATUCK RIVER DRAINAGE BASIN (Cont'd.)

RIVER SECTION	Present Water Quality Conditions	Classification
Moscow Brook from and including Yawgoo Pond, Winchock Pond and Locustville Pond to its confluence with Wood River	B	B
Canonchet Brook from and including Ashville Pond and Blue Pond to its confluence with Wood River	B	B
Pequiant Brook from and including Watchaug Pond to its confluence with the Pawcatuck River	B	B
Tomaquag Brook to its confluence with Pawcatuck River	A	A
Chapman Pond and Aguntaug Brook	B	B
Ashaway River to Ashaway Road highway bridge	A	A
Ashaway River from Ashaway Road highway bridge to confluence with Pawcatuck River	C	C
Pawcatuck River from and including Worden Pond to dam at Kenyon	B	B
Pawcatuck River from dam at Kenyon to 1/4 mile downstream of Horseshoe Falls Dam at Shannock	C	C
Pawcatuck River from 1/4 mile downstream of Horseshoe Falls Dam at Shannock to Carolina Dam	C	B
Pawcatuck River from Carolina Dam to Didle Hole	B	B
Pawcatuck River from Didle Hole to Meeting House Bridge	C	C
Pawcatuck River from Meeting House Bridge to dam at White Rock	B	B
Pawcatuck River to Main Street highway bridge - Westerly	C	C
Pawcatuck River from Main Street highway bridge in Westerly to Pawcatuck Rock	SC	SC
Pawcatuck River from Pawcatuck Rock to a line from Pawcatuck Point to Rhodes Point	SC	SB
Little Narragansett Bay and Watch Hill Cove from a line from Pawcatuck Point to Rhodes Point	SB	SA
Block Island Sound, west of Napatree Point	SA	SA

THAMES RIVER BASIN

RIVER SECTION	PRESENT WATER QUALITY CONDITIONS	CLASSIFICATION
Croff Farm Brook to Rhode Island-Connecticut state line	B	B
Blackmore Brook including Cedar Swamp Pond and Wakefield Pond to Rhode Island-Connecticut state line	B	B

THAMES RIVER BASIN (Cont'd.)

RIVER SECTION	PRESENT WATER QUALITY CONDITIONS	CLASSIFICATION
Keech Brook, including Peck Pond, to Rhode Island-Connecticut state line	B	B
Mary Brown Brook including Hawkins Pond, Clarkville Pond, Bowdish Reservoir, Wilbur Pond, and Lake Washington to Rhode Island-Connecticut state line	B	B
Lacy Brook including Nowry Meadow Brook to Rhode Island-Connecticut state line	B	B
Whetstone Brook including Killingly Pond to Rhode Island-Connecticut state line	B	B
Moosup River to Rhode Island-Connecticut state line including all its tributaries	A	A
Pachaug Brook including Beach Pond to Rhode Island-Connecticut state line	B	B

WOONASQUATUCKET RIVER BASIN

RIVER SECTION	PRESENT WATER QUALITY CONDITIONS	CLASSIFICATION
Stillwater River and its tributaries, including Nine Foot Brook and Waterman Reservoir, to its entrance into Stillwater Reservoir	B	B
Slack Reservoir and the brook from Slack Reservoir to Stillwater River	B	B
Sprague Upper Reservoir and Sprague Lower Reservoir to Stillwater River	B	B
Mountaindale Reservoir	B	B
Woonasquatucket River and Stillwater Reservoir	B	B
Woonasquatucket River and Stillwater Pond, Capron Pond and Georgiaville Pond	B	B
Woonasquatucket River from Georgiaville Pond Dam to Esmond Mill Drive	B	B
Woonasquatucket River from Esmond Mill Drive to its confluence with the Providence River in Providence	C	C

MOSHASSUCK RIVER BASIN

RIVER SECTION	PRESENT WATER QUALITY CONDITIONS	CLASSIFICATION
Moshassuck River above and including Bleachery Pond, Barney Pond, and Olney Pond	B	B

RIVER SECTION	PRESENT WATER QUALITY CONDITIONS	CLASSIFICATION
Moshassuck River downstream of Bleachery Pond to confluence with Providence River at Providence	C	C
West River including Wenscott Reservoir to 1/2 mile downstream of Mineral Spring Avenue	B	B
West River 1/2 mile downstream from Mineral Spring Avenue to confluence with Moshassuck River	C	B

TEN MILE RIVER BASIN

RIVER SECTION	PRESENT WATER QUALITY CONDITIONS	CLASSIFICATION
Ten Mile River from Massachusetts-Rhode Island state line to Newman Avenue Dam	C	C
Ten Mile River from Newman Avenue Dam to confluence with Seekonk River	C	B
Seven Mile River from Massachusetts-Rhode Island state line to its confluence with Ten Mile River	C	C

SAUGATUCKET RIVER DRAINAGE BASIN

RIVER SECTION	PRESENT WATER QUALITY CONDITIONS	CLASSIFICATION
Saugatucket River including Indian Lake and Saugatucket Pond to North Road, Peace Dale, South Kingstown	B	B
Rocky Brook including Asa Pond, Peace Dale Reservoir and Rocky Brook Reservoir to its confluence with Saugatucket River, Peace Dale, South Kingstown	B	B
Indian Run Brook including Indian River Reservoir to its confluence with Saugatucket River, Peace Dale, Kingstown.	C	B
Saugatucket River from Kingston Road in Peace Dale to the Main Street Dam in Wakefield (1.1 miles)	B	B

NARRAGANSETT BAY DRAINAGE BASIN

And Other Sea Waters

SECTION	PRESENT WATER QUALITY CONDITIONS	CLASSIFICATION
Seekonk River from Main Street Dam, Pawtucket, to India Point, Providence	SC	SC
Providence River from Providence south to a line from Edgewood Yacht Club to Pomham Rocks	SD	SC
Providence River south of a line from Edgewood Yacht Club to Pomham Rocks and north of a line from Gaspee Point to Bullock Point	SC	SC
Providence River south of a line from Gaspee Point to Bullock Point and north of a line from the eastern extremity of Elgin Street, Conimicut to the entrance of Massachuck Creek, Barrington	SC	SB
Providence River south of a line from the eastern extremity of Elgin Street, to the entrance of Massachuck Creek, Barrington north and west of a line from Conimicut Point to Old Tower at Nayatt Point	SB	SB
Buckeye Brook from downstream end of Warwick Pond to Bay	C	B
Near shore areas from Conimicut Point to Warwick Neck Light	SA/SB	SA
Warren and Barrington Rivers from Massachusetts-Rhode Island State line to railroad bridges north of Rt. 103	SA/SB	SA
Warren and Barrington Rivers from railroad bridges north of Rt. 103 to a line from the concrete jetty at the north end of the Warren Town Beach through Nun Buoy 14 and its extension to the Barrington Shore	SC	SC
Warren River south of a line from the concrete jetty at the north end of the Warren Town Beach through Nun Buoy 14 and its extension to the Barrington Shore and north of a line from Adams Point to Jacobs Point	SB	SB
Upper Narragansett Bay in the vicinity of North Farm on the Bay south of line from the northernmost extremity of the breakwater at the North Farm marina easterly to the shore, and east and north of the breakwater at the North Farm marina (5 acres)	SA/SB	SB
Mount Hope Bay east and north of lines joining the following points: The end of Brayton's Point, Somerset Buoy R "4" and Borden's Wharf, Tiverton	SC	SC

RIVER SECTION	PRESENT WATER QUALITY CONDITIONS	CLASSIFICATION
Mount Hope Bay west and south of lines joining the following points: The end of Brayton Point, Somerset: Buoy R "4" and Borden's Wharf, Tiverton and east of lines joining the following points: the end of Gardner's Neck Road, Swansea; Buoy N "2", through Buoy C "1A" to Common Fence Point, Portsmouth; and north of a line drawn from Portsmouth to Tiverton at the Stone Bridge	SB	SB
Mount Hope Bay west and south of lines joining the following points: the end of Gardner's Neck Road, Swansea, Buoy N "2"; Buoy C "1A", and Common Fence Point, Portsmouth; south of a line from the first dock north of the entrance to the Kickamuit River and extended to the west shore and east of a line from shore to shore passing through the most westerly points of the two center piers of the Mount Hope Bridge	SB	SA
Kickamuit River from the Massachusetts-Rhode Island State line southerly to School House Road	B	B
Kickamuit River southerly from School House Road to Child Street Bridge	A	A
Kickamuit River southerly from Child Street Bridge to a line from the easternmost end of Smith Street to the northwestern most tip of Coggeshall peninsula	SA	SA
The Kickamuit River southerly from a line from the eastern most end of Smith Street to the northwestern most tip of the Coggeshall peninsula to the river mouth	SA/SB	SA
Stafford Pond and Sucker Brook to Rhode Island - Massachusetts state line	B	B
Sin and Flesh Brook to Fish Street	C	C
Sin and Flesh Brook from Fish Street to Main Street (Rt. 77) Tiverton	B	B
Adamsville Brook to Rhode Island-Massachusetts state line, Tiverton	B	B
Dundary Brook to Meetinghouse Lane	B	B
Dundary Brook from Meetinghouse Lane to 1 mile downstream of Meetinghouse Lane (Little Compton, Rhode Island [1 mile])	C	C

STATION	PRESENT WATER QUALITY CONDITIONS	CLASSIFICATION
Dundery Brook from 1 mile downstream of Meetinghouse Lane to Briggs Marsh (1 mile)	B	B
Sakonnet River off the east shore of Portsmouth in the vicinity of Elmhurst Academy	SC	SC
Sakonnet River south and west of a line from the Rhode Island Department of Environmental Management range marker located approximately 1000 feet north of the eastern end of Sherwood Terrace Road, Portsmouth, Rhode Island, to Can Buoy 7 and north and west of a line from the Rhode Island Department of Environmental Management range marker located just north of McCorrie Point to Nun Buoy 10 (25 acres)	SC	SC
Bristol Harbor east of a line from McKee's Wharf on Bristol Neck to light at Coast Guard Station dock	SC	SC
Bristol Harbor west of a line from McKee's Wharf on Bristol Neck to light at Coast Guard Station and east of a line from the northern most indentation of Bristol Harbor to the northeast extremity of Hog Island and north of a line from the northeast extremity of Hog Island to McKee's Wharf on Bristol Neck	SB	SB
Inner Apponaug Cove	SC	SC
Outer Apponaug Cove and northwest of a line from Cedar Tree Point to end of Neptune Avenue on the west shore	SB	SB
Warwick Cove north of a line from boat ramp at Oakland Beach to rock abutment of abandoned railroad trestle on east shore	SB	SB
Greenwich Cove south of Long Point	SC	SC
Greenwich Cove north of Long Point and west of a line from the northerly point of Long Point to the southerly point of Chepiwanoxet Peninsula	SA/SB	SB
Potter Cove at Prudence Island	SA/SB	SA
The waters in the vicinity of East Ferry west of a line from Bryer Point to Lincoln Street (61 acres)	SA/SB	SB
West Passage off Jamestown in the vicinity of West Ferry, south and east of a line from the Rhode Island Department of Environmental Management range marker located at the western end of Watson Avenue to Dutch Island Light House and north and east of a line from the southwest corner of the Old Ferry dock to the northeast extremity of Dutch Island	SA/SB	SB

SECTION	PRESENT WATER QUALITY CONDITIONS	CLASSIFICATION
The waters within 500 feet of the firing pier of the U.S. Navy Torpedo Testing Station, Gould Island	SA	SA
The waters within a 35 foot radius of the outfall from the boat building facility at Arnold Point	SC	SC
The waters in the area easterly from a line drawn from Coggeshall Point southwesterly to the southeasternmost point of Dyer Island and the area easterly from a line drawn from Carr Point northwesterly to the southeasternmost point of Dyer Island	SC	SC
The waters in the vicinity of Taylor Point which are within a 300 foot radius of the Jamestown marine outfall sewer (7 acres)	SC	SC
The waters in the vicinity of Taylor Point, exclusive of those waters described above, south of a line from the northernmost extremity of Taylor Point to Can Buoy 13, north of a line from a point of land approximately 1000 feet south of the Newport Bridge to the northernmost extremity of Rose Island, and within 1000 feet of the shoreline of Jamestown (49 acres)	SA/SB	SB
The waters in the vicinity of Wharton's Shipyard which are south and west of a line from a point of land approximately 3000 feet north of Bull Point to the northernmost of "the Dumplings", and west of a line from the northernmost of the "Dumplings" to a point of land approximately 1000 feet north of Bull Point (17 acres)	SA/SB	SB
Waters in the vicinity of East Cove and Fort Wetherill which are west of a line from the northeast corner of the pier at Fort Wetherill to a point of land in the northern shore of East Cove	SA/SB	SB
Unnamed Brook from Greene Lane, Middletown, Rhode Island to East Passage, Narragansett Bay (1 1/2 mile)	C	B
Unnamed Brook upstream of Greene Lane to headwaters	B	B
Easton Pond, Middletown and Newport	B	B
East of a line from Ida Lewis Rock to the southern extremity of Goat Island, east of a line from the northern extremity of Goat Island to the west shore of Coasters Harbor Island, east of a line from the west shore of Coasters Harbor Island to the western extremity of Coddington Point and south and east of a line from the southwestern extremity of Coddington Point to the northern most point of the Coddington Cove breakwater	SC	SC

SECTION	PRESENT WATER QUALITY CONDITIONS	CLASSIFICATION
The area within 1000 feet off of Monroe Street (in the Fort Adams Naval housing complex) on the west shore of Fort Adams, east of line from Fort Adams Light to Rose Island Light to Buoy (FLR) Bell 14 and a line from Buoy (FLR) Bell 14 through Nun Buoy 16 at Coddington Point and its extension to the end (southeastern most point) of the Coddington Cove breakwater	SB	SB
Waters within a 600 foot radius of Greene Lane, Middletown	SA/SB	SB
The waters in the vicinity of Fort Adams, Newport, which are within a 300 foot radius of the Fort Adams marine outfall sewer (4.1 acres).	SC	SC
The waters in the vicinity of Coasters Harbor which are within 500 feet of the Newport marine outfall sewer (18 acres).	SC	SC
The waters in the vicinity of Piers No. 1 and No. 2 at the Davisville Depot that a south of a line from a northeast corner of Pier No. 2 (thence northerly pier at the Davisville Depot) to Nun Buoy 14, north of a line from the Rhode Island Department of Environmental Management range marker located on the bulkhead at approximately 300 feet south of Pier No. 1 (the more southerly pier at the Davisville Depot) to Nun Buoy 12, including all waters between the above described lines which are west of a line and the extension of a line from the northeastern end of the bulkhead at Quonset State Airport through Nun Buoy 16	SC	SC
The waters in the vicinity of Quonset Point within 1500 feet of shore from the western end of the carrier pier to a point 1000 feet north of Quonset Point	SC	SC
The waters in the vicinity of Quonset Point exclusive of those waters described above, north and east of the intersection of a line extending from Fourth Street, North Kingstown, southeast to the northeasternmost point on Fox Island and a line drawn from the Wickford Lighthouse to Buoy R 6, west of the line from Buoy R6 to Nun Buoy 10, south of the line from Nun Buoy 10 through F G Buoy 11 extended to the shore	SB	SB
Wickford Harbor including Mill Cove and Mill Creek west of a line from the northerly extremity of Big Rock Point to the easterly extremity of Cornelius Island, west and south of a line from the northerly extremity of Cornelius Island to a point 1000 feet north of Calf Neck and Mill Creek south of a line from Camp Avenue culvert and not including Wickford Cove	SB	SB

SECTION	PRESENT WATER QUALITY CONDITIONS	CLASSIFICATION
Wickford Cove	SC	SC
Fry Brook southerly most branch and mainstem to the confluence of the Hunt River (1 1/2 miles)	C	B
Upper Fry Brook tributaries	B	B
Hunt River from French Town Road to Austin Road (1 1/2 miles)	C	B
Hunt River from Austin Road to tidal waters	B	B
Annaquatucket River, including Belleville Pond, Oak Hill Road, Kettle Hole Pond, and Secret Lake, to Boston Neck Road	B	B
West of the mouth of Bissel Cove	SB	SB
Silverlake, Carr Pond and adjoining brook	B	B
The waters in the vicinity of South Ferry within 500 feet of the University of Rhode Island Narragansett Bay Marine Campus (9 acres)	SC	SC
The waters in the vicinity of South Ferry Road, Narragansett, south of a line from the Rhode Island Department of Environmental Management range marker located approximately 1000 feet north of South Ferry Road to Dutch Island lighthouse and west of a line from the eastern extremity of Casey Point to the eastern extremity of Bonnet Shores and north of a line from the Rhode Island Department of Environmental Management range marker located approximately 1500 feet south of South Ferry Road to the northern extremity of Beavertail, Jamestown	SB	SB
The waters in the vicinity of Tucker's Dock which are within a 500 foot radius of the South Kingstown/Narragansett Regional Sewage Treatment Plant outfall (18 acres)	SC	SC
The waters in the vicinity of Tucker's Dock, exclusive of those waters described above, which are within 2500 feet of any point on the shoreline between Continental Road and Hazard Avenue (207 acres)	SB	SB
The waters in the vicinity of Scarborough within 500 feet of the marine outfall sewer located approximately 2000 feet, bearing 133° from a point of land at the northern boundary of Fort Nathaniel Greene (18 acres)	SC	SC
The waters in the vicinity of Scarborough which are more than 500 feet but less than 1500 feet away from the marine outfall sewer located approximately 2000 bearings 133 degrees from a point of land at the northern boundary of Fort Nathaniel Greene (144 acres)	SB	SB

SECTION	PRESENT WATER QUALITY CONDITIONS	CLASSIFICATION
Upper Point Judith Pond north of Can Buoy 25 including the Saugatucket River downstream of the Main Street Dam (43 acres)	SB	SB
The waters in the vicinity of Galilee within 500 feet of the shore from the northern end at the breachway to the western side of the Great Island Road bridge	SB	SB
The waters in the vicinity of Jerusalem within 500 feet of the shore from the breachway to a point approximately 1000 feet north of the State Pier (23 acres)	SC	SB
The waters in the vicinity of Snug Harbor within 500 feet of shore from Gooseberry Road to High Point (24 acres)	SB	SB
Great Salt Pond, New Shoreham south of a line from a point 1000 feet northwest of Champlin's Dock to Can Buoy 5 and southwest of a line from Can Buoy 5 to a point 1000 feet north of the narrows on the southeast shore of the same pond	SA/SB	SB
The waters in the vicinity of Old Harbor which are within a 500 foot radius of the Block Island marine outfall (12 acres)	SC	SC
The waters in the vicinity of Old Harbor, exclusive of the waters described above, which are within 1000 feet from shore from a point 1000 feet north of the Block Island marine outfall sewer to a point 1000 feet south of the marine outfall sewer (31 acres)	SB	SB
The waters in the vicinity of Old Harbor west of a line from the fixed red light at the end of the northern breakwater to the shore at Pecbly Beach which are not included in the SB & SC areas above (23 acres)	SB	SB
All other sea waters of Narragansett Bay, Sakonnet River, Rhode Island Sound and Coastal ponds, Block Island Sound and coastal ponds not delineated above	SA	SA

APPENDIX B
R.I. DEM AMBIENT WATER QUALITY GUIDELINES FOR PRIORITY POLLUTANTS

I. Purpose. This Appendix contains the ambient water guidelines referenced in Sections 6.32 and 6.33 of the Rhode Island Water Quality Regulations as amended. The purpose of these guidelines is to use optimally and consistently all quality data pertaining to the aquatic toxicity of a pollutant in order to determine a concentration of that pollutant which will be protective of aquatic life. These guidelines will be used to assess the quality of any fresh, estuarine, or marine surface water body and to set permit limitations for any facility which discharges into such waters.

All guidelines are subject to site-specific modification procedures referenced in Sections 6.32 and 6.33 of the Regulations and described in Appendix C. In addition, permit limitations may be based on considerations other than aquatic organism toxicity (see definition of "effluent limitation").

This Appendix to the Regulations shall be revised annually or as necessary. Any amendments will be subject to public notice and public comment. It is expected that these guidelines shall be revised and updated as new pollutants are detected and new information becomes available.

All numerical concentrations and equations listed in this Appendix shall be termed collectively the "RIDEM Ambient Water Quality Guidelines".

In addition to the guidelines, table 4 of this Appendix contains a complete list of "priority pollutants".

II. Derivation of Fresh Water Guidelines. RIDEM guidelines for fresh water can be divided into two categories according to the methodology by which they were derived. The first set of fresh water guidelines was adopted from the EPA 1986 Water Quality Criteria, while the second set was developed using minimum data base requirements and an uncertainty factor approach. When evaluating a request for site specific modification of a guideline (see Appendix C), the methodology by which the guideline was derived should be considered. For this reason, the two sets of guidelines are listed separately below.

A. *EPA Water Quality Criteria*

EPA has published water quality criteria for the protection of aquatic life for 23 of the 126 priority pollutants (45 FR 79318 November 28, 1980 and as amended at 50 FR 30784, July 29, 1985). These pollutants are priority metals and pesticides, and PCBs and cyanide. The EPA Water Quality Criteria consist of both an acute concentration and a chronic concentration for each pollutant. To protect aquatic life, the one-hour average concentration of a pollutant should not exceed acute criteria while the four-day average concentration of a pollutant should not exceed the chronic criteria more than once every 3 years on the average. The methodology by which these EPA criteria were derived is given in the Federal Register announcement.

On 29 July 1985, EPA published in the Federal Register (50 FR 30784) revisions of the 1980 water quality criteria. These criteria, which have been adopted by the State, appear in Table I. A comprehensive summary of the most recent water quality criteria can be found in the EPA "Gold Book" (1986).

TABLE I

FRESH WATER AQUATIC LIFE CRITERIA
EPA 1986

Name	Acute (ug/l)	Chronic (ug/l)
Arsenic	360	190
Cadmium	$e^{(1.128[\ln H]-3.828)}$	$e^{(.7852[\ln H]-3.49)}$
Chromium III	$e^{(.819[\ln H]+3.688)}$	$e^{(.819[\ln H]+1.561)}$
Chromium VI	16	11
Copper	$e^{(.9422[\ln H]-1.464)}$	$e^{(.8545[\ln H]-1.465)}$
Lead	$e^{(1.273[\ln H]-1.46)}$	$e^{(1.273[\ln H]-4.705)}$
Mercury	2.4	0.012
Nickel	$e^{(.846[\ln H]+3.3612)}$	$e^{(.846[\ln H]+1.1645)}$
Selenium (Selenite)	260	35
Silver	$e^{(1.72[\ln H]-6.52)}$	acute/45 [a]
Zinc	$e^{(.8473[\ln H]+.8604)}$	$(.8473[\ln H]+.7614)$
—		
Aldrin	4	- [b]
Dieldrin	1	0.0019
Chlordane	2.4	0.0043

Name	Acute (ug/l)	Chronic (ug/l)
DDT	1.1	0.001
Endosulfan	0.22	0.056
Endrin	0.18	0.0023
Heptachlor	0.52	0.0038
Gamma-BHC (Lindane)	2.0	0.08
Toxaphene	0.73	0.0002
—		
Cyanide	22	5.2
PCBs	2	0.014

NOTES: H = hardness (mg/l as $CaCO_3$)

(a) No EPA chronic criteria is available for silver. The chronic value should be determined by dividing the acute value, given by the hardness equation, by an acute to chronic ratio of 45.

(b) - indicates that no data is available.

B. *Minimum Data Base Guidelines*

RIDEM has derived freshwater guidelines for many pollutants for which EPA Water Quality criteria are not available. In order for a guideline to be derived, the toxicity data base for the pollutants must meet minimum requirements. These guidelines are given in Table II.

The data base must contain at least two acute toxicity test results expressed as either an EC_{50} or an LC_{50} as specified in the EPA Water Quality Criteria Guidelines (45 FR 79343, 1980). "LC_{50}" is defined as the concentration of a test material in a suitable diluent at which 50 percent of the exposed organisms die during a specified time period. "EC_{50}" is defined as the concentration of a test material in a suitable diluent at which 50 percent of the exposed organisms exhibit a specified response during a specified time period.

The two acute toxicity test results shall consist of:

1. One daphnid (*D. magna* or *D. pulex*)
2. One fish, either:

(a) fathead minnow (*Pimephales promelas*)

(b) bluegill (*Lepomis macrochirus*)

(c) rainbow trout (*Salmo gairdneri*)

For every pollutant which meets these minimum data requirements, acute and chronic guidelines are derived using the following equations:

Lowest LC_{50} or EC_{50} × .05 = Acute guideline

Acute guideline ÷ 45 = Chronic guideline

The uncertainty factor, .05, is intended to provide an adequate margin of safety to protect most aquatic organisms from acutely toxic effects. The uncertainty factor was selected by calculating uncertainty factor guidelines for those pollutants with EPA Water Quality Criteria. These guidelines were most similar to the EPA Water Quality Criteria when an uncertainty factor of .05 was used.

The acute guideline is divided by an acute to chronic ratio of 45 to yield the chronic guideline. This ratio was derived by the State of Michigan using all available acute to chronic values for priority pollutant tests performed on fresh water species. It was determined that 80% of the pollutants would have a geometric mean acute to chronic ratio of 45 or less.

The methodology by which these criteria are derived is similar to that used in the EPA Red Book (1976) which preceded the 1980 Water Quality Criteria.

TABLE II: RIDEM MINIMUM DATA BASE GUIDELINES

Name	Acute (µg/l)	Chronic (µg/l)
Acrolein	2.9	.06
Acrylonitrile	378	8.4
Antimony	450	10
Arsenic III (inorganic)	52	1.2
Benzene	265	5.9
Beryllium	7.5	.17
Carbon tetrachloride	1365	30
*Chlorinated benzenes		
Chlorobenzene	795	18
1,2,4-trichlorobenzene	75	1.7
1,2,3,5-tetrachlorobenzene	321	7.1
pentachlorobenzene	13	.28
*Chlorinated ethanes		
1,1,2-trichloroethane	900	20
1,1,2,2-tetrachloroethane	466	10
1,2-dichloroethane	5900	131
1,1,1,2-tetrachloroethane	980	22
pentachloroethane	362	8.0
hexachloroethane	49	1.1
*Chlorinated naphthalenes		
1-chloronaphthalene	80	1.8
*Chlorinated phenols		
2-chlorophenol	129	2.9
4-chlorophenol	192	4.3

TABLE II (con't)

Name	Acute (µg/l)	Chronic (µg/l)
2,4-dichlorophenol	101	2.2
2,4,5-trichlorophenol	23	.51
2,4,6-trichlorophenol	16	.36
2,3,4,6-tetrachlorophenol	7	.16
2,3,5,6-tetrachlorophenol	8.5	.19
pentachlorophenol	2.2	.05
4-chloro-2-methylphenol	15	.32
2,4-dichloro-6-methylphenol	22	.48
Chloroform	1445	32
*Dichlorobenzenes		
1,2-dichlorobenzene	79	1.8
1,3-dichlorobenzene	390	8.7
1,4-dichlorobenzene	56	1.2
*Dichloroethylenes		
1,1-dichloroethylene	580	13
*Dichloropropanes		
1,1-dichloropropane	1150	26
1,2-dichloropropane	2625	58
1,3-dichloropropane	303	6.7
2,4-dimethylphenol	106	2.4
*Dinitrotoluenes		
2,3-dinitrotoluene	17	.37
2,4-dinitrotoluene	1550	34
Diphenylhydrazine	14	.31

TABLE II (con't)

Name	Acute (µg/l)	Chronic (µg/l)
Ethyl benzene	1600	36
*Haloethers		
4-bromophenyl phenyl ether	18	.4
*Halomethanes		
Methylene chloride	9650	214
Bromoform	1465	33
Hexachlorocyclopentadiene	.35	.008
Isophorone	5850	130
Naphthalene	115	2.6
Nitrobenzene	1350	30
*Nitrophenols		
4-nitrophenol	414	9.2
2,4-dinitrophenol	31	.69
2,4,6-trinitrophenol	4235	94
2,4-dinitro-6-methyl phenol	12	.26
*Nitrosamines		
N-nitrosodiphenylamine	293	6.5

TABLE II (con't)

Name	Acute (µg/l)	Chronic (µg/l)
Phenol	251	5.6
*Phthalate esters		
Dimethyl phthalate	1650	37
Diethyl phthalate	2605	58
Butyl benzyl phthalate	85	1.9
Bis (2-ethyl hexyl) phthalate	355	12
*Polynuclear aromatic hydrocarbons		
Acenaphthene	85	1.9
Fluoranthene	199	4.4
Tetrachloroethylene	240	5.3
Thallium	46	1.0
Toluene	635	14
Trichloroethylene	1950	43

NOTE: * denotes chemical group

III. Derivation of Estuarine and Marine Water Guidelines. EPA 1986 Ambient Water Quality Criteria for estuarine and marine waters shall be adopted as State water quality guidelines for those pollutants for which they were derived. These guidelines are given in Table III. At this time, no minimum data base guidelines for priority pollutants in marine waters have been derived.

TABLE III

SALTWATER AQUATIC LIFE CRITERIA
EPA 1986

Name	Acute (ug/l)	Chronic (ug/l)
Arsenic III	69	36
Cadmium	43	9.3
Chromium VI	1100	50
Copper	2.9	2.9
Lead	140	5.6
Mercury	2.1	0.025
Nickel	75	8.3
Selenium (Selenite)	410	54
Silver	2.3	-
Zinc	95	86
—		
Aldrin	1.3	-
Dieldrin	0.71	0.0019
Chlordane	0.09	0.004
DDT	0.13	0.001
Endosulfan	0.034	0.0087
Endrin	0.037	0.0023
Heptachlor	0.053	0.0036

Name	Acute (ug/l)	Chronic (ug/l)
Gamma-BHC (Lindane)	0.16	-
Toxaphene	0.21	0.0002
—		
Cyanide	1.0	1.0
PCBs	10	0.03

IV. Detection Limits. If the State guideline for any pollutant is lower than the "detection limit" for that pollutant, the detection limit shall be considered to be the guideline.

V. Priority Pollutants Without Guidelines. Any pollutant listed on the most recent EPA priority list published in accordance with Section 307(a)(1) of the Clean Water Act (Table IV of this Appendix) for which there is no RIDEM Ambient Water Quality Guidelines shall be regulated in accordance with Section 6.32 and 6.33 of the Regulations.

Table IV
126 Priority Pollutants

The following comprise the list of toxic pollutants designated pursuant to Section 307(a)(1) of the Act:

1. acenaphthene
2. acrolein
3. acrylonitrile
4. benzene
5. benzidine
6. carbon tetrachloride (tetrachloromethane)

Chlorinated Benzenes

7. chlorobenzene
8. 1,2,4-trichlorobenzene
9. hexachlorobenzene

Chlorinated Ethanes

10. 1,2-dichloroethane
11. 1,1,1-trichloroethane
12. hexachloroethane
13. 1,1-dichloroethane
14. 1,1,2-trichloroethane
15. 1,1,2,2-tetrachloroethane
16. chloroethane

Chloroalkyl Ethers

17. bis(2-chloroethyl) ether
18. 2-chloroethyl vinyl ether

Chlorinated Naphthalene

19. 2-chloronapthalene

Chlorinated Phenols

20. 2,4,6-trichlorophenol
21. 4-chloro-3-methylphenol
22. chloroform (trichloromethane)
23. 2-chlorophenol

Dichlorobenzenes

24. 1,2-dichlorobenzene
25. 1,3-dichlorobenzene
26. 1,4-dichlorobenzene

Dichlorobenzidine

27. 3,3-dichlorobenzidine

Dichloroethylenes

28. 1,1-dichloroethylene
29. 1,2-trans-dichloroethylene

30. 2,4-dichlorophenol

Dichloropropane and Dichloropropene

31. 1,2-dichloropropane
32. 1,3-dichloropropene (cis and trans isomers)

33. 2,4-dimethylphenol

Dinitrotoluene

34. 2,4-dinitrotoluene
35. 2,6-dinitrotoluene

36. 1,2-diphenylhydrazine
37. ethylbenzene
38. fluoranthene

Haloethers

39. 4-chlorophenyl phenyl ether
40. 4-bromophenyl phenyl ether
41. bis(2-chloroisopropyl) ether
42. bis(2-chloroethoxy) methane

Halomethanes

43. methylene chloride (dichloromethane)
44. methyl chloride (chloromethane)
45. methyl bromide (bromomethane)
46. bromoform (tribromomethane)
47. dichlorobromomethane
48. chlorodibromomethane

49. hexachlorobutadiene
50. hexachlorocyclopentadiene
51. isophorone
52. naphthalene
53. nitrobenzene

Nitrophenols

54. 2-nitrophenol
55. 4-nitrophenol
56. 2,4-dinitrophenol
57. 4,6-dinitro-2-methylphenol

Nitrosamines

58. N-nitrosodimethylamine
59. N-nitrosodiphenylamine
60. N-nitrosodi-n-propylamine

61. pentachlorophenol
62. phenol

Phthalate Esters

63. bis-(2-ethylhexyl) phthalate
64. butyl benzyl phthalate
65. di-n-butyl phthalate
66. di-n-octyl phthalate
67. diethly phthalate
68. dimethyl phthalate

Polynuclear Aromatic Hydrocarbons

69. benzo(a)anthracene (1,2-benzanthracene)
70. benzo(a)pyrene (3,4-benzopyrene)
71. 3,4-benzofluoranthene
72. benzo(k)fluorathene (11,12-benzofluoranthene)
73. chrysene
74. acenaphthylene
75. anthracene
76. benzo(ghi)perylene (1,12-benzoperylene)
77. fluorene
78. phenanthrene
79. dibenzo(ah)anthracene (1,2,5,6-dibenzanthracene)
80. indeno (1,2,3-cd) pyrene (2,3-o-phenylenepyrene)
81. pyrene

82. tetrachloroethylene

83. toluene

84. trichloroethylene

85. vinyl chloride (chloroethylene)

Pesticides and Metabolites

86. aldrin

87. dieldrin

88. chlordane (technical mixture and metabolites)

DDT and Metabolites

89. 4,4' -DDT

90. 4,4' -DDE (p.p' -DDE)

91. 4,4' -DDD (p.p' -TDE)

Endosulfan and Metabolites

92. a-endosulfan-Alpha

93. b-endosulfan-Beta

94. endosulfan sulfate

Endrin and Metabolites

95. endrin

96. endrin aldehyde

Heptachlor and Metabolites

97. heptachlor

98. heptachlor epoxide

Hexachlorocyclohexane

99. a-BHC-Alpha

100. b-BHC-Beta

101. g-BHC (lindane) Gamma

102. d-BHC-Delta

Polychlorinated Biphenyls (PCBs)

103. PCB-1242 (Arochlor 1242)

104. PCB-1254 (Arochlor 1254)

105. PCB-1221 (Arochlor 1221)

106. PCB-1232 (Arochlor 1232)

107. PCB-1248 (Arochlor 1248)

108. PCB-1260 (Arochlor 1260)

109. PCB-1016 (Arochlor 1016)

110. toxaphene

Metals, Asbestos and Cyanide

111. antimony and compounds
112. arsenic and compounds
113. asbestos
114. beryllium and compounds
115. cadmium and compounds
116. chromium and compounds
117. copper and compounds
118. cyanides
119. lead and compounds
120. mercury and compounds
121. nickel and compounds
122. selenium and compounds
123. silver and compounds
124. thallium and compounds
125. zinc and compounds
126. 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)

APPENDIX C

Bioassay Protocol and Site Specific Modification of State Guidelines

I. Purpose. This appendix contains a protocol for performing bioassays on industrial and municipal effluents, and guidelines for using bioassay results to modify state guidelines for a given discharger. The purpose of this procedure is primarily to be used as a monitoring tool of the toxicity of permitted dischargers and to identify cases where the state guidelines are either too lenient or too stringent due to the specific composition of the effluent and/or the receiving water. Neither negative nor positive bioassay results shall warrant modification of the guideline automatically, but rather the merit of each potential case for modification shall be evaluated individually. In addition, permit limitations may be based on considerations other than aquatic organism toxicity (see definition of "effluent limitation").

II. Bioassay Protocol. Industrial and municipal dischargers may be required to perform bioassays in accordance with permit requirements or a request for additional information made by the Director in accordance with Section 46-12-18 of the R.I. Water Pollution Control Law.

The Director may require a variety of biomonitoring tests including: screening and range finding tests, and definitive tests for acute and chronic toxicity. Any further requirements by the Director shall be conducted in accordance with the latest EPA approved methods. Unless stated otherwise by the Director, the effluent shall be tested initially for acute toxicity according to the following protocol:

A. General

a. Facilities which discharge into fresh waters shall perform the test on both water fleas (*Daphnia manga or Daphnia pulex*) and fathead minnows (*Pimephales promelas*) age less than 30 days. Facilities which discharge to marine or estuarine waters shall perform the test on mysid (Mysidopsis sp.) age 1-5 days, and silverside (Menidia sp.) age less than 30 days, or other species as required by the Director.

b. The test may be static unless loss of DO due to high BOD or loss of potentially toxic volatile pollutants warrants use of a replacement or flow-through test procedure.

c. For single discharge situations, the effluent shall be diluted with receiving water collected immediately upstream of the effluent's zone of influence, unless indicated otherwise by the Director. For multiple discharge situations where the upstream water may contribute significantly to the toxicity of the effluent, the diluent shall be a designated raw water source unless indicated otherwise by the Director. Future tests may require use of upstream water and/or both upstream water and raw water as the diluent at the discretion of the Director on a case-by-case basis.

d. The report of test results shall include a No Observed Acute Effect Level (NOAEL) which is defined as the highest concentration of the effluent (in percent effluent) in which 90% or more of the test animals survive, and an LC_{50} which is defined as the concentration of the effluent which is lethal to 50% of the exposed organisms. The report shall identify the statistical technique(s) used to calculate the LC_{50} and the 95% confidence limits for the LC_{50}. The raw bench data shall be submitted with the report.

e. All chlorinated effluent samples must be received by the testing laboratory within 24 hours of the completion of sampling and testing must be initiated immediately upon receipt of the sample by the testing laboratory.

f. Acute bioassay tests shall be conducted in accordance with protocols listed in the latest edition of Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms (EPA-600/4-85-013), incorporating any deviations from protocol listed herein, or additional methods if approved by the Director.

If selecting a consultant, the discharger should consider:

a. The commitment of management and staff to an effective quality assurance program.

b. Staff experience and education.

c. Adequate laboratory space and equipment to conduct testing.

d. Data handling, record keeping, review, interpretation and reporting.

e. Written test protocols and quality control practices.

B. Definitive Tests

a. Dischargers or their consultants shall test a representative composite sample of their effluent for acute toxicity.

b. The duration of the test shall be 48 hours for daphnia and 96 hours for all other species.

c. A portion of each effluent sample used for the toxicity testing will be chemically analyzed. DEM will advise the permittee of all pollutants requiring analysis after considering all contaminants listed in the application, anticipated to be present, or under consideration for limitation in a permit. In addition, the Department shall require chemical analysis of the dilution water if it is suspected to contain significant levels of pollutants.

C. Acute Range Finding Tests

a. Acute range finding toxicity tests are offered as a cost effective measure to provide the Permittee and the State with other much needed data. These tests are to include only ten organisms per 6 effluent concentrations (eg. 100, 75, 50, 25, 10, 1%) and dilution water as a control.

b. Dischargers or their consultants shall test a representative grab sample of their effluent for acute toxicity.

c. The duration of the test shall be 48 hours for all species tested.

III. Modification of Guidelines Based on Bioassay Results

In accordance with Section 6.32 and 6.33 of the regulations as amended, the RIDEM guidelines may be modified based on the results of bioassays in order to better represent site-specific conditions.

A. Modification of state guidelines may be warranted in either of two generalized cases:

1. If a discharger is in compliance with state ambient water quality guidelines given in Appendix B, yet bioassay test results demonstrate that the effluent is likely to cause toxic conditions in the receiving water, then the state guidelines shall not be considered protective for the given site and discharge, therefore, permit limitations may be adjusted to attain the non-chronically toxic level in the receiving water.

Bioassay results shall be interpreted in the following manner to determine if toxic conditions are likely to occur in the receiving water:

Equation 1:

$$Na = C_S \times \frac{NOAEL}{100}$$

Equation 2:

$$Nc = \frac{Na}{ACR}$$

Where:

NOAEL = No Observed Acute Effect Level, determined by toxicity tests and defined as the highest concentration of the effluent (in percent effluent) in which 90% or more of the test animals survive.

C_s = the concentration of the pollutant in the effluent sample before dilution (ug/l)

Na = the non-acutely toxic concentration of the pollutant (ug/l)

Nc = the non-chronically toxic concentration of the pollutant (ug/l)

ACR = acute to chronic ratio established for each pollutant using EPA and RIDEM water quality criteria documents or other more appropriate data. A default value of 45 shall be used if no reliable information is available.

For waters classified as B, C or SC, if Nc is less than RIDEM guideline, then the guideline may not be protective of water quality and modification may be warranted.

If the determination of significant positive bioassay results is made, the discharger must follow the procedures outlined below:

a. For uses which protect aquatic life and habitat, the concentration of each pollutant in the effluent shall not exceed the concentration which results in attainment of the non-chronically toxic level in the receiving water.

— Freshwater:

Using Nc from equation 2, the following equation shall be used to determine the appropriate concentration in the effluent for each pollutant that was detected during the test:

$$\text{Equation 3: } C_E = Nc \frac{(Q_u + Q_E)}{Q_E}$$

Where:

C_E = concentration in the effluent which will result in non-chronically toxic conditions in the receiving water under low flow conditions (ug/1)

Q_u = ten year, seven day low flow for the receiving water (MGD)

QE = flow of the effluent (MGD)

—Saltwater:

The non-chronically toxic effluent concentration for each pollutant in the effluent sample shall be calculated by multiplying Nc, from equation 2 with the appropriate dilution factor. The dilution factor shall be calculated for both near field and far field using equations in Section 17.12(b)(ii) of the RIPDES regulations, or other methods which are found to be acceptable by DEM.

b. The discharger shall conduct a Toxicity Reduction Evaluation. This evaluation shall include:

1. isolation of the sources of effluent toxicity.

2. determination of the specific causative pollutants if possible.

3. determination of the effectiveness of pollution control options in reducing the effluent toxicity.

4. demonstration of reduced toxicity using bioassays after the control option is installed.

Permits based on the results of the Toxicity Reduction Evaluation shall consist of limitations of specific toxic pollutants and/or limitations of pollutants which are proven to be indicators of toxicity.

2. If any discharger is discharging or proposes to discharge an effluent which is predicted to result in a violation of a RIDEM Ambient Water Quality Guideline for one or more pollutants in the receiving water after low flow dilution, the discharger may petition the Director to develop site specific criteria for the specific location and effluent based on significant negative bioassay results. If the results are determined to be significant by the Director, the site-specific protective effluent concentration (C) will be determined using equations 1 and 2, and either equation 3 or the marine water dilution equations in Section 17(b)(ii) of the RIPDES regulations. If the results of the bioassay, conducted to develop site specific limits, demonstrate that the effluent is likely to cause toxic conditions in the receiving water, the Director may develop permit limitations based on the results as outlined above.

B. The Director's evaluation of the significance of negative or positive bioassay results shall include:

1. the frequency and consistency of test results

2. the test protocol including:

a. number of species tested

b. survivability of the control group

c. test method (static, replacement, flow-through)

d. quality assurance and quality control used by the laboratory.

3. analyses of the effluent sample used in the bioassay: complexity and variability of the effluent.

4. similarity of dilution water used in the test to the the anticipated composition of the receiving water under worst case conditions.

5. relative certainty of the acute to chronic ratio used in bioassay interpretation.

6. relative certainty of the RIDEM Ambient Water Quality Guideline.

U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

APPENDIX B
FIELD SAMPLING METHODOLOGY PLAN

PHASE II RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER,
NEWPORT, RHODE ISLAND

Prepared by:
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Windsor, Connecticut

Prepared for:
Northern Division - Naval Facilities
Engineering Command
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March 1993

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1.0 AMBIENT SURVEYS

Ambient surveys provide a means of measuring concentrations of volatile organic compounds, and combustible gases and oxygen during all Phase II field investigation activities. Data produced from ambient surveys provide "real time" data from which field personnel may monitor site hazards, and act accordingly.

The following two ambient survey techniques will be used throughout the course of investigations at each site.

- Volatile Organic Compound Survey
- Combustible Gas and Oxygen Survey

1.1 VOLATILE ORGANIC COMPOUND SURVEY

An ambient air monitoring program will be conducted at each site prior to and during field investigation activities. An OVA Flame Ionization detector (FID) (Century Organic Vapor Analyzer OVA 128, or equivalent) and a photoionization detector (PID) (HNu Model PI-101 Photoanalyzer with 10.2 eV lamp, or equivalent) will be used to survey the site area prior to sampling activities to assess individual site background conditions. During the site sampling activities these instruments will also be used to continuously monitor ambient and sample concentrations of volatile organic vapors.

Since instruments performing measurements have inherent limitations arising from equipment limitations (fluctuations or drift) and changes in ambient conditions, instrument adjustments may be required to maintain their calibration. Calibration checks of the HNu and OVA will be preformed a minimum of twice per day (at the beginning and end of each day). The OVA and HNu will be calibrated with a hydrocarbon-free "zero" gas and a known hydrocarbon concentration. The OVA and HNu calibration gases consist of concentrations of 10 ppm methane in air and approximately 54 ppm isobutylene in air, respectively. Changes in instrument settings will be noted in the field notebooks under instrument calibration.

1.2 COMBUSTIBLE GAS AND OXYGEN SURVEY

Prior to initiating site activities, sites will be screened for combustible gases and oxygen with a combination combustible gas (lower explosive limit - LEL) and oxygen (O_2) meter. During subsurface explorations, or in any confined spaces, an LEL/O_2 meter will also be used continuously to measure for combustible gases and oxygen. The LEL/O_2 meter will be calibrated a minimum of twice per day (start and finish) with a pentane gas/oxygen mixture.

2.0 GEOPHYSICAL SURVEYS

Geophysical surveys provide a means of measuring: the electrical conductivity of subsurface soil, rock, and ground water through electromagnetics (EM); areas of anomalous magnetic field strength through magnetometer surveys, and subsurface profiles through seismic refraction.

During geophysical surveys, potential interferences to the survey data such as power lines, fences, and other surficial ferromagnetic objects will be noted in field notebooks. Base stations will also be established at each of the RI site from which electromagnetic and magnetic readings will be obtained during the surveys to account for natural variations in the earth's magnetic field.

The geophysical surveys are being used to aid in determining subsurface conditions (e.g., fill/waste areas) at the RI sites. The findings of the geophysical surveys may be used to "fine tune" planned soil, monitoring well, and/or test pit sampling locations. Significant deviations from this plan as a result of the geophysical survey findings will be discussed with representatives of the Navy, EPA, and RIDEM prior to implementation of such modifications.

The following three geophysical survey techniques will be used in the planned investigations of the RI sites.

- Electromagnetic (EM) Terrain Conductivity
- Magnetometer
- Seismic Refraction

2.1 ELECTROMAGNETIC TERRAIN CONDUCTIVITY

The survey will be conducted using a Geonics EM-31 electromagnetic terrain conductivity meter, or equivalent. The EM-31 has a fixed intercoil spacing of 3.7 meters (12 feet) and an effective penetration depth of approximately 6 meters (20 feet). In general, the EM surveys will be used to aid in determining the location and/or extent of buried electrically conductive objects (e.g., tanks, drums, piping) and waste areas (pits, fill). This information may aid in "fine-tuning" the final locations for investigative borings and/or wells.

The EM surveys will be conducted continuously along traverses spaced at intervals established in individual Field Sampling Plans. More detailed EM surveys may be conducted around those areas suspected of having buried objects/materials and around areas of detected anomalies. Anomalies are identified by large fluctuations in EM-31 readings. These fluctuations can either be positive (much higher than background) or negative (near or below zero). To determine if the anomaly is located near the surface or at depth, EM measurements will be obtained in both the horizontal and vertical dipole configurations at each, significantly different from background, detected anomaly.

2.2 MAGNETOMETER SURVEY

The magnetic survey will be conducted with a Geometrics G-856 proton precession land magnetometer, or equivalent. The magnetic surveys will be used to identify areas of buried ferrous metal. The magnetic data will also aid in distinguishing any conductivity (EM-31) anomalies due to ferrous metal from electrically conductive, non-ferrous objects. The magnetometer utilizes the precession of spinning protons of the hydrogen atoms in a sample of fluid (kerosene, alcohol, or water) to measure total magnetic field intensity. The total magnetic field value measured by the proton precession magnetometer is the net vector sum of the ambient earth's field and any local induced and/or remanent perturbations.

The magnetometer surveys will be conducted at evenly spaced points along traverses spaced at intervals established in the individual Field Sampling Plans. More detailed magnetometer surveys may be conducted around those areas suspected of having buried objects/materials and around areas of detected anomalies.

In addition to the magnetometer, a magnetic locator (Schonstedt Model GA-52B, or equivalent) will be used to investigate those areas where magnetic anomalies are detected with the EM-31 or magnetometer. The magnetic locator is designed to locate buried ferromagnetic objects. The magnetic locator will be used to check subsurface investigation locations (i.e., borings and test pits) prior to drilling and/or excavation activities for the possible presence of unknown buried utilities and other buried hazards (e.g., drums, tanks). If unknown buried metallic objects are detected at a planned sample location, the sample location will be moved to

avoid the detected anomaly. The source of the anomaly will be assessed with any other detected anomalies at the site for consideration for further investigations (e.g., test pits).

2.3 SEISMIC REFRACTION SURVEY

A seismic refraction survey is a means of determining the depths to a refracting horizon and the thickness of major seismic discontinuities overlying the high-velocity refracting horizon. The seismic velocities measured by this technique can be used to calculate the mechanical properties of subsurface materials (moduli values), as well as for material identification and stratigraphic correlation.

Interpretations are made from travel time curves showing the measurement of the time required for a compressional seismic wave to travel from the source ("shot") point to each group of vibration sensitive devices (seismometers or geophones). The geophones are located at known intervals along the ground surface. Various seismic sources may be used, including a drop weight, an air gun, and small explosive charges.

The elastic wave measured in the seismic refraction method, the "P" or compressional wave, is the first arrival of energy from the source at the detector. This elastic wave travels from the energy source in a path causing adjacent solid particles to oscillate in the direction of wave propagation. An example of how seismic refraction will determine type material and depth is presented below. The example site has an upper layer composed of a lower velocity material than the bottom layer (i.e., bedrock). At smaller distances between source and detector the first arriving waves will be direct waves that travel near the ground surface through the lower velocity material. At greater distance, the first arrival at the detector will be a refracted wave that has taken an indirect path through two layers. The refracted wave will arrive before the direct wave at a greater distance along the spread because the time gained in travel through the higher-speed material compensates for the longer path. Depth computations are based on the ratio of the layer velocities and the horizontal distance from the energy source to the point at which the refracted wave overtakes the direct wave.

The specifications for the seismic refraction survey at each site will be determined during pre-investigation site visits with geophysical subcontractors.

3.0 SOIL GAS SURVEY

In general, soil gas sampling will be used at specified RI sites to aid in defining the presence, nature, and/or extent of subsurface volatile organic compound (VOC) contamination. Increased concentrations of gaseous VOCs are commonly present within pore spaces of VOC contaminated unsaturated soils, above contaminated buried wastes, and above contaminant plumes of ground water. Analysis of soil gas is an effective screening method to assess the presence and extent of an area contaminated with VOCs. The soil gas survey information is intended to aid in directing surface and subsurface investigation activities at individual sites.

The findings of the soil gas surveys may be used to "fine tune" planned sampling locations. Significant deviations from this plan as a result of the soil gas survey findings will be discussed with representatives of the Navy, EPA, and RIDEM prior to implementation of any such modifications.

3.1 SAMPLING STRATEGY AND SAMPLE LOCATION

A sample grid may be established in individual site Field Sampling Plans to initially characterize appropriate areas in a systematic manner. Additionally, a set number of biased survey points may be established at a site in areas of concern. During the soil gas survey, the sampling grid will be extended, within Navy controlled property, to sufficiently define areas of detected volatile organic contamination. Sampling points may be added to provide further definition, as judged necessary by the TRC-EC field team leader. Any areas of staining or vegetative stress will be noted in the soil gas field notebook and located on a site map.

3.2 SOIL GAS SAMPLING METHODS

All soil gas points will be sampled by a truck mounted-hydraulic sampling device (e.g., geoprobe). Interconnectable lengths of 1" diameter steel pipe will be advanced by the hydraulic sampling device to the required sampling depth. The sampling depths will be determined by evaluating the depth to water, potential contamination sources, and overburden material. In general, two to three soil gas samples will be collected per probe location. The soil gas samples are typically collected from approximately six feet below grade, at a mid-point in the vadose soil

column, and from the interval just above the water table. Thus, the soil gas sample number and depths are primarily dependant upon the depth to ground water. However, subsurface conditions (e.g., bedrock, fill) may prohibit the depth of soil gas sampling. Upon reaching the required sample depth, the bottom of the steel pipe will be opened and a small diameter stainless steel probe attached to teflon tubing will be lowered through the steel casing to the bottom of the hole. Packing material or an inflatable packer will be located just above the perforations at the base of the probe. This will isolate the sampling zone from the steel pipe annulus. Each soil gas sample will be collected from the prescribed depth through the probe after a pump has extracted three apparatus air volumes from the probe. The soil gas sample will then be extracted from the air mass by inserting a glass gas tight syringe into the polyethylene tubing which connects the probe to the vacuum pump. The syringe will extract up to 1 ml of air, the exact volume extracted depends on the concentration of volatile organics in the sample. The sample will then be submitted to a climate-controlled mobile laboratory for "real time" analytical results.

Soil gas samples will be analyzed on a gas chromatograph equipped with a flame-ionization detector (FID). All soil gas samples will be screened for petroleum products using modified (for soil gas) EPA 602 procedures. Soil gas samples will also be run simultaneously through an electron capture detector (ECD) for chlorinated compounds typically contained in industrial solvents, following modified (for soil gas) EPA 601 procedures. Between all sample injections (including unknowns) the syringe will be heated to 60^0C and flushed with UPC grade nitrogen. Standards will be analyzed in order to quantify the following compounds (to a reporting limit of 1.0 ug/l). A total FID volatiles compound concentration will also be calculated for each soil gas sample run.

The laboratory-grade gas chromatograph (GC) will be calibrated prior to the initiation of field work each day. Calibration curves for the GC will include at least three points, on which a linear regression will be run to determine the detector response curve. Analyte standards will be analyzed at intervals of every 10 soil gas samples during analysis. Check standards will also be run at the end of each day to gauge the calibration status. The GC will not analyze any samples if the correlation coefficients of any standardized compounds are less than 0.99.

Field blank samples are collected by drawing pre-purified nitrogen or ambient air (filtered through an MSA organic cartridge filter) through the sampling apparatus and probes prior to each days sampling activities, after every twentieth sample, and at the conclusion of each day. Field blank samples are labeled and analyzed in the same manner as the actual field samples and are visually indistinguishable from the actual field samples (i.e., blind to analyst).

Prior to each days work the soil gas steel pipe will be washed with a non-phosphate detergent/distilled water solution, and wiped dry with clean paper towels. The pipe will then be rinsed with distilled water and wiped dry with clean paper towels. The sampling probe will be washed externally with detergent/distilled water and scrubbed with clean paper towels. The exterior of the probe will be rinsed with distilled water and wiped with clean paper towels. The interior of the probe will be flushed with detergent/distilled water and purged for approximately 30 seconds with 20 psi of ultra-zero grade air, pre-purified nitrogen, or filtered ambient air.

3.3 SAMPLE DESIGNATION AND ANALYSES

For each soil gas sample collected, the soil gas grid number, depth, and the ambient air temperature (at the time of collection) will be recorded in the field log book.

4.0 SURFACE SOIL SAMPLING

The objectives of the surface soil sampling are to assess the presence and nature of surface soil contamination at each RI site. This information will aid in meeting overall sampling plan objectives. Site area specific background surface soil samples will be collected.

4.1 SAMPLING STRATEGY AND SAMPLE LOCATION

Surface soil sampling and other sampling activities have previously been conducted at all of the RI sites. When appropriate, the findings and results of previous investigations were used in establishing the surface soil sampling strategy at each RI site. Surface soil samples will be collected and analyzed as discrete samples.

4.2 SURFACE SOIL SAMPLING METHODS

Surface soil samples will be collected directly with a stainless steel spoon. In some instances (e.g., dense soil) a stainless steel, hand bucket auger may be used to assist in the collection of the samples. Soil samples will be collected within the 0 to 1 foot horizon consistent with EPA risk assessment protocol. Soil samples to be analyzed for VOCs will be collected from the bottom (6 or 9 inches below ground surface) of the 0-1 foot zone. These samples will be transferred directly to the sample container to minimize loss of VOCs from the sample. Other surface soil samples will be collected directly from the ground surface (0-3 inches), below any surface vegetation (leaves, grass, etc.) with a dedicated stainless-steel spoon. All but the sample portion for VOC analysis will be homogenized in a stainless steel bowl prior to being placed into appropriate containers.

Stainless steel spoons and bowls will be dedicated to each sample and will be laboratory decontaminated. Other sampling devices (hand augers) will be decontaminated prior to each use in the field. A geologic and general description (e.g. stains, odors) of each surface soil sample collected will be recorded in a field notebook.

4.3 SURFACE SOIL SAMPLE DESIGNATION

Surface soil samples will be assigned a designated field identification number which will reference the RI site number, sample type, sample location, and sampling date. Below is an example of a surface soil sample identification number:

Example: MP-SS2-032093

where: MP = McAllister Point Landfill
SS = Surface Soil Sample
2 = Sample Location Number
032093 = Sampling Date (March 20, 1993)

5.0 TEST PIT OPERATIONS

The objective of the test pitting program is to physically access and assess the nature of unknown subsurface materials. Significant findings of the test pit investigation will be reviewed with representatives of the Navy, EPA, and RIDEM to evaluate the adequacy of the Phase II RI exploration program.

5.1 TEST PIT SAMPLING METHOD

Test pit excavation activities will be conducted with a backhoe or trackhoe. Test pits will be excavated to the observed ground water table, located feature or anomaly source, or the maximum reach or capability of the backhoe. Information obtained from geophysical or soil gas surveys will be used to aid in "fine tuning" planned test pit locations, as appropriate.

The test pit samples will be collected directly from the backhoe bucket with a dedicated, decontaminated stainless steel spoon. Samples will be collected from the middle of the bucket, at least three to four inches below the surface of bucket material. The sample matrix will be homogenized (or mixed) in a dedicated, decontaminated stainless steel bowl. However, first the sample aliquot for VOC analysis will be placed directly in an appropriate container prior to mixing the sample in a bowl. A geologic and general description of the sample material will be recorded in a field notebook along with the depth and location from which each sample is collected.

Test pit soil samples will be monitored for the presence of total volatile organic vapors with a flame or photo-ionization detector. Test pit excavations will be photographed and staked for survey purposes. Additionally the size (depth, width and length) of the test pit and depth to observed ground water will be recorded at each location. All test pits will be backfilled upon completion of test pit characterization (geologic log, photographic log, instrument survey, documentation of the location/nature of visual contamination, and the collection of soil samples).

5.2 TEST PIT SAMPLE DESIGNATION

Test pit samples will be assigned a designated field identification number which will reference the RI site number, sample type, sample location number, test pit sample number, and sampling date. Below is an example a test pit sample identification number:

Example: FF-TP12-032593

where:
FF = Old Fire Fighting Training Area
TP = Test Pit Sample
1 = Test Pit Location Number
2 = Test Pit Sample Number
032593 = Sampling Date (March 25, 1993)

6.0 TEST BORINGS

Subsurface test borings will be conducted to aid in assessing the presence and nature of soil contamination at individual sites. Information obtained from the geophysical and soil gas surveys may be used to "fine tune" planned test boring locations at each site. Information obtained from the test boring activities may in turn, be used to "fine tune" any planned monitoring well locations. In instances where test boring findings indicate an ideal location for a well (e.g., high levels of contamination observed in fill or aquifer), the test boring may be used for installation of a ground water monitoring well. The rationale for any deviations to the Field Sampling Plans, based upon such field observation, will be discussed with representatives of the Navy, EPA, and RIDEM prior to implementation of such modifications.

6.1 SAMPLING STRATEGY AND LOCATION

Test borings will be drilled and sampled to aid in assessing subsurface soil characteristics and the nature of soil contamination at individual sites. When appropriate, site background information and the findings and results of previous investigations were used in establishing the test boring plan.

6.2 SUBSURFACE SOIL BORING AND SAMPLING METHODS

Split spoon soil samples will be collected at 2.0-foot intervals from each borehole. Standard penetration tests [ASTM D1586-84 (1984)] will be conducted for every 2.0-foot sampling interval. The physical characteristics of each soil sample will be geologically logged and generally described in a field notebook. General observations which may be described include staining, odors, fill material, and wastes. Soil samples to be submitted for laboratory analyses will be transferred from the split spoon to the sample container with a dedicated stainless-steel spoon. Split spoon samples will be collected from the 0 to 1 foot zone for the surface soil assessment. If insufficient soil volume is present to meet laboratory analytical requirements an additional volume of soil will be collected from a second split spoon completed immediately adjacent to the first. The portion of the soil sample which will be analyzed for VOCs will be collected as a discrete sample from the 0.5 to 1 foot portion of the first split

spoon. All other analytical fractions will be homogenized prior to filling sampling containers. Sampling equipment (e.g., augers, drilling rods, spoons) will be decontaminated prior to each use as described in the project Quality Assurance/Quality Control Plan. Split spoon soil samples will be monitored for the presence of total VOC vapors with an organic vapor analyzer immediately upon opening. Field observations will be recorded in a field notebook.

At sites or boring locations open to the public, test borings will be backfilled to within 1.0 foot of the ground surface, after which a cement-bentonite grout will be used to "top-off" the hole to minimize potential future human exposure to contaminated drill cuttings. Remaining drill cuttings will be handled as described in the Investigation Derived Waste Plan in Appendix E of this Work Plan.

6.3 TEST BORING SAMPLE DESIGNATION

Test boring samples submitted for laboratory analyses will be assigned a designated field identification number which will reference the RI site number, sample type, sample location, sample number, and sampling date. Below is an example of a test boring soil sample identification number:

Example: FF-B42-041293

where: FF = Fire Fighting Training Area
B4 = Test Boring Location Number
2 = Second Sample Interval
041293 = Sampling Date (April 12, 1993)

7.0 MONITORING WELLS AND PIEZOMETERS

Monitoring wells will be installed to aid in assessing the nature and extent of any ground water contamination. The monitoring wells and piezometers will be used to provide hydrogeologic information on the aquifer characteristics. Four separate discussions on the monitoring well and piezometer investigations are presented below concerning the following: well sampling strategy, well and piezometer construction details, well sampling methods, and the well sample designation plan.

7.1 MONITORING WELL LOCATIONS

Information obtained from initial Phase II RI field activities (e.g., test borings, soil gas sampling, geophysical surveys) may be used to "fine tune" the final well locations at each RI site, as justified by the information.

7.2 WELL BORING, DRILLING AND SAMPLING METHODS

The boreholes for overburden wells will be advanced using 4¼-inch minimum inside diameter (I.D.) hollow-stem augers. Split spoon samples will be collected continuously at 2.0-foot intervals from the well borings until the water table has been reached or split-spoon refusal (encountered boulders or bedrock). After the water table has been encountered split-spoon soil samples will be collected at 5-foot intervals or an identifiable change in strata. The split-spoons will be advanced according to the standard penetration test method [ASTM 1586-84 (1984)]. The standard penetration test defines split-spoon refusal as less than six inches of penetration for 100 blows with a 140 pound hammer falling 30 inches in conformance with ASTM 1586-84. The physical characteristics of each soil sample will be visually characterized and geologically described in a field notebook. Split spoon samples will also be monitored with a flame or photo-ionization detector (OVA or HNu). Observations will be recorded in the field notebook.

Soil samples to be submitted for laboratory analyses will be transferred directly from the split spoon to the sample container with a dedicated decontaminated stainless-steel spoon. Sampling equipment (e.g., augers, drilling rods, split-spoons) will be decontaminated prior to each use.

At sites where sampler or auger refusal is encountered prior to the water table, a bedrock core will be collected to characterize the bedrock. The monitoring well borehole will be advanced ten feet into the bedrock with two 5-foot, double-tube, Nx rock core barrels. Once the cores are retrieved and opened, a description of the bedrock will be recorded in a field notebook. The rock core will be kept and stored in a core box for future reference. Prior to construction of the overburden monitoring well, the open borehole in the bedrock will be backfilled with a bentonite slurry to the top of the bedrock surface and allowed to set overnight.

The final depth of monitoring wells will be assessed by TRC-EC field personnel. Variables to be considered in establishing the final well depth will include material encountered, observed contamination, geologic material, depth to the water table, and sites sampling objectives.

Well boring drill cuttings will be handled in accordance with the Investigation Derived Waste Plan described in Appendix E of this Work Plan.

7.3 WELL AND PIEZOMETER CONSTRUCTION

Drilling and well/piezometer construction activities will be subcontracted to a qualified well drilling firm. On-site drilling activities will be conducted under the supervision of a TRC-EC geologist/engineer.

Monitoring well construction specifications for this project include the following:

- Six inch borehole (minimum);
- Two-inch inside diameter PVC riser and screen;
- Threaded or press joints only on PVC pipe (no glued joints);
- Silica (quartz) sand backfill to two foot above the screened interval;
- Two foot minimum thick bentonite seal above the sand pack;
- Portland cement/bentonite slurry (about 6:1 ratio respectively) in the well annulus from the top of the bentonite seal to the surface;
- All casing sealant and drilling fluids will be mixed with potable water;
- Vented well cap; and
- Steel casing with a locking cap will be securely set in cement over the well casing stick up and a minimum of three feet below the ground surface. Wells will be clearly numbered on casing. In paved areas, and high traffic areas, wells will be installed with curb boxes constructed at or slightly below grade.

Consistent with State of Rhode Island ground water regulations; the joints on PVC well material will be fitted with an "O" ring or wrapped with teflon tape. The well screen slot size shall retain at least 90% of the grain size of the filter pack. A bottom cap and a sump sediment trap shall be installed. The ground surface seal shall extend to a minimum of 40 inches below the land surface and shall be flared such that the diameter at the top is greater than the diameter at the bottom. The top of the ground surface seal shall be sloped away from the well casing and shall be imprinted with the designation of the monitoring well.

Well screen and riser lengths may vary for each well. Screen lengths for wells intercepting the water table will be a maximum of ten feet, with no more than five feet extending above the water table. The five-foot length of screen above the water table is intended to maintain the water table within the screened interval during seasonal and/or diurnal ground water fluctuations. A ten-foot screen length will be used for deep wells installed below the water table. Well riser lengths will be field-determined so the top of the casing extends approximately one to two feet above the ground surface for wells with stick-up protective casing and approximately four to six inches below grade for wells with flush-mounted curb boxes. The driller and TRC-EC geologist/engineer will maintain accurate written logs of the well construction details.

The piezometer drilling activities will be performed by the drilling subcontractor under the supervision of a TRC-EC geologist/engineer. Construction specifications for the piezometer nests includes the following:

- 3-inch borehole (minimum);
- 1-inch inside diameter PVC riser;
- Threaded or pressed joints only on PVC pipe (no glued joints);
- Silica (quartz) sand backfill to 1 foot above the screened interval;
- 2-foot thick bentonite seal above the sand pack;
- Backfill drilling materials to 2 feet below ground surface;
- Portland cement grout to surface;
- Vented piezometer cap; and
- Steel casing with a locking cap will be securely set in concrete over the well casing stick-up and a minimum of 2 feet below the ground surface. Piezometer numbers will be clearly labelled on the casing.

7.4 WELL DEVELOPMENT

Wells will be developed by the surge block and pump technique. Fine-grained material around the well screen will be drawn into the well and removed by agitating the well water with a surge block and simultaneously pumping water from the well at a low discharge rate. A centrifugal pump outfitted with ASTM drinking water grade polyethylene tubing will be used for removing the water from the well. To prevent cross-contamination between the wells, the surge block will be decontaminated between each well. The surge block will be decontaminated with non-phosphate detergent and tap water, rinsed with tap water, rinsed with methanol, air dried, and rinsed with deionized water. The polyethylene tubing will also be replaced between each well. The dedicated new tubing will be rinsed with deionized water prior to its use. Water produced during well development will be drummed for characterization and analysis.

Should the depth of the well or to ground water prohibit the use of the surge block and pumping technique, an alternative method will be used to develop the well. A suitable pumping device (e.g., submersible pump, Waterra™ hand pump) will instead be placed in the well and used for development. Equipment inserted into the well for development will either be dedicated to that well, or, at a minimum, washed with non-phosphate detergent and tap water, and rinsed with tap water and then deionized water prior to each use.

The volume of ground water extracted from each monitoring well during development will be determined by continually monitoring the following parameters: pH, temperature, specific conductance, and turbidity. Development will continue until pH, temperature, and specific conductance have all stabilized and turbidity is $\leq$ 10 NTU's. If the 10 NTU criteria is not achievable, the parties on-site will determine if a turbidity standard of $\pm 10\%$ on successive well volumes is appropriate. At the time of development of newly installed Phase II wells, the turbidity of existing wells will be checked in accordance with the above criteria.

7.5 GROUND WATER SAMPLING METHODS

A period of at least two weeks will elapse between well development and ground water sampling. Prior to the initiation of sampling activities and immediately upon opening each well a headspace reading will be measured from the casing of each well with a PID or FID. The water level of each monitoring well will then be measured to the nearest 0.01 ft with an

electronic water sensing device (Solinist Model 101) and recorded in a field notebook. The water level indicator will be decontaminated with deionized water prior to each use unless visual observations (e.g., oil, odors) indicate additional decontamination is necessary. Additionally, at those sites where the presence of a non-aqueous phase liquid (NAPL) is anticipated due to previous site information or as potentially indicated by test or monitoring well boring observations, the presence of NAPLs will be assessed (e.g., the thickness of the NAPL will be determined) prior to sampling with an oil/water interface probe. At a minimum, the interface probe will be decontaminated with non-phosphate detergent, tap water, methanol, hexane, tap water and then deionized water after each use. NAPLs known to exist in a well will be sampled and analyzed for TCL VOCs and subject to a petroleum GC fingerprint analysis, prior to purging if an adequate sample volume is obtained from the well.

Prior to ground water sampling, a minimum of three well volumes will be purged from each well using either a hand-operated bailer, a peristaltic pump (preferred), a centrifugal pump, or a submersible pump. The ground water extracted during purging will be continually monitored for pH, temperature, specific conductance, and turbidity. Ground water will be purged until the pH, temperature, and specific conductance have all stabilized and turbidity has stabilized to $\pm$ 10% on successive well volumes. Purging rates will be kept below three gallons/minute to avoid over-pumping or pumping the well to dryness. In addition, the well will be purged from the top of the water column down to allow the purging of the entire water column. The well will be sampled within two hours of purging.

Ground water samples will be collected with dedicated/decontaminated teflon bailers. A teflon leader-line approximately 3-feet in length will be attached to the end of the bailer. A polyethylene coated nylon rope will then be attached to the teflon line and used to lower and raise the bailer in the monitoring well. The ground water sample will be collected by slowly lowering the bailer into the well until the bailer is filled with water. Once filled, the bailer will be raised to the surface where the ground water will be transferred to the appropriate sample containers. The order of sample bottle filling is as follows: TCL VOC (immediately upon completion of purging the well), TCL BNA, TCL pesticides/PCBs, and TAL metals, cyanide, TOC, BOD, COD, and TSS. The teflon bailers will be laboratory-decontaminated prior to use. Ground water samples which will be analyzed for dissolved metals will be filtered through a

0.45 micron filter immediately following collection. Filtered samples will be preserved with nitric acid to a pH of less than 2.

The pH, specific conductance, temperature, dissolved oxygen, salinity, and redox potential of the ground water will be measured in the field immediately after sample collection. The pH, temperature, and redox potential will be measured using an Orion Model SA 230 meter, or equivalent. Specific conductance and salinity will be measured with a YSI Model 33 SCT meter, or equivalent. Dissolved oxygen will be measured with a YSI Model 51B Oxygen meter, or equivalent. Field measurements will be recorded in a field notebook.

7.6 WELL SAMPLE DESIGNATION

Ground water and well boring soil samples will be assigned a designated field identification number which will reference the RI site number, sample type, sample location number, and sampling date. The following are examples of ground water and well boring soil sample identification numbers:

Ground Water Sample:
Example: TF5-MW1-032893

where: TF5 = Tank Farm Five
MW = Monitoring Well Water Sample
1 = Well Number
032893 = Sampling Date (March 28, 1993)

Boring Soil Sample:
Example: MP-B12-032893

where: MP = McAllister Point Landfill
B1 = Well Boring Soil Sample and Number
2 = Second Sample Interval
032893 = Sampling Date (March 28, 1993)

8.0 SURFACE WATER SAMPLING

Surface water samples will be collected from specified RI sites. The collection of surface water samples will aid in characterizing and identifying potential site-related impacts on the sampled surface water bodies.

8.1 SURFACE WATER SAMPLING METHOD

Surface water samples will be collected directly from the surface water body of interest in appropriate sample containers. Surface water samples will be collected by partially submerging the appropriate sample containers in the water body. Care will be taken to minimize turbulence during sampling. Surface water sampling will start downstream and proceed upstream. Surface water samples will be collected prior to any sediment or biota samples at a particular location.

The pH, specific conductance, temperature, dissolved oxygen, turbidity, and salinity of the surface water at each sample location will be measured in the field. The pH will be measured to the nearest tenth of a standard unit and temperature to the nearest degree Centigrade using an Orion Model SA 230 meter, or equivalent. Specific conductance and salinity will be measured with a YSI Model 33 SCT meter, or equivalent. The dissolved oxygen will be measured with a YSI Model 51B oxygen meter. Turbidity will be measured with an HF Scientific Model 15C Turbidity Meter, or equivalent.

A graduated stake will be driven into the sediments at each surface water sample location (for locations with less than four feet of water) for recording the depth of water at the time of sampling and for future reference in locating the sample location.

8.2 SURFACE WATER SAMPLE DESIGNATIONS

Surface water samples submitted for laboratory analyses will be assigned a designated field identification number which will reference the RI site number, sample type, sample location, sample number, and sampling date. The following is an example of a surface water sample identification number:

Example: TF4-SW1-040593

where: NC = Tank Farm Four
SW = Surface Water Sample
1 = Sample Number
040593 = Sampling Date (April 5, 1993)

9.0 SEDIMENT SAMPLING

Sediment samples will be collected from specified RI sites. The collection of sediment samples will aid in characterizing and identifying potential site-related impacts on the sampled surface water bodies.

9.1 SEDIMENT SAMPLING METHODS

Sediment samples will be collected with a precleaned two-inch diameter by two-foot long fiberglass hand coring device. This device will be equipped with a top mounted check valve to prevent sample washout during retrieval through the overlying water column. Core liners will be constructed of fiberglass or similar material. Core ends will be screened with a flame or photo-ionization detector for the presence of organic vapors immediately upon collection and all readings recorded. The portion of the core which indicates evidence of contamination (e.g. odors, discoloration, etc.) will be retained for laboratory analysis. In the absence of obvious zones of contamination, a composite sample will be retained from the entire 2-foot core.

In the event that stones or other material precludes effective use of the above sampling devices, sediment samples will be collected with a spade and spoon. All sediment samples (except VOC aliquot) will be thoroughly mixed in a stainless steel bowl prior to their placement into sample containers. Sediment sample VOC aliquots will be immediately removed from the bowl prior to mixing and placed in an appropriate sample container. Attempts will be made to remove rocks, weeds, water, and other non-sample matrix materials from the sediment sample matrix to ensure that each sediment sample contains greater than 30% solids. The physical and geologic characteristics of each sediment sample will also be recorded in a field notebook. Sample cores will be stored at approximately 4 degrees Centigrade following collection and VOC screening.

9.2 SEDIMENT SAMPLE DESIGNATIONS

Sediment samples submitted for laboratory analyses will be assigned a designated field identification number which will reference the site number, sample type, sample location, sample number, and sampling date. Below is an example of a sediment sample identification number:

Example: TF5-SD1-040593

where: TF5 = Tank Farm Five
SD = Sediment Sample
1 = Sample Number
040593 = Sampling Date (April 5, 1993)

10.0 LAND SURVEYING

Following the completion of the field sampling activities at each of the sites, the sites will be surveyed by a State of Rhode Island registered surveyor. The physical site features along with the location, elevation, and coordinates of sampling stations (outside of buildings) will be determined in the survey. Each sampling location will be referenced to the State of Rhode Island Grid Coordinate System. Completed wells will be surveyed for elevation of the top of the protective casing, top of the well casing, and the adjacent land surface to the nearest 0.01 foot. Previously completed wells, if any, will also be surveyed at this time. All elevations will be referenced to a United States Geological Survey benchmark (mean sea level -msl) and/or mean low water level (mlw) to the nearest 0.01 foot.

U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

APPENDIX C
HEALTH AND SAFETY PLAN

PHASE II RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared by:
TRC Environmental Corporation
Windsor, Connecticut

Prepared for:
Northern Division - Naval Facilities
Engineering Command
Lester, Pennsylvania

March, 1993

TRC-EC Project No. 6760-N81-110
Contract No. N62472-86-C-1282

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PHASE II RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

HEALTH AND SAFETY PLAN APPROVALS

TRC Program Manager	Date
TRC Project Manager	Date
TRC Health & Safety Director	Date
Northern Division Representative	Date

TRC

PHASE II RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

PERSONNEL SAFETY - ACKNOWLEDGEMENT FORM

All TRC project personnel are required to make the following statement prior to conducting work at the Naval Education and Training Center, Newport, Rhode Island.

I, _____ state that:

1. I have read and fully understand the Phase II NETC Health and Safety Plan and my individual responsibilities.

2. I agree to abide by the Health and Safety provisions of this Plan.

_____
Signature

_____
Date

TRC

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1.0 INTRODUCTION

This Health and Safety Plan (HASP) has been prepared by TRC Environmental Corporation (TRC-EC) for specific application to the Phase II Remedial Investigation/ Feasibility Study (RI/FS) for the Naval Facilities Engineering Command (NAVFAC), Northern Division. The HASP has been developed for the Phase II RI of four sites located at the Naval Education and Training Center (NETC) in Newport, Rhode Island. The location of the Newport Naval Base is shown on Figure 1. The four sites included under the Phase II RI are the following:

Site Number	Name
01	McAllister Point Landfill
09	Old Fire Fighting Training Area
12	Tank Farm Four
13	Tank Farm Five

This Health and Safety Plan has been prepared to protect worker health and safety during investigation activities at the four sites shown on Figure 1. Maps of each of the RI sites are provided as Figures 2 through 5. The HASP is intended as an update to the March, 1989 Phase I RI Health and Safety Plan. Additional details on site-specific health and safety considerations (e.g., nature of wastes, work zones, task personnel protection levels) are provided in the site-specific Field Sampling Plans provided in Volume III of this Work Plan.

Section 2.0 of the HASP describes the anticipated hazards which may be encountered at the sites. Section 3.0 discusses project staffing, organization and responsibilities. Section 4.0 describes TRC-EC's Corporate Health and Safety program and adherence to regulatory standards. Section 5.0 describes site control measures to be employed at the site to maintain order and minimize chemical and physical hazards to on-site personnel, visitors, and the public. Section 6.0 describes site Health and Safety orientation meetings, and weekly Health and Safety meeting updates. Section 7.0 describes task specific Health and Safety procedures as well as chemical and physical hazards, site monitoring, action levels, personnel protective equipment, and decontamination and disposal procedures. Lastly, Section 8.0 describes emergency procedures, emergency phone numbers, and presents a map of the route to a hospital from the sites.

1.1 Project Objectives

The objective of this Work Plan is to define the level of investigation planned to assess the presence and nature of environmental contamination at the four RI sites. The site investigations will be conducted at each site to assess the presence of any hazardous substances, the nature of any disposed materials, and the potential for releases of contamination from the site. The findings of these RI investigations will be used to support the ecological and public health risk assessment and feasibility study activities for each site.

One of the purposes of this HASP is to inform site personnel of the currently known and suspected hazards associated with work at each site. All site personnel, including subcontractors, are required to become familiar with and follow provisions of this plan. Although all employees are required to follow the guidelines set forth herein, the safety of site personnel is ultimately the responsibility of the individual and their respective employers. Copies of this HASP will be available to on-site personnel for orientation to anticipated on-site hazards (based on currently available data), as well as the health and safety procedures to be followed during implementation of this program. TRC-EC or the Navy cannot be responsible for enforcing provisions of this plan for the health and safety of site personnel other than their own employees.

To meet project objectives, field explorations will include the following activities: ambient air, soil gas and geophysical surveys; soil, sediment, surface water, and ground water sampling; and soil borings and monitoring well. The field investigation activities planned for each of the sites are described in the site-specific Field Sampling Plans provided in Volumes III of this Work Plan. Each of the planned work tasks are summarized below.

1.2 Work Tasks

This section summarizes the Phase II field activities planned at the four sites.

1.2.1 Geophysical Surveys

Geophysical surveys will be conducted at two of the five RI sites (Sites 01 and 09). The geophysical surveys will consist of seismic refraction and electromagnetic (EM) surveys. The seismic surveys will be used to determine the bedrock topography at the sites and the EM surveys will be used to further investigate Phase I anomalies and site salt water intrusion. In addition, a

magnetometer survey will be conducted at to further investigate significant anomalies detected in Phase I at Site 09. The findings of the Site 09 EM and magnetometer surveys will be used to support the planned Phase II test pit investigation activities. The surveys will be conducted in a manner defined for each site in the site-specific Field Sampling Plans (e.g., grid spacings, walkover).

1.2.2 Soil Sampling

Soil samples will be collected from each of the four sites. Samples will be collected from a variety of locations including surface soils and subsurface borings. Samples will be concentrated in areas identified through historic information, geophysical surveys, soil gas surveys, and/or the findings of the Phase I RI as areas of potential contamination. The objective of soil sampling will be to assess the nature and extent of soil contamination at each of the sites. Each soil sample will also be screened for the presence of total volatile organic vapors/gases with a photoionization and/or flame ionization detector.

1.2.3 Surface Water and Sediment Sampling

Surface water and sediment samples will be collected from two of the sites, Tank Farm Four and Tank Farm Five, during the Phase II RI. The Phase II surface water and sediment investigations at these sites is in part based upon the Phase I RI findings. The objective of the surface water and sediment sampling program is to further assess the impacts, if any, of the sites on the brooks which pass through the sites.

1.2.4 Monitoring Well Installation and Development

Additional monitoring wells will be installed and sampled at all four of the RI sites. The findings of the Phase I RI indicate the need to further investigate areas of site ground water contamination and the background ground water quality for each of the sites. Thus, the overall objective of the Phase II monitoring well installation program is to further assess the ground water quality at each of the sites.

1.2.5 Ground Water Sampling

Ground water monitoring wells installed at each of the sites in Phase I and those planned for installation in Phase II will be sampled. Ground water samples will be collected from all of the wells after they have been properly developed and purged. Water levels measurements will also be taken at each of the site wells routinely throughout the Phase II RI. The ground water sampling procedures are fully described in Appendix B of Volume III of this Work Plan.

1.2.6 Land Survey

Following completion of the field investigation activities, all of the site sampling locations will be established on individual site maps. The coordinates and elevations of all sample points will be determined. The site features and topography will also be located during the survey. The objective of the land survey will be to provide a map of each site which shows the main site features and all of the Phase I and Phase II sample locations. The coordinates and elevations of all sampling points will also be tabulated.

2.0 SITE HAZARD SUMMARY

Hazards which may be encountered at this site can be classified into three general categories: chemical, physical, and natural. Chemical hazards are site specific and involve potential exposure to chemical contaminants in soil, ground water, and volatilized components in air. Physical hazards are generally occupationally specific and involve some type of accident. Natural hazards are created by natural environmental circumstances such as weather, poisonous plants, poisonous animals, insect bites, etc.

2.1 Chemical Hazards

A review of the available historic information indicates a number of potential contaminants may be present at each of the sites. Tables 1 through 4 summarize suspected contaminants at each of the four sites.

The potential for exposure to site contaminants could result from inhalation, ingestion, or direct contact (skin absorption) with soils or waters contaminated with volatile organic hydrocarbons. Common symptoms of acute exposure to VOCs include headaches, dizziness, nausea, eye irritation, fatigue, loss of coordination, visual disturbances, abdominal pains, and cardiac arrythmia. Chronic exposures to solvents, hydrocarbons, and lead can lead to skin diseases; nervous and respiratory system disorders; kidney, liver, brain, and heart malfunctions; and cancer.

Potential contaminants from former site use activities that may be encountered at each of the sites are summarized in the site background sections of the site-specific Field Sampling Plans. Below is a summary of the known site contaminants based upon the findings of the Phase I RI.

2.1.1 Site 01- McAllister Point Landfill

The findings of the Phase I RI are presented below:

Soil Assessment - Volatile organic compounds (VOCs), base neutral/acid extractable organic compounds (BNAs) (including polynuclear aromatic hydrocarbons (PAHs), pesticides, polychlorinated biphenyls (PCBs), and inorganics were all detected in on-site soils. The major areas of the site where contaminants were detected in the soil at elevated levels include the following:

- Northern area - PAHs;
- North-central area - BNAs, PAHs, and inorganics;
- Central landfill area - VOCs, BNAs, PCBs and inorganics;
- South of access road - BNAs, PAHs, and inorganics; and
- Shoreline - BNAs, PAHs, and inorganics.

Significant **VOC** contamination (i.e., greater than 1 ppm total VOCs) was detected in soils and fill in the central portion of the landfill area but VOC levels were not consistently high throughout the depth of the soil horizons sampled. **BNAs** were detected at elevated levels (i.e., greater than 10 ppm total BNAs) throughout the site, with the highest levels (i.e., greater than 100 ppm total BNAs) detected at spot locations in the central and southern portions of the site. Elevated levels of total carcinogenic PAHs (i.e., greater than 1 ppm) were also detected at locations where total BNA concentrations were less than 10 ppm. These locations were generally in the northern portion of the site, with smaller areas identified in the southern portion of the site and along the shoreline.

Pesticides were detected at low levels (i.e., 10's of ppb) in surface soil samples across the site, while **PCBs** were detected in surface and subsurface soils. PCBs were detected in surface soils along the shoreline and in subsurface soils in the north-central and southern portions of the site. No soil boring samples exceeded the 10 ppm RIDEM PCB soil action level. **Inorganics** levels in the soils and fill were compared to off-site background surface soil levels. Inorganics were detected in soil and fill samples collected from across the site at levels exceeding background levels. The highest inorganic levels were detected in soils from the central and south-central portions of the landfill, in the northern portion of the site (ash materials), in the southern portion of the site, and along the shoreline.

<u>Ground Water Assessment</u> - VOCs, BNAs, PCBs and inorganics were all detected in ground water samples. The major areas of the site where contaminants were detected at levels exceeding action levels include the following:

- Northern area - inorganics;
- North-central area - inorganics;
- Central landfill area - VOCs, and inorganics; and
- South of access road - VOCs, PCBs, and inorganics.

VOC detections, consisting mostly of petroleum-related VOCs (e.g., xylene, benzene) were limited to wells located in the central and southern portions of the site. VOCs were also detected in soil boring samples collected at the depth of the water table from the north-central to southern portions of the site, indicating the potential for ground water contamination throughout this area. Oil was observed in one well (MW-5S) in the southern portion of the site five months after it was sampled. No **BNAs** were detected above ground water action levels and no **pesticides** were detected in ground water samples. A **PCB** concentration of 150 ppb was detected in the well in the southern portion of the site (MW-5S) in which oil was subsequently observed. The highest levels of **inorganic** analytes were detected in wells from the north-central to southern portions of the site.

The complete list of contaminants of concern at the McAllister Point Landfill, as determined in the Phase I Human Health Risk Assessment, is provided in Table 1.

2.1.2 Site 09- Old Fire Fighting Training Area

The findings of the Phase I RI are presented below:

Soil Assessment - VOCs, BNAs, pesticides, PCBs, and inorganics were all detected in on-site soils. The major areas where contaminants were detected in the soils at elevated levels include the following:

- Northern area - VOCs, BNAs, and inorganics;
- Central area - VOCs, and inorganics
- Western area - BNAs;
- Eastern area - BNAs, caPAHs, and inorganics; and
- Southern area (off-site) - BNAs.

Significant **VOC** contamination (i.e., greater than 1 ppm total VOCs) was detected in subsurface soils at the depth of the water table in the central portion of the site (B-6) and in the north central portion of the site (M-2). In the central portion of the site, detected contaminants were petroleum-related VOCs, while in the northern area, only 2-butanone was detected. Soil samples collected at both of these locations generally exhibited petroleum odors and/or visible oil contamination.

BNAs were detected at elevated levels (i.e., greater than 10 ppm total BNAs) in the northern, western, and eastern portions of the site. The subsurface samples collected from the western portion of the site (at B-7) exhibited a strong petroleum odor. BNAs were also detected at levels greater than 10 ppm at the off-site well boring (M-5). Carcinogenic PAHs were detected at levels greater than 1 ppm, but total BNA concentrations were less than 10 ppm in samples collected from the eastern portion of the site.

Pesticides were detected at low levels (i.e., 10's of ppb) in surface soil samples across the site. One surface soil sample exhibited **PCBs** at 80 ppb, well below the 10 ppm RIDEM PCB soil action level.

Inorganics were detected at levels exceeding background levels in soil samples collected throughout the central and eastern portions of the site. The highest inorganic levels were generally detected in subsurface soils collected at well location M-2, in the northern portion of the site, although background inorganic levels were also exceeded at boring B-1.

Ground Water Assessment - VOCs, BNAs, and inorganics were detected in ground water samples. The major areas of the site where contaminants were detected at levels exceeding action levels include the following:

- Northern area - BNAs and inorganics;
- Central area - inorganics;
- Western area - inorganics;
- Eastern area - inorganics; and
- Southern area (off-site) - inorganics.

VOCs were not detected at concentrations exceeding ground water action levels in any ground water samples. However, at well location M-4, elevated soil gas readings in the soil, petroleum odors in the soil and ground water samples, and a sheen on the ground water sample indicate a potential for subsurface VOC contamination in this area. Elevated soil gas readings, petroleum odors and/or sheens were also observed in association with other well locations at this site. Four **BNA** compounds were detected above ground water action levels in one well (MW-2) in the northern portion of the site. A strong petroleum odor and sheen were observed during ground water sampling at this well. No **pesticides** or **PCBs** were detected in ground water samples. While inorganic concentrations exceeded ground water action levels in all wells, including the background well, the highest levels of **inorganic** analytes were detected in wells in the central to northern portions of the site.

The complete list of contaminants of concern at the Old Fire Fighting Training Area, as determined in the Phase I Human Health Risk Assessment, is provided in Table 2.

2.1.3 Site 12- Tank Farm Four

The findings of the Phase I RI are presented below:

Soil Assessment - VOCs, BNAs, pesticides, and inorganics were detected in on-site soils. In general, minimal soil contamination was detected at the site, with the exception of elevated TPH levels detected in surface soils adjacent to the oil/water separator and in a soil boring sample collected along the site access road.

VOCs were detected in three subsurface soil samples at very low levels (i.e., less than 5 ppb) and are not considered to represent significant subsurface VOC contamination. **BNAs** were not detected at levels greater than the contaminant-comparison level (i.e., greater than 10 ppm total

BNAs). Only one soil sample exhibited BNAs at a concentration greater that 1 ppm (3.3 ppm) and that concentration consisted entirely of di-n-butylphthalate. Therefore, BNA soil contamination at this site is not considered to be significant. **Pesticides** were detected at low levels (i.e., less than 10 ppb) in one surface soil and one subsurface soil sample and are not considered to be significant soil contaminants. No **PCBs** were detected in soil samples. **Inorganics** were generally detected at levels less than or slightly exceeding (1 to 7 ppm above) background levels in soil samples. Therefore, there does not appear to be significant inorganic soil contamination at this site. **Total petroleum hydrocarbons** (TPH) analysis of soil samples identified the presence of TPH across the site, ranging in concentration from 3 to 270 ppm. The highest TPH levels were detected in a subsurface soil sample collected along the site access road (boring M-1) and in a surface soil sample collected from adjacent to the oil/water separator.

Ground Water Assessment - BNAs, and inorganics were detected in ground water samples. Inorganics were detected at levels exceeding action levels in all wells on-site.

VOCs were not detected in any ground water samples, which coincides with their absence in soil samples. One **BNA** compound, bis(2-ethylhexyl)phthalate (a common laboratory contaminant) was detected in two on-site wells. No ground water action levels were exceeded for BNAs. No **pesticides** or **PCBs** were detected in ground water samples. While inorganic concentrations exceeded ground water action levels in both shallow and deep wells, including the background well, the highest levels of **inorganic** analytes were detected in wells in the northeast to southwest portions of the site.

Surface Water and Sediment Assessment - VOCs, BNAs pesticides and inorganics were detected in sediment samples and VOCs and inorganics were detected in surface water samples. One **VOC**, carbon disulfide, was detected in one sediment sample at 21 ppb, which is not considered to be a significant level of sediment contamination. Three **BNAs** were detected in sediment samples, with a maximum total BNA concentration of 780 ppb, well below the contaminant-comparison level of 1 ppm. One **pesticide**, 4.4'-DDT was detected in three sediment samples at concentrations of 2.8 to 5.9 ppb. No **PCBs** were detected in sediment samples. Arsenic, cobalt and iron were the only

inorganic analytes detected in soils at levels exceeding background. Higher inorganic concentrations were generally detected in the 0-1 foot sediment sample interval than the 1-2 foot interval.

Two **VOCs**, carbon disulfide and carbon tetrachloride, were detected in surface water samples. No surface water quality criteria for VOCs were exceeded. No **BNAs, pesticides or PCBs** were detected in surface water. Cadmium, lead and zinc were the only **inorganic** analytes detected at levels exceeding surface water quality criteria. The highest levels of inorganic analytes were detected in the surface water sample collected closest to the mouth of Normans Brook, as it enters Narragansett Bay.

<u>Structure Sample Assessment</u> - The distribution of contaminants within the oil/water separator and demolished unknown structure (referred to as the ruins) was as follows:

- Oil/water separator -
  Soil: VOCs, BNAs, and inorganics; and
  Sludge: BNAs, PCBs and inorganics.
- Ruins -
  Soil/sediment: inorganics; and
  Water: inorganics.

VOCs were detected in the soil/sediment and sludge samples collected from the oil/water separator and from the ruins on-site, although total VOC levels were less than the contaminant-comparison level of 1 ppm. The soil/sediment sample collected from the ruins exhibited the greatest VOC concentration (680 ppb tetrachloro-ethene). This sample was visibly contaminated (e.g., odor, sheen). **BNAs** were detected in the soil/sediment and sludge samples. The sludge sample was the only sample with a total BNA concentration greater than the contaminant-comparison level of 10 ppm and a carcinogenic PAH concentration greater than the contaminant-comparison level of 1 ppm. No **pesticides** were detected in soil/sediment or sludge samples. A **PCB** compound was identified in the sludge sample at a concentration of 12 ppb, well below the RIDEM soil action level of 10 ppm. Cobalt and iron were the only **inorganics** detected at levels exceeding background levels and were only detected in the ruins sample.

No **VOCs, BNAs, pesticides, or PCBs** were detected in the surface water sample collected from the ruins. Lead and zinc were the only **inorganic** analytes which were detected in the water sample at levels exceeding surface water quality criteria.

Tank Contents Assessment - The distribution of contaminants within the oil and water samples collected from the on-site tanks was as follows:

- Oil: VOCs, BNAs, and inorganics; and
- Water: VOCs, BNAs, and inorganics.

VOCs were detected in the oil samples collected from the on-site tanks at very elevated levels. The VOCs consisted of benzene, toluene, ethylbenzene, and xylene. Total VOC levels exceeded 10 ppm in a majority of the tanks. EP Toxicity extraction and analysis of oil samples detected no EP Toxicity analytes; low levels of toluene, ethylbenzene and xylene in a TCL/TAL analysis of the EP Toxicity extraction leachate from one sample. A TCL/TAL analysis of the TCLP extraction leachate from the same oil sample detected concentrations of these compounds at levels three orders of magnitude greater than the EP Toxicity results. **BNAs** were detected in the oil samples and consisted primarily of PAHs. Total BNA levels in excess of 1,500 ppm were detected in four of the oil samples. Oil samples were not analyzed for **pesticides**. No **PCBs** were detected in the oil samples, although detection limits ranged from 12 to 24 ppm. Iron, lead and zinc were the only **inorganics** detected in greater than 50% of the oil samples. TAL metals analysis of EP Toxicity and TCLP oil leachates identified inorganic analytes. The EP Toxicity extract analyses detected silver and arsenic, analytes which were not detected in the CLP method extract.

VOCs were detected in all of the tank water samples, with total VOC concentrations ranging from 13 to 346 ppb. The main VOC compounds detected included the same VOCs detected in the oil samples. **BNAs** detected in the water samples consisted of PAH compounds, phenols, phthalate esters and dibenzofuran. Total BNA concentrations ranged from 10 to 202 ppb. Tank water samples were not analyzed for **pesticides** or **PCBs**. The **inorganics** detected in greater than 50% of the tank water samples include barium, calcium, iron, potassium, magnesium, manganese, sodium, lead and zinc. The analyte concentrations in the water samples were typically higher than those detected in the oil samples.

The complete list of contaminants of concern for Tank Farm Four, as determined in the Phase I Human Health Risk Assessment, is provided in Table 3.

2.1.4 Site 13- Tank Farm Five

The findings of the Phase I RI are presented below:

Soil Assessment - VOCs, BNAs, pesticides, and inorganics were detected in on-site soils. In general, minimal soil contamination was detected at the site, with the exception of elevated TPH levels detected in surface soils adjacent to the on-site oil\water separator and at several of the underground storage tank locations.

VOCs were detected in surface and subsurface soil samples at very low levels (i.e., less than 10 ppb) and are not considered to represent significant subsurface VOC contamination. **BNAs** were not detected at levels greater than the contaminant-comparison level (i.e., greater than 10 ppm total BNAs). Only two soil samples exhibited BNAs at a concentration greater that 1 ppm (4.6 and 1.3 ppm) and those concentrations consisted entirely of phthalate esters and PAHs, respectively. Therefore, BNA soil contamination at this site is not considered to be significant. **Pesticides** were detected at low levels (i.e., 10's of ppb) in two surface soil and one subsurface soil sample and are not considered to be significant soil contaminants. No **PCBs** were detected in soil samples. **Inorganics** were generally detected at levels exceeding background levels in subsurface soil samples. Lead was detected above background in one surface soil sample collected from adjacent to the oil/water separator. **Total petroleum hydrocarbons** (TPH) analysis of soil samples identified the presence of TPH across the site, ranging in concentration from 4 to 60,000 ppm. The highest TPH levels were detected in visibly oily samples collected at Tank 50. Significantly elevated levels of TPH (TPH greater than 100 ppm) were detected in surface soil samples collected at Tanks 49, 50, 51 and 55.

Ground Water Assessment - VOCs, BNAs, and inorganics were detected in ground water samples. VOCs and inorganics were detected at levels exceeding ground water action levels.

VOCs were detected at levels exceeding ground water action levels in only one on-site well (MW-53W) and consisted mainly of petroleum-related VOCs. Petroleum product was also observed in wells MW-53W and MW-53E, both located in the ring drain of Tank 53. The presence of low VOC levels in downgradient well MW-4 indicates the potential migration of the ground water contamination observed adjacent to Tank 53. **BNAs** were only detected in well MW-53W and

consisted entirely of PAHs. Detected levels did not exceed ground water action levels. No **Pesticides** or **PCBs** were detected in ground water samples. While inorganic concentrations exceeded ground water action levels in all wells, including the background well, the highest levels of **inorganic** analytes were detected in wells in the central portion of the site.

<u>Surface Water and Sediment Assessment</u> - Lead and TPH were detected in sediment samples; no PCBs, lead or TPH were detected in surface water.

No **PCBs** were detected in sediment samples. **Lead** was detected in all sediment samples but at levels less than background soil levels. **TPH** was detected in sediment samples at concentrations ranging from 4 to 155 ppm, with detected levels increasing with distance downstream.

<u>Structure Sample Assessment</u> - The distribution of contaminants within the oil/water separator was as follows:

- Soil: VOCs, BNAs, and inorganics; and
- Water: inorganics.

One **VOC** was detected in one soil sample collected from the oil/water separator at a very low (2 ppb) level. Low levels of two **BNAs** were detected in one soil sample collected from the oil/water separator. No **pesticides or PCBs** were detected in soil samples and no **inorganics** were detected in the soil samples at levels exceeding background levels.

No **VOCs, BNAs, pesticides, or PCBs** were detected in the surface water sample collected from the oil/water separator. Cadmium was the only **inorganic** analyte which was detected in the water sample at levels exceeding surface water quality criteria.

<u>Tank Contents Assessment</u> - The distribution of contaminants within the oil and water samples collected from the on-site tanks was as follows:

- Oil: VOCs, BNAs, and inorganics; and
- Water: VOCs, BNAs, and inorganics.

VOCs were detected in the oil samples collected from the on-site tanks at very elevated levels. The VOCs consisted of petroleum-related hydrocarbons and chlorinated hydrocarbons. Total

VOC levels exceeded 100 ppm in a majority of the tanks. **BNAs** were detected in the oil samples and consisted primarily of PAHs and bis(2-ethylhexyl)phthalate. Total BNA levels in excess of 1,000 ppm were detected in six of the oil samples. Only PAHs were detected in the oil sludge sample. Oil samples were not analyzed for **pesticides**. No **PCBs** were detected in the oil samples. Iron and lead were the only **inorganics** detected in greater than 50% of the oil samples. The EP Toxicity extract analysis detected barium at a level which exceeds the EP Toxicity federal standard.

VOCs were detected in all of the tank water samples, with total VOC concentrations ranging from 2 to 4,917 ppb. The main VOC compounds detected included the same VOCs detected in the oil samples. **BNAs** detected in the water samples consisted of PAH compounds, phenols, and dibenzofuran. Total BNA concentrations ranged from 31 to 895 ppb. Tank water samples were not analyzed for **pesticides** or **PCBs**. The **inorganics** detected in greater than 50% of the tank water samples include barium, calcium, iron, potassium, magnesium, manganese, and sodium. The analyte concentrations in the water samples were typically higher than those detected in the oil samples.

The complete list of contaminants of concern at Tank Farm Five, as determined by the Phase I Human Health Risk Assessment, is provided in Table 4.

2.2 Physical Hazards

Primary physical hazards at the site are those associated with drilling and excavation activities. Hazards that could be encountered during subsurface explorations include falls and trips, injury from lifting heavy objects, falling objects, eye injuries, head injuries, and pinched or crushed hands and feet. A fire hazard may also be present due to the use of gasoline-powered equipment, and the possible presence of flammable materials in subsurface soils.

2.3 Natural Hazards

Natural hazards such as weather, poisonous plants, animals, and insects cannot always be avoided. Based on available information and current site conditions, the site safety officer and field personnel shall use their best judgement to avoid these potential hazards.

Natural hazards also include exposure to adverse weather conditions including heat and cold stress. Methods of symptom recognition, preventive measures, and first aid methods for cold and heat stress are provided as an Attachment to this HASP.

3.0 STAFF RESPONSIBILITIES

3.1 Project Staff Responsibilities

TRC-EC staff listed below will be responsible for the respective activities listed.

3.1.1 Program Manager

- Holds ultimate responsibility for satisfactory completion of the project.
- Reports status of field activities to the Navy Northern Division Engineer-In-Charge.

3.1.2 Project Manager

- Provides overall project management and control.
- Maintains day-to-day liaison with NETC Environmental Coordinator and subcontractors.
- Notifies NETC Environmental Coordinator of any site emergencies.
- Prepares, reviews, and transmits project documents to the Navy.
- Conducts the initial health and safety site orientations.

3.1.3 Health and Safety Director

- Assists in the development and review of the HASP.
- Provides on-going industrial hygiene support to the Project Manager.
- Reviews and approves significant changes and/or deviations to the HASP.
- Provides consultation to the Project Manager on technical aspects of the HASP and its implementation.

3.1.4 Field Operations Manager

- Coordinates and supervises fieldwork.
- Reports daily progress of fieldwork to the Project Manager.
- Notifies Project Manager of deviations from the Health and Safety Plan.
- Assures that fieldwork proceeds according to Health and Safety Plan requirements.
- Designates On-Site Coordinator (OSC)

3.1.5 On-Site Coordinator (OSC)

- Primary responsibility for notification of and transport of injured field personnel to a hospital in the event of an accident.
- Monitors field investigations to ensure compliance with the approved HASP.
- Recommends modification of the HASP to the Project Manager as soon as practical after it is apparent that the Plan should be modified.
- Keeps non-essential personnel outside study zone boundaries. Logs in the field notebook personnel who enter into the study zone.
- Appoints alternate on-site coordinator on an as needed basis.
- Uses appropriate portable field instruments to monitor site conditions during investigatory activities.
- Maintains a log of field activities, monitoring data, and site meetings.

3.1.6 On-Site Coordinator - Alternates(s)

- Assumes all functions and responsibilities of the OSC in his/her absence.

3.1.7 Subcontractors

- Immediately notify the Field Operations Manager or On-Site Coordinator of hazardous or potentially hazardous conditions or environments that are not addressed or not adequately addressed in the HASP.

- Conduct work in a safe manner.

4.0 REGULATORY REQUIREMENTS AND PERSONNEL QUALIFICATIONS

To be authorized for field explorations, TRC-EC field personnel and subcontractor field personnel (drilling, test pit, and soil gas contractors) must meet the minimum requirements described in these subsections. Documentation of the requirements described below will be maintained by TRC-EC for TRC-EC personnel involved in field activities. Subcontractors and regulatory personnel are responsible for maintaining the required documentation for their field personnel.

4.1 Medical Monitoring

In compliance with OSHA medical monitoring regulations (29 CFR 1910.120), field supervisory personnel and field sampling personnel shall have received an examination by a licensed occupational physician. The most recent exam shall have been received within the 12-month period proceeding this work, and each employee shall have been determined by the attending physician to be physically able to perform the work and to use respiratory and other protective equipment as required for field investigations.

4.2 Health and Safety Training

Field personnel shall have received training and/or experience which, at a minimum, satisfies the OSHA regulations for hazardous waste and emergency response (29 CFR 1910.120).

4.3 Respirator Training

All personnel who enter the Exclusion Zone shall have completed a respiratory protection program which, at a minimum, satisfies the OSHA regulations (29 CFR 1910.134). This program shall include: 1) instruction in the proper use and limitations of respirators; 2) proper fitting of personnel for a respirator, using a qualitative or quantitative fit test method; and 3) teaching personnel how to conduct a positive and/or negative pressure fit test. The respirator which is used to fit test personnel will be individually assigned and available for site work. TRC-EC provides respiratory protection to employees involved in activities at work locations where the presence of respirable hazards is known or suspected.

Field staff assigned to this project shall be capable of using and inspecting a cartridge respirator. All field staff shall have their own personal respirator. The maintenance of that respirator shall be the responsibility of the individual. OSHA requires that respirators be inspected both before and after use and that respirators not used routinely shall be inspected after use and at least monthly. At the time the respirator is issued and used, the individual receiving it shall test the fit (qualitatively), and inspect the gaskets, exhalation valve, face shield, head straps, and cartridges.

Individuals are responsible for cleaning/disinfecting their respirators. Acceptable procedures include washing using respirator-approved detergent/disinfectant in warm water and rinsing or air drying in a clean place. Respirators will be used on a site specific basis as described in Section 7.0.

5.0 SITE ACCESS AND CONTROL

The RI sites consists of four separate areas located within the confines of the Newport Naval Base. In general, physical access to parcels comprising the areas of investigation are inherently restricted by being on the Newport Naval Base or naval property and by way of chain-link fencing at several of the sites.

The purpose of the site control measures presented in this section are to maintain order at the site and to minimize chemical and physical hazards to on-site personnel, visitors, and the public. Three work zone/areas will be established for each of the sites: a support zone, a decontamination zone, and an exclusion zone. The site-specific access considerations and work zones established for each of the site investigations are presented in the site-specific Field Sampling Plans in Volume III of this Work Plan. Below are general descriptions of each of the three work zones.

5.1 Support Zones

The support zones are considered "clean areas" and provide areas or locations where field personnel can take breaks and store field investigation equipment. The support zones also contain site safety and emergency supply equipment (e.g., first aid kits, eye wash units, HASP) and field communication equipment (e.g., mobile phone, walkie talkie).

The support zones at three of the sites (Site 01, 09, and 12) will consist of the on-site personnel vehicles and nearby off-site areas. The support zone for Site 13, Tank Farm Five, will consist of a mobile field office trailer. This field office trailer will also be the command center for all of the sites field investigation activities.

5.2 Exclusion Zones

At one of the sites (Site 01) the exclusion zone will consist of the entire site during the field investigation activities. However, given the open access and current active conditions of the other three sites, activity-specific exclusion zones will be established. During subsurface explorations (e.g., soil borings, and test pits), the OSC or alternate will establish a 25-foot exclusion zone around the operating equipment (e.g., drill rig, backhoe), as allowed by area or access constraints. The exclusion zone will be demarcated with caution tape or barricades. Site-specific exclusion zones have been established in the Field Sampling Plans.

The OSC or alternate will be responsible for keeping nonessential personnel outside the exclusion zone boundaries. In the event that visitors or unauthorized personnel are present during field activities, the OSC or alternate shall verbally request that they maintain a safe distance outside of the area marked by the caution tape and safety cones. Prior to entering the exclusion zone, site personnel shall have donned the proper personnel protective equipment (PPE) for expected site conditions, as outlined in Section 7.0, or as determined by the OSC or alternate.

5.3 Decontamination Zone

A contamination reduction station, or decontamination zone, will be established adjacent to the exclusion zones. The decontamination zone will be established at the upwind side of the exclusion zone and will consist of a taped off area adequate in size to comfortably contain decontamination equipment. Personnel exiting the exclusion zone shall undergo appropriate decontamination, if required by the task-specific procedures described in Section 7.0. A heavy equipment (e.g., drill rigs, backhoes) decontamination area for all of the site will be located on Site 01, McAllister Point Landfill, at the area established in Phase I.

Site-specific decontamination zones are discussed in the Field Sampling Plans. Disposal of investigation derived waste materials is described in Appendix E of this Work Plan.

6.0 GENERAL HEALTH AND SAFETY WORK PRECAUTIONS

6.1 Health and Safety Site Orientation

All site investigation personnel shall be required to read this HASP and attend the Health and Safety Site Orientation meeting. Documentation of attendees will be maintained as part of project records. The HASP will accompany field personnel to each site and shall be maintained at a location known to each individual working on-site.

The Project Manager or OSC will conduct a health and safety site orientation prior to the initiation of field activities. The orientation will cover all aspects of this HASP. Particular emphasis will be placed on a review of potential site contaminants and their potential health effects; accident prevention; safe work procedures; precautionary measures; use of personnel protective equipment; and emergency response procedures. All field staff are required to attend.

6.2 Health and Safety Briefings

The OSC or alternate will conduct a Health and Safety Briefing on a routine basis. Topics to be covered include personnel protective equipment, personnel and equipment decontamination procedures, accident prevention, and any modifications or amendments to the Health and Safety Plan. All field staff are required to attend. A Safety Meeting Summary Form documenting personnel attending each meeting will be maintained in project files.

7.0 TASK-SPECIFIC HEALTH AND SAFETY PROCEDURES

7.1 General

The following general health and safety procedures will be employed for work conducted at each of the five sites.

7.1.1 Chemical and Physical Hazards

The activities which do not involve subsurface activities (geophysical and land surveys) could result in the exposure of workers to contaminated surface soils or vapors. Such an occurrence can lead to worker exposure via inhalation or permeation through the skin (skin absorption). However, in general, non-invasive activities do not require direct contact with site soils and/or waters, and therefore exposures are anticipated to be minimal.

7.1.2 Site Monitoring

The OSC shall use an HNu PI-101 (or equivalent) photoionization detector (PID) (or flame ionization detector - FID, OVA 128, or equivalent) to monitor organic vapors in the breathing zone at the upwind boundary of the Exclusion Zone at the beginning of each day, to establish a daily background reading.

The federal regulation 20 CFR Part 1910.120 (h)(2-3) indicates air monitoring is required upon initial entry, and periodic monitoring shall be conducted when the possibility of an immediately dangerous to life and health (IDLH) condition exists or when there is an indication that exposures may have risen over permissible or published limits since prior monitoring. The air monitoring program conducted on site is intended to be consistent with these requirements.

7.1.3 Action Levels

All field work will begin in personnel protective gear as defined in the individual site Field Sampling Plans provided as Volume III. Based on the PID/FID readings in the breathing zone, or site conditions, the OSC shall upgrade or downgrade Personnel Protective Equipment (PPE) requirements as described below.

The following action levels are based on PID breathing zone readings:

- 0 to 1 PID unit above background: Level D
- 1 to 5 PID unit above background for longer than one minute:

  Modified Level D

- 5 to 25 PID units above background: Level C
- 25 PID units or greater: discontinue operations. Make arrangements to continue work in Level B protective equipment or use Level B to retrieve/demobilize equipment.

The OSC may also make the decision to upgrade the PPE requirements, even if positive PID readings are not noted. This decision will be based on site conditions including visual or sensory observation of soil or ground water contamination, or other site hazards.

Action levels were set below the PEL's/TLV's of the most abundant substances suspected at the sites.

7.1.4 Personnel Protective Equipment (PPE)

This section contains specific provisions for the use of Personnel Protective Equipment (PPE). It shall be the responsibility of the OSC to make the determination of the level of PPE to be used by personnel within the Exclusion Zone. The decision of the OSC will be based on site monitoring (Section 7.1.2), action levels (Section 7.1.3), knowledge of the site, and observed site conditions. Changes affecting the level of PPE defined in the HASP will be at the direction and approval of the TRC-EC Project Manager and/or TRC-EC Director of Health and Safety, except in the case of an emergency during which time it will be the responsibility of the On-Site Coordinator to modify PPE levels.

The following is a discussion of the anticipated levels of personnel protection based upon historical information and the findings of the Phase I RI.

Level D protection shall be used at the start of most field work. Level D protection shall include use of the following items:

- work clothes;
- hard hat;

- work boots; and
- chemical protective gloves when collecting soil and water samples (solvex/nitrile).
- inner glove liners (latex/vinyl)

Level D protection may also include the use of a polycarbonate faceshield, attached to the hard hat, in the event that potential splash conditions are present. Splash conditions are most likely to be present during decontamination of heavy equipment. Use of the splashguard shall be at the discretion of the OSC.

A Modified Level D, which includes Level D plus additional PPE (e.g., tyvek, boot covers), will be during subsurface investigation activities (drilling, test pits).

An upgrade to Level C may be necessary if the concentration of VOCs detected in the breathing zone of the workers exceeds the action level of 5 PID units discussed in Section 7.1.3, or if warranted by other site conditions. Level C protection will include all of the PPE required for Modified Level D plus appropriate respiratory protection. The specific respirator to be used for Level C protection shall be a NIOSH-approved respirator with compatible cartridges. Respirator cartridges will be changed at the first sign of break through, or daily at a minimum, when in use.

It is anticipated that protective Level D or Modified Level D will be appropriate for carrying out most work tasks related to this project. A sufficient inventory of necessary equipment will be maintained on-site to provide these levels of protection for all site personnel who must work within the Exclusion Zone.

7.1.5 Decontamination

Upon leaving the Exclusion Zone, personnel must undergo appropriate decontamination. The nature of the decontamination requirements will depend on the nature of the work conducted and whether immediate re-entry into the Exclusion Zone is planned, or if complete egress from the Exclusion Zone is intended.

The personnel decontamination requirements will also depend on the level of protection used within the Exclusion Zone and the suspected degree of contamination. This area will be located immediately outside the access opening of the Exclusion Zone on its apparent upwind side. This area shall contain the decontamination stations necessary to allow rest breaks and respirator cartridge changes (if appropriate), as well as for complete decontamination as required for food and beverage

breaks, or exiting the work area. Periodic air monitoring will be conducted in the contamination reduction zone (decontamination area) when this area is used.

Equipment decontamination will occur in designated areas. The heavy equipment decontamination for all of the sites will occur in a designated area on Site 01, the McAllister Point Landfill. Field decontamination of other sampling equipment will occur at locations designated for each site. Most of the field sampling equipment (e.g., spoon, bailers) will be laboratory decontaminated to, in part, reduce the amount of field-generated waste. The equipment decontamination procedures are described in the QAPP in Appendix D.

7.1.6 Field Generated Waste Handling

The handling of materials generated during site activities (e.g., drill cuttings, purge/development water, PPE) will be conducted as described in the Investigation Derived Waste Plan contained in Appendix E of this Work Plan. All site visitors (e.g., regulators, auditors) shall dispose of their expendable PPE along with that of the field investigation personnel.

7.2 General Site Media Sampling

This section describes the health and safety considerations for all general or non-intrusive site sampling activities. Such activities would include surface soil sampling, tank sampling, structure sampling, ground water and surface water sampling, and sediment sampling.

7.2.1 Chemical Hazards

Media sampling activities at the sites will include the collection of the following samples types: surficial soil, sediment, surface water, and ground water. These activities may result in the exposure of workers to potentially contaminated soils and ground water, washwater from decontamination of personnel protective equipment, and vapors released from site media. Such an occurrence can lead to worker exposure via inhalation, ingestion, and permeation through the skin (skin absorption). Proper PPE and monitoring will be used during the field investigation activities to reduce the potential for chemical exposures.

7.2.2 Site Monitoring

During non-intrusive sampling activities, the OSC or designee shall use a PID/FID to monitor the following:

- At each soil sampling point or monitoring well prior to sampling.
- The site workers breathing zone continuously during active sampling activities.
- Downhole and near open pit areas during drilling and excavation activities.

Other monitoring equipment used during tank and structure sampling activities will include a combustible gas/oxygen meter (LEL/O2) to monitor for the presence of flammable vapors/gases or abnormal oxygen levels.

7.2.3 Action Levels

Unless otherwise determined by OSC, Level D protection will generally be used for non-intrusive media sampling tasks. However, for ground water sampling and tank/structure sampling activities, a minimum of Modified Level D protection will be used by sampling personnel. Based on PID and LEL/O2 readings measured in the breathing zone or site conditions, the OSC shall upgrade or downgrade Personnel Protective Equipment (PPE) requirements.

Action levels to be used for media sampling activities were previously outlined in Section 7.1.

7.2.4 Personnel Protective Equipment (PPE)

Based on site conditions and action levels described in Section 7.1, the OSC shall upgrade personnel protective requirements commensurate with site hazards. The OSC may also make the decision to upgrade the PPE requirements, even if positive PID readings are not noted. This decision will be based on site conditions including visual or sensory observations of potential contamination. In particular, the presence of free product or other contaminants in ground water, soil, or sediment may require an upgrade of PPE requirements.

7.2.5 Exclusion Zone

In recognition of the increased risk to workers of exposure to contaminated soils or ground water, a minimum exclusion zone of approximately 15 feet will be established around all sampling activities. Nonessential personnel shall be prohibited from entering the exclusion zone.

Monitoring results will be considered when establishing exclusion zone boundaries. In general, if elevated readings are encountered, the exclusion zone will be enlarged from that described in the plan and if no detectable readings are encountered the exclusion zone will remain as described above.

7.3 Subsurface Exploration Activities

7.3.1 Chemical and Physical Hazards

Subsurface exploration activities include completion of test pit and boring activities. These activities may results in the exposure of workers to potentially contaminated soils and ground water, washwater from decontamination of personnel protective equipment, and vapors released from contaminated site media. Such an occurrence can lead to worker exposure via inhalation, ingestion, and permeation through the skin (skin absorption).

7.3.2 Site Monitoring

The OSC shall use a PID or FID to:

- Monitor organic vapors in the breathing zone at the upwind boundary of the Exclusion Zone at the beginning of each day, to establish a daily background reading.
- Monitor organic vapors in the worker's breathing zone during active subsurface explorations.
- Monitor the workers breathing zone at fifteen-minute intervals or continuously during active subsurface explorations, if elevated levels of organic vapors are detected.

Other monitoring equipment will include an combustible gas/oxygen meter to monitor the ambient air and downhole or pit vapors to monitor for explosive vapors and oxygen content.

7.3.3 Action Levels

Unless otherwise determined by the OSC, Modified Level D protection shall be used for the subsurface exploration tasks. Based on positive PID/FID readings in the breathing zone or site conditions, the OSC shall upgrade Personnel Protective Equipment (PPE) requirements, as appropriate.

Action levels to be used for subsurface exploration activities are outlined in Section 7.1. Additional action levels for the combustible gas/oxygen meter are as follows:

A. If airborne concentrations of flammable vapors exceed 10 percent of the lower explosive limit (LEL), no ignition sources will be permitted in the area.

B. If ambient conditions exceed 25 percent of the LEL at a distance of one foot from the source, or ten percent at a distance of two feet or greater, then site operations will be halted and appropriate corrective actions (upgrade of PPE, or abandonment of the exploration) will be taken.

7.3.4 Personnel Protective Equipment (PPE)

Based on site conditions and action levels described in Section 7.1 above, the OSC shall upgrade or downgrade personnel protective requirements commensurate with site hazards. The OSC may also make the decision to upgrade the PPE requirements, even if positive PID requirements are not noted. This decision will be based on site conditions including visual or sensory observations of potential contamination.

During subsurface exploration activities and well installation activities, an upgrade to Modified Level D protection may be required. Necessary equipment for Modified Level D protection will include that of Level D plus the additional PPE listed below:

- chemically resistant boots, PVC/rubber overboots, or disposable boot covers;
- Tyvek or equivalent jump suit (with ankles and wrists duct taped);
- chemically protective outer gloves (solvex/nitrile); and
- inner glove liners (latex/vinyl).

If odorous soils are detected during subsurface explorations the following procedures will be employed:

- if PID or FID readings of auger spoils are consistently above 5 PID units, the air monitoring frequency will be increased; and,
- a change, if necessary, to the appropriate PPE will occur.

7.3.5 Exclusion Zone

In recognition of the increased risk of physical injury and exposure to chemical contaminants during subsurface investigation activities, an exclusion zone of a minimum of approximately 25 feet shall be established around exploration equipment (i.e., drill rig, backhoe). Nonessential personnel shall be prohibited from entering the exclusion zone. All personnel entering the exclusion zone will be required to wear appropriate personnel protective equipment.

8.0 EMERGENCY RESPONSE

8.1 Emergency Information

A list of emergency phone numbers will be maintained at individual sites during active investigation activities. In addition, a copy of this HASP will accompany field personnel to each site and shall be maintained at a location known to each individual working on-site.

The Newport Hospital is the nearest medical facility. A map with a suggested route to the hospital from each site is provided along with emergency phone numbers in the site specific field sampling plans. The Newport Hospital will accept and treat (to the extent it is capable) workers exposed to various suspect substances or physically injured at the project site.

In the event of a site emergency, the OSC or alternate shall evacuate site personnel to a safe area and then contact the appropriate authorities listed above. As soon as practical, after contacting the authorities and ensuring the safety of site personnel, the OSC shall contact the TRC-EC Project Manager.

8.2 General Procedures

An OSHA approved first aid kit, eye wash bottles, and a fire extinguisher rated for Class A, B and C fires will be present within or near the Exclusion Zone during subsurface explorations. It shall be the responsibility of the OSC to make a determination as to the proper response for a particular emergency. As soon as practical after emergency response, the OSC shall brief the Project Manager as to the nature of the incident, and response actions taken. The OSC, Project Manager, and Health and Safety Director, shall evaluate the site conditions and make a determination regarding any measures that could be taken in the future to prevent incidents of a similar nature from being repeated. The Project Manager shall notify the NAVFAC Project Officer regarding site emergencies.

8.3 Emergency Response Plan - Specific Incidents

8.3.1 Chemical Exposures

Inhalation

- If site personnel experience symptoms suggesting exposure to toxic chemicals (light-headedness, dizziness, headache, nausea, shortness of breath or burning sensation in the mouth, throat or lungs), the person should be immediately escorted from the contaminated environment to fresh air.

- If unconscious, the victim should be removed from the contaminated area immediately and brought to the nearest hospital. Rescuers shall wear appropriate Personnel Protective Equipment during rescue.

- If the victim is no longer breathing, he/she shall be moved away from the contaminated area. Immediate mouth-to-mouth resuscitation or some alternate form of effective artificial respiration shall begin.

- If the victim has no pulse, he/she shall be moved away from the contaminated area and cardio-pulmonary resuscitation (CPR) should begin immediately. It may be necessary for the victim to receive artificial resuscitation and CPR simultaneously.

Should any of the above scenarios be encountered, emergency medical attention/advice must be obtained immediately. The TRC-EC Project Manager should be notified of the situation and the affected individual(s) status as soon as practical.

Skin Exposure

If there is skin contact with toxic or potentially toxic chemicals, the skin should be washed with copious amounts of soap and water. If clothing is contaminated, it should be removed immediately and the skin washed thoroughly with running water. All contaminated parts of the body should be thoroughly washed. It may be necessary to wash repeatedly.

Ingestion

If site personnel ingest known toxic chemicals or suspected contaminated materials, obtain medical attention immediately.

Eye Exposure

If foreign matter should get into the eyes they should be flooded with water so that all surfaces are washed thoroughly. Washing should be continued for at least fifteen minutes. Medical attention should be obtained immediately.

8.3.2 Injury of Personnel

At a minimum, one person on site will be trained in Standard Red Cross First Aid. In the event of an emergency, this person will administer appropriate first aid and arrange transportation for injured personnel to the designated medical facility, if necessary. This person will evaluate the site conditions to determine if the causal hazard still exists. Site personnel shall not re-enter the Exclusion Zone until the cause of the injury is determined, and the Exclusion Zone is designated safe to re-enter.

8.3.3 Fire/Explosion

In the event of a fire or explosion, the OSC shall alert the NETC Fire Department by calling from a phone nearby the affected area. All personnel shall move to a safe distance from the involved area. The OSC shall make a determination regarding the severity of the fire, and whether site personnel shall attempt to extinguish it. Fires shall not be fought by site personnel if an explosion

TABLES

TABLE 1
SUMMARY OF CONTAMINANTS
MCALLISTER POINT LANDFILL

COMPOUND NAME	RANGE OF SURFACE SOIL SAMPLES (mg/kg)	RANGE OF SUBSURFACE SOIL SAMPLES (mg/kg)	RANGE OF GROUND WATER SAMPLES (mg/L)
INORGANICS			
Antimony	4.0–91.4	3.5–167	0.022–0.259
Arsenic	1.9–20	2–22.9	.0021–0.0894
Beryllium	0.16–1.7	0.33–2	0.002–0.0128
Cadmium	0.8–2	0.57–8.6	0.003–0.0571
Chromium	5.2–69.2	4.7–78.1	0.0169–0.248
Cobalt	3.6–20.2	1.5–28	0.0223–0.737
Copper	13.4–6070	11–1760	0.0573–3.16
Lead	7.3–1980	2.1–886	0.003–4.8
Manganese	217–678	45.5–1300	0.0578–21
Mercury	0.14–1.6	0.11–2.9	0.00032–0.0084
Nickel	3.4–105	2.7–68.3	0.0167–0.678
Selenium	0.35–2	0.33–4.2	0.0025
Zinc	38.1–19200	18.3–2090	0.168–12.1
VOLATILES			
1,1–Dichloroethene	X 0.009	X0.006	X0.005
1,1,1–Trichloroethane	0.0035–0.009	0.003–0.010	X0.005
1,1,2–Trichloroethane	X 0.008–0.009	X0.006	X0.005
1,1,2,2–Tetrachloroethane	X 0.006–0.012	X0.006	X0.005
1,2–Dichloroethane	X 0.009	X0.006	X0.005
1,2–Dichloroethene	X 0.009	0.006–0.34	X0.005
1,2–Dichloropropane	X 0.008–0.009	X0.006	X0.005
2–Hexanone	X 0.014–0.025	0.011–0.023	X0.01
Benzene	X 0.008–0.009	0.004–0.006	0.001–0.006
Bromodichloromethane	X 0.008–0.009	X0.006	X0.005
Bromoform	X 0.008–0.009	X0.005–0.012	X0.005
Carbon Tetrachloride	X 0.008–0.009	X0.006	X0.005
Chlorobenzene	0.002–0.012	0.001–0.032	0.005–0.011
Chloroform	X 0.009	0.003–0.006	X0.005
Chloromethane	X 0.01–0.017	X0.012–1.7	X0.01
Dibromochloromethane	X 0.008–0.009	X0.006–0.012	X0.005
Ethylbenzene	X 0.006–0.012	0.002–0.38	0.002–0.012
Styrene	X 0.006–0.012	X0.006	X0.005
Tetrachloroethene	0.002–0.012	0.002–0.38	X0.005
Toluene	0.002–0.012	0.001–0.68	0.001–0.005
Trichloroethene	X 0.008–0.009	0.001–0.240	X0.005
Vinyl chloride	X 0.015–0.017	X0.012–0.013	X0.01
Xylenes	X 0.006–0.012	0.003–0.73	0.002–0.160

X : Values "UJ" qualified data only
ND : Not Detected

TRC

TABLE 1 (continued)
SUMMARY OF CONTAMINANTS
MCALLISTER POINT LANDFILL

COMPOUND NAME	RANGE OF SURFACE SOIL SAMPLES (mg/kg)	RANGE OF SUBSURFACE SOIL SAMPLES (mg/kg)	RANGE OF GROUND WATER SAMPLES (mg/L)
SEMIVOLATILES			
1,4-Dichlorobenzene	X .44	0.05-2.2	0.01
2-Methylnapthalene	0.099-1.1	0.05-4.5	0.001-0.043
2,4-Dichlorophenol	X .44	0.054-2.7	ND
2,4,5-Trichlorophenol	X 2.2	0.11-14.0	ND
3,3'-Dichlorobenzidine	X 0.87-16.0	X0.785-5.4	X0.02
Acenaphthene	0.11-3.8	0.057-5.8	0.003-0.045
Acenaphthylene	0.44-0.052	0.068-2.7	X0.01
Anthracene	0.044-6.8	0.057-2.7	0.003-0.01
Benzo(a)anthracene	0.052-19.0	0.044-3.7	X0.01
Benzo(a)pyrene	0.44-16.0	0.073-3.2	X0.01
Benzo(b)fluoranthene	0.12-15.0	0.05-2.7	X0.01
Benzo(ghi)perylene	0.2-8.4	0.067-2.7	X0.01
Benzo(k)fluoranthene	0.119-14.0	0.052-2.9	X0.01
Bis(2ethylhexyl)phthalate	0.44-7.9	0.11-12.0	X0.01
Butylbenzylphthalate	0.44-7.9	0.31-2.7	X0.01
Chrysene	0.072-18.0	0.05-3.6	X0.01
Dibenzofuran	0.05-2.8	0.043-4.0	0.01-0.019
Dibenzo(a,h)anthracene	0.074-7.9	0.3-2.7	X0.01
Diethylphthalate	0.275	0.045-2.7	0.001-0.01
Dimethylphthalate	X 0.44	X0.39-2.7	X0.01
Di-n-butylphthalate	0.44	0.046-6.7	X0.01
Di-n-octylphthalate	X 0.37-7.9	X0.096-2.7	X0.01
Fluoranthene	0.17-46.0	0.047-5.9	0.002-0.01
Fluorene	0.09-4.7	0.044-4.4	0.003-0.025
Indeno(123cd)pyrene	0.16-8.9	0.21-2.7	X0.01
Naphthalene	0.044-3.0	0.047-3.0	0.003-0.24
Phenanthrene	0.060-26.0	0.06-6.2	0.003-0.021
Phenol	X 0.44	0.15-2.7	ND
Pyrene	0.098-27.0	0.045-4.4	0.001-0.01
PESTICIDES			
4,4'-DDD	0.019-0.19	0.0033-0.2	ND
4,4'-DDE	0.0107-0.024	0.0023-0.2	ND
4,4'-DDT	0.007-1.8	0.0044-0.3	ND
Aldrin	X 0.0095	X0.0085-0.1	ND
Alpha-BHC	X 0.0095	X0.0085-0.1	ND
Alpha-chlordane	X 0.095	X0.0845-1.0	ND

X : Values "UJ" qualified data only
ND : Not Detected

TRC

TABLE 1 (continued)
SUMMARY OF CONTAMINANTS
MCALLISTER POINT LANDFILL

COMPOUND NAME	RANGE OF SURFACE SOIL SAMPLES (mg/kg)	RANGE OF SUBSURFACE SOIL SAMPLES (mg/kg)	RANGE OF GROUND WATER SAMPLES (mg/L)
Beta-BHC	X 0.0095	X0.0085-0.1	ND
Deildrin	X 0.019	X0.017-0.2	ND
Delta-BHC	X 0.0095	X0.0085-0.1	ND
Endosulfan I	X 0.0095	X0.0085-0.1	ND
Endosulfan II	X 0.019	X0.017-0.2	ND
Endosulfan Sulfate	X 0.019	X0.017-0.2	ND
Endrin	X 0.019	X0.017-0.2	ND
Endrin ketone	X 0.019	X0.017-0.2	ND
Gamma-BHC	X 0.0095	X0.0085-0.1	ND
Gamma-chlordane	X 0.095	X0.0845-1.0	ND
Heptachlor	X 0.0095	X0.0085-0.1	ND
Heptachlor epoxide	X 0.0095	X0.0085-0.1	ND
Methoxychlor	X 0.095	X0.0845-1.0	ND
Toxaphene	X .19	X0.087-2.0	ND
PCB'S			
Aroclor-1016	X 0.095	X0.0845-1.0	ND
Aroclor-1221	X 0.095	X0.0845-1.0	ND
Aroclor-1232	X 0.095	X0.0845-1.0	ND
Aroclor-1242	0.095	0.044-1.0	ND
Aroclor-1248	X 0.095	0.0845-1.0	ND
Aroclor-1254	0.13-0.61	0.025-2.0	ND
Aroclor-1260	X 0.19	X0.17-2.0	ND

X : Values "UJ" qualified data only
ND : Not Detected

TABLE 2
SUMMARY OF CONTAMINANTS
OLD FIREFIGHTING TRAINING AREA

COMPOUND NAME	RANGE OF SURFACE SOIL SAMPLES (mg/kg)	RANGE OF SUBSURFACE SOIL SAMPLES (mg/kg)	RANGE OF GROUND WATER SAMPLES (ug/L)
INORGANICS			
Aluminum	5070–10600	3210–11900	1890–44600
Antimony	5.6	3.9–5.5	ND
Arsenic	2–8.9	1.3–9.6	2–16.6
Barium	8–28.3	4.9–57.5	39.9–569
Beryllium	0.39–0.48	0.17–0.35	2.4
Cadmium	0.94	0.56–8.1	48.8
Chromium	6.8–18.8	5.4–15.2	5.4–47
Cobalt	4.7–20	2.8–20.5	21.1–50
Copper	11.2–44.3	6.1–312	31.8–1030
Lead	19–77.8	0.64–777	11.7–4120
Manganese	174–750	70.7–960	1410–8720
Mercury	0.17	0.16–0.21	1.3–2.1
Nickel	5.4–25.6	5.8–28.8	51.5–81.5
Selenium	0.53	0.31–1.7	ND
Zinc	26.2–142	23.6–2580	108–12400
VOLATILES			
1,1–Dichloroethene	ND	X0.005	X5–25
1,1,2,2–Tetrachloroethane	ND	X0.005–0.007	X5–25
Benzene	ND	X0.005	X5–25
Carbon disulfide	ND	0.003–0.011	X5–25
Chloroform	ND	X0.005–0.008	2–25
Chloromethane	X 0.012	X0.011–0.014	X10–50
Ethylbenzene	ND	0.005–0.16	X5–25
Styrene	ND	X0.005–0.007	X5–25
Tetrachloroethene	0.002	X0.005–0.007	X5–25
Toluene	ND	0.001–0.067	X5–25
Vinyl chloride	ND	X0.011	X10–50
Xylenes	ND	0.005–1.2	X5–25

X : Values "UJ" qualified data only
ND : Not Detected

TRC

TABLE 2 (continued)
SUMMARY OF CONTAMINANTS
OLD FIREFIGHTING TRAINING AREA

COMPOUND NAME	RANGE OF SURFACE SOIL SAMPLES (mg/kg)	RANGE OF SUBSURFACE SOIL SAMPLES (mg/kg)	RANGE OF GROUND WATER SAMPLES (ug/L)
SEMIVOLATILES			
Acenaphthene	0.5–0.94	0.13–1.6	2.0–24.0
Acenaphthylene	X 0.5–0.52	0.054–0.46	X10.0
Anthracene	0.5–1.5	0.066–1.1	9.0–10.0
Benzo(a)anthracene	0.13–3.3	0.089–1.8	3.0–10.0
Benzo(a)pyrene	0.12–2.7	0.084–1.6	2.0–10.0
Benzo(b)fluoranthene	0.12–2.8	0.083–1.4	1.0–10.0
Benzo(ghi)perylene	X 0.5–.52	0.075–0.74	X10.0
Benzo(k)fluoranthene	0.091–3.1	0.062–1.4	X10.0
Bis(2–ethylhexyl)phthalate	X 0.5–0.59	X0.43	X10.0
Butylbenzylphthalate	X 0.5–0.59	X0.43–0.46	X10.0
Chrysene	0.11–2.8	0.076–1.7	4.0–10.0
Dibenzofuran	0.5–0.65	0.17–0.46	1.0–10.0
Dibenzo(a,h)anthracene	X 0.5–0.52	0.06–0.46	X10
Di–n–butylphthalate	X 0.5–0.52	X0.43–0.46	X10
Di–n–octylphthalate	X 0.5–0.52	X0.43–0.46	X10
Fluoranthene	0.073–8	0.088–3.7	6.0–10.0
Fluorene	0.5–1.2	0.2–0.73	1.0–21.0
Indeno(123cd)pyrene	X 0.5–0.52	0.071–0.62	X10.0
Naphthalene	0.48–0.52	0.078–0.43	X10.0
Phenanthrene	0.083–7.2	0.057–4.6	10.0--44.0
Phenol	X 0.5–0.52	0.045–0.49	ND
Pyrene	0.1–5.7	0.072–4.9	10.0--23.0
PESTICIDES			
4,4'–DDD	ND	ND	ND
4,4'–DDE	.0029–.0081	ND	ND
4,4'–DDT	.0023–.0088	ND	ND

X : Values "UJ" qualified data only
ND : Not Detected

TRC

TABLE 3
SUMMARY OF CONTAMINANTS
TANK FARM 4

COMPOUND NAME	RANGE OF SURFACE SOIL SAMPLES (mg/kg)	RANGE OF SUBSURFACE SOIL SAMPLES (mg/kg)	RANGE OF GROUND WATER SAMPLES (ug/L)	RANGE OF SEDIMENT SAMPLES (mg/kg)	RANGE OF SURFACE WATER SAMPLES (ug/L)
INORGANICS					
Aluminum	2110–12200	1010–11700	84–251000	6370–10300	150–370
Antimony	X 3.5–4.7	5.6–8.7	ND	X4.8–6.4	ND
Arsenic	6.6–8.5	3.2–18.7	2–448	7.05–21.1	X2
Barium	16.5–32.8	5.6–21.9	5–676	5.6–28.9	10.8–12.4
Beryllium	0.2–0.52	0.27–0.47	7.2–8.5	.46	ND
Cadmium	ND	ND	3–8.5	ND	3.0–3.3
Calcium	633–1030	143–1520	8050–86600	274.9–666	19100–30000
Chromium	3.7–15.1	3.8–19.1	4–391	12–25.9	4
Cobalt	12.5–19.3	11.7–22	8.6–669	12.5–16.1	ND
Copper	13.6–25.8	13.8–35.2	5.1–569	11.6–16.1	ND
Cyanide	ND	ND	ND	ND	ND
Iron	10600–41100	18400–41000	3450–96200	23500–41100	365–18000
Lead	11.5–40	4.1–11.9	3–156	5.2–16.4	3–3.8
Magnesium	861–2610	409–4460	9220–96200	2110–3250	2370–18100
Manganese	108–471	308–642.5	565–11500	178–396	22.6–1930
Mercury	0.13	ND	ND	ND	ND
Nickel	18.5–27.2	14.6–37.7	81.5–749	ND	ND
Potassium	182–253	428	723–12800	238–275	2920–11000
Selenium	ND	0.31–0.41	X2.0–20.0	0.66	3.1
Silver	ND	0.625	3–30.8	ND	ND
Sodium	ND	ND	2280–27700	ND	5730–17900
Thallium	X 0.68–0.88	0.61–0.69	X4–40	X0.41–0.55	X1
Vandium	17.9–18.1	11.1–20.7	114–168	ND	5
Zinc	56.9–83.4	49.3–103	60.6–1450	56.1–72.7	325–1190
VOLATILES					
1,1,1–Trichloroethane	X 0.006	ND	ND	X0.006	ND
1,1,2–Trichloroethane	X 0.006	ND	ND	X0.006	ND
1,1,2,2–Tetrachloroethane	X 0.006	ND	ND	X0.006	ND
1,2–Dichloropropane	X 0.006	ND	ND	X0.006	ND
1,3–Dichloropropene (Cis)	X 0.006	ND	ND	X0.006	ND
1,3–Dichloropropene (Trans)	X 0.006	ND	ND	X0.006	ND
Benzene	X 0.006	ND	ND	X0.006	ND
Bromodichloromethane	X 0.006	ND	ND	X0.006	ND
Bromoform	X 0.006	ND	ND	X0.006	ND
Carbon disulfide	X 0.006–0.025	ND	ND	ND	4–26
Carbon Tetrachloride	X 0.006	ND	ND	X0.006	3
Dibromochloromethane	X 0.006	ND	ND	X0.006	ND
Styrene	X 0.006	ND	ND	X0.006	ND
Tetrachloroethene	0.002–0.68	0.002	ND	X0.006	ND
Trichloroethene	X 0.006	ND	ND	X0.006	ND
SEMIVOLATILES					
1,4–Dichlorobenzene	X 0.5	X0.38	ND	ND	ND
2–Methylnapthalene	0.19	X0.38	ND	ND	ND
2,4–Dinitrotoluene	X 0.5	X0.38	ND	ND	ND
2,4,5–Trichlorophenol	X 2.5	X1.9	ND	ND	ND
2,4,6–Trichlorophenol	X 0.5	X0.38	ND	ND	ND
2,6–Dinitrotoluene	X 0.5	X0.38	ND	ND	ND
3,3'–Dichlorobenzidine	X 1.0	X0.77	X20.0	X0.86	ND
Acenaphthene	0.076	X0.38	ND	ND	ND
Anthracene	0.13	X0.38	ND	ND	ND
Benzo(a)anthracene	0.1–0.16	X0.38	ND	X0.43	ND
Benzo(a)pyrene	0.075	X0.38	ND	X0.43–0.45	ND
Benzo(b)fluoranthene	0.086	X0.38	ND	X0.43–0.45	ND

X : Values "UJ" qualified data only
ND : Not Detected

TRC

TABLE 3 (continued)
SUMMARY OF CONTAMINANTS
TANK FARM 4

COMPOUND NAME	RANGE OF SURFACE SOIL SAMPLES (mg/kg)	RANGE OF SUBSURFACE SOIL SAMPLES (mg/kg)	RANGE OF GROUND WATER SAMPLES (ug/L)	RANGE OF SEDIMENT SAMPLES (mg/kg)	RANGE OF SURFACE WATER SAMPLES (ug/L)
SEMIVOLATILES (cont)					
Benzo(ghi)perylene	ND	X0.38	ND	X0.43–0.45	ND
Benzo(k)fluoranthene	ND	X0.38	ND	X0.43–0.45	ND
Bis(2–chloroethyl)ether	X 0.5	X0.38	ND	ND	ND
Bis(2ethylhexyl)phthalate	6.8	ND	ND	X0.43	2
Butylbenzylphthalate	X 0.5	X0.38	ND	X0.43	ND
Chrysene	0.12–9.6	X0.38	ND	X0.43	ND
Dibenzo(a,h)anthracene	ND	X0.38	ND	X0.43–0.45	ND
Di–n–butylphthalate	0.06	0.38	ND	0.595	1
Fluoranthene	0.13–0.26	X0.38	ND	ND	ND
Fluorene	0.19	X0.38	ND	ND	ND
Hexachlorobenzene	X 0.5	X0.38	ND	ND	ND
Hexachlorobutadiene	X 0.5	X0.38	ND	ND	ND
Hexachloroethane	X 0.5	X0.38	ND	ND	ND
Indeno(123cd)pyrene	ND	X0.38	ND	X0.43–0.45	ND
Isophorone	X 0.5	X0.38	ND	ND	ND
Naphthalene	X 0.5	X0.38	ND	ND	ND
Nitrobenzene	X 0.5	X0.38	ND	ND	ND
N–nitroso–di–n–propylamine	X 0.5	X0.38	ND	ND	ND
N–nitrosodiphenylamine	X 0.5	X0.38	ND	ND	ND
Pentachlorophenol	X 2.5	X1.9	ND	ND	ND
Phenanthrene	0.12–7.3	X0.38	ND	ND	ND
Phenol	0.052–0.15	X0.38	ND	ND	4
Pyrene	0.48–6.0	X0.38	ND	X0.43	ND
PESTICIDES					
4,4'–DDD	ND	ND	ND	ND	ND
4,4'–DDE	0.0045	ND	ND	ND	ND
4,4'–DDT	ND	0.017	ND	12.4	ND
Aldrin	ND	0.003	ND	ND	ND
Alpha–chlorodane	ND	ND	ND	ND	ND
Deildrin	ND	0.01	ND	ND	ND
Heptachlor	ND	0.003	ND	ND	ND
Toxaphene	X 0.0021	ND	ND	ND	ND

X : Values "UJ" qualified data only
ND : Not Detected

TRC

TABLE 4
SUMMARY OF CONTAMINANTS
TANK FARM 5

COMPOUND NAME	RANGE OF SURFACE SOIL SAMPLES (mg/kg)	RANGE OF SUBSURFACE SOIL SAMPLES (mg/kg)	RANGE OF GROUND WATER SAMPLES (ug/L)	RANGE OF SEDIMENT SAMPLES (mg/kg)	RANGE OF SURFACE WATER SAMPLES (ug/L) a
INORGANICS					
Aluminum	2730–9550	4750–15000	3900–190000	ND	163
Antimony	5.3–5.4	7.7–10.1	ND	ND	ND
Arsenic	6.6–10.1	7–31.3	21.4–265	ND	ND
Barium	8.8–19.9	6.5–15.1	24–489	ND	28.4
Beryllium	0.175–0.27	0.31–0.56	2.4–10.2	ND	ND
Cadmium	ND	ND	5.0	ND	3.3
Chromium	2.45–14	7.1–16.5	2.4–384	ND	ND
Cobalt	2.4–15.1	7.7–42.5	22.8–295	ND	ND
Copper	24.3–19.6	12.8–41	52.4–304	ND	ND
Iron	4480–25500	16000–50700	34700–787100	ND	1900
Lead	5.1–56.6	2.7–13.9	13.4–630	ND	ND
Manganese	122–445	224–715	1240–10200	ND	304
Mercury	2.0–54.0	ND	ND	ND	ND
Nickel	19.5–21.0	16.1–43.6	78.9–530	ND	ND
Selenium	X0.39	0.41	2–20	ND	X 2
Silver	0.7	0.77–1.7	6.3–24.5	ND	ND
Thallium	X0.9	ND	4.0	ND	X ND
Vanadium	20.3–21.0	11–40.6	86.1–108	ND	ND
Zinc	55.5–83	37.4–93.3	69.8–1630	ND	65.1
VOLATILES					
1,1–Dichloroethane	ND	ND	4–23	ND	ND
1,1,1–Trichloroethane	X0.006	ND	10–190	ND	ND
1,1,2–Trichloroethane	X0.006	ND	ND	ND	ND
1,1,2,2–Tetrachloroethane	X0.006	ND	ND	ND	ND
1,2–Dichloroethene	ND	ND	17–630	ND	ND
1,2–Dichloropropane	X0.006	ND	ND	ND	ND
1,3–Dichloropropene (Cis)	X0.006	ND	ND	ND	ND
1,3–Dichloropropene (Trans)	X0.006	ND	ND	ND	ND
Benzene	X0.006	ND	ND	ND	ND
Bromodichloromethane	X0.006	ND	ND	ND	ND
Bromoform	X0.006	ND	ND	ND	ND
Carbon Tetrachloride	X0.006	X0.007	ND	ND	ND
Chloroform	ND	ND	3–7	ND	ND
Dibromochloromethane	X0.006	ND	ND	ND	ND
Ethylbenzene	X0.006	ND	47	ND	ND
Styrene	X0.006	ND	ND	ND	ND
Tetrachloroethene	0.002–0.006	0.001	7	ND	ND
Toluene	0.002–0.006	0.003	38	ND	ND
Trichloroethene	X0.006	ND	4–38	ND	ND
Xylenes	0.002–0.006	ND	100	ND	ND
SEMIVOLATILES					
1,4–Dichlorobenzene	X0.41	X0.37–0.43	X10	ND	ND
2–Methylnapthalene	X0.41	X0.37–0.43	10–71	ND	ND
2,4–Dinitrotoluene	X0.41	X0.37–0.43	X10	ND	ND
2,6–Dinitrotoluene	X0.41	X0.37–0.43	X10	ND	ND
3,3'–Dichlorobenzidine	X0.81	X0.75–0.87	X20	ND	ND
Anthracene	0.045–0.41	X0.37–0.43	X10	ND	ND
Benzoic acid	X2.0–2.2	0.095–2.2	ND	ND	X 50
Benzo(a)anthracene	0.084–0.41	X0.37–0.43	X10	ND	ND
Benzo(a)pyrene	0.069–0.41	X0.37–0.43	X10	ND	ND
Benzo(b)fluoranthene	0.14–0.41	X0.37–0.43	X10	ND	ND
Benzo(k)fluoranthene	0.07–0.41	X0.37–0.43	X10	ND	ND
Bis(2–chloroethyl)ether	X0.41	X0.37–0.43	X10	ND	ND

X : Values "UJ" qualified data only
ND : Not Detected

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TABLE 4 (continued)
SUMMARY OF CONTAMINANTS
TANK FARM 5

COMPOUND NAME	RANGE OF SURFACE SOIL SAMPLES (mg/kg)	RANGE OF SUBSURFACE SOIL SAMPLES (mg/kg)	RANGE OF GROUND WATER SAMPLES (ug/L)	RANGE OF SEDIMENT SAMPLES (mg/kg)	RANGE OF SURFACE WATER SAMPLES (ug/L) a
SEMIVOLATILES (cont)					
Bis(2ethylhexyl)phthalate	0.071–0.41	0.43	X10	ND	ND
Butylbenzylphthalate	X 0.41	X0.43–2.0	X10	ND	ND
Chrysene	0.05–0.41	X0.37–0.43	X10	ND	ND
Dibenzo(a,h)anthracene	X 0.41	X0.37–0.43	X10	ND	ND
Di–n–butylphthalate	0.046–0.41	0.12–2.6	X10	ND	ND
Fluoranthene	0.18–0.41	X0.37–0.43	X10	ND	ND
Fluorene	X 0.41	X0.37–0.43	10–45	ND	ND
Hexachlorobenzene	X 0.41	X0.37–0.43	X10	ND	ND
Hexachlorobutadiene	X 0.41	X0.37–0.43	X10	ND	ND
Hexachloroethane	X 0.41	X0.37–0.43	X10	ND	ND
Indeno(123cd)pyrene	X 0.41	X0.37–0.43	X10	ND	ND
Isophorone	X 0.41	X0.37–0.43	10	ND	ND
Naphthalene	X 0.41	X0.37–0.43	10–27	ND	ND
N–nitroso–di–n–propylamine	X 0.41	X0.37–0.43	X10	ND	ND
N–nitrosodiphenylamine	X 0.41	X0.37–0.43	X10	ND	ND
Pentachlorophenol	X 2.0	X1.9–2.2	ND	ND	ND
Phenanthrene	0.072–0.41	X0.37–0.43	10–42	ND	ND
Pyrene	X 0.41	X0.37–0.43	10–21	ND	ND
PESTICIDES					
4,4'–DDE	0.025–0.032	0.0036	ND	ND	ND
4,4'–DDT	0.031–0.074	0.017	ND	ND	ND

X : Values "UJ" qualified data only
ND : Not Detected

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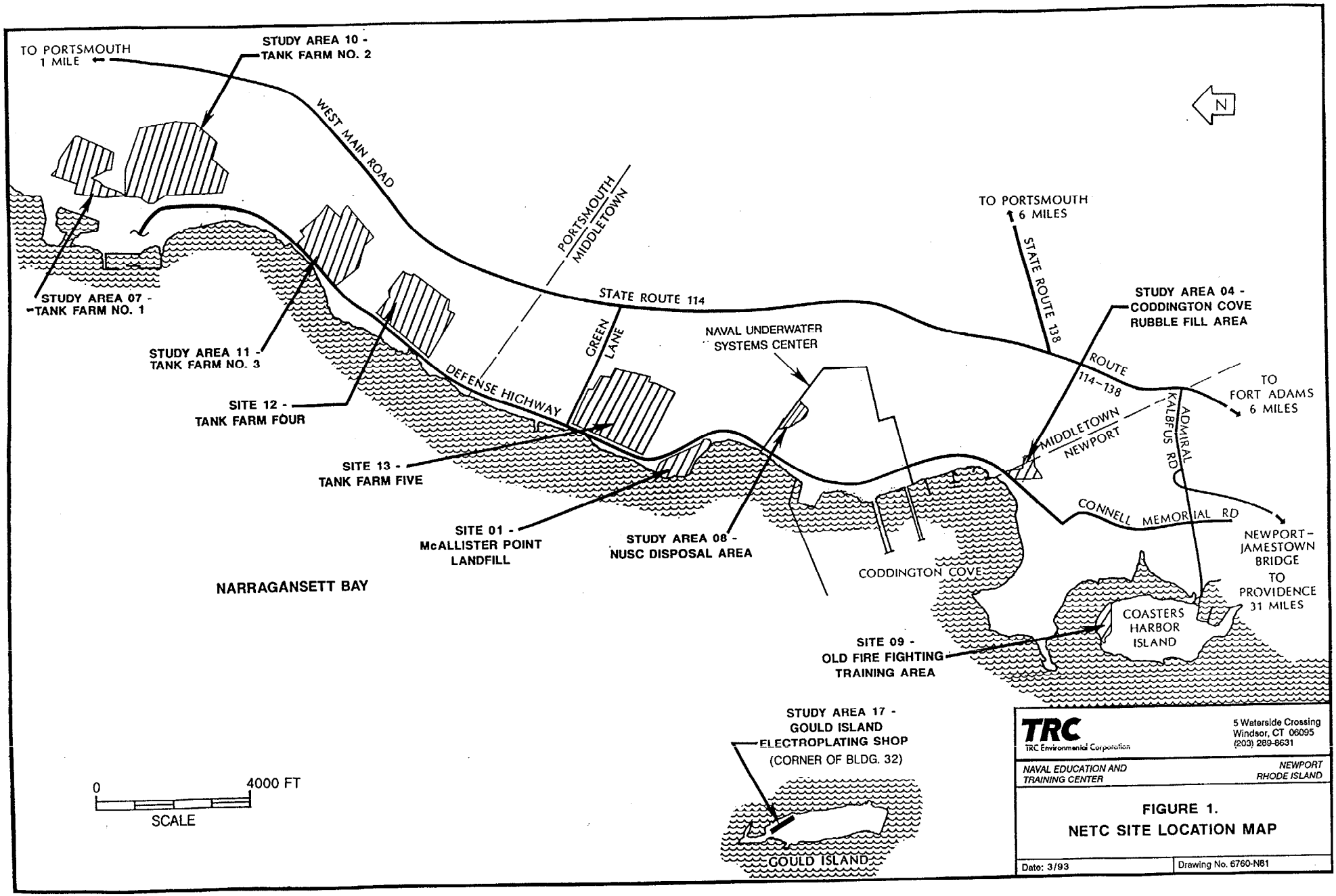
FIGURES


TO PORTSMOUTH
1 MILE
STUDY AREA 10 -
TANK FARM NO. 2
WEST MAIN ROAD
PORTSMOUTH
MIDDLETOWN
STATE ROUTE 114
GREEN LANE
DEFENSE HIGHWAY
STUDY AREA 07 -
TANK FARM NO. 1
STUDY AREA 11 -
TANK FARM NO. 3
SITE 12 -
TANK FARM FOUR
SITE 13 -
TANK FARM FIVE
SITE 01 -
McALLISTER POINT
LANDFILL
STUDY AREA 08 -
NUSC DISPOSAL AREA
NAVAL UNDERWATER
SYSTEMS CENTER
NARRAGANSETT BAY
TO PORTSMOUTH
6 MILES
STATE ROUTE 138
STUDY AREA 04 -
CODDINGTON COVE
RUBBLE FILL AREA
ROUTE
114-138
MIDDLETOWN
NEWPORT
ADMIRAL
KALBFUS RD
TO
FORT ADAMS
6 MILES
CONNELL MEMORIAL RD
NEWPORT-
JAMESTOWN
BRIDGE
TO
PROVIDENCE
31 MILES
CODDINGTON COVE
COASTERS
HARBOR
ISLAND
SITE 09 -
OLD FIRE FIGHTING
TRAINING AREA
STUDY AREA 17 -
GOULD ISLAND
ELECTROPLATING SHOP
(CORNER OF BLDG. 32)
GOULD ISLAND
N
0
4000 FT
SCALE
TRC
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5 Waterside Crossing
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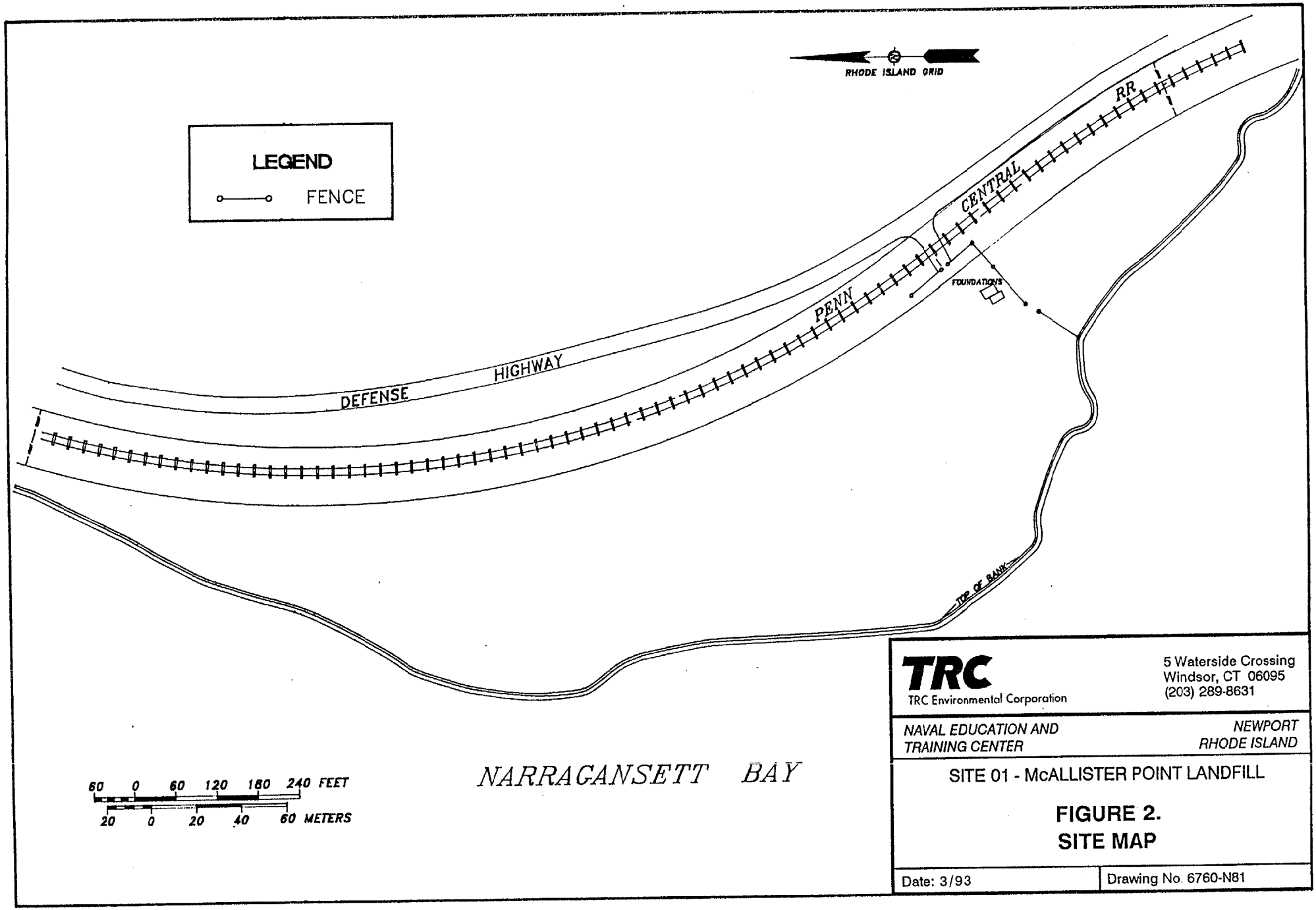
NAVAL EDUCATION AND
TRAINING CENTER
NEWPORT
RHODE ISLAND
FIGURE 1.
NETC SITE LOCATION MAP
Date: 3/93
Drawing No. 6760-N81


RHODE ISLAND GRID
LEGEND
FENCE
DEFENSE HIGHWAY
PENN CENTRAL RR
FOUNDATIONS
TOP OF BANK
NARRAGANSETT BAY
60 0 60 120 180 240 FEET
20 0 20 40 60 METERS
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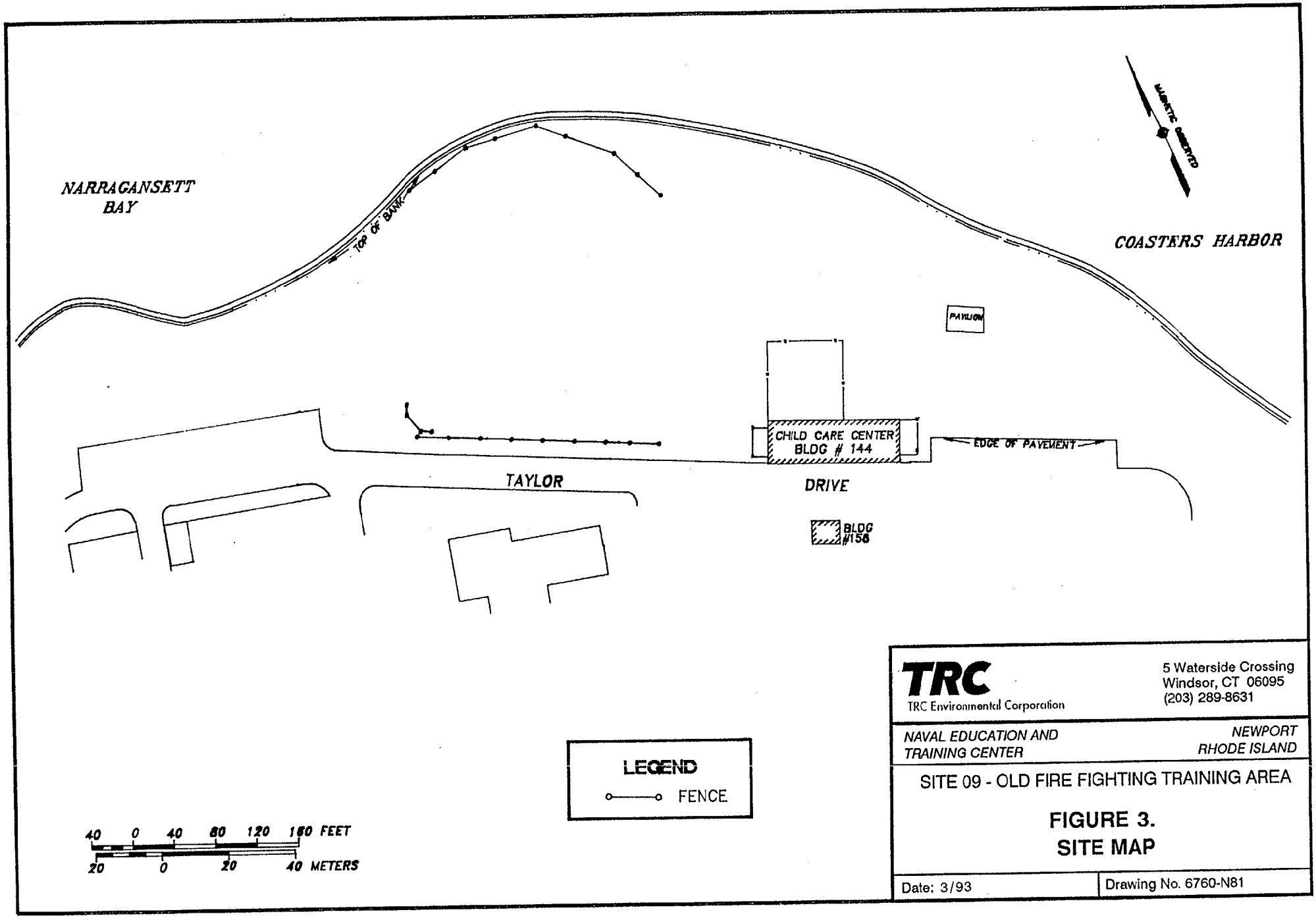
NEWPORT RHODE ISLAND
SITE 01 - McALLISTER POINT LANDFILL
FIGURE 2.
SITE MAP
Date: 3/93
Drawing No. 6760-N81



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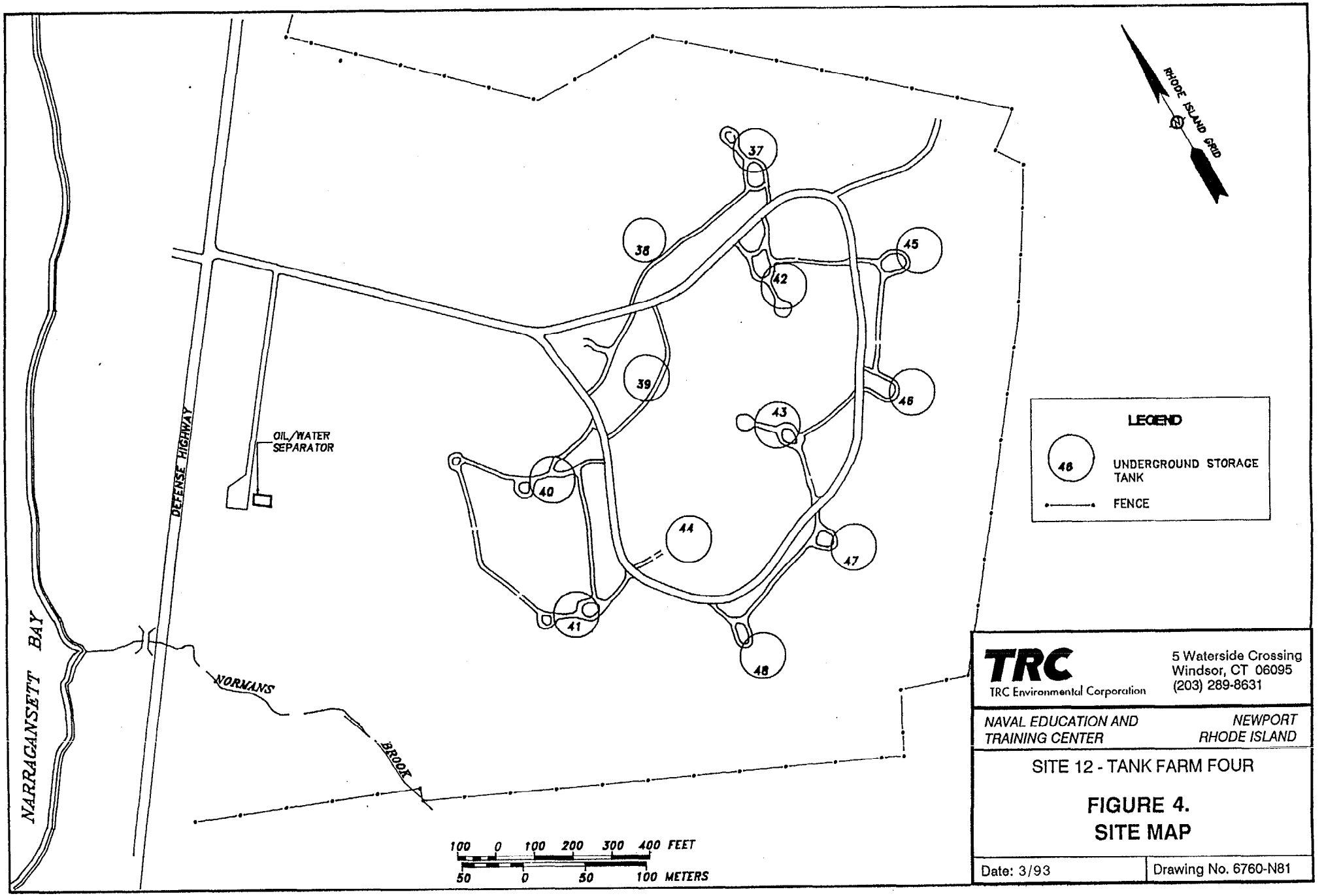
NEWPORT RHODE ISLAND

SITE 09 - OLD FIRE FIGHTING TRAINING AREA

FIGURE 3.
SITE MAP

Date: 3/93

Drawing No. 6760-N81


RHODE ISLAND GRID
LEGEND
46 UNDERGROUND STORAGE TANK
FENCE
37
38
39
40
41
42
43
44
45
46
47
48
OIL/WATER SEPARATOR
DEFENSE HIGHWAY
NARRAGANSETT BAY
NORMANS BROOK
100 0 100 200 300 400 FEET
50 0 50 100 METERS
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NEWPORT RHODE ISLAND
SITE 12 - TANK FARM FOUR
FIGURE 4.
SITE MAP
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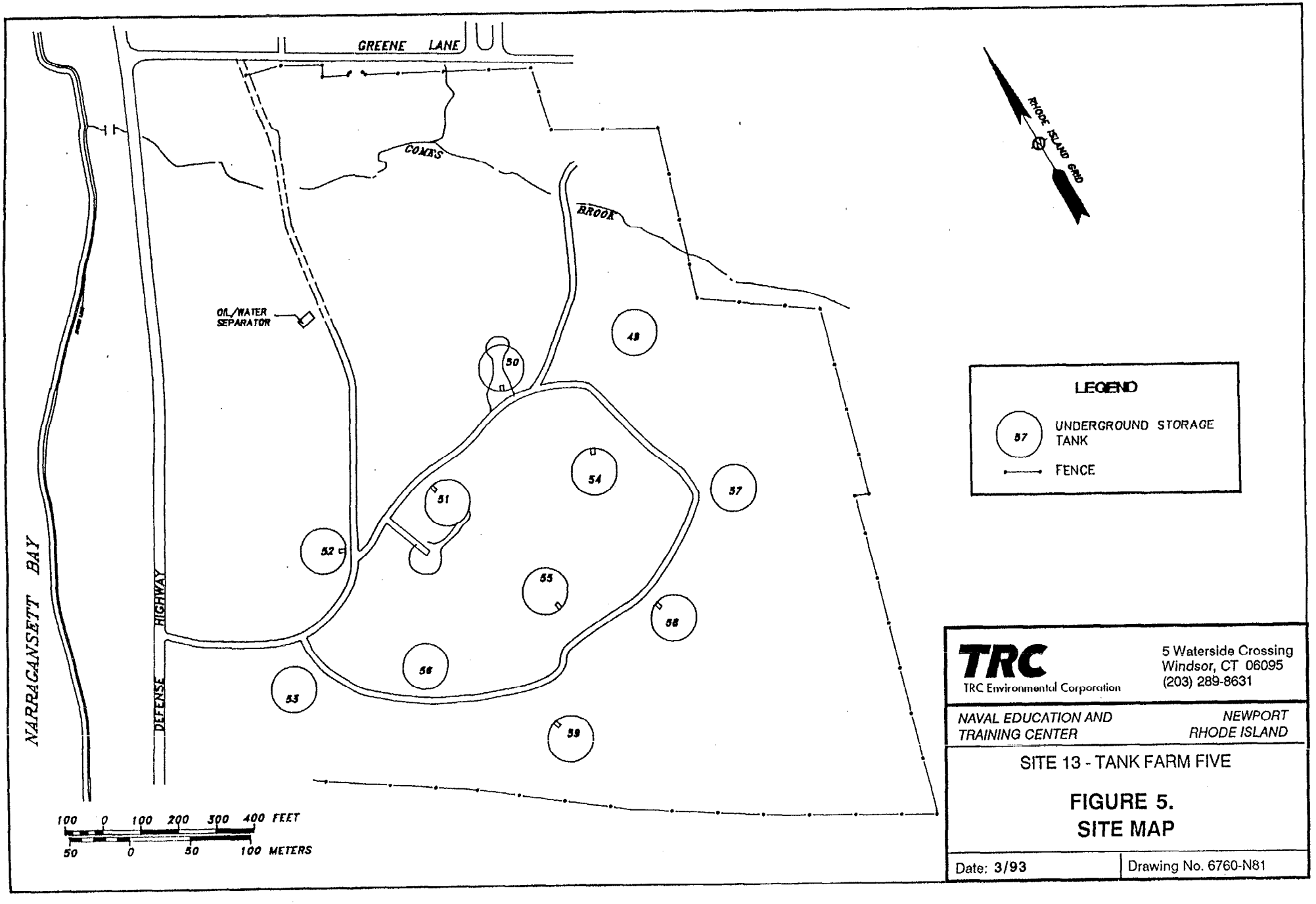
Drawing No. 6760-N81


GREENE LANE
COMMS
BROOK
OIL/WATER SEPARATOR
NARRAGANSETT BAY
DEFENSE HIGHWAY
RHODE ISLAND GRID
49
50
51
52
53
54
55
56
57
58
59
LEGEND
57 UNDERGROUND STORAGE TANK
FENCE
100 0 100 200 300 400 FEET
50 0 50 100 METERS
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NEWPORT RHODE ISLAND
SITE 13 - TANK FARM FIVE
FIGURE 5.
SITE MAP
Date: 3/93
Drawing No. 6760-N81

U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

APPENDIX D
QUALITY ASSURANCE PROJECT PLAN

PHASE II RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared by:
TRC Environmental Corporation
Windsor, Connecticut

Prepared For:
Northern Division - Naval Facilities
Engineering Command
Lester, Pennsylvania

March 1993

TRC-EC Project No. 6760-N81-110
Contract No. N62472-86-C-1282

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QUALITY ASSURANCE PROJECT PLAN (QAPP) APPROVAL SHEET

PHASE II RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

March 1993

Approved by:	_____	_____	_____
	TRC-EC Project Manager	Signature	Date
Approved by:	_____	_____	_____
	TRC-EC QA Officer	Signature	Date
Approved by:	_____	_____	_____
	Laboratory QC Coordinator	Signature	Date
Approved by:	_____	_____	_____
	Engineer-In-Charge Northern Division Naval Facilities Engineering Command	Signature	Date
Approved by:	_____	_____	_____
	Northern Division QA Officer	Signature	Date
Approved by:	_____	_____	_____
	NETC Environmental Coordinator	Signature	Date

TRC

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1.0 PROJECT DESCRIPTION

1.1 Introduction

This Quality Assurance Project Plan (QAPP) has been developed for use in conjunction with Phase II Remedial Investigation sampling activities at the Naval Education and Training Center (NETC) in Newport, Rhode Island. This Phase II sampling program builds on the findings of previous site studies conducted at NETC-Newport under the Navy Assessment and Control of Installation Pollutants (NACIP) program. Previous site studies included an Initial Assessment Study (IAS) conducted in 1983, and the first phase of the NACIP Confirmation Study procedure, the Verification Step study, which was completed in 1986, and the Phase I Remedial Investigation which was completed in 1991.

Navy policy calls for following EPA guidance and procedures while conducting investigations and remedial action at all Navy waste sites. The specific tasks outlined in the current Navy Installation Restoration (IR) Program are consistent with EPA guidance, and provide a structure for conducting an RI/FS based on the National Contingency Plan (NCP). This project entails the planning process for the second phase of the RI/FS investigation. The work plan for the RI is designed to characterize the nature and extent of contamination; verify the probable contaminant sources; and collect data to evaluate the need for remedial action(s). The RI sampling program is designed to meet all applicable guidance for Superfund, RCRA, and the Navy IR program.

The QAPP serves as a controlling mechanism during field sampling, sample laboratory analysis, and data validation to ensure all data collected are valid, reliable, and legally-defensible. The QAPP outlines the organization, objectives, and all Quality Assurance/Quality Control (QA/QC) activities which will ensure achievement of desired data quality goals.

1.2 Location

The Naval Education and Training Center (NETC) is located within the Newport Naval Base, which encompasses approximately six miles of the western shore of Aquidneck Island, Newport County, Rhode Island. Aquidneck Island is comprised of three towns; Newport, Middletown, and Portsmouth. A map of the relative locations of NETC area is provided as

Figure 1. NETC serves as a training facility and provides logistic support for the Newport Naval Base. NETC occupies approximately 1,063 acres of land.

1.3 History

Extensive information on the history of the Newport Naval Base was presented in the Initial Assessment Study (Envirodyne Engineers, 1983). Text from this report has been excerpted and referenced with appropriate page numbers below.

> "The Newport area was first used by the Navy during the Civil War when the Naval Academy was moved from Annapolis, Maryland to Newport in order to protect it from Confederate troops. The Naval Academy operated at Newport for about four years before returning to Annapolis.
>
> In 1869, the experimental Torpedo Station at Goat Island was established. This was the Navy's first permanent activity at Newport. The station was responsible for developing torpedoes and conducting experimental work on other forms of Naval ordnance.
>
> In 1881, Coasters Harbor Island was acquired by the Navy from the City of Newport and used for training purposes. In 1884, the Naval War College was established on the island. A causeway and bridge linking the island to the mainland was constructed in 1892. In 1894, the USS Constellation was permanently anchored as a training ship for the Naval War College.
>
> The Melville area was established as a coaling station for the steam-powered ships in 1900. The Navy purchased 160 acres of land and constructed the Narragansett Bay Coal Depot. With the advent of ships burning liquid fuel, it became necessary to add oil tanks. Consequently, in 1910, four fuel oil tanks were added in the Melville area. These tanks are still used today.
>
> In 1913, the Navy established the Naval Hospital on the mainland of Aquidneck Island. At this time the main hospital building was constructed.
>
> The outbreak of Word War I caused a significant increase in military activity at Newport. Some 1,700 men were sent to Newport and housed in tents on Coddington Point and Coasters Harbor Island. A bridge was built at this time connecting Coddington Point with Coasters Harbor Island. In 1918, Coddington Point was purchased by the Navy. Much of the base organization was then transferred to Coddington Point. During the war, numerous destroyers and cruisers were fueled by the Melville Coal Depot and fuel tanks. By this time, a pipeline had been extended to the north fueling pier and two additional oil tanks constructed.

Following World War I, fuel oil gradually replaced the use of coal by the Navy fleet. In 1921, the Coal Depot was changed to the Navy Fuel Depot. In 1931, the coal barges and coaling equipment were sold to the highest bidder.

In 1923, some two hundred buildings, which were part of the emergency war camps established on Coddington Point, were stripped and sold for scrap. The base remained relatively inactive until the onset of World War II.

Reactivation of the base occurred in the late 1930's as a result of military build-up in Europe. Just prior to the reactivation, a 1938 hurricane and tidal wave had destroyed or severely damaged over 100 buildings and much of the sea walls. In 1940, Coddington Cove was acquired for use as a supply station, and hundreds of Quonset huts were constructed throughout the base. Additional barracks were constructed on Coasters Harbor Island, increasing the base housing capacity to over 3,500 men. Power plant facilities were also constructed at this time. Coddington Point was reactivated to house thousands of recruits. The Anchorage housing complex in the Coddington Cove area was constructed in 1942. In the Melville area, additional fuel facilities were constructed along with a Motor Torpedo Squadron Boat Training Center and nets for harbor defense. Tank Farms 1 through 5 were constructed during this time period. The Fire Fighting School, Fire Control Training Building, and the Steam Engineering Building were constructed in 1944.

The Torpedo Station at Goat Island was very active during World War II and had expanded its operation to Gould Island. The Torpedo Station employed more than 13,000 people and manufactured 80 percent of all torpedoes used by our country during the war. The station was the largest single industry ever operated in Rhode Island.

Following World War II, naval activities at Newport converted to a peace time status. This resulted in a reduction of naval activity. Some 300 Quonset huts and buildings were removed, and the entire naval complex was consolidated into a single naval command designated the U.S. Naval Base in 1946.

The Naval Base adjusted to its peace time status by increasing its activities in the fields of research and development, specialized training, and preparedness for modern warfare. There was a brief period during the Korean War when some 25,000 sailors trained at Newport.

In 1951, the Torpedo Station was permanently disestablished after 83 years of service. Future manufacture of torpedoes was to be awarded to private industry. In place of the Torpedo Station, a new research and development facility, the Naval Underwater Ordnance Station, was established and given the responsibility of overseeing the private contractors. The Officer Candidate School was also established in 1951.

In 1952, the Training Station and other naval schools were disestablished, and the U.S. Naval Station and the U.S. Naval Schools Command were established.

In 1955, Pier 1 was constructed, with Pier 2 being added in 1957. Newport became the headquarters of the Commander Cruiser-Destroyer Force Atlantic in 1962. Some 55 naval warships and auxiliary craft were homeported at Newport. New housing and bachelor quarters were added in the late 1950's and early 1960's.

Major expansion of the Naval War College occurred during the late 1950's and early 1970's, transforming the college into a major university. In July of 1971, The Naval Schools Command was restructured and named the Naval Officer Training Center (NOTC).

In April of 1973, the Shore Establishment Realignment Program (SER) was announced and resulted in the largest reorganization of Naval forces in the Newport Area. The fleet stationed in Newport was relocated to other naval stations on the east coast. SER resulted in the disestablishment of the Naval Communication Station and the Fleet Training Center and related activities. The Public Works Center, Naval Supply Center, Naval Station and Naval Base were absorbed by NOTC. In April of 1974, NOTC was changed to the Naval Education and Training Center (NETC).

The drastic changes which resulted from SER caused a reduction of Navy personnel, both military and civilian, in excess of 14,000. Coupled with the reductions at the Naval Construction Battalion Center at Davisville, and the closure of the Naval Air Station at Quonset Point, SER had severe economic impacts in the Narragansett Bay area.

The reorganization brought about by SER resulted in the Navy excessing some 1,629 [1,374] acres of its 2,420 [2,805] acres. Some of the land has been leased to the State of Rhode Island pending final sale of the land by the General Services Administration.... The Navy also leases 44 acres of land in Coddington Cove to the State of Rhode Island and Economic Development Corporation. The state has subleased this property to a private enterprise engaging in shipbuilding and repair. Also, a fish food processing operation utilizes the cold storage warehouse in Building 42 near Pier 1.

The above information on the history of the installation was obtained from the most recent Master Plan (NORTHDIV, 1980), the 1981 Annual Report of the Navy in the Rhode Island Area (NETC Public Affairs Office, 1981), and the Command Histories at the Naval History Office in Washington, D.C."

(pp. 5-6 to 5-14)

1.4 Previous Site Investigations

The NETC facility has been under assessment through the Department of the Navy's Assessment and Control of Installation Pollutants (NACIP) program. The NACIP program was established to identify and control environmental contamination from past use and disposal of hazardous substances at Naval installations. The NACIP program is part of the Department of Defense Installation Restoration Program, which is similar to the U.S. EPA's Superfund program authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

The NACIP program consists of three phases: Phase I - Initial Assessment Study (IAS), Phase II - Confirmation Study (CS), and Phase III - Remedial Measures phase.

The IAS (Envirodyne Engineers, 1983) identified areas where potential contamination from past waste storage, handling, or disposal practices may pose threats to human health or the environment. Eighteen potentially contaminated areas were identified in the IAS report. Two of the areas were subsequently found to be outside of the scope of the NACIP program and were not discussed further in the report. The IAS concluded that no further action was required at three of the areas. Further investigation was recommended at the remaining thirteen areas.

A Confirmation Study was conducted at six of the thirteen areas recommended for further investigation. Confirmation studies were conducted for three of the five RI sites. The Confirmation Studies (Loureiro Engineering, 1986) conducted at McAllister Point Landfill, Tank Farm Four, and Melville North Landfill consisted of two steps: a Verification Step and a Characterization Step. The objectives of the Verification Step were to locate sources of contamination, determine the presence of specific toxic and hazardous materials, and determine general site hydrogeology. The objective of the Characterization Step was to develop a quantitative assessment of the contamination identified in the Verification Step.

Under the IR Program, Phase I Remedial Investigations (RI) have been conducted at five of the IAS sites on the NETC. The findings of the Phase I RI are presented in a draft RI report (TRC-EC, 1991).

1.5 Current Site Investigations

Phase II Remedial Investigations will be conducted at the following four RI sites:

Site 01 McAllister Point Landfill
Site 09 Old Fire Fighting Training Area
Site 12 Tank Farm Four
Site 13 Tank Farm Five

The planned Phase II RI field activities for the four RI sites are presented in Volume III of this Work Plan. The plans for the Phase II investigation of the non-NPL site, the Melville North Landfill site (Site 02), which was investigated in the Phase I RI will be presented in a separate Work Plan. The locations of the four RI sites discussed in this Work Plan are shown on Figure 3.

1.6 Project Scope

An objective of this Remedial Investigation program is to gather sufficient information on the nature and extent of contamination at each site. The results of the Remedial Investigations should enable a technically-supported judgement as to whether specific site conditions constitute environmental, health or safety hazards.

The field activities and the associated sample matrices analyses for the four site investigations will be discussed in this Work Plan. The sample program makes extensive use of Target Compound List (TCL) and Target Analyte List (TAL) analyses using EPA-CLP protocols, as defined in the USEPA Contract Laboratory Program (CLP) Statement of Work (SOW) for Organic Analysis; Multi-Media, Multi-Concentration; SOW No. 3/90; revised July 1991, and in the USEPA CLP SOW for Inorganic Analysis; Multi-Media, Multi-Concentration; SOW No. 3/90; revised September 1991. These EPA CLP requirements will be followed during this study. Naval Energy and Environmental Support Activity (NEESA) guidance (Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program, NEESA 20.2-047B, 1988) for Level D analyses and data validation will also be followed by the laboratory and data validator. A copy of these requirements are provided as Appendix A. Where EPA-CLP protocols and NEESA guidance differ, the more stringent requirements will be followed.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 Introduction

This project will be largely performed by TRC-EC. Project review will be performed by a Technical Review Committee assembled by the Northern Division. The names and addresses of select individuals involved in the project review and oversight appear below.

U.S. Navy

- Northern Division Code 1823
  Naval Facilities Engineering Command
  10 Industrial Highway, Mail Stop #82
  Lester, PA 19113

  Mr. Francisco LaGreca, Engineer-In-Charge
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- Naval Education and Training Center
  Public Works Dept., Bldg. 1
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TRC-EC

- 5 Waterside Crossing
  Windsor, CT 06095

  Mr. Robert C. Smith, P.E., Program Manager
  Mr. James Peronto, P.E., Project Manager
  (203) 289-8631

Rhode Island DEM

- Air and Hazardous Materials Division
  291 Promenade Street
  Providence, RI 02908

  Mr. Paul Kulpa
  (401) 277-2797

U.S. EPA

- Region I
  Federal Facilities Section
  90 Canal Street, 2nd Floor
  Boston, MA 02203

  Ms. Carol Keating, Remedial Project Manager
  (617) 573-5769

Figure 1 presents the organizational chart for the NETC - Newport RI/FS project showing staff positions responsible for each project element. The responsibilities of TRC-EC's Project Manager and QA/QC staff are briefly described below.

2.2 Project Manager's Responsibility

The TRC-EC Project Manager will provide overall direction to the project team, and will be held responsible for successful project completion. The Project Manager will be the primary contact for the Northern Division's Engineer-In-Charge (EIC).

2.3 QA Manager's Responsibility

TRC-EC's Corporate QA Manager will be the responsible Quality Assurance Officer for this project. The QA Manager reports independently to the Corporate President and, hence, has full authority to act independently from the technical line management structure. He will serve as TRC-EC's primary contact with the Northern Division's QA staff, if so requested by the EIC.

He will monitor compliance of the project with the QAPP plan, and perform any necessary performance or system audits.

The TRC-EC QA Manager will initiate and monitor any necessary formal corrective actions. He will assist in preparing QA/QC project summaries for the RI Report, including analysis of precision, accuracy, and completeness of data collected.

2.4 Field QC Coordinator's Responsibilities

A Field QC Coordinator will be selected for this project. The Field QC Coordinator will work with the field team in preparing for the sampling events, and also during the field work. He or she will be on site to ensure required QC procedures are followed for sample collection and handling; will initiate informal and/or formal corrective actions, as necessary; and will maintain and report QC records and results to the TRC-EC Project Manager and QA Officer. The QC field coordinator will also serve as the QA/QC Manager for the project. This person will be responsible for ensuring all analytical deliverables have been received and subsequently validated in accordance with this QAPP.

2.5 Laboratory QC Coordinator

The analytical laboratory selected for this project, a NEESA-approved and EPA CLP laboratory, will also designate a QC Coordinator who will function as part of the project QC team. The duties of the laboratory QC Coordinator or designee will include, at a minimum, the following:

- Direct preparation of sample containers;
- Direct preparation and inclusion of blind QC samples in sample load in a fashion unrecognizable to analysts;
- Monitor use of known QC samples, blanks and duplicates, as required by specific projects;
- Maintain records of performance on known and blind QC samples as a measure of analytical precision and accuracy (control charts, etc.); and
- Direct and monitor recordkeeping and sample tracking activities.

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

3.1 Introduction

The overall quality assurance objective for laboratory analysis of environmental samples is to provide a laboratory QA/QC program that is, at a minimum, equal to the U.S. EPA Contract Laboratory Program (CLP). The quality control limits of accuracy and precision for laboratory analyses are governed by the methods and equipment used. Laboratory QA/QC requirements defined in CLP protocol are designed to ensure that acceptable levels of data accuracy and precision are maintained throughout the analytical program. These requirements are detailed in the U.S. EPA CLP Statement of Work (SOW) for Organic Analysis; Multi-Media, Multi-Concentration; SOW No. 3/90; revised August 1991 and in the U.S. EPA CLP SOW for Inorganic Analysis; Multi-Media, Multi-Concentration; SOW No. 3/90; March 1990. These requirements will be followed during this study. In addition, Navy NEESA Level D analysis requirements will be followed when more stringent.

It must be recognized that QA objectives may be attainable only for samples that are homogeneous and do not have inherent matrix-related problems. In the event that QA objectives cannot be met on specific samples, groups of samples or sample types, the analytical laboratory will make every reasonable effort to determine the cause of non-attainment and, if such is due to instrument malfunction, operator error, or other identifiable cause within the control of the laboratory, the samples affected will be reanalyzed, if possible. Should non-attainment of QA objectives be due to sample inhomogeneity, sample matrix interference, or other sample-related causes, reanalyses will be treated as additional analyses.

For many EPA-approved methods, interlaboratory method verification studies have been used to establish QC criteria which may be regarded as an inherent part of the method. In those cases, such criteria will take precedence except for deviations from such criteria that can be reasonably attributed to sample-related cases.

The quality assurance objectives for all measurement data include considerations of precision, accuracy, completeness, representativeness, and comparability as described below.

3.2 Precision and Accuracy

The precision of a measurement is an expression of mutual agreement of multiple measurement values of the same property conducted under prescribed similar conditions. Precision reflects the repeatability of the measurement. Precision is evaluated most directly by recording and comparing multiple measurements of the same parameter on the same sample under the same conditions. Precision is usually expressed in terms of the standard deviation. The precision objectives for analytical parameters are specified in the CLP protocols. Except as otherwise specified by the method, the QC objective for precision under this project will be ± 20 percent (relative percent difference) as determined by duplicate analyses. It must be recognized that for analytes at concentrations of less than five times the method detection limit (MDL), this objective is unlikely to be met.

The degree of accuracy of a measurement is based on a comparison of the measured value with an accepted reference or true value, or is a measure of system bias. Accuracy of an analytical procedure is best determined based on analysis of a known or "spiked" sample quantity. The degree of accuracy and the recovery of analyte to be expected for the analysis of QA samples and spiked samples is dependent upon the matrix, method of analysis, and compound or element being determined. The concentration of the analyte relative to the detection limit is also a major factor in determining the accuracy of the measurement. Except as otherwise specified by a method, the QC objective for accuracy under this project will be 75 to 125 percent (percent recovery), as determined by sample spike recoveries. Alternately, accuracy may be assessed through the analyses of appropriate standard reference materials, certified standards, or samples, as available.

3.3 Completeness

Completeness is a measure of the amount of valid data obtained from the measurement system relative to the amount anticipated under ideal conditions. This project's QC objective for completeness, as determined by the percentage of valid data generated, will be ≥ 90 percent.

3.4 Representativeness

Samples taken must be representative of the population. Where appropriate, the population will be statistically characterized to express: 1) the degree to which the data accurately and precisely represent a characteristic of a population, 2) parameter variations at a sampling point, and 3) a process, or an environmental condition. Sample selection and handling procedures will be conducted to obtain the most representative sample possible. Sampling devices will be decontaminated between sampling points to ensure that cross-contamination does not occur between samples.

Representativeness will also be monitored by collection and analysis of the following QC field samples:

- Trip blanks;
- Field blanks;
- Source water blanks; and
- Duplicate samples.

These QC samples will be collected in accordance with Section 4.4 of the QAPP.

Representative samples will be collected through the following actions:

- Collect samples from locations fully representing the site conditions;
- Use appropriate sampling procedures and equipment;
- Use appropriate analytical methodologies; and
- Analyze for appropriate parameters using appropriate detection limits.

Field duplicate and field blank samples will be shipped as blind samples to the laboratory. These samples will be numbered similarly to other samples except fictitious sample identifiers will be assigned. Trip blanks will be labelled as such and shipped with samples being analyzed for volatile organics. Samples for matrix spike and matrix spike duplicates will be designated on the chain-of-custody forms and sample labels. Water samples for matrix spike and matrix spike duplicate analyses for organic parameters will be collected in triplicate; samples for matrix spike analyses for inorganic parameters will be collected in duplicate.

The laboratory will make appropriate efforts to assure that the samples are adequately homogenized prior to taking aliquots for analysis, so reported results represent samples received.

Some techniques of homogenization (e.g., compositing) expose the sample to significant risk of contamination or loss through volatilization, and will be avoided.

3.5 Comparability

Consistency in sample acquisition, handling, analysis and level of QA/QC is necessary so that the analytical results may be compared. Where appropriate, the results of the analyses will be compared with the results obtained in previous studies. The laboratory will also use EPA-approved methods and reporting units, in order to assure that the data will be comparable to other similarly generated data sets.

4.0 SAMPLING PROCEDURES

4.1 Introduction

The following matrices will be sampled during the Phase II field investigation study at NETC - Newport: soil, sediment, surface water, ground water, leachate, and possibly non-aqueous phase liquids (NAPLs). All sample collection and monitoring methodology are presented in Appendix B of Volume III of this Work Plan. These procedures will be implemented in order to collect representative data for remedial planning guidance. All sample media collected will be handled in accordance with this Quality Assurance Project Plan and the Field Sampling Plan. All analytical methods and estimated detection limits are subsequently described in Section 7.0 of this document, including analysis for the Target Compound List (TCL) and Target Analyte List (TAL), as well as all other parameters for this project.

4.2 Selection of Sampling Locations

The locations of samples for each of the sites at NETC-Newport appear in the site specific Field Sampling Plans in Volume III of this Work Plan.

4.3 Sample Collection, Handling, and Shipping

It is important to use appropriate sample containers so that no chemical alteration occurs between the collection of samples in the field, and the receipt of samples at the laboratory. The sample bottles will be prepared and shipped to the field by the laboratory, under the direction of the laboratory QC coordinator. The sample bottles will be transported to the site within a sealed shipping cooler.

Sample containers will be selected to ensure compatibility with the potential contaminants and to minimize breakage during transportation. Aqueous phase samples for organic analyses will be contained in glass vials with teflon-lined, screw-type caps. Sample bottles, analytical methods and preservation required are listed in Table 1 for soil and sediment samples and in Table 2 for aqueous samples. Holding times are further defined in Table 3, for the analytical methods listed in Tables 1 and 2.

Sample labels will be filled out at the time of sampling and will be affixed to each container to identify the sample number, collector's name, date and time of collection, location of the sampling point, preservatives added, and analyses requested for the sample.

Ground water samples collected from wells will be analyzed for total metals and consequently, filtering will not be conducted in the field prior to the addition of preservatives for these analyses. However, field filtering (0.45 micron filter), followed by the addition of preservatives, will be conducted on a select subset of samples described in the site specific field sampling plans. Water samples to be analyzed for cyanide will be checked in the field for the presence of chlorine using potassium iodide (KI) starch paper. If chlorine is present, a pre-weighed (0.6 gram) amount of ascorbic acid will be added to the sample.

All ground water and surface water samples will also be field tested for the following parameters according to the listed methods: pH (EPA Method 150.1), temperature (EPA Method 170.1), conductivity (EPA Method 120.1), salinity (Standard Method 2520), dissolved oxygen (EPA Method 360.1), and turbidity (Standard Method 214A). Select ground water and surface water samples will also be collected for laboratory analysis according to the listed methods: hardness (EPA Method 130.2). Ground water samples will also be laboratory tested for redox potential (Standard Method D1498-76) and cation exchange capacity (SW 846 Method SW 9080/9081).

After the bottles for a given sample site have been filled, they will be placed in a shipping cooler. Field personnel will add bags of crushed ice or ice packs to the shipping coolers as the samples are collected. Each sample container will be cushioned with packing materials and sealed in a refrigerated cooler container for shipment to the laboratory by overnight delivery. Daily sample collection activities will be scheduled in order to assure overnight delivery of samples.

A chain-of-custody record will be prepared and will accompany all samples to provide documentation of all samples collected and to trace sample possession. Chain-of-custody procedures are discussed in detail in Section 5 of this document.

4.4 Field Quality Control (QC) Samples

Table 4 lists the percentage of field QC samples per sample matrix for the Level D analyses, based on current Navy (NEESA) guidance. A sampling event is defined as the time from which the sampling personnel arrive at the site until these personnel complete the sampling task. An example of two events would occur if sampling personnel went to a site for 3 weeks, drilled borings, and installed ground water monitoring wells. During this task, soil and water samples were collected for laboratory analysis. The sampling crew subsequently left the site for two months, thus concluding the first sampling event. The crew later returned to collect another set of ground water samples over a 3-day period. The second visit would constitute the second sampling event.

Trip blanks, field blanks, and duplicate samples will be collected as part of each sampling event, in order to ascertain a measure of quality control during each sampling round. The following sections describe the purpose and usage of each of these types of samples.

4.4.1 Trip Blanks

Trip blanks are defined as samples which originate as analyte-free water which is placed in volatile organic vials and preserved with HCl in the laboratory and shipped to the site in the sample cooler with sample containers. These vials are subsequently returned to the laboratory with samples for volatile organics analysis (VOA). One trip blank will accompany each cooler containing samples to be analyzed for VOAs, and will be stored at the laboratory with the samples. Trip blanks will be analyzed in order to evaluate the effect of ambient site conditions and sample shipment on sample integrity, and to ensure proper sample container preparation and handling techniques. All trip blanks will be labeled according to the proper chain-of-custody procedures and will be analyzed for volatile organic compounds.

4.4.2 Field Blanks

Field blanks will be collected in order to determine the effectiveness of the decontamination of sample collection equipment. The field blank will be collected by pouring laboratory-supplied, analyte-free deionized water for inorganic fraction analyses and HPLC-grade water for organic fraction analyses over the decontaminated sample collection equipment (i.e.,

bailer, stainless steel spoon, etc.) and into the appropriate sample containers. Field blanks will be collected for each matrix sampled. All field blanks will be analyzed for the same analytical parameters as the sample matrix. A minimum of one field blank will be collected for every 20 samples or per day per matrix, whichever is greater. All field blanks will be preserved in accordance with the methods specified in Table 2, labeled according to the proper chain-of-custody procedures, and stored and shipped according to the procedures discussed previously.

4.4.3 Source Water Blanks

Source water blanks consist of the source water (obtained from NETC-Newport water supply) used for decontamination (e.g., steam cleaning). At a minimum, one source blank from each source of water will be collected and analyzed for the same parameters as the related samples. In addition, samples of the distilled water used in sampling equipment decontamination will also be analyzed for the full TCL/TAL.

4.4.4 Field Duplicates

Duplicate samples will be collected, homogenized, and split. The procedure for collecting duplicate samples consists of alternating the collection of the sample between the sample collection bottle and the duplicate collection bottle. Duplicate samples are two separate samples taken from the same source. Replicate samples are two aliquots taken from the same sample container and analyzed independently. Samples for volatile organic compound analyses will not be mixed, but equal portions of the sample will be collected simultaneously and placed in 40-ml glass vials. Field duplicates will be collected at a frequency of 10 percent per sample matrix (NEESA - Level D). All duplicate samples will be sent as "blind" (unknown duplicate samples) to the primary laboratory responsible for the sample analysis.

4.4.5. Regulatory Splits

If regulatory agencies (state or federal) wish to obtain samples for independent analysis which are duplicates of those collected by TRC-EC, these regulatory split samples will be collected in the same manner as field duplicates. However, these splits will be sent by the regulatory agency to a separate, independent laboratory for analysis.

4.5 Field Decontamination Procedures

Drill rigs, backhoes, and drilling equipment will be decontaminated prior to moving to a site. Drilling equipment used for multiple boreholes will be decontaminated prior to each use. All decontamination of drill rigs and drilling equipment (e.g., augers, rods) will be conducted at designated decontamination areas with a steam cleaner. Decontamination of sampling equipment will be performed at designated decontamination areas. Sampling equipment such as split-spoons, stainless steel spoons or spatulas, and stainless steel mixing bowls will be decontaminated using the following procedures:

- Wash and scrub with low phosphate detergent in tap water;
- Rinse with tap water;
- Rinse with 10% nitric acid (1% nitric acid on carbon steel split-spoons);
- Rinse with tap water;
- Rinse with hexane and methanol - pesticide grade solvents or better;
- Rinse with distilled water (demonstrated to be analyte-free);
- Air dry - on clean polyethlyene sheeting; and
- Wrap in aluminum foil, shiny side out for transport (if not being used immediately).

NOTE: Clean equipment may rest on -- but never be wrapped in clean polyethylene sheeting.

An attempt will be made to coordinate a drilling sequence hierarchy from less likely to more likely contaminated boring locations to reduce the potential for cross-contamination between locations. All sampling equipment will be decontaminated prior to use at each sampling location.

All decontamination rinsates will be collected and contained in drums for subsequent determination of proper handling and/or disposal.

5.0 SAMPLE CUSTODY

5.1 Introduction

Sample custody procedures will be observed to ensure the validity of the data generated during this program. Sample chain-of-custody will be initiated with selection and preparation of the sample containers. To reduce the chance for error, the number of personnel handling samples will be restricted, and one person will be assigned the responsibility of field sample custodian.

On-site monitoring data will be controlled and entered daily in permanent log books, as appropriate. Personnel involved with the sample chain-of-custody process will be trained in sample collection and handling procedures prior to project initiation.

5.2 Field Sample Custody

Sample custody and documentation procedures described in this section will be followed throughout all sample collection activities at NETC-Newport. Components of sample custody procedures include the use of field notebooks, sample labels, and chain-of-custody forms.

5.2.1 Field Notebooks

The TRC-EC project manager will oversee the maintenance of all field notebooks. Field notebooks will be bound books, preferably with consecutively numbered pages, that are at least 4 inches x 7 inches in size. Field notebooks will be maintained by the TRC-EC field team leader and other team members to provide a daily record of significant events, observations, and measurements during the field investigation activities. All notebook entries will be signed and dated.

All information pertinent to the field survey and/or sampling will be recorded in the notebooks. Field notebook entries will include the following information (at a minimum):

- Name and address of field contact;
- Name and title of author, date and time of entry, and physical/ environmental conditions during field activity;
- Names of field crew;
- Names and titles of any site visitors;
- Type of sampling activity;

- Location of sampling activity;
- Description of sampling point(s);
- Date and time of sample collection;
- Sample media (e.g., soil, sediment, ground water, etc.);
- Sample collection method;
- Number and volume of sample(s) taken;
- Analyses to be performed;
- Sample preservatives;
- Sample identification number(s);
- Field observations;
- Any field measurements made such as pH, temperature, conductivity, water level, etc.;
- References for all maps and photographs of the sampling site(s); and

All original data recorded in either the field notebooks, on sample labels, or in the chain-of-custody records will be written with waterproof ink. None of these accountable, serialized documents will be destroyed or discarded, even if they are illegible or contain inaccuracies.

If an error is made on an accountable document assigned to an individual, that individual will make all corrections by crossing a line through the error and entering the correct information and initialing the cross-out. The erroneous information will not be obliterated. Any subsequent error discovered on an accountable document will be corrected by the person who made the entry, and will be initialed and dated, as appropriate.

5.2.2 Sample Labels

All samples obtained at the site will be placed in an appropriate sample container for preservation prior to shipment to the laboratory. Each sample will be individually identified with a separate identification label recorded with a unique sample identifier. The information recorded on the label will include:

- Project name/project number/location;
- Sample identifier/number;
- Analysis to be performed;
- Preservatives used, especially any non-standard types, and any other field preparation of the sample;
- Date of collection;

- Time of collection (a four-digit number indicating the 24-hour (military) clock time of collection; e.g., 1430 for 2:30 p.m.);
- Number of containers per analyte (i.e., 1 of 2, etc.); and
- Sampler's initials.

Examples of TRC-EC's proposed sample identification labeling format for each sample type are presented in Appendix B of the project Field Sampling Plan.

5.2.3 Custody Seals

Samples will be placed in sample coolers and the coolers will be sealed with custody seals prior to shipment to the laboratory. Clear adhesive tape will be placed over the seals to ensure that seals are not accidentally broken during shipment.

5.2.4 Chain-of-Custody Records

All samples will be accompanied by a chain-of-custody record, an example of which is shown on Figure 2. A chain-of-custody record will accompany the sample from initial sample container selection and preparation commencing at the laboratory, to the field for sample containment and preservation, and through its return to the laboratory. If samples are split and sent to different laboratories, a copy of the chain-of-custody record will be sent with each sample.

The "Remarks" column in the chain-of-custody record will be used to record specific considerations associated with sample acquisition such as: sample type, container type, and sample preservation methods. When transferring samples, the individuals relinquishing and assuming sample custody will sign, date, and note the transfer time on the record.

A minimum of two copies of the chain-of-custody record will follow each sample to the laboratory. The laboratory will maintain one file copy, and the completed original will be returned to the TRC-EC Project Manager. A copy of the completed original will be returned as a part of the final analytical report. This record will be used to document sample custody transfer from the sampler, to another TRC-EC team member, to a shipper, or to the laboratory, and also to verify the date of sample receipt in the laboratory.

Shipments will be sent by overnight carrier with appropriate bill of lading documentation. Bills of lading will be retained as part of the permanent program documentation.

5.2.5 Sample Shipment

Samples will be delivered to the laboratory for analysis as soon as practical after the number of samples and sample containers is sufficient to comprise a shipment, preferably the same day the samples are collected. Sample shipment will occur at a minimum frequency of every other day. All samples will be stored in coolers at a temperature of 4°C. The samples will be accompanied by the chain-of-custody record. During sampling and sample shipment activities, the TRC-EC field team leader (or his designee) will contact the laboratory daily to provide information about impending shipments.

5.2.6 Sample Master Log Notebook

In addition to the field notebook documentation, all samples will be documented in a master sample log notebook for future reference. This master sample log will include the following information: sample identifier, sampling date and time (military), sampling personnel, matrix type (i.e., soil), containers/parameters for analysis, date and method of shipment, any sample preservation, and any other pertinent information relating to the sample(s). The master sample log will be consistently updated during sampling activities in the field for review during field audits. Upon completion of sampling activities, the master sample log notebook will be delivered to the TRC-EC Project Manager.

5.3 Laboratory Sample Custody

The TRC-EC Field QC Coordinator will notify the laboratory of upcoming field sampling activities and subsequent sample transfer to the laboratory. This notification will include information concerning the number and type of samples to be shipped, as well as the anticipated sample arrival date.

The laboratory will designate a sample custodian who will be responsible for maintaining sample custody and for maintaining all associated custodial documentation records. After receiving the samples, the sample custodian will check the original chain-of-custody record and

request for analysis documents against the labeled contents of each sample container for correctness and traceability. The sample custodian will then sign the chain-of-custody record and record the date and time that the sample shipment was received at the laboratory. The samples will then be logged into the laboratory system.

Care will be exercised in the laboratory to annotate any labeling or descriptive errors associated with the sample containers. In the event of discrepant documentation, the laboratory will immediately contact the TRC-EC Field QC Coordinator as part of the corrective action process. A qualitative assessment of each sample container will be performed to note any anomalies, such as broken or leaking bottles. This assessment will be recorded as part of the incoming chain-of-custody procedure.

Samples will be stored in a secured dark area and at a temperature of approximately 4°C, if necessary, until analyses are performed. A laboratory chain-of-custody record will accompany the sample or sample fraction through final analysis for sample control. A copy of the chain-of-custody record will accompany the laboratory's analytical report and will become a permanent part of the project's records. The pH of incoming water samples will be checked by the laboratory when preservatives have been added to the sample. Details of the chain-of-custody for laboratory activities will be provided in the laboratory's QA manual.

5.4 Evidence File

The TRC-EC Project Manager will serve as file custodian. At the project's completion, the files will be returned to the Navy's Northern Division Office where they will be permanently archived.

The evidence file will contain all incoming materials related to the project such as: sketches, correspondence, authorizations, and logs. These documents will be placed in the project file as soon as possible. If correspondence is needed for reference by project personnel, a copy will be made rather than manipulating the original. All records shall be legible and easily identifiable.

Examples of the types of records that will be maintained in the project file are:

- Field documents;
- Correspondence;
- Photographs;
- Laboratory data;
- Reports; and
- Subcontract agreements.

Out-going project correspondence and reports will be reviewed by the Project Manager or designee prior to mailing.

To prevent the inadvertent use of obsolete or superseded project-related procedures, all personnel of the laboratory and project staffs will be responsible for reporting changes in protocol to the Laboratory Project Manager and the Laboratory Director. The Laboratory Project Manager and Laboratory Director will then inform the project and laboratory staffs and the Quality Assurance Officer of these changes, as appropriate.

Revisions to procedures shall be subject to the same level of review and approval as the original document. Outdated procedures shall be marked "void". The voided document may be destroyed at the request of the Laboratory Project Manager; however, it is recommended that one copy of the voided document be maintained in the project file. The date and reason why the document was voided will be recorded.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the instrument manufacturer's specifications.

Laboratory instrumentation calibration procedures and frequencies are specified in the Contract Laboratory Program (CLP) Statement of Work (SOW), for Organic Analysis; Multi-Media, Multi-Concentration; SOW No. 3/90; revised July 1991 and in the CLP SOW for Inorganic Analysis; Multi-Media, Multi-Concentration; SOW No. 3/90; September 1991, and will be strictly followed for those analytes analyzed by CLP protocols. For all other analyses for which EPA-approved methods exist, the laboratory will employ such methods and follow the specified calibration procedures and frequencies. The laboratory quality control program includes strict adherence to routine calibration procedures. A description of calibration procedures and frequencies for non-CLP methods will be provided by the laboratory selected for this program.

Analysis of blank samples, duplicate samples, spiked blanks, and matrix blanks will be performed where possible to document the effectiveness of calibration procedures. Method blanks contain all the reagents used in the preparation and analysis of the samples and are processed through the entire analytical scheme to assess spurious contamination from reagents, glassware and other materials used during analysis. The terms method blank and laboratory blank are interchangeable. A matrix blank denotes a blank of a similar matrix (e.g., for liquids a blank of distilled-deionized reagent grade high purity water may be used; for soils/sediments high purity sand may be used). A spike blank is a method blank which has had a known concentration of a particular compound or analyte added to it to assure adequate percent recovery of the compound/analyte.

Records of calibration, repair, or replacement will be maintained by the designated laboratory personnel performing quality control activities. Calibration records of assigned laboratories will be filed and maintained at the laboratory location where the work is performed and subject to QA audit.

Calibration of field instruments will be performed at approved intervals as specified by the manufacturer or more frequently, as conditions dictate. At a minimum all field instruments will

be calibrated at the beginning and end of each day. Calibrations may also be performed at the start and completion of each test run; however, such calibrations will be re-initiated as a result of delay due to meals, work shift change, or instrument damage. Calibration standards used as reference standards will be traceable to the National Bureau of Standards (NBS), when possible. Calibration procedures for field instruments will be as specified by the instrument manufacturer. Equipment manuals describing calibration procedures will be maintained in the field office during site investigations.

7.0 ANALYTICAL PROCEDURES

7.1 Introduction

EPA-approved methods will be used for all analyses for which such methods exist. Target Compound List (TCL) and Target Analyte List (TAL) parameters will be analyzed by Contract Laboratory Program (CLP) protocols. The laboratory will follow methods detailed in the CLP Statement of Work (SOW) for Organic Analyses, Multi-media, Multi-concentration, 3/90, revised July 1991, and the SOW for Inorganics Analyses, Multi-media, Multi-concentration, 3/90, revised September, 1991. US Navy NEESA guidance for Level D analyses will also be adhered to by the laboratory when more stringent than the CLP requirements.

If sample contaminant concentrations are high, then CLP protocols for low and medium concentration samples may be required. In this case, sample runs at lower dilutions will be performed to obtain quantitative results for parameters present at lower concentrations. That is, samples are pre-screened to estimate concentration levels. According to EPA methodology, high concentration samples are diluted to bring them within a linear working range. Low concentration samples are set aside and then analyzed within the same linear working range. It may not be possible to quantitate sample results in parts per billion for samples where "pure" waste (fuel product, paint, powder, etc.) is encountered. A decision tree approach will be followed, in order to quantitate the sample when high levels of contamination are encountered. In this case, detection limits will be raised for all analytes on the sample, as the sample is diluted.

7.2 Target Compound List - Organic Compounds

All organic compound analyses will be conducted according to the U.S. EPA CLP, Statement of Work for Organic Analyses, SOW 3/90, revised August 1991. The organic compounds contained in the TCL will be determined using proven methods to identify and quantify volatile, semi-volatile and pesticide/PCB compounds. The TCL compounds and CLP-required detection limits are shown in Tables 5 through 7. The actual detection limits obtainable for a specific sample depend upon matrix interferences. If the CLP detection limit is unachievable for a particular sample, an explanation of the problem and supporting evidence will be provided by the laboratory in the case narrative summary submitted with the deliverables.

Each set of samples will be analyzed in conjunction with the analysis of QC samples, including field duplicates, blanks, matrix spikes and matrix spike duplicate (MS/MSD) samples for quality control determinations. The frequency of analysis of the QC samples, as previously presented in Section 4.4, will not be less than one per 20 samples and at least one per sampling day for field blanks, not less than one per 10 samples for field duplicates, and not less than one per 20 samples for MS/MSD samples (see Table 2). All samples, field duplicates, blanks, matrix spike and matrix spike duplicates will be fortified with surrogate spiking compounds as shown in Table 8. The CLP recommended guidelines for percentage recovery of the surrogate compounds are provided in Table 9. The percentage recovery of the matrix spiking compounds and relative percentage difference of duplicate analyses will be calculated to obtain measurements of the analyses accuracy and precision.

7.3 Target Analyte List - Metals

All water and soil samples will be prepared for analyses as described by procedures for each respective matrix and analysis method described in the U.S. EPA CLP, Statement of Work for Inorganic Analyses (SOW 3/90). Each set of samples, or 20 samples, whichever is more frequent, will be analyzed with a preparation blank, duplicate sample, and matrix spiked sample. Each group of 20 samples will be analyzed with a laboratory control sample of similar matrix. The Target Analyte List (TAL) for metals and inorganics and associated detection limits are listed in Table 10.

The atomic absorption (AA) instrument will be calibrated through the use of a minimum of three calibration standards prepared by dilution of certified stock solutions. Calibration standards will contain acid(s) at the same concentration as the digestates. An analysis blank will then be prepared, and one calibration standard will be at the EPA-CLP required detection limit for the metal being evaluated. The other standard concentrations will bracket the concentration range of the samples. A continuing calibration standard, prepared from a different stock solution than that used for the calibration standards, will be prepared and analyzed after every ten samples or every two hours of continuous instrument operation. The value of the continuing calibration standard concentration must agree with requirements of the CLP SOW.

8.0 DATA REDUCTION, VALIDATION, AND REPORTING

8.1 Introduction

The procedures used for calculations and data reduction are specified in each analytical method referenced in Section 7.0 of this document. Raw data will be entered in bound laboratory notebooks. A separate book will be maintained for each analytical procedure. The data will be entered such that sufficient space remains to enter all subsequent calculations required to arrive at the final (reported) value for each sample. Calculations include factors such as sample dilution ratios, corrections for titrant normality, and conversion to dry-weight basis for solid samples. Instrument chart recordings and calculator printouts will be labeled and attached to their respective pages, except for voluminous gas chromatograms which will be cross-referenced and stored separately.

Calculations will be checked from the raw data to final value stages prior to reporting the results for a group of samples. Results obtained from extreme ends of standard curves generated by linear regression calculator programs will be checked against graphically-produced standard curves if the correlation coefficient of a program curve is less than 0.995.

Data will generally be reported as micrograms of analyte per liter for aqueous samples or micrograms per kilogram (dry weight) for solid or non-aqueous liquid samples. Concentration units will always be listed on reports and any special conditions, such as dry weight conversions, will be noted. The data reporting form will also include the unique sample number assigned to each sample, details of sample collection including the client's identification number, and the dates of sample receipt and report preparation.

8.2 Data Reduction

8.2.1 Target Compound List Compounds

Instrument performance test data will accompany the raw data during data reduction. The following criteria must be attained to make a qualitative identification of an organic pollutant using Gas Chromatograph/Mass Spectrometer (GC/MS) techniques:

- Characteristic ions for each compound of interest must maximize in the same or within one scan of each other.

- Retention time must occur within ± 1 percent of the retention time of the authentic compound.

- Relative peak heights of the three characteristic ions in the Extracted Ion Current Profile (EICP) must fall within $\pm$ 20 percent of the relative intensities of these ions in a reference mass spectrum. The reference mass spectrum can be obtained by a standard analyzed in the GC/MS system or from a reference library.

- The entire mass spectrum of the compound of interest is compared to the reference compound.

Structural isomers having similar mass spectra can be explicitly identified only if the resolution between authentic isomers in a standard mix is acceptable. Acceptable resolution is achieved if the baseline-to-valley height between the isomers is less than 25 percent of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.

When a compound has been identified, the quantitation of that compound is based on the integrated abundance from the EICP of the primary characteristic ion. The base peak ion of internal and surrogate standards is used in the quantitation. If the sample produces an interference for the first listed ion, a secondary ion is used to quantitate. Quantification is performed using internal standard techniques.

To ensure that reported data are accurate, all resultant data are verified. Retention items and area counts are checked carefully for correct identification and accurate quantification.

8.2.2 Metals and Cyanide

The concentrations of metals determined by Atomic Absorption Spectroscopy (AAS) measurements are obtained by comparison of absorbance values with those obtained from the analyses of known standards. A linear regression plot of absorbance versus concentration will be used to determine a concentration factor for linearity of response.

In the event of low (<85%) or high (>115%) post-digestion spike recovery, the analysis will be repeated using the method of known additions to determine potential matrix interferences. CLP criteria will be maintained for analyses of samples of similar matrix. The mean percentage recovery and standard deviation will be calculated from a minimum of 20 analyses. A warning

limit of ± 2 standard deviations from the mean and a control limit of ± 3 standard deviations will be used to establish that the test is providing accurate data.

8.3 Data Validation

Data validation is the process of reviewing data and associated quality control criteria and accepting, qualifying, or rejecting it on the basis of sound criteria. Project supervisory and QC personnel will use validation methods and criteria appropriate to the type of data and the purpose of the measurement. Records of all data will be maintained, even that judged to be an "outlying" or anomalous value. The QA/QC Manager validating the data will have sufficient knowledge of the technical work to identify questionable values.

8.3.1 Field Data Validation

Field sampling data will be validated by the TRC-EC Field QC Coordinator or QA/QC Manager, based on their judgment of the representativeness of the sample, maintenance and cleanliness of sampling equipment, and adherence to the approved, written sample collection procedure.

The following criteria will be used to evaluate the field sampling data:

- Use of approved sampling procedures;
- Use of reagents/standards that conform to QC-specified criteria; and
- Proper chain-of-custody maintained and documented.

8.3.2 Analytical Data Validation

Analytical data validation will include validation procedures within the laboratory and independent of the laboratory.

Data from laboratory analyses will be validated by the Laboratory QC Coordinator using criteria outlined below. Results from field and laboratory method blanks, replicate samples, equipment rinsates and internal QC samples will be used to validate analytical results.

The criteria listed below will be used to evaluate the analytical data:

- Use of approved analytical procedures;
- Use of properly operating and calibrated instrumentation;
- Acceptable results from analyses of laboratory control samples (i.e., the reported values should fall within the 95 percent confidence interval for these samples); and
- Precision and accuracy for this project should be comparable to that achieved in previous analytical programs and consistent with objectives stated in Section 7 of this QAPP.

Independent of the analytical laboratory, analytical data validation will be conducted which will follow the most stringent of the requirements and protocols specified in the following documents:

U.S. EPA, "Region I Laboratory Data Validation: Functional Guidelines for Evaluating Organic Analyses", February 1988; modified November 1988;

U.S. EPA, "Region I Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses", June 1988, modified February 1989;

U.S. EPA, Contract Laboratory Program Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration, 3/90, revised August 1991;

U.S. EPA, Contract Laboratory Program, Statement of Work for Inorganic Analysis, Multi-Media, Multi-Concentration, 3/90, revised September 1991; and

U.S. Navy/NEESA, Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program (NEESA 20.2-047B), June 1988.

All of the Phase II RI data will be validated in accordance with these requirements.

The data validation activities focus on areas of the analytical process which are under the laboratory's control when analyzing samples. The data qualifiers which result from validation represent the QC areas under the laboratory's control which could have been improved. Qualifiers attached to the data during validation supersede the qualifiers assigned by the laboratory.

Areas reviewed in the validation of organic data include the following: sample holding times, gas chromatography/mass spectroscopy (GC/MS) tuning, instrument calibration, blank analysis, surrogate recovery, matrix spike/matrix spike duplicates, internal standards (IS) performance, Target Compound List (TCL) compound identification, compound quantitation and reported detection limits, tentatively identified compounds, system performance, and overall assessment of the data for usability.

The areas reviewed in the validation of inorganic data include the following: sample holding times, instrument calibration and initial calibration verification, continuing calibration verification, Contract Required Detection Limit (CRDL) standards for Atomic Absorption (AA) and Inductively Coupled Plasma (ICP) spectrometers, initial and continuing calibration blank analysis, ICP interference check sample analysis, spiked sample analysis, post digested spike sample recovery analysis, duplicate sample analysis, laboratory control sample analysis, ICP serial dilution analysis, graphite furnace AA QC analysis, quarterly verification of instrument parameter report, and sample result verification.

8.4 Identification and Treatment of Outliers

Any data point which deviates markedly from others in its set of measurements will be investigated; however, the suspected outlier will be recorded and retained in the data set. The following tests will be used to identify outliers.

Dixon's test for extreme observations is an easily computed procedure for determining whether a single very large or very small value is consistent with the remaining data. The one-tailed t-test for difference may also be used in this case. It should be noted that these tests are designed for testing a single value. If more than one outlier is suspected in the same data set, other statistical methods, such as analysis of variance, tolerance intervals, or control charts, will be considered and the most appropriate method will be used and documented.

Since an outlier may result from unique circumstances at the time of sample analysis or data collection, those persons involved in the analysis and data reduction will be consulted. This may provide information on an experimental reason for the outlier. Further statistical analysis will be performed with and without the outlier to determine its effect on the conclusions. In many cases, two data sets will be reported, one including and one excluding the outlier.

In summary, every effort will be made to include the outlying values in the reported data. If the value is rejected, it will be identified as an outlier, reported with its data set and its omission noted.

8.5 Analytical Deliverables

Analytical deliverables will meet the requirements of the USEPA CLP SOW for Organic Analysis; Multi-Media, Multi-Concentration, 3/90, revised July 1991, and the USEPA CLP SOW for Inorganic Analysis, Multi-Media, Multi-Concentration, 3/90, revised September 1991.

9.0 INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

9.1 Introduction

Quality control checks will be performed to ensure the collection of representative samples and the generation of valid analytical results on these samples. These checks will be performed by project participants through the program under the guidance of the TRC-EC QA Officer.

9.2 Data Collection and Sampling QC Procedures

The TRC-EC internal QC checks for the sampling aspects of this program will include, but not be limited to, the following:

- Use of field notebooks to ensure completeness, traceability, and comparability of the samples collected.
- Field checking of field notebooks and sample labels by a second person to ensure accuracy and completeness.
- Strict adherence to the sample chain-of-custody procedures outlined in Section 5 of this document.
- Collection and analysis of trip blanks, source blanks, field blanks, and field duplicates.
- Calibration of the field monitoring equipment (e.g., HNU, OVA), as described in Section 6 of this document.

9.3 Analytical QC Procedures

9.3.1 Trip Blank Analysis

Volatile organic samples are susceptible to contamination by diffusion of organic contaminants through the Teflon-faced silicone rubber septum of the sample vial. Therefore, trip blanks will be analyzed to monitor for possible sample contamination during shipment. Trip blanks will be prepared by filling two volatile vials with laboratory-supplied, organic-free water which then will be shipped with the field sampling kit. Trip blanks will be preserved by the laboratory with hydrochloric acid. Trip blanks accompany the sample bottles through collection and shipment to the laboratory and are stored with the samples. Following the analyses, if the

trip blanks indicate possible contamination of the samples, depending upon the nature and extent of the contamination, the sample results will be qualified with respect to the contamination detected in the trip blanks. Results of trip blank analyses will be maintained with the corresponding sample analyses data in the project file.

9.3.2 Reagent Blank Analysis

A reagent blank is a volume of deionized, distilled laboratory water carried through the entire analytical procedure. The volume of the blank must be approximately equal to the sample volume processed. A reagent blank should be performed with each group of samples. Analysis of the blank verifies that method interferences caused by contaminants in solvents, reagents, glassware, and other sample processing hardware are known and minimized. Optimally, a reagent blank should meet CLP criteria. Results of reagent blank analyses will be maintained with the corresponding analytical data in the project file.

9.3.3 Duplicate Sample Analysis

Duplicate analyses are performed to evaluate the precision of an analysis. Results of the duplicate analyses are used to determine the relative percent differences between duplicate samples. Field (blind) duplicate samples will be collected for each media sampled at a frequency of one per ten samples collected. Duplicate analysis results will be reported together in the final RI report.

9.3.4 Verification/Reference Standard

On a quarterly basis, the laboratory Quality Control Coordinator introduces a group of prepared verification samples, or standard reference materials, into the analytical testing regime. The laboratory checks and approves the purity of standards and reagents prior to use. Results of the verification/reference standard data will be summarized, evaluated, and presented to laboratory management for review and corrective actions, if appropriate.

9.3.5 Other Laboratory Quality Control Checks

Quality control checks will be performed to ensure the collection of representative samples and the generation of valid analytical results on these samples. These checks are performed by project participants under the guidance of QC personnel.

The laboratory will make use of various types of QC samples to document the validity of the generated data. The following types of QC samples are routinely used:

Calibration Check Samples--One of the working calibration standards which is periodically used to check that the original calibration is still valid.

Spiked Samples--Replicate aliquots of project samples are spiked with components of interest and carried through the entire preparative and analytical scheme.

Laboratory Control Samples (LCS)--These samples are prepared from EPA Environmental Monitoring Systems Laboratory (EMSL) concentrates or National Bureau of Standards (NBS) standard reference materials. The LCS are used to establish that an instrument or procedure is in control. An LCS is normally carried through the entire sample preparation and analysis procedure.

Surrogate Spikes--Samples requiring analysis by GC/MS are routinely surrogate-spiked with a series of deuterated analogues of the components of interest. It is anticipated that these compounds would assess the behavior of actual components in individual program samples during the entire preparation and analysis scheme.

Matrix Spikes/Matrix Spike Duplicates (MS/MSD)--One MS/MSD pair will be run per 20 samples for each different matrix analyzed. These pairs will be spiked with the target compounds of concern for that matrix.

All values which fall outside the QC limits described in the analytical method will be noted. The following analytical guidelines will be used to check recovery values which fall outside the QC limits:

1. All recovery data are evaluated to determine if the QC limits are appropriate and if a problem may exist even though the limits are being achieved (e.g., one compound that is consistently barely within the lower limit).

2. All recovery data which are outside the established limits are evaluated. This evaluation includes an independent check of the calculation.

3. Corrective action is performed if any of the following are observed:

   - All recovery values in any one analysis are outside the established limits.
   - Over 50 percent of the values for a given sample set are outside limits.
   - One compound is outside the limits in over 50 percent of the samples.

Reagents used in the laboratory are normally of analytical reagent grade or higher purity. Each lot of acid or solvent used is checked for acceptability prior to laboratory use. All reagents are labeled with the date received and date opened. All glassware is precleaned according to specifications contained in the analytical method. Standard laboratory practices for laboratory cleanliness, personnel training, and other general procedures are used. A summary of all laboratory quality control analyses and the corresponding control determination is presented in Table 11.

9.3.6 Laboratory Control Charts

The control chart displays data in a format which graphically compares the variability of all test results with the average or expected variability of small groups of data. The variability may be due to random (indeterminate) or assignable (determinate) causes. The control chart distinguishes indeterminate from determinate variation in a process or method by its control limits. If a value falls outside the control limits, it is considered out-of-control, almost certainly due to a determinate cause which has been added to the indeterminate variations. The control chart signals the need to investigate, find the determinate cause, and correct it. Construction of a control chart requires a minimum of 14 to 20 duplicate sets of data points (which limits its use).

QC samples and instrument calibrations lend themselves most readily to the gathering of the data. Calculation of control limits and the values are usually plotted chronologically so that trends or cycles can be readily detected. If QC sample measurements show an out-of-control condition, it can be expected that subsequent sample analyses might yield invalid data. The control chart is an effective indicator of the need for corrective action.

For volatile and semi-volatile organics and pesticide analyses performed by GC/MS, surrogate recoveries from the method blank are the control sample. For other organics (e.g., PCBs, dioxins/furans), an LCS (spiked blank) is used to plot the control charts. An LCS is also used as the control point for inorganic analyses.

10.0 PREVENTIVE MAINTENANCE

10.1 Preventive Maintenance Procedures

Field equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with the manufacturer's specified recommendations and written procedure developed by the operators.

The laboratory will follow an orderly program of positive actions to prevent the failure of laboratory equipment or instruments during use. This preventive maintenance and careful calibration helps to assure accurate measurements from instrumentation. Routine maintenance procedures are followed for all instruments, glassware, reagents, analytical balances, and equipment used to produce deionized water. Specific procedures will be outlined in the laboratory Standard Operating Procedures (SOPs).

10.2 Schedules

Manufacturer's procedures identify the schedule for servicing critical items in order to minimize the downtime of the measurement system. It will be the responsibility of the operator to adhere to this maintenance schedule and to arrange any necessary and prompt service as required. Service to the equipment, instruments, tools, gauges, etc., shall be performed by qualified personnel.

In the absence of any manufacturer's recommended maintenance criteria, a maintenance procedure will be developed by the operator based upon experience and previous use of the equipment.

10.3 Records

Logs are maintained to record maintenance and service procedures and schedules. All maintenance records will be documented and traceable to the specific equipment, instruments, tools and gauges. Records produced shall be reviewed, maintained, and filed by the operators at the laboratories and by the data and sample control personnel when and if equipment, instruments, tools and gauges are used at the sites. The project QA officer may audit these records to verify complete adherence to these procedures.

10.4 Spare Parts

Critical spare parts are maintained by TRC-EC and the laboratory for field and analytical equipment, respectively. These spare parts will be stored for availability and used in order to reduce equipment downtime.

11.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

11.1 Introduction

Procedures used to assess data precision and accuracy will be in accordance with 44 FR 69533 "Guidelines Establishing Test Procedures for the Analyses of Pollutants", Appendix III Example Quality Assurance and Quality Control Procedures for Organic Priority Pollutants", December 3, 1979. Completeness is recorded by comparing the number of parameters initially analyzed with the number of parameters successfully completed and validated. For this project, a target control limit of greater than 90 percent will be used.

11.2 Accuracy

The percent recovery is calculated as:

$$\% = \frac{S_o - S_s}{S} \times 100$$

where: So = The background value, i.e., the value obtained by analyzing the sample.

S = Concentration of the spike added to the sample.

Ss = Value obtained by analyzing the sample with the spike added.

% = Percent recovery.

11.3 Precision

The relative percent difference is calculated as:

$$1/2 \times \frac{(V_1 - V_2)}{(V_1 + V_2)} \times 100 = \% \text{ difference}$$

where: V1,V2 = The two values obtained by analyzing the duplicate samples.

11.4 Completeness

Completeness will be reported as the percentage of all measurements made whose results are judged to be valid. The procedures to be used for validating data and determination of outliers are contained in Section 8.0 of this QAPP. The following formula will be used to estimate completeness:

$$C = 100 \times \frac{V}{T}$$

where: C = Percent completeness.

V = Number of measurements judged valid.

T = Total number of measurements.

12.0 CORRECTIVE ACTION

12.1 Introduction

The acceptance limits for the sampling and analyses under this program will be those stated in the method or defined by other means in the QAPP. Corrective actions are often immediate in nature, implemented by the analyst or Project Manager. The corrective action usually involves recalculation, reanalysis, or repeating sample collection.

12.2 Immediate Corrective Action

If an immediate corrective action can be taken as part of normal operating procedures, the collection of poor quality data can be avoided. Instrument and equipment malfunctions are amenable to this type of action. QC procedures include troubleshooting guides and corrective action suggestions. The actions taken will be noted in field or laboratory notebooks, but no other formal documentation is required, unless further corrective action is necessary. These on-the-spot corrective actions are an everyday part of the QA/QC system.

Corrective action during the field sampling portion of a program is most often a result of equipment failure or an operator oversight and may require repeating a sampling run. Operator oversight is best avoided by having field crew members audit each others' work before and after a test. Every effort will be made by the field team leader to ensure that all QC procedures are followed. If potential problems are not solved as an immediate corrective action, TRC-EC will apply formalized long-term corrective action, if necessary.

Corrective action for analytical work will include recalibration of instruments, reanalysis of known QC samples and, if necessary, reanalysis of actual field samples. Specific QC procedures and checklists are used by the laboratory to help analysts detect the need for corrective action. Often the person's experience will be valuable in alerting the operator to suspicious data or malfunctioning equipment.

12.3 Long-Term Corrective Action

The need for long-term corrective action may be identified by standard QC procedures, control charts, performance or system audits. Any quality problem which cannot be solved by immediate corrective action falls into the long-term category. The TRC-EC QA system ensures

that the quality problem is reported to a person responsible for correcting it, and who is part of a closed-loop action and follow-up plan.

The essential steps in the closed-loop corrective action system are listed below:

- Identify and define the problem;
- Assign responsibility for investigating the problem;
- Investigate and determine the cause of the problem;
- Determine a corrective action to eliminate the problem;
- Assign and accept responsibility for implementing the corrective action;
- Establish effectiveness of the corrective action and implement it; and
- Verify that the corrective action has eliminated the problem.

Documentation of the problem is important to the system. A Corrective Action Request Form (Figure 3) is filled out by the person finding the quality problem. This form identifies the problem, possible causes, and the person responsible for action on the problem. The responsible person may be an analyst, field team leader, QC coordinator, or the QA Officer. If no person is identified as responsible for action, the QA Officer investigates the situation and determines who is responsible in each case.

The Corrective Action Request Form includes a description of the corrective action planned and the date it was taken, and space for follow-up. The QA Officer checks to be sure that initial action has been taken and appears effective and, at an appropriate later date, checks again to see if the problem has been fully solved. The QA Officer receives a copy of all Corrective Action Forms and enters them in the Corrective Action Log. This permanent record aids the QA Officer in follow-up and makes any quality problems visible to management. The log may also prove valuable in listing a similar problem and its solution.

12.4 Out-of-Control Events and Corrective Action

Procedures are outlined as to what corrective action is taken if an out-of-control event occurs, and how it is documented and used to improve laboratory performance. Procedures for assuring that results for samples processed during out-of-control conditions are not reported are also outlined, as well as the conditions necessary to reestablish control and criteria for assuring the system is operating properly. The documentation is easily used by all personnel and is part of routine laboratory procedure.

It is recognized that several levels of out-of-control events may occur. Three examples are given below with corrective actions to be taken:

1. Observations Corrected by Analyst at the Bench--The calibration of an instrument is not linear. The analyst finds this and corrects it prior to continuing to analyze samples. The laboratory documents this event and notes that the corrective action was to recalibrate, and that no samples were affected as none were analyzed prior to calibration.

2. Corrective Actions Taken by Supervisor--A matrix spike recovery is out-of-control and the laboratory supervisor finds this after the samples for the day have been analyzed. The supervisor documents that the laboratory blank spiked with surrogates or standards was in control and that other sample spikes were in control, therefore, no re-analysis of the sample is required.

3. Corrective Actions at the Receiving Level--The sample container is broken. The analyst notes this and documents whether or not more sample is available. If no more sample is available, TRC-EC is notified and the decision documented.

13.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

13.1 Internal TRC-EC Reports

The Project QC Coordinator will provide monthly reports of QC activities for the TRC-EC QA Officer and QA/QC Manager. These reports detail the results of quality control analysis, problems encountered, and any corrective action required.

All Corrective Action Forms will be submitted to the TRC-EC QA Officer for initial approval of the corrective action planned. A copy will be provided to the appropriate technical division manager. All system audit reports will be provided to the Program Manager and Project Manager.

13.2 Laboratory Reports

The laboratory QC Coordinator prepares written quarterly reports on QC activities for the laboratory Technical Director and QA Manager. These reports detail the results of QA procedures, problems encountered, and any corrective action which may have been required. All Corrective Action forms are submitted to the QA Manager for initial approval of the planned corrective action, and a copy is provided to the Technical Director. All system audit reports are provided to the Technical Director.

Each data transmittal contains a summary of QA/QC activities; this summary will include:

- Estimates of precision, accuracy and completeness of data;
- Reports of performance and system audits;
- Quality problems found; and
- Corrective actions taken.

The final data report submitted to TRC-EC by the laboratory will include a summary of QA/QC activities during the project. The QC Coordinator and QA Manager will participate in

preparing this report. The summary of QA/QC results for the analytical work conducted for the NETC-Newport project will be included in the final RI Report.

13.3 Reports to the U.S. Navy Northern Division

The status of on-going laboratory QA/QC activity will be presented in the project progress reports. Monthly progress reports will be sent from the laboratory to the Navy's Engineer-In-Charge and NEESA QA/QC contract representative, as required. The final RI report for the project will include a section summarizing the significant findings of all QA/QC laboratory activity.

TABLES

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TABLE 1

CONTAINERS AND PRESERVATION METHODS
FOR SOIL, SEDIMENT, AND/OR WASTE SAMPLES

Number Containers per Sample	Sample Container	Preservation Methods[a]	Analytical Method	Compounds (2)
Organics				
2	125 ml, wide-mouth glass, Teflon -lined cap	Cool, 4°C	CLP SOW	TCL VOA
1	1-250 ml, wide-mouth amber glass, Teflon -lined cap	Cool, 4°C	CLP SOW	TCL-BNA, P/P
1	1-125 ml, wide-mouth glass Teflon -lined cap	Cool, 4°C	EPA 418.1	Total Petroleum Hydrocarbons
1	1-250 ml, wide-mouth amber glass, Teflon -lined cap	Cool, 4°C	Mod. EPA 8280	Dioxins/ Furans
Inorganics				
1	250-ml, wide-mouth glass, Teflon -lined cap	Cool, 4°C	CLP SOW[b]	Metals and Cyanide
1	1000 ml, wide-mouth glass	NA	ASTMD422-63	Grain Size
1	500 ml, wide-mouth glass, Teflon-lined cap	Cool, 4°C	SW 9081, SW9060, EPA 376.3	Cation Exchange, TOC, Acid Volatile Sulfides (AVS)

VOA = Volatile Organic Analyses.
TCL = Target Compound List.
BNA = Base Neutral and Acid Extractable Analyses.
P/P = Pesticide/PCB Analyses.
CLP SOW = Contract Laboratory Program - Statement of Work.
Organics - SOW 3/90, revised July 1991.
Inorganics - SOW 3/90, revised September 1991.

(a) All samples will be stored in a refrigerated, dark area.

(b) Metals analyses, except mercury, will be performed by the furnace atomic absorption (As, Pb, Se, Tl) and inductively coupled plasma (ICP) atomic emission spectrometric methods. Mercury will be analyzed by the manual cold vapor atomic absorption method. Total cyanide will be analyzed by the manual spectrophotometric method.

TABLE 2

CONTAINERS AND PRESERVATION METHODS FOR AQUEOUS SAMPLES

Number Containers per Sample[a]	Sample Container	Preservation Methods[b]	Analytical Method	Compound(s)
Organics				
2	40 ml, glass, Teflon -lined cap	Cool, 4°C HCl to pH < 2	CLP SOW	TCL-VOA
1	1-gal, narrow-mouth amber glass, Teflon -lined cap	Cool, 4°C	CLP SOW	TCL-BNA, P/P
Inorganics				
1	500 ml, polyethylene	Cool, 4°C HNO_3 to pH <2	CLP SOW[c]	Metals
1	1 L, polyethylene	Cool, 4°C NaOH to pH >12[d]	CLP SOW[c]	Cyanide
1	1 L, polyethylene	Cool, 4°C	EPA 405.1	BOD
1	500ml, polyethylene	Cool, 4°C; HCL to pH <2	EPA 160.2; EPA 9060	TSS, TOC
1	500ml, polyethylene	Cool, 4°C H_2SO_4 to pH <2	EPA 410.2	COD
1	100ml, polyethylene	$HN0_3$ to pH <2	EPA 130.2	Hardness
1	100ml, polyethylene	Cool, 4°C	EPA 325.2	Chloride

TCL = Target Compound List.
VOA = Volatile Organic Analyses.
BNA = Base Neutral and Acid Extractable Compounds.
P/P = Pesticides/PCB Analyses.
CLP SOW = Contract Laboratory Program - Statement of Work.
Organics - SOW 3/90, revised August 1991.
Inorganics - SOW 3/90, March 1990.

(a) One in 20 organic aqueous samples will be collected in triplicate for matrix spike and matrix spike duplicate analyses in accordance with CLP protocols; one in 20 inorganic aqueous samples will be collected in duplicate for matrix spike analyses.

(b) All samples will be stored in a refrigerated, dark area.

(c) Metals analyses, except mercury, will be performed by the furnace atomic absorption (As, Pb, Se, Tl) and inductively coupled plasma (ICP) atomic emission spectrometric methods. Mercury will be analyzed by the manual cold vapor atomic absorption method. Total cyanide will be analyzed by the manual spectrophotometric method.

(d) Water samples to be analyzed for cyanide will be checked in the field for the presence of chlorine using potassium iodide (KI) starch paper. If chlorine is present, 0.6 g ascorbic acid will be added.

TABLE 3

HOLDINGS TIMES FOR SOIL, SEDIMENT, AQUEOUS AND/OR WASTE SAMPLES

Parameter	CLP Holding Time for Samples	
	Aqueous	Soil/Sediment/Waste
TCL Volatile Organic Compounds	10 days from VTSR	10 days from VTSR
TCL Base Neutral/Acid Extractable Compounds	5 days to extraction from VTSR; 40 days from extraction	7 days[1] extraction from VTSR; 40 days from extraction
TCL Pesticide/PCB Compounds	5 days to extraction; 40 days from extraction	7 days[1] to extraction; 40 days from extraction
Total Petroleum Hydrocarbons	28 Days[2]	28 Days
TAL Metals and Cyanide	6 months; except Hg - 26 days and Cn-12 days	6 months; except Hg - 26 days and Cn-12 days
Dioxins/Furans	NE	NE
BOD	48 Hours	NA
COD	28 Days	NA
TOC	28 Days[2]	28 Days
TSS	14 Days	NA
Grain Size	NA	NE
Cation Exchange Capacity	NA	NE
Acid Volatile Sulfides (AVS)	NA	NE
Hardness	6 Months	NA

NE = Not Established; no holding times established according to the CLP SOW or applicable methods.
NA = Not Applicable.
VTSR = Verified Time of Sample Receipt.
[1] = U.S. EPA Region I requirement.
[2] = If preserved with H_2SO_4 or HCL to pH <2.

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TABLE 4

FIELD QC SAMPLES PER SAMPLING EVENT
(NEESA GUIDANCE FOR LEVEL D)

Type of Sample	Level C	
	Metals	Organics
Trip blank (for volatiles only)	NA[a]	1/cooler
Field blank	1/20 samples per matrix or 1/day/matrix for all analytes, whichever is greater	
Source water blank	1/each source of water	
Field duplicates[c]	10%	10%
Regulatory splits	AN[b]	AN[b]

[a] NA - Not applicable.

[b] AN - As needed.

[c] All field duplicates will be submitted as "blind" duplicates for quality control determinations.

TABLE 5

TARGET COMPOUND LIST (TCL) VOLATILE COMPOUNDS AND DETECTION LIMITS

Volatiles	CAS Number	Detection Limits[a] Water (ug/l)	Low Soil/Sediment[b] (ug/kg)
Chloromethane	74-87-3	10	10
Bromomethane	74-83-9	10	10
Vinyl chloride	75-01-4	10	10
Chloroethane	75-00-3	10	10
Methylene chloride	75-09-2	10	10
Acetone	67-64-1	10	10
Carbon disulfide	75-15-0	10	10
1,1-Dichloroethene	75-35-4	10	10
1,1-Dichloroethane	75-35-3	10	10
1,2-Dichloroethene (total)	156-60-5	10	10
Chloroform	67-66-3	10	10
1,2-Dichloroethane	107-06-2	10	10
2-Butanone	78-93-3	10	10
1,1,1-Trichloroethane	71-55-6	10	10
Carbon tetrachloride	56-23-5	10	10
Bromodichloromethane	75-27-4	10	10
1,2-Dichloropropane	78-87-5	10	10
cis-1,3-Dichloropropene	10061-01-5	10	10
Trichloroethene	79-01-6	10	10
Dibromochloromethane	124-48-1	10	10
1,1,2-Trichloroethane	79-00-5	10	10
Benzene	71-43-2	10	10
trans-1,3-Dichloropropene	10061-02-6	10	10
Bromoform	75-25-2	10	10
4-Methyl-2-pentanone	108-10-1	10	10

TABLE 5

(Continued)

TARGET COMPOUND LIST (TCL) VOLATILE
COMPOUNDS AND DETECTION LIMITS

Volatiles	CAS Number	Detection Limits[a] Water (ug/l)	Low Soil/Sediment[b] (ug/kg)
2-Hexanone	591-78-6	10	10
Tetrachloroethene	127-18-4	10	10
Toluene	108-88-3	10	10
1,1,2,2-Tetrachloroethane	79-34-5	10	10
Chlorobenzene	108-90-7	10	10
Ethyl benzene	100-41-4	10	10
Styrene	100-42-5	10	10
Total xylenes	1330-20-7	10	10

[a] Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated for soil/sediment calculated on dry weight basis will be higher.

[b] Medium soil/sediment detection limits for volatile TCL compounds are 120 times the individual low soil/sediment detection limits.

Note: Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

TABLE 6

TARGET COMPOUND LIST (TCL) SEMIVOLATILE
COMPOUNDS AND DETECTION LIMITS

Semivolatiles	CAS Number	Detection Limits[a] Water (ug/l)	Low Soil/Sediment[b] (ug/kg)
Phenol	108-95-2	10	330
Bis(2-chloroethyl)ether	111-44-4	10	330
2-Chlorophenol	95-57-8	10	330
1,3-Dichlorobenzene	541-73-1	10	330
1,4-Dichlorobenzene	106-46-7	10	330
1,2-Dichlorobenzene	95-50-1	10	330
2-Methylphenol	95-48-7	10	330
2,2'-oxybis(1-Chloropropane)[c]	108-60-1	10	330
4-Methylphenol	106-44-5	10	330
N-Nitroso-di-n-propylamine	621-64-7	10	330
Hexachloroethane	67-72-1	10	330
Nitrobenzene	98-95-3	10	330
Isophorone	78-59-1	10	330
2-Nitrophenol	88-75-5	10	330
2,4-Dimethylphenol	105-67-9	10	330
Bis(2-chloroethoxy)methane	111-91-1	10	330
2,4-Dichlorophenol	120-83-2	10	330
1,2,4-Trichlorobenzene	120-82-1	10	330
Naphthalene	91-20-3	10	330
4-Chloroaniline	106-47-8	10	330
Hexachlorobutadiene	87-68-3	10	330
4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
2-Methylnaphthalene	91-57-6	10	330
Hexachlorocyclopentadiene	77-47-4	10	330
2,4,6-Trichlorophenol	88-06-2	10	330
2,4,5-Trichlorophenol	95-95-4	25	800
2-Chloronaphthalene	91-58-7	10	330
2-Nitroaniline	88-74-4	25	800

TABLE 6

(Continued)

TARGET COMPOUND LIST (TCL) SEMIVOLATILE
COMPOUNDS AND DETECTION LIMITS

Semivolatiles	CAS Number	Detection Limits[a] Water (ug/l)	Detection Limits[a] LowSoil/Sediment[b] (ug/kg)
Dimethylphthalate	131-11-3	10	330
Acenaphthylene	208-96-8	10	330
2,6-Dinitrotoluene	606-20-2	10	330
3-Nitroaniline	99-09-2	25	800
Acenaphthene	83-32-9	10	330
2,4-Dinitrophenol	51-28-5	25	800
4-Nitrophenol	100-02-7	25	800
Dibenzofuran	132-64-9	10	330
2,4-Dinitrotoluene	121-14-2	10	330
Diethylphthalate	84-66-2	10	330
4-Chlorophenyl-phenylether	7005-72-3	10	330
Fluorene	86-73-7	10	330
4-Nitroaniline	100-01-6	25	800
4,6-Dinitro-2-methylphenol	534-52-1	25	800
N-nitrosodiphenylamine	86-30-6	10	330
4-Bromophenyl-phenylether	101-55-3	10	330
Hexachlorobenzene	118-74-1	10	330
Pentachlorophenol	87-86-5	25	800
Phenanthrene	85-01-8	10	330
Anthracene	120-12-7	10	330
Carbazole	86-74-8	10	330
Di-n-butylphthalate	84-74-2	10	330
Fluoranthene	206-44-0	10	330
Pyrene	129-00-0	10	330
Butylbenzylphthalate	85-68-7	10	330
3,3'-Dichlorobenzidine	91-94-1	10	330

TABLE 6

(Continued)

TARGET COMPOUND LIST (TCL) SEMIVOLATILE
COMPOUNDS AND DETECTION LIMITS

Semivolatiles	CAS Number	Detection Limits[a] Water (ug/l)	Detection Limits[a] LowSoil/Sediment[b] (ug/kg)
Benzo(a)anthracene	56-55-3	10	330
Chrysene	218-01-9	10	330
Bis(2-ethylhexyl)phthalate	117-81-7	10	330
Di-n-octylphthalate	117-84-0	10	330
Benzo(b)fluoranthene	205-99-2	10	330
Benzo(k)fluoranthene	207-08-9	10	330
Benzo(a)pyrene	50-32-8	10	330
Indeno(1,2,3-cd)pyrene	193-39-5	10	330
Dibenzo(a,h)anthracene	53-70-3	10	330
Benzo(g,h,i)perylene	191-24-2	10	330

(a) Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated for soil/sediment calculated on dry weight basis will be higher.

(b) Medium soil/sediment detection limits for semivolatile TCL compounds with a low detection limit of 330 ug/kg are 10,000 ug/kg; for semivolatiles with a low detection limit of 800 ug/kg, they are 25,000 ug/kg.

(c) Previously known by the name bis(2-chloroisopropyl)ether.

Note: Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

TABLE 7

TARGET COMPOUND LIST (TCL) PESTICIDES, PCBs, AND DETECTION LIMITS

Pesticides/PCBs	CAS Number	Detection Limits[a] Water (ug/l)	Detection Limits[a] Soil/Sediment[b] (ug/kg)
alpha-BHC	319-84-6	0.05	1.7
beta-BHC	319-85-7	0.05	1.7
delta-BHC	319-86-8	0.05	1.7
gamma-BHC (Lindane)	58-89-9	0.05	1.7
Heptachlor	76-44-8	0.05	1.7
Aldrin	309-00-2	0.05	1.7
Heptachlor epoxide	1024-57-3	0.05	1.7
Endosulfan I	959-98-8	0.05	1.7
Dieldrin	60-57-1	0.10	3.3
4,4'-DDE	72-55-9	0.10	3.3
Endrin	72-20-8	0.10	3.3
Endosulfan II	33213-65-9	0.10	3.3
4,4'-DDD	72-54-8	0.10	3.3
Endosulfan sulfate	1031-07-8	0.10	3.3
4,4'-DDT	50-29-3	0.10	3.3
Methoxychlor	72-43-5	0.50	17.0
Endrin ketone	53494-70-5	0.10	3.3
Endrin aldehyde	7421-93-4	0.10	3.3
alpha-Chlordane	5103-71-9	0.05	1.7
gamma-Chlordane	5103-74-2	0.05	1.7
Toxaphene	8001-35-2	5.0	170.0
AROCLOR-1016	12674-11-2	1.0	33.0
AROCLOR-1221	11104-28-2	2.0	67.0
AROCLOR-1232	11141-16-5	1.0	33.0
AROCLOR-1242	53469-21-9	1.0	33.0
AROCLOR-1248	12672-29-6	1.0	33.0
AROCLOR-1254	11097-69-1	1.0	33.0
AROCLOR-1260	11096-82-5	1.0	33.0

(a) Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated for soil/sediment calculated on dry weight basis will be higher.

(b) There is no differentiation between the preparation of low and medium soil samples in this method for the ?analysis of pesticides/aroclors.

Note: Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

TABLE 8

SURROGATE SPIKE RECOVERY RANGE

Fraction	Surrogate Compounds	Water % Recovery	Soil/Sediment % Recovery
Volatiles	Toluene-d_8	88-110	84-138
	Bromofluorobenzene	86-115	59-113
	1,2-Dichloroethane-d_4	76-114	70-121
Semi-Volatiles	Nitrobenzene-d_5	35-114	23-120
	2-Fluorobiphenyl	43-116	30-115
	Terphenyl-d_{14}	33-141	18-137
	Phenol-d_5	10-110	24-113
	2-Fluorophenol	21-110	25-121
	2,4,6-Tribromophenol	10-123	19-122
	2-Chlorophenol-d_4	33-110	(20-130)[a]
	1,2-Dichlorobenzene-d_4	16-110	(20-130)[a]
Pesticides	Tetrachloro-m-xylene	(60-150)[a]	(60-150)[a]
	Decachlorobiphenyl	(60-150)[a]	(60-150)[a]

[a] Advisory limits only

TABLE 9

MATRIX SPIKE RECOVERY LIMITS

Fraction	Matrix Spike Compound	Water[a]	Soil/Sediment[a]
VOA	1,1-Dichloroethene	61-145	59-172
VOA	Trichloroethene	71-120	62-137
VOA	Chlorobenzene	75-130	60-133
VOA	Toluene	76-125	59-139
VOA	Benzene	76-127	66-142
BN	1,2,4-Trichlorobenzene	39-98	38-107
BN	Acenaphthene	46-118	31-137
BN	2,4-Dinitrotoluene	24-96	28-89
BN	Pyrene	26-127	35-142
BN	N-Nitroso-di-n-propylamine	41-116	41-126
BN	1,4-Dichlorobenzene	36-97	28-104
Acid	Pentachlorophenol	9-103	17-109
Acid	Phenol	12-110	26-90
Acid	2-Chlorophenol	27-123	25-102
Acid	4-Chloro-3-methylphenol	23-97	26-103
Acid	4-Nitrophenol	10-80	11-114
Pesticide	gamma-BHC (Lindane)	56-123	46-127
Pesticide	Heptachlor	40-131	35-130
Pesticide	Aldrin	40-120	34-132
Pesticide	Dieldrin	52-126	31-134
Pesticide	Endrin	56-121	42-139
Pesticide	4,4'-DDT	38-127	23-134

[a] These limits are for advisory purposes only. They are not to be used to determine if a sample should be reanalyzed. When sufficient multi-laboratory data are available, standard limits will be calculated.

TABLE 10

TARGET ANALYTE LIST (TAL) INORGANICS AND
CONTRACT REQUIRED DETECTION LIMITS (CRDL)[a]

Element	Detection Limit	
	Water (ug/l)	Low Soil/Sediment (ug/g)
Aluminum	200	40
Antimony	60	12
Arsenic	10	2
Barium	200	40
Beryllium	5	1
Cadmium	1.5[c]	1
Calcium	5,000	1,000
Chromium	10	2
Cobalt	50	10
Copper	12[d]	5
Iron	100	20
Lead	3	1
Magnesium	5,000	1,000
Manganese	15	3
Mercury	0.05[e]	0.1[b]
Nickel	40	8
Potassium	5,000	1,000
Selenium	5	1
Silver	1[c]	2
Sodium	5,000	1,000
Thallium	10	2
Vanadium	50	10
Zinc	20	4
Cyanide	10	1

[a] Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable. Soil/sediment CRDLs are based on sample wet weights. Dry weight CRDLs will depend on the moisture content of the individual samples.

[b] Different aliquot.

[c] Obtain CRDL by using Graphite Furnace Atomic Absorption (AA).

[d] Obtain CRDL by using InduS]SxoS8SxJS'xctively Coupled Plasma (ICP).

[e] Obtain CRDL by using Cold Vapor Atomic Absorption (AA).

TABLE 11

LABORATORY QUALITY CONTROL ANALYSES

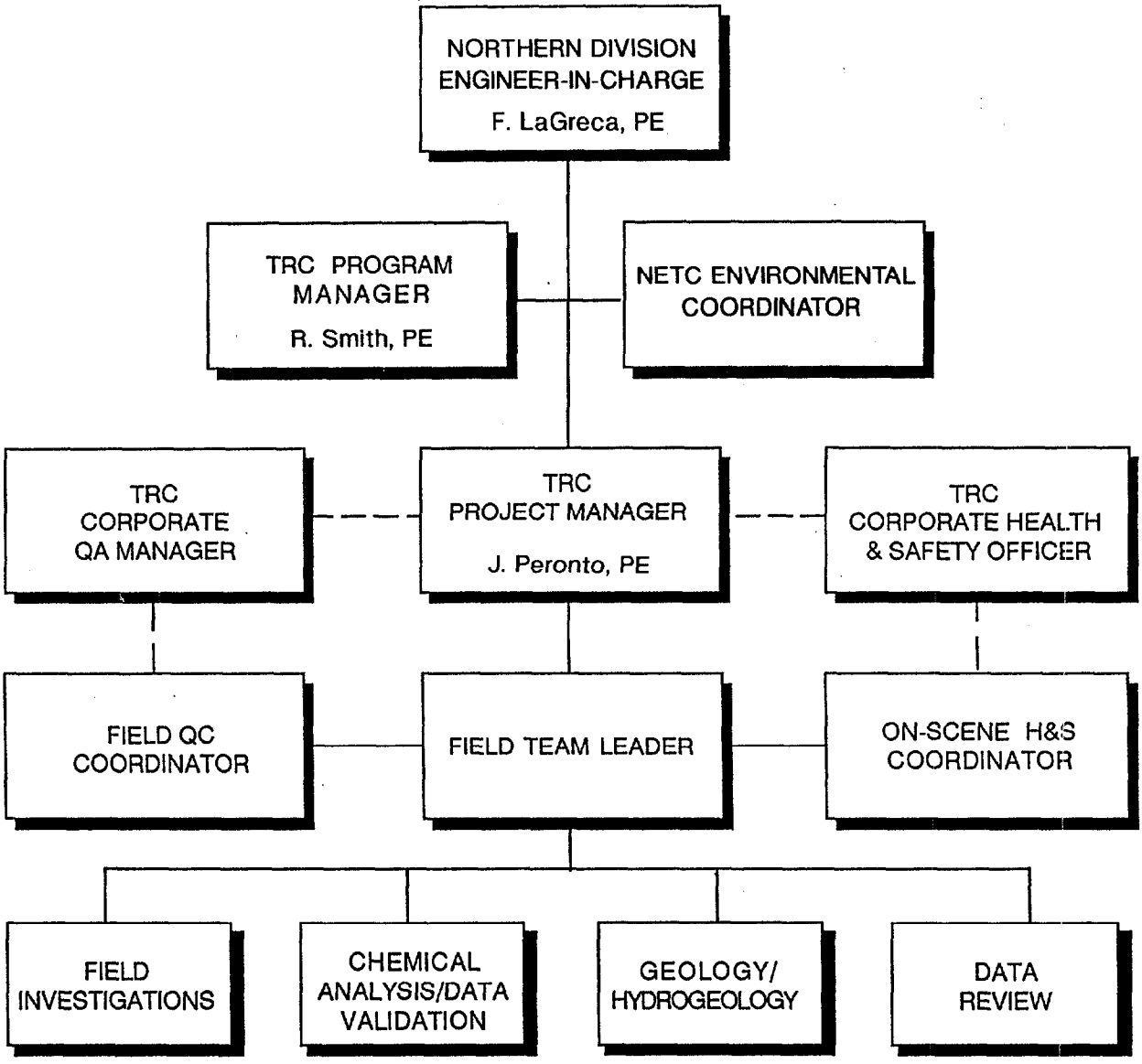
Analysis type	Frequency[a]	Control
Organic analyses		
Blank	1	Surrogate compounds
LCS and/or spiked blank	1	% recovery, analytes of interest
Duplicate	2	RPD
Matrix spike	1	% recovery of target analyte(s)
Matrix spike duplicate	1	RPD and % recovery
Inorganic Analyses		
Blank	1	No contamination
LCS and/or spiked blank	1	% recovery, analytes of interest
Duplicate	1	RPD
Matrix spike	1	% recovery of target analyte(s)

[a] Frequency is based on a batch of 20 samples or less of a similar matrix or whenever samples are extracted, whichever is more frequent.

LCS = Laboratory Control Sample

RPD = Relative Percent Difference

FIGURES



TRC
TRC Environmental Corporation

5 Waterside Crossing
Windsor, CT 06095
(203) 289-8631

NAVAL EDUCATION AND TRAINING CENTER — *NEWPORT RHODE ISLAND*

FIGURE 1.

PROJECT ORGANIZATION

Date: 3/93 | Drawing No. 6760-N81

TRC Environmental Corporation

CHAIN OF CUSTODY RECORD

PROJECT NO.	PROJECT NAME					PARAMETERS										№ 2043
SAMPLERS: *(Signature)*					(Printed)											REMARKS
FIELD SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS										

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
(Printed)		(Printed)	(Printed)		(Printed)

Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks
(Printed)		(Printed)		

Distribution: Original Plus One Accompanies Shipment (white and yellow); Copy to Coordinator Field Files (pink).

FIGURE 2. CHAIN OF CUSTODY RECORD

FIGURE 3
CORRECTIVE ACTION REQUEST FORM

CORRECTIVE ACTION REQUEST FOR NO. _____

Originator _____ Date _____

Person Responsible for Replying _____ Contract Involved _____

Description of problem and when identified: _____

_____

_____

_____

State cause of problem, if known or suspected: _____

_____

_____

Sequence of Corrective Action: (If no responsible person is identified, notify QA Officer immediately. Submit all CA forms to QA Officer for initial approval of CA.)

State Date, Person, and Action Planned: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

CA Initially Approved by: _____ Date: _____

Follow-up Dates: _____

Final CA Approval by: _____ Date: _____

Information copies to:

RESPONSIBLE PERSON/QC COORDINATOR: _____

QA OFFICER: _____

PROJECT MANAGER: _____

APPENDIX A

NEESA LEVEL D REQUIREMENTS

JUNE 1988

SAMPLING AND CHEMICAL ANALYSIS QUALITY ASSURANCE REQUIREMENTS FOR THE NAVY INSTALLATION RESTORATION PROGRAM

NEESA 20.2-047B

NAVAL ENERGY AND ENVIRONMENTAL SUPPORT ACTIVITY
Port Hueneme, California 93043

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SAMPLING AND CHEMICAL ANALYSIS QUALITY ASSURANCE REQUIREMENTS FOR THE NAVY INSTALLATION RESTORATION PROGRAM

NEESA 20.2-047B
Project Manager: Anthony R. Sturtzer

September 1985
First Revision June 1986
Second Revision June 1988

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under
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Environmental Restoration Department (Code 112E)
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LIST OF ACRONYMS

AA	Atomic Absorption
ASTM	American Society for Testing Materials
BNA	Base Neutral Acids
CCC	Calibration Check Compounds
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CLP	Contract Laboratory Protocol
COC	Chain of Custody
DQO	Data Quality Objective
EFD	Engineering Field Division (U.S. Navy)
EIC	Engineer in Charge (U.S. Navy)
FEL	Field Equipment Log
GC	Gas Chromatography
HSL	Hazardous Substances List
IRP	Installation Restoration Program
ICP	Inductively Coupled Plasma
LQAC	Laboratory Quality Assurance Coordinator
MPR	Monthly Progress Report
MS	Mass Spectrometry
NCR	NEESA Contract Representative (Martin Marietta Energy Systems, Inc.)
NEESA	Naval Energy and Environmental Support Activity
NPL	National Priorities List
PCB	Polychlorinated Biphenyl
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
RRF	Relative Response Factor
RSD	Relative Standard Deviation
SOW	Statement of Work
SPCC	System Performance Check Compounds
TCL	Toxic Contaminant List
VOA	Volatile Organic

1. INTRODUCTION

The Installation Restoration Program (IRP) identifies and evaluates past hazardous material disposal sites in order to control the migration of hazardous contaminants. The program also controls hazards that may result from these past disposal operations. The IRP has the following phases: Preliminary Assessment/Records Search, Site Inspection/Remedial Investigation, Technical Base Development, Feasibility Study, and implementation of selected alternatives for remediation. During any of these phases, analysis of soil, water, and waste samples may be performed. The Navy program for the IRP includes performing field investigations and analysis of samples. The purpose of this document is to specify the requirements for the control of the accuracy, precision, and completeness of the samples, and data from the point of collection through reporting. Because every instance and concern may not be addressed in this document, contractors are encouraged to discuss any questions with the Navy engineer in charge (EIC) or the appropriate Naval Energy and Environmental Support Activity (NEESA) contract representative (NCR).

1.1 SCOPE

Laboratories performing studies in support of the IRP are required to obtain Navy approval prior to beginning field studies or analyses of samples and to maintain that approved status throughout the site characterization. The laboratory approval is specific to a particular study for a given site and Statement of Work (SOW). The Navy Requirements document provides guidance to the laboratories on obtaining and maintaining approval. Should more than one laboratory be involved in the analysis of samples from a single site, each laboratory performing analysis must be approved and must comply with the quality control (QC) requirements. These objectives and requirements conform, in general, with the *U.S. Environmental Protection Agency Federal Register*, November 29, 1983 (p. 53937 or 40 CFR 792), the *Food and Drug Administration Federal Register*, December 22, 1978 (p. 59986 or 21 CFR 58), the *Quality Assurance Program Requirements for Nuclear Facilities*, ANSI/ASME NQA-1, 1986 ed., and the *Interim Guidelines and Preparing Quality Assurance Project Plans* (U.S. EPA, EPA-600/4-83-004, QAMS-005/80).

Each laboratory is required to submit a Laboratory Analysis Quality Assurance (QA) Plan. Each engineering contractor must submit a site work plan as part of the approval process. The laboratory's QA plan and the site work plan are emphasized, since the content of those plans and the laboratory's strict adherence to it are essential for obtaining and maintaining Navy approval. Certain basic requirements are stressed--a laboratory QA coordinator (LQAC), the use of accepted analytical methods, careful documentation of chain of custody (COC), corrective action policy, and use of control charts. The laboratory-approval process and subsequent laboratory reporting requirements provide the mechanism for verifying that a laboratory is adhering to its QA and work plan.

Currently, most IRP studies do not include analysis of air, plant, or tissue samples. Future revisions that will include more discussion as to available methods for biota and air are planned. If questions on these methods arise, the NCR may be consulted at the Martin Marietta Energy Systems, Inc., Analytical Chemistry Department at the Oak Ridge Gaseous Diffusion Plant. Where Environmental Protection Agency (EPA) methods are not available for biota, methods from other agencies and published methods which have undergone method validation by the laboratory requesting approval must be used. On occasion, when methods are required for biota and no EPA method is available, the proposed method must be submitted to the NCR for approval.

1.2 APPROACH

The approach reflected in this document is one of outlining requirements and allowing the laboratories, principally through their QA plans, to detail their approach to meeting these requirements. For example, with the exception of the laboratory control sample program, see Sect. 4.4, the discussion of QC procedures includes a requirement that warning and action limits be set but allows each laboratory to describe its procedures for establishing such limits. The specific organization and presentation of the laboratory plan are left largely to the discretion of the laboratory, although certain areas must be addressed.

In order for the above approach to work, emphasis must be placed on effective communication between the laboratory, the Navy EIC, the NCR, and the engineering subcontractor. All documents must be concise, well organized, and free of jargon that might hinder constructive review and evaluation.

1.3 LEVELS OF QC

Data quality objectives (DQOs) are requirements needed to support decisions relative to the various stages of remedial actions. Throughout the project planning process, DQOs are supplied through qualitative and quantitative statements. They are specified in such documents as sampling plans, work plans and QA plans. Five general levels of analytical options to support data collection are identified by Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The Navy has adopted three of the analytical levels as QC requirements. They are C, D, and E, which correlate with Levels 3, 4, and 5 described in *Data Quality Objectives for Remedial Response Activities Development Process* by the EPA. These levels are based on the type of site to be investigated, the level of accuracy and precision required and the intended use of the data. The level of QC required at the site will be decided by the Navy EIC. Analytical requirements for the remaining two levels have not been defined. Table 1.1 outlines the basic QC requirements at each level. The laboratory method requirements for each level of QC are outlined in Sect. 7.

Table 1.1. Overall plan for QC based on type of site

DQO Levels[1]	Type of Site	QC Requirements						
3	Major Non-NPL Level C	PE sample	Laboratory[2] audit	QA Plan review	Use EPA-approved method[3]	Monthly review	10% field duplicates	Review of final data
4	NPL Level D	PE sample	Laboratory[2] audit	QA Plan review	Use CLP procedures	Monthly review	10% field duplicates	CLP validation
5	Non-NPL Level E	PE sample	Laboratory[2] audit	QA Plan review	Use EPA-approved methods.[3] Non-EPA methods for tissue and explosives.	Monthly review	5% Field duplicates	Review of final data

[1]QC criteria for DQO Levels 1 and 2 has not been defined.
[2]All laboratory audits will be performed by the NCR.
[3]Includes methods from SW 846, Amercian Society for Testing Materials, and Federal Register.

CLP = Contract laboratory protocol
PE = Performance evaluation samples
DQO = Data quality objective

1.3.1 Level C QC

A site requiring Level C QC would be a site near a populated area, not on the NPL, and not likely to be undergoing litigation. The Level C QC includes review and approval of the laboratory QA and the site work plan. The laboratory must successfully analyze a performance sample, undergo an audit, correct deficiencies found during the audit, and provide MPRs on QA. The laboratory that performs Level C QC must have passed the performance sample furnished by the Superfund CLP in the past year. The laboratory does not need to be receiving CLP bid lots of samples.

Level C allows the use of non-CLP methods but requires that the methods be accepted EPA methods listed in Tables 7.1 through 7.5. All methods used must be EPA methods or be equivalent to EPA methods. Further discussion about these methods is presented in Sect. 7. The laboratory must successfully analyze a performance sample, undergo an audit, correct deficiencies found during the audit, and provide MPRs on QA. These audits will be administered and evaluated by the NCR. The Navy audit and performance sample are required in addition to any specified by the EPA Superfund Program.

1.3.2 Level D QC

Level D QC is to be used for sites that are on or about to be on the National Priorities List (NPL). These sites are typically near populated areas and are likely to undergo litigation. Level D QC includes review and approval of the laboratory QA plan, the site work plan, and the field QA plan. The laboratory must successfully analyze a performance sample, undergo an audit, correct deficiencies found during the audit, and provide monthly progress reports (MPRs) on QA. These activities will be administered and evaluated by the NCR. This audit and the analysis performance sample are in addition to those related to the EPA Superfund Program. The laboratory that performs Level D QC must have passed the performance sample furnished through the Superfund Contract Laboratory Protocol (CLP) and must be able to generate the CLP deliverables. For a Level D site, the CLP methods are used and the CLP data package generated. The Navy audit and performance sample are required in addition to any specified by the EPA Superfund Program.

1.3.3 Level E QC

A site requiring Level E QC will be located away from a populated area, will not be an NPL site, and will have a low probability of litigation. Level E QC includes review and approval of the laboratory QA plan and the site work plan. The laboratory must successfully analyze a performance sample, undergo an audit, correct deficiencies found during the audit, and provide MPRs on QA. For Level E, the laboratory is not required to have passed a CLP performance sample. Level E allows the use of non-CLP methods but requires that the methods be accepted EPA methods listed in Tables 7.1 through 7.5. All methods used must be EPA or equivalent. Further discussion about these methods is presented in

Sect. 7. Level E QC is also appropriate for analysis of the contents of underground storage tanks where the samples are primarily pure product or waste.

1.4 ROLES AND RESPONSIBILITIES

As indicated in Fig. 1.1, the organizations involved are NEESA, the Navy Engineering Field Division (EFD), and the subcontractors. Each organization has multiple tasks and groups that support the project. Fig. 1.1 includes the structure of the organization related to the IRP process. A brief description of the key roles and responsibilities is listed.

1. Navy Energy and Environmental Support Activity

   NEESA is responsible for ensuring that the quality of laboratory analyses performed during the various phases of the IRP is acceptable. NEESA is also responsible for managing the NCR.

2. Engineering Field Division

   The EIC at the EFD provides the site information and history, provides logistical assistance, specifies the site requires investigation and reviews results and recommendations.

3. Engineer in Charge

   The EIC is responsible for coordinating procurement, finance, and reporting; for ensuring that all documents are reviewed by the NCR; for communicating comments from the NCR and other technical reviewers to the subcontractors; and for ensuring that the subcontractors address all the comments submitted and take appropriate corrective actions.

4. NEESA Contract Representative

   The NCR is responsible for ensuring that each project has appropriate overall QA. The NCR reviews laboratory QA plans, work plans, submits performance sample data, provides field and laboratory audits, and reviews data from the site. The questions from subcontractors and the EIC regarding specific field and laboratory QC practices are directed to the NCR. The NCR also provides evaluation of referee samples.

5. Engineering Subcontractor

   Each project has an engineering subcontractor that specializes in setting up the sampling for IRP studies, evaluating the hydrology and geology of a site, assessing risks of contamination, and designing and implementing clean-up techniques. Each engineering firm is required to have a laboratory available to perform sample analysis.

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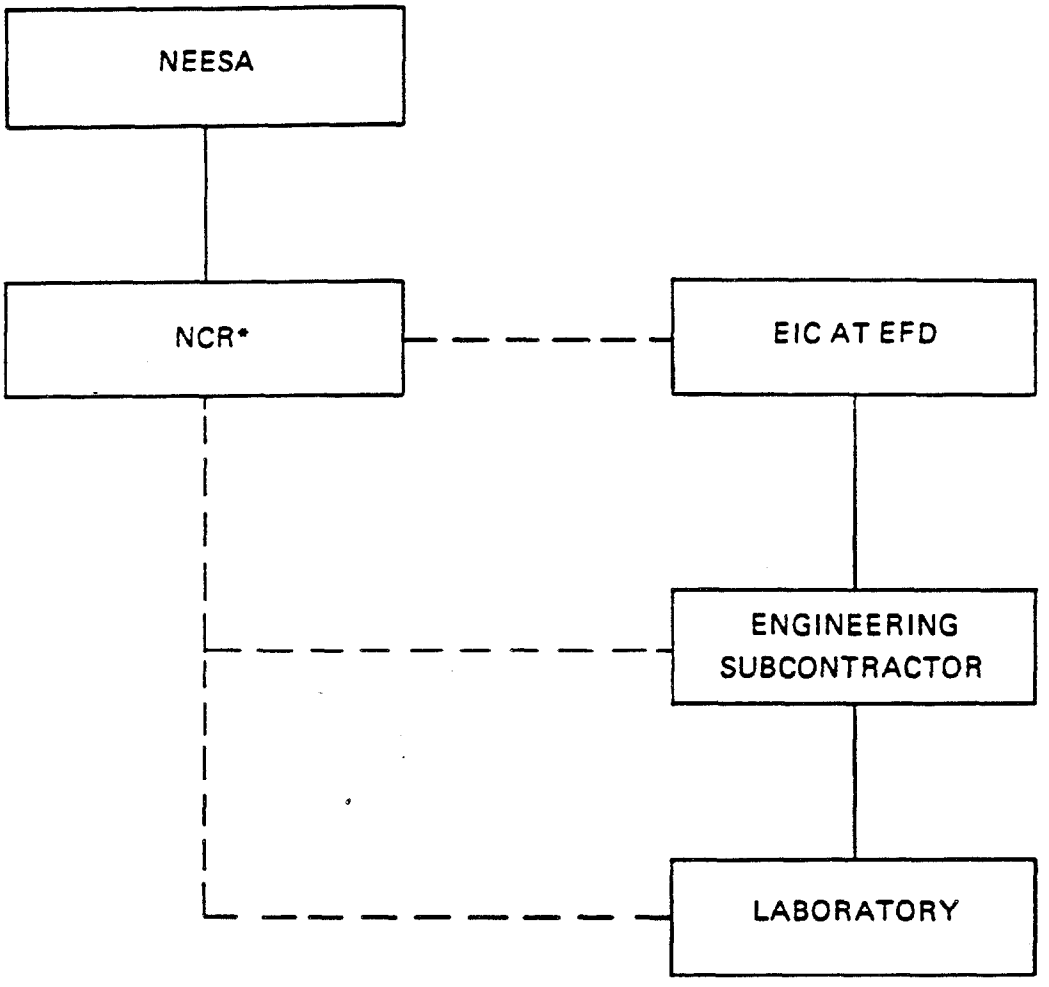

*NCR-MARTIN MARIETTA ENERGY SYSTEMS, INC.

Fig. 1.1. QA Organization

The engineering firm also employs drillers and other personnel to perform IRP tasks. The engineering firm submits a site-specific work plan.

6. Analytical Laboratory

The analytical laboratory is employed by the engineering firm and must adhere to the laboratory requirements in this document. The laboratory is required to prepare and submit a laboratory QA plan, to analyze and submit the results of proficiency testing, to submit to an on-site inspection, and to correct any deficiencies cited during inspection by the NCR. The laboratories are required to identify a LQAC responsible for overall QA. The LQAC must not be responsible for schedule, costs, or personnel other than QA assistants. It is preferred that the LQAC report to the laboratory director. The LQAC must have the authority to stop work on projects if QC problems arise which affect the quality of the data produced.

2. APPROVAL PROCESS

Prior to beginning any field studies or analysis of samples from the field, contract laboratories will be required to receive Navy approval. This section describes the laboratory approval process in terms of the activities and documentation required of participants in the process.

2.1 OVERVIEW

Laboratory approval is necessary to ensure that contract laboratories meet the minimum requirements for a QC program that facilitates the generation of data of defensible accuracy and precision. Specific objectives of the approval process are as follows:

- to communicate Navy's QC requirements to the laboratories,
- to verify that such requirements are being met by each laboratory prior to analysis of Navy field samples,
- to establish plans for maintaining the QC program while work is being done for the Navy, and
- to ensure that proper communication and planning have been done between the engineering subcontractor and the laboratory prior to the laboratory receiving samples.

The above objectives will be met through an approval process that includes the following elements:

- proficiency testing through analysis of performance samples,
- laboratory inspection and audit,
- reviewing laboratory QA plans,
- reviewing site-specific QC plans, and
- reviewing of sampling plans including QC procedures.

The overall process and the above elements are described in detail in the remainder of this section.

2.1.1 The Laboratory Approval Process

The laboratory approval process, as depicted in Fig. 2.1, begins with the engineering subcontractor awarding a contract to the laboratory. The engineering subcontractor is responsible for supplying a site-specific work plan to the NCR. The laboratory and engineering contractors are required to prepare a site-specific work plan and laboratory QA plan.

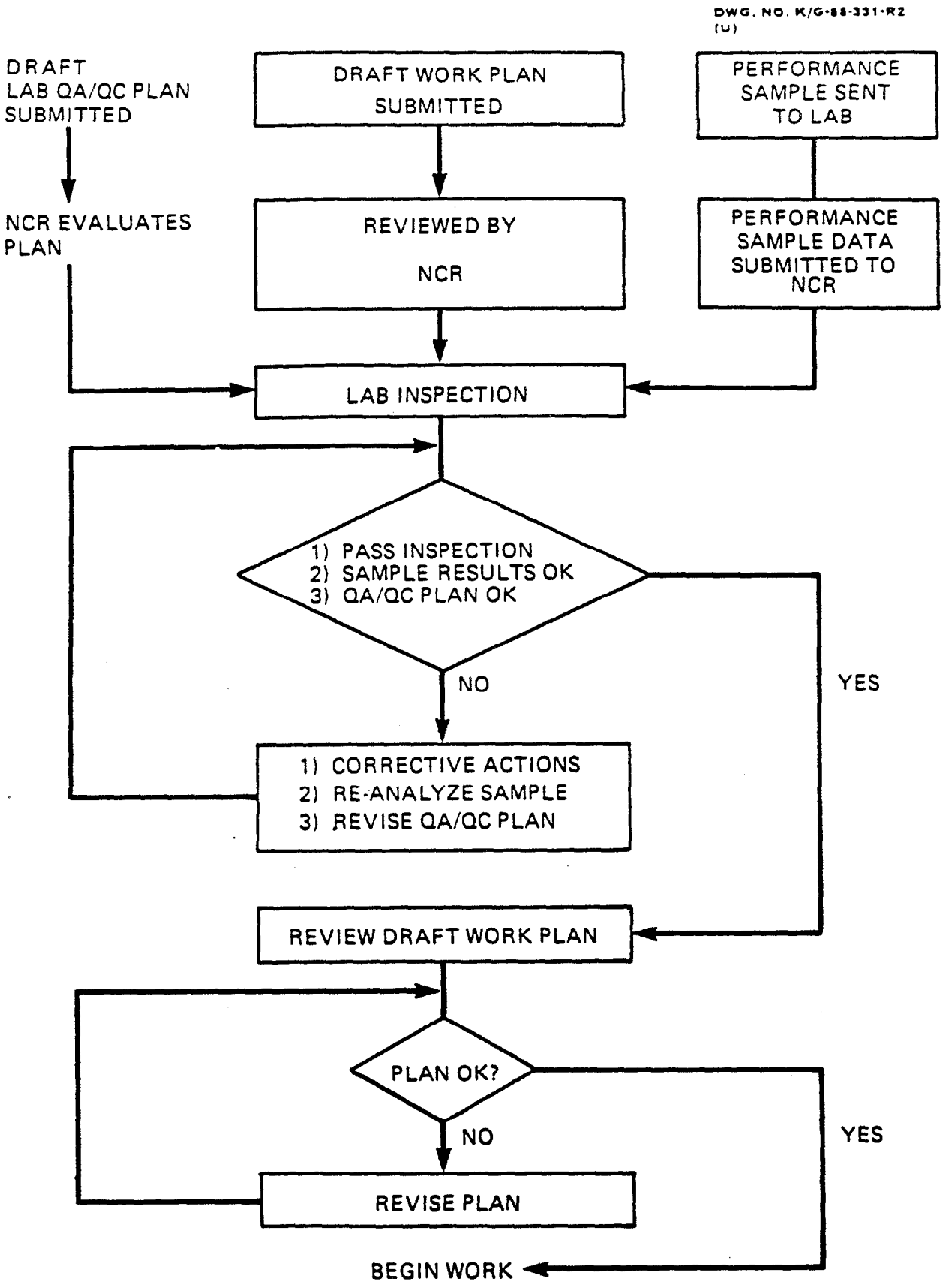

Fig. 2.1. Approval and Review Process

The site-specific work plan shall include a section on QA. This section shall either outline the field and laboratory QA or shall reference documents which outline the QA procedures. The laboratory shall successfully analyze proficiency samples. The site-specific work plan, QA plans, and the results of the proficiency test are submitted to the NCR who will evaluate this information. The QA plans, the proficiency test results, and a draft work plan shall be received and evaluated by the NCR prior to scheduling a laboratory inspection. Based on the results of these evaluations and the inspection, the laboratory and engineering firm may be required to revise their QA plans, to retest a proficiency sample(s), to revise the work plan, or to prepare and implement a corrective action plan addressing deficiencies cited during the inspection.

Approval to begin work on samples is based on a combination of satisfactory QA plans and a site-specific work plan, satisfactory results of proficiency testing, and acceptable laboratory inspection. Approval may be granted to perform all or part of the methods required for a study.

2.1.2 Laboratory Reapproval

If a laboratory is requested to analyze samples from a second site, the NCR will evaluate the similarity between the analysis from the first and the second sites. The past performance of the laboratory and the time elapsed from previous sample analysis determine the steps the laboratory must follow to be reapproved. If a laboratory has performed well in the past, if the methods in the first and second work plan are similar, and if it has been less than a year since the first approval, the engineering contractor may only need to submit the site work plan, and work may proceed. If the laboratory's past performance was satisfactory but it has been longer than a year since a performance sample was analyzed, the laboratory must successfully analyze a new performance sample.

Any changes in personnel or general laboratory QA must be submitted to the NCR prior to receiving approval to begin the next site.

Figure 2.2 shows a flow diagram of the reapproval process.

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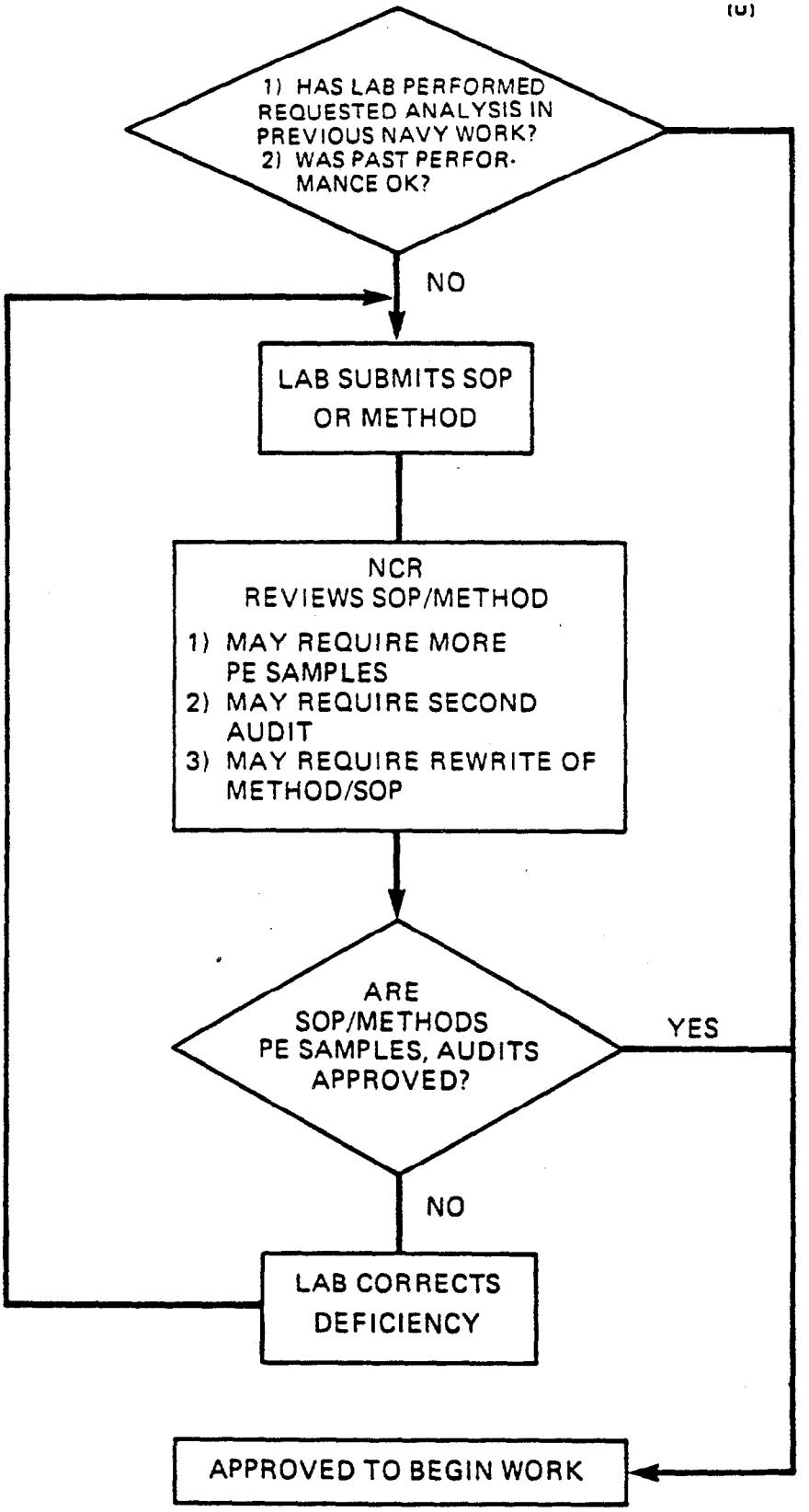

Fig. 2.2. Laboratory Reapproval Process

3. SITE-SPECIFIC QC REQUIREMENTS

The following are the requirements for the site-specific QC section to be included in the site-specific work plan or to be presented as a separate QC document.

3.1 CONTENTS OF SITE-SPECIFIC QC SECTION

1. The laboratory must be identified along with all other subcontractors.

2. Any pertinent state environmental or EPA federal/regional requirements shall be presented. This includes specific procedures or clean-up levels.

3. References must be made to the appropriate corporate or laboratory QA plans which contain pertinent information.

4. A discussion of COC and shipping practices must be provided.

5. Tables of the following shall be included.

   - Analytical methods and numbers of samples of each matrix to be collected at each site.

   - List of analytes to be identified and quantitated.

   - List of holding times, preservatives, amount of sample required, and container requirements.

   - List of the number, type, and matrix of field and laboratory QC samples by site. This includes trip blanks, equipment rinsates, field blanks, field duplicates, laboratory method blanks, laboratory matrix spikes and duplicates.

   - List of sample volume and bottles vs method.

6. All site-specific field sampling procedures which are not included in any corporate QA plan shall be presented.

7. Decontamination procedures for both drilling and sampling equipment shall be described.

8. Data quality objectives shall be discussed. This shall include precision, accuracy, and completeness required for acceptable data.

3.2 STATE AND REGION REQUIREMENTS FOR SITE QC PLAN

In addition to, or in place of, the requirements in this document, those requirements specific to the state or EPA region applicable to the

site shall be considered. Any state- or region-specific requests must be addressed in the site work plan.

3.3 SAMPLING DESIGN

Every site is unique in its own way. To this end, a sampling rationale shall be included with the work plan. The rationale should define and explain thoroughly the sampling statistics, the equipment involved, and anticipating data to be gained by this proposed methodology.

3.4 PRESERVATIVES

After samples have been taken, they shall be sent to the laboratory for analysis within 24 h after collection to ensure that the most reliable and accurate answers will be obtained as a result of the analysis. The holding time begins from the date of collection in the field. Preservatives shall be added in the field. Tables 3.1, 3.2, and 3.3 present the holding times, type of containers, and preservatives to be used. A table corresponding to each of the three different methods such as those from the *Federal Register; SW-846* 3rd ed.; and CLP is presented. The site-specific plan shall outline which preservatives will be used, and it shall be based on these tables. Freezing of samples shall not be permitted.

3.5 SAMPLE CONTAINER CLEANING PROCEDURES

In general, glass bottles with Teflon lids are used for organic samples, while polypropylene is used for metals and other inorganics. The following specifies the bottle cleaning required. If precleaned bottles are purchased, this must be noted in the work or field QA plan and approved by the NCR. If precleaned bottles are used, a certificate indicating that the bottles are analyte free must be provided.

3.5.1 Cleaning Procedure for Glass Bottles

1. Wash glass bottles, Teflon liners, and caps in hot tap water with laboratory-grade nonphosphate detergent.

2. Rinse three times with tap water.

3. Rinse with 1:1 nitric acid (metals-grade), American Society for Testing Materials (ASTM) Type I deionized water.

4. Rinse three times with ASTM Type I deionized water.

5. Rinse with pesticide-grade methylene chloride using 20 mL for 1/2-gal container and 5 mL for 4- and 8-oz containers.

6. Oven dry at 125°C. Allow to cool to room temperature in an enclosed contaminant-free environment.

Table 3.1 Required containers, preservation techniques, and holding times (40 CFR, Part 136, July 1, 1987)

Parameter No./name	Container [1]	Preservation [2,3]	Maximum holding time [4]
Table IA—Bacteria[5] Tests			
1–4 Coliform: fecal and total	P, G	Cool, 4°C, 0.008% $Na_2S_2O_3$[6]	6 hours
5 Fecal streptococci	P, G	do	Do
Table IB—Inorganic Tests			
1 Acidity	P, G	Cool, 4°C	14 days
2 Alkalinity	P, G	do	Do
4 Ammonia	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days
9 Biochemical oxygen demand	P, G	Cool, 4°C	48 hours
11 Bromide	P, G	None required	28 days
14 Biochemical oxygen demand, carbonaceous	P, G	Cool, 4°C	48 hours
15 Chemical oxygen demand	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days
16 Chloride	P, G	None required	Do
17 Chlorine, total residual	P, G	do	Analyze immediately
21 Color	P, G	Cool, 4°C	48 hours
23–24 Cyanide, total and amenable to chlorination	P	Cool, 4°C, NaOH to pH > 12, 0.6g ascorbic acid [7]	14 days [8]
25 Fluoride	P, G	None required	28 days
27 Hardness	P, G	HNO_3 to pH < 2, H_2SO_4 to pH < 2	6 months
28 Hydrogen ion (pH)	P, G	None required	Analyze immediately
31, 43 Kjeldahl and organic nitrogen	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days
Metals [9]			
18 Chromium VI	P, G	Cool, 4°C	24 hours
35 Mercury	P, G	HNO_3 to pH < 2	28 days
3, 5–8, 10, 12, 13, 19, 20, 22, 26, 29, 30, 32–34, 36, 37, 45, 47, 51, 52, 58–60, 62, 63, 70–72, 74, 75 Metals, except chromium VI and mercury	P, G	do	6 months
38 Nitrate	P, G	Cool, 4°C	48 hours
39 Nitrate-nitrite	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days
40 Nitrite	P, G	Cool, 4°C	48 hours
41 Oil and grease	G	Cool, 4°C, H_2SO_4 to pH < 2	28 days
42 Organic carbon	P, G	Cool, 4°C, HCl or H_2SO_4 to pH < 2	Do
44 Orthophosphate	P, G	Filter immediately. Cool, 4°C	48 hours
46 Oxygen, Dissolved Probe	G Bottle and top	None required	Analyze immediately
47 Winkler	do	Fix on site and store in dark	8 hours
48 Phenols	G only	Cool, 4°C, H_2SO_4 to pH < 2	28 days
49 Phosphorus (elemental)	G	Cool, 4°C	48 hours
50 Phosphorus, total	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days
53 Residue, total	P, G	Cool, 4°C	7 days
54 Residue, Filterable	P, G	do	48 hours
55 Residue, Nonfilterable (TSS)	P, G	do	7 days
56 Residue, Settleable	P, G	do	48 hours
57 Residue, volatile	P	do	7 days
61 Silica	P, G	do	28 days
64 Specific conductance	P, G	do	Do
65 Sulfate	P, G	do	Do
66 Sulfide	P, G	Cool, 4°C, add zinc acetate plus sodium hydroxide to pH > 9	7 days
67 Sulfite	P, G	None required	Analyze immediately
68 Surfactants	P, G	Cool, 4°C	48 hours
69 Temperature	P, G	None required	Analyze
73 Turbidity	P, G	Cool, 4°C	48 hours
Table IC—Organic Tests [10]			
13, 18–20, 22, 24–28, 34–37, 39–43, 45–47, 56, 66, 68, 69, 92–95, 97 Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4°C, 0.008% $Na_2S_2O_3$[6]	14 days
6, 57, 90 Purgeable aromatic hydrocarbons	do	Cool, 4°C, 0.008% $Na_2S_2O_3$[6], HCl[11] to pH2[12]	Do
3, 4 Acrolein and acrylonitrile	do	Cool, 4°C, 0.008% $Na_2S_2O_3$[6], Adjust pH to 4–5[13]	Do
23, 30, 44, 49, 53, 67, 70, 71, 83, 85–86 Phenols[14]	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[6]	7 days until extraction, 40 days after extraction
7, 38 Benzidines[14]	do	do	7 days until extraction[15]
14, 17, 48, 50–52 Phthalate esters[14]	do	Cool, 4°C	7 days until extraction, 40 days after extraction
72–74 Nitrosamines[14,16]	do	Cool, 4°C, store in dark, 0.008% $Na_2S_2O_3$[6]	Do
76–82 PCBs[14], acrylonitrile	do	Cool, 4°C	Do
54, 55, 65, 69 Nitroaromatics and isophorone[14]	do	Cool, 4°C, 0.008% $Na_2S_2O_3$[6], store in dark	Do
1, 2, 5, 8–12, 32, 33, 58, 59, 64, 68, 84, 86 Polynuclear aromatic hydrocarbons[14]	do	do	Do
15, 16, 21, 31, 75 Haloethers[14]	do	Cool, 4°C, 0.008% $Na_2S_2O_3$[6]	Do
29, 35–37, 60–63, 91 Chlorinated hydrocarbons[14]	do	Cool, 4°C	Do
87 TCDD[14]	do	Cool, 4°C, 0.008% $Na_2S_2O_3$[6]	Do
Table ID—Pesticides Tests			
1–70 Pesticides[14]	do	Cool, 4°C, pH 5–9[17]	Do
Table IE—Radiological Tests			
1–5 Alpha, beta and radium	P, G	HNO_3 to pH < 2	6 months

[1] Polyethylene (P) or Glass (G).

[2] Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.

[3] When any sample is to be shipped by common carrier or sent through the United States Mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

[4] Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer time, and has received a variance from the Regional Administrator under § 136.3(e). Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show that this is necessary to maintain sample stability. See § 136.3(e) for details.

[5] Should only be used in the presence of residual chlorine.

[6] Maximum holding time is 24 hours when sulfide is present. Optionally all samples may be tested with lead acetate paper before pH adjustments in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

[7] Samples should be filtered immediately on-site before adding preservative for dissolved metals.

[8] Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

[9] Sample receiving no pH adjustment must be analyzed within seven days of sampling.

[10] The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.

[11] When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6–9; samples preserved in this manner may be held for seven days before extraction and for forty days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re the requirement for thiosulfate reduction of residual chlorine), and footnotes 12, 13 (re the analysis of benzidine).

[12] If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0 ± 0.2 to prevent rearrangement to benzidine.

[13] Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxident-free) atmosphere.

[14] For the analysis of diphenylnitrosamine add 0.008% $Na_2S_2O_3$ and adjust pH to 7–10 with NaOH within 24 hours of sampling.

[15] The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin add 0.008% $Na_2S_2O_3$.

Table 3.2 Preservative and holding times for the contract laboratory protocol

Parameter	Container	Preservative	Holding Time Soil	Holding Time Water
Volatiles by gas chromatography/mass spectroscopy (GC/MS)	Water - 40-mL glass vial with Teflon-lined septa	Cool, 4°C	10 days	10 days
	Soil-glass with Teflon-lined septa			
PCB/ pesticides	G, Teflon-lined-lid	Cool, 4°C	Extract within 10 days, analyze 40 days	Extract within 5 days, analyze 40 days
Extractable organics	G, Teflon lined-lid	Cool, 4°C	Extract within 10 days, analyze 40 days	Extract within 5 days, analyze 40 days
Metals	P, G	HNO_3 to pH<2	6 months	6 months
Mercury	P, G	HNO_3 to pH<2	26 days	26 days
Cyanide	P, G	NaOH to pH>12 Cool 4°C add 0.6 g ascorbic acid if residual chlorine present	14 days	14 days
Chromium VI	P, G	HNO_3 to pH<2	24 h	24 h

7. Place liners in lids and cap containers.

8. Store in contaminant-free area. (Amber glass containers shall not be exposed to sunlight).

Table 3.3 Preservatives and holding times for EPA-document SW-846 (3rd ed.)

Parameter	Container	Preservative	Holding Time Soil	Holding Time Water
Volatiles by GC/MS, and GC	Water - 40-mL glass vial with Teflon-lined septa Soil-glass with Teflon-lined septa	Cool, 4°C	14 days	14 days
PCB/ pesticides	G, Teflon-lined lid	Cool, 4°C	Extract within 7 days, analyze 40 days	Extract within 7 days, analyze 40 days
Extractable organics	G, Teflon-lined lid	Cool, 4°C	Extract within 7 days, analyze 40 days	Extract within 7 days, analyze 40 days
Metals	P, G	HNO_3 to pH<2	6 months	6 months
Mercury	P, G	HNO_3 to pH<2	28 days	28 days
Cyanide	P, G	NaOH to pH>12 Cool 4°C add 0.6 g ascorbic acid if residual chlorine present	14 days	14 days
Chromium	P, G	HNO_3 to pH<2	24 h	24 h

3.5.2. Cleaning Procedure for Bottles Used for Volatile Organics (40-mL Glass)

1. Wash glass vials, Teflon-backed septa, Teflon liners, and caps in hot tap water using laboratory-grade nonphosphate detergent.

2. Rinse three times with tap water.

3. Rinse three times with ASTM Type I deionized water.

4. Oven dry vials, septa, and liners at 125°C.

5. Allow vials, septa, and liners to cool to room temperature in an enclosed contaminant-free environment.

6. Seal 40-mL vials with septa (Teflon side down) and cap.

7. Store in contaminant-free area.

3.5.3. Cleaning Procedure for Polyethylene Bottles

1. Wash polyethylene bottles and caps in hot tap water with laboratory-grad nonphosphate detergent.

2. Rinse with 1:1 nitric acid (metals-grade), ASTM deionized water).

3. Rinse three times with ASTM Type I deionized water.

4. Invert and air dry in contaminant-free environment.

3.5.4. All Bottles Should Be

1. Capped and labeled with sample numbers and packed in cooler or box.

2. Stored in contaminant-free area.

3.6 ORGANIZATION AND PERSONNEL

All management personnel responsible for performing field sampling or analytical work shall be listed along with their job assignment and years of experience in performing this type of work. Any education and training related to the tasks performed for this project shall also be listed.

3.7 FIELD QC SAMPLES

Although the number of QC samples changes, the types of field QC samples remain the same regardless of the level of QC implemented. Table 3.4 lists the percentage of field QC samples per level per sample matrix. A sampling event is considered to be from the time the sampling personnel arrive at the site until these personnel leave for more than a day. An example of two events would occur if sampling personnel went to a site for three weeks, drilled borings, and put groundwater wells in place. During this visit, soil and water samples were collected. The sampling crew left the site for two months, thus concluding the first sampling event. The crew later returned to collect another set of groundwater samples over a three-day period. The second visit would constitute the second sampling event.

Table 3.4. Field QC samples per sampling event

Type of Sample	Level C		Level D		Level E	
	Metal	Organic	Metal	Organic	Metal	Organic
Trip blank (for volatiles only)	NA[1]	1/cooler	NA[1]	1/cooler	NA[1]	1/cooler
Equipment rinsate[2]	1/day	1/day	1/day	1/day	1/day	1/day
Field blank	1/source/event for all levels and all analytes					
Field duplicates[3]	10%	10%	10%	10%	5%	5%
Referee duplicate[3]						

[1]NA - Not applicable.

[2]Samples are collected daily; however, only samples from every other day are analyzed. Other samples are held and analyzed only if evidence of contamination exists.

[3]The duplicate must be taken from the same sample which will become the laboratory matrix/spike duplicate for organics or for the sample used as a duplicate in inorganic analysis.

The following information defines and explains the blanks, duplicates, and referee samples.

1. Trip Blanks

Trip blanks are defined as samples which originate from analyte-free water taken from the laboratory to the sampling site and returned to the laboratory with the volatile organic (VOA) samples. One trip blank should accompany each cooler containing VOAs, should be stored at the laboratory with the samples, and analyzed by the laboratory. Trip blanks are only analyzed for VOAs.

2. Equipment Rinsates

Equipment rinsates are the final analyte-free water rinse from equipment cleaning collected daily during a sampling event. Initially, samples from every other day should be analyzed. If analytes pertinent to the project are found in the rinsate, the remaining samples must be analyzed. The results from the blanks will be used to flag or assess the levels of analytes in the samples. This comparison is made during data validation. The rinsates are analyzed for the same parameters as the related samples.

3. Field Blanks

Field blanks consist of the source water used in decontamination and steam cleaning. At a minimum, one field blank from each event and each source of water must be collected and analyzed for the same parameters as the related samples.

4. Field Duplicates/Splits

Duplicates or splits for soil samples are collected, homogenized, and split. All samples except VOAs are homogenized and split. Volatiles are not mixed, but select segments of soil are taken from the length of the core and placed in 40-mL glass vials. Cores may be sealed and shipped to the laboratory for subsampling if the project deems this appropriate. The duplicates for water samples should be collected simultaneously. Field duplicates should be collected at a frequency of 10% per sample matrix for Levels D and C. For Level E, the duplicates should be analyzed at a frequency of 5%. All the duplicates should be sent to the primary laboratory responsible for analysis. The same samples used for field duplicates shall be split by the laboratory and be used as the laboratory duplicate or matrix spike. This means that for the duplicate sample, there will be analyses of the normal sample, the field duplicate, and the laboratory matrix spike/duplicate.

5. Referee Duplicates

Duplicates/splits shall be sent to the referee QA laboratory if regulators (state or region) collect split samples or if a special problem occurs in sample analysis or collection. These duplicates/splits are collected and analyzed in addition to the field duplicates mentioned in the previous paragraph.

3.8 CHAIN OF CUSTODY

Samples, other than those collected for *in situ* field measurements or analyses, are identified by using a standard sample label which is attached to the sample container. The sample labels are sequentially numbered and are accountable. The following information shall be included on the sample label.

1. Site name.
2. Field identification or sample station number.
3. Date and time of sample collection.
4. Designation of the sample as a grab or composite.
5. Type of sample (matrix) and a brief description of the sampling location.
6. The signature of the sampler.
7. Sample preservation and preservative used.
8. The general types of analyses to be conducted.

If a sample is split with another party, sample labels with identical information shall be attached to each of the sample containers.

The COC record is used to record the custody of samples and shall accompany samples at all times. The following information shall be supplied to complete the COC record.

1. Project name.
2. Signature of samplers.
3. Sampling station number or sample number, date and time of collection, grab or composite sample designation, and a brief description of the type of sample and sampling location.
4. Signatures of individuals involved in sample transfer (i.e., relinquishing and accepting samples). Individuals receiving the samples shall sign, date, and note the time that they received the samples on the form.
5. Matrix.

Sample analysis request sheets serve as official communication to the laboratory of the particular analyses required for each sample and provide further evidence that the COC is complete.

COC records initiated in the field shall be placed in a plastic cover and taped to the inside of the shipping container used for sample transport from the field to the laboratory.

3.9 SHIPPING REQUIREMENTS

Shipping containers shall be secured using nylon strapping tape and custody seals to ensure that samples have not been disturbed during transport. The custody seals shall be placed on the containers so they cannot be opened without breaking the seal.

Samples which must be kept at 4°C shall be shipped in insulated containers with either freezer forms or ice. If ice is used, it shall be placed in a container so that the water will not fill the cooler as the ice melts. The samples shall be shipped within 24 h of collection to allow the laboratory to meet holding times. The Department of Transportation regulations shall be used for packaging, quantities of shipment, and the way samples are sent. Each subcontractor responsible for sampling shall become familiar with the regulations.

Copies of the signed COC forms shall be delivered with the data packages. The originals shall remain on file with the contractor or with the laboratory.

3.10 SAMPLE RECEIPT

Upon receipt, the laboratory shall sign and keep copies of the air bill. The COC shall be signed. The temperature of the cooler shall be

measured and documented. The condition of the samples shall be documented. If any breakage or discrepancy arises between COC, sample labels, and requested analysis, the sample custodian will notify the engineering subcontractor. The pH of incoming samples shall be checked and documented upon receipt. Any discrepancy or improper preservation shall be noted by the laboratory as an out-of-control event and shall be documented on an out-of-control form with the corrective action taken. The out-of-control form shall be signed and dated by the custodian and any other person responsible for corrective action.

4. LABORATORY QA PLAN REQUIREMENTS

An essential step in the sequence of events leading to Navy approval of contract laboratories is the preparation and acceptance of a QA plan for each laboratory.

The contents and format of an acceptable plan are described below. If the laboratory has a general QA plan in place, this should be sent for review. In this case, a site-specific QA plan may not be needed. Any deviations or additions to the normal laboratory QA should be documented in the site-specific work plan.

4.1 PURPOSE AND SCOPE

The QA plan is a statement of the laboratory's approach to ensuring that quality data are generated from the analysis of Navy samples. In the context of laboratory approval, the plan provides a basis for evaluating a laboratory's QC procedures. This evaluation includes a critical review of the plan and verification of the laboratory's adherence to the plan through inspection.

4.2 ORGANIZATION AND CONTENTS OF PLAN

The items listed below may be presented in any order that the laboratory desires; however, the list includes the items that are required in the QA plan.

1. Title Page with Provision for Signatures
2. Table of Contents
3. Organization and Personnel
4. Personnel Training
5. Sample-Handling Practices and COC
6. Material Procurement and Control
7. Facilities and Equipment
8. Equipment Maintenance
9. Analytical Procedures
10. Calibration
11. Limits of Detection
12. Analysis of QC Samples and Documentation
13. Out-of-Control Events and Corrective Action
14. Data Evaluation and Data Reduction
15. Holding Times and Preservatives
16. Internal Laboratory Audits and Approvals from Other Agencies
17. Document Control
18. QA Reports to Management
19. Accuracy, Precision, and Completness

1. Title Page with Provisions for Signature

   A title page with provision of approval signatures and date of revision shall be provided.

2. Table of Contents

   A table of contents shall be provided.

3. Laboratory Organization and Personnel

   This section provides an overview of the laboratory organization as it relates to implementation of the QC program. The roles, responsibilities, and authority of key laboratory personnel are described with emphasis on the authority given the LQAC with regard to QC monitoring, reporting, and corrective action.

   An appendix shall contain a list of all the personnel, their assignments and responsibilities, degrees of education, and the years of applicable experience.

4. Personnel Training

   The plan shall address how personnel are trained in laboratory methods, in QC, and in safety policies.

5. Sample-Handling Practices and COC

   This section shall include tracking of samples through the laboratory, receipt of samples, verification of preservation, login of samples, and COC. Sample storage and disposal shall also be included. Preparation of bottles and glassware washing shall also be included.

6. Material Procurement and Control

   This section shall include a description of procedures for purchasing materials, quality inspection prior to use in sample analysis, chemical and standard inventory, solvent storage policies, and laboratory waste disposal.

7. Facilities and Equipment

   A list of basic types of equipment, year of purchase, and general description of the facility assures that the laboratory is large enough to handle the sample load expected and that the equipment is capable of performing the analysis.

8. Equipment Maintenance

   This section shall include general information as to who performs both major, preventive, and day-to-day maintenance and how it is documented.

9. Analytical Procedures

This section shall contain a list of all procedures that the laboratory offers (by method number and matrix) in the event that future work may require analyses not specified in the SOW.

Any method variances must be reported, and any documentation from EPA for approvals-of-method variances shall be presented to assure that they are known prior to sample analysis.

The laboratory policy and implementation procedures shall emphasize that methods are available to the analyst.

10. Calibration

This section shall include calibration procedures by instrument type, calibration frequency, reference standards used, calibration acceptance criteria, and calibration documentations procedures. Calibration applies to both instruments such as gas and liquid chromatography, GC/MS, inductively coupled plasma (ICP), atomic absorption (AA), infrared and ultraviolet spectroscopy, and wet chemical methods.

The method for assuring that balances, refrigerators, and ovens are accurate and how these pieces of equipment are checked must be outlined. Balances and ovens must be checked prior to use. Balances must also be checked by an outside company annually.

11. Limits of Detection

The laboratory shall indicate what the typical method-detection limits are for water, soil, and any other matrix commonly analyzed by the laboratory, with the understanding that this varies with the sample matrix. The procedures for determining the limits of detection for each type of method and the frequency of detection limit verification shall be outlined.

12. Analysis of QC Samples and Documentation

This section shall summarize the QC procedures and documentation to be used in the day-to-day operation of the laboratory. The discussion shall emphasize the following:

- analysis of field, method, and reagent blanks;
- analysis of duplicates, spiked samples, spiked laboratory blanks, and reference or control standards such as EPA check standards;
- the criteria used to establish warning and action limits for the above types of QC samples;

- documentation and examples of control data and control charts (see Sect. 4.4) for explanation of control charts and their usage;
- the frequency of blanks and other QC samples and controls;
- how the data from the QC samples are reported and reviewed;
- who reviews and makes decisions from the QC data;
- details of how requirements of minimum control program in Sect. 8.2 will be met; and
- verification of calibration.

13. Out-of-Control Events and Corrective Action

This section shall contain a definition as to the types of out-of-control occurrences, how these occurrences are documented, and who is responsible for correction and documentation. It is recognized that several out-of-control events occur. Four examples are given.

- Observations Corrected at the Bench - If the calibration of an instrument is not linear, the analyst may find this and correct it prior to continuing to analyze samples. The laboratory may document this and note that the corrective action was to recalibrate and that no samples were affected, as none were analyzed prior to calibration.
- Corrective Actions Taken by Supervisor - A matrix spike recovery is out of control and the laboratory supervisor finds this after the samples for the day have been analyzed. The supervisor shall document that the laboratory blank spiked with surrogates or standards was in control and that other sample spikes were in control; therefore, no reanalysis of the sample is required.
- Corrective Actions at the Receiving Level - If the sample is broken, the analyst may note this and document whether or not more sample is available. If no more sample is available, the customer shall be notified and the decision documented.
- Statistical Out-of-Control Events - If a control chart is being monitored and the measured parameter exceeds the 99% confidence limit then explanation shall be documented as to when the parameter exceeded statistical limits.
  - Procedures shall be outlined as to what corrective action is taken if an out-of-control event occurs and how it is documented and used to improve laboratory performance. The documentation shall be easily used by all personnel and shall be part of routine laboratory procedure.

- Procedures for assuring that results for samples processed during out-of-control conditions are not reported shall be outlined.

- The conditions necessary to reestablish control and criteria for assuring the system is operating properly.

14. Data Evaluation and Data Reduction

A discussion of data evolution procedures for each analytical method as well as for an entire data set shall be included. The process of certification of reviewed data shall be outlined with an explanation of how suspect data are flagged if they are suspect but still reported.

15. Holding Times and Preservatives

The document shall include laboratory policy for meeting holding times for sample analysis and how it is assured that these are met. The sample storage requirements, holding times, and preservatives specified in Tables 3.1, 3.2 and 3.3 are minimal criteria for Navy approval.

16. Internal Laboratory Audits and Approvals from Other Agencies

A listing of approvals from other agencies and states gives an indication of the general quality and type of laboratory experience the organization has. If the laboratory performs self-audits, the frequency and method of documentation shall be outlined.

17. Document Control

The QA plan shall outline the flow of documents containing COC and data. The plan shall explain how documents are checked, signed, and filed.

18. QA Reports to Management

The plan shall include the frequency and information of management QA reports.

19. Accuracy, Precision, and Completeness

The plan shall include the laboratory's definition and method of evaluating the precision, accuracy, and completeness of measurement parameters and of evaluating data sets.

4.3 CONTROL SAMPLES

Control samples are those samples containing known concentrations of analytes that are introduced into a run of environmental samples to

monitor the performance of the analytical system. Control samples involving duplicates, blanks, analytical standards, reference materials, and spikes can be used in different phases of the overall analysis from sampling through storage, transportation, and preparation to the analytical method itself. The choice of types of controls relates to the analysis phase(s) to be controlled and the information (e.g., precision, accuracy, interferences, recovery) to be developed.

The QA plan describes generally how and where such control mechanisms are used by the laboratory. Control materials may be purchased from commercial sources, the National Bureau of Standards, or the EPA. A brief description of each control sample (or set of samples) used shall be provided in the MPR, subsequent to its introduction, and shall cover the following items.

1. Where the control samples are made.

2. How they are made.

3. How many are made and with what frequency.

4. How they are used.

   - Physically (e.g., placed in the sample tray along with 14 environmental samples just before the samples enter the processing stream).

   - Analytically (e.g., used to determine the recovery factor of the procedures; used to check for interferences).

5. Frequency of analysis of control sample.

4.4 CONTROL CHARTS

Control charts provide a useful tool in assessing QC efforts and improving processes through graphic displays of a parameter(s) and its variability over time. The parameter plotted on the chart is usually related to control sample testing--either directly in terms of concentrations or indirectly in terms of derived information such as means of concentrations, ranges of concentrations, percent recovery of spikes, relative percent differences based on duplicate results, or slopes of least-squares data fits.

The laboratory should include in its QA plan, as required in Sect. 4.2, a brief description of the basic methodology used in control charting, covering such considerations as the following.

1. Verification that the methods are valid and working properly prior to beginning control charts.

2. Number of control samples per run.

3. Number of runs analyzed.

4. Parameters to be plotted against time and the general formulae for developing these parameters.

5. Statistical/mathematical basis for assigning warning and rejection limits on the charts in terms of, for example, standard deviation.

6. Types of shifts, trends, or biases that may typically be revealed by these charts.

4.4.1 Method Blank/Spike Control Program

Controls are required for only the methods and analytes pertinent to the program. The laboratory shall employ a measurement-control program which, as a minimum, consists of monitoring the results of laboratory preparation and analysis of control samples using statistical control charts. The basis of this program is to demonstrate that the laboratory method for sample preparation and analysis is working properly. This minimum program consists of using the laboratory's distilled and/or deionized water and spiking it with known compounds or elements. By plotting the results of the method blank spike on control charts, a true picture of the actual process of sample analysis is obtained with fewer problems from matrix effects and sample nonhomogeneity. This information, used in conjunction with matrix spike recoveries, can aid in determining whether an out-of-control condition is due to laboratory problems or matrix problems. Therefore, one batch of control material is the spiked laboratory blank water. The second batch of control material is a soil or sand. This soil can be pulverized and homogenized. If the soil used is known to contain some of the analytes of interest, then no spiking may be required. Additional spiking may be done to an aliquot of control soil just prior to sample preparation. The method blank/spike water (laboratory water) should be analyzed when water samples are analyzed and the method blank/spike soil analyzed alongside soil or waste samples.

The analytes selected for spiking should be representative of the compound class for the organics. It is suggested that the surrogates used for volatiles and base/neutral/acids (BNAs) analyses be used as control analytes for the GC/MS methods. At least two pesticides should be used when pesticide methods are performed and one polychlorinated biphenyl (PCB) when PCBs are analyzed. For wet chemical methods, a single spike of an appropriate control for each method may be used. As an example for cyanide, a control of sodium cyanide from a source other than that used for calibration may be spiked into water and analyzed alongside the water samples. For the metals, it is suggested that at least three of the metals typically analyzed by ICP be monitored and that each element analyzed by furnace or flame atomic absorption be monitored.

4.4.2 Control Sample Quality

The laboratory QA plan shall describe the steps which will be taken to ensure and verify the quality of the two types of control samples of Sect. 4.4.1. The QA plan shall address the following concerns pertaining to the control batches.

1. How the batch will be selected.
2. Shelf life of control batch.
3. Under what conditions the batch will be stored.
4. How the batch will be homogenized.
5. How and when the individual samples will be taken.
6. How and when the sample will be spiked.
7. How the batch will be replaced as it is depleted.
8. How the control charts will be affected by changes in batches.

The QA plan shall address the following concerns pertaining to the spikes.

1. What compound/element will be used to spike.
2. How the spike material will be selected.
3. Target concentration of spiking compound/element.
4. How long the spike is expected to last.
5. Under what conditions the spike will be stored.
6. How the spike will be homogenized.
7. How and when the individual samples will be taken.
8. How the spike will be replaced as it is depleted.
9. How the control charts will be affected by changes in spikes.

4.4.3 Minimum Statistical Control Charting

As a minimum, the laboratory shall run two control charts for each analyte listed in Table 4.1. These charts shall monitor the laboratory measurements obtained from individually spiked water samples and individually spiked soil samples.

Each control chart shall consist of a center line, two warning limits, and two control limits. The control chart parameters should be calculated according to the formulae provided in Table 4.2. A minimum of 20 points/chart shall be obtained prior to the initial attempt to establish the control chart parameters.

If the laboratory does not have 20 points to use in setting control chart limits, the recommended EPA recoveries for the method will be used until such time as 20 points are attained.

4.4.4 Minimum Criteria for an Out-of-Control Condition

A laboratory process for a particular analyte should be considered out of statistical control whenever, as a minimum, any one of the following conditions is demonstrated by a control chart monitoring that analyte.

1. Any one point is outside of the control limits.
2. Any three consecutive points are outside the warning limits.
3. Any eight consecutive points are on the same side of the centerline.
4. Any six consecutive points are such that each point is larger (smaller) than its immediate predecessor.
5. Any obvious cyclic pattern is seen in the points.

Table 4.1. Typical number of analyses to be monitored through measurement control program

Number	Analyses
10	Metals by AA and ICP
1	Mercury
3	Volatiles
1	Wet chemicals
1	PCB
2	Pesticides
3	Base neutrals
3	Acids

4.4.5 Reactions to Out-of-Statistical-Control Conditions on Control Samples

The laboratory QA plan shall describe the steps which will be taken in the occurrence of an out-of-statistical-control condition from the control charts of Sect. 4.2.3. The steps should be similar to those requested in Sect. 4.6 but shall include those actions related to the quality and stability of the control batches, sampling, spiking, and handling of the control samples.

4.4.6 Administration of the Control Charts

The laboratory QA plan shall address the following aspects of administering the control charts of Sect. 4.4.2.

1. What types of laboratory activities the control charts will monitor.
2. How often control samples will be run.
3. How soon after results are obtained will charts be monitored.
4. Who is responsible for reading the charts.
5. How will changes in people, equipment, processes affect the charts.
6. How often and under what circumstances will limits be updated.

4.4.7 Statistical Quality of the Control Charts

The formulae for the control chart parameters given by Table 4.2 are those commonly accepted and used. They are based on normally distributed measurements and short-term variation. If these bases are inappropriate, the charts will not perform as desired. The charts will either falsely signal out-of-control warnings more frequently than usual, fail to detect existing out-of-control conditions as often as they ordinarily would, or both (for different types of out-of-control states). In order to correct any problems due to improperly fitting control charts, the laboratory may propose alternate methods for setting the control chart parameters for those analytes of Table 4.2. All such proposals

Table 4.2. Control chart formula for Water and Soil Control Batch Program

Definitions

Let X_1, X_2, X_3, ..., X_n ($n \geq 20$) represent the first n time-ordered determinations for an analyte of Table 4.2 from either the water or soil control batch program.

Then, define the following:

$\bar{X}$ = average = $(1/n)(X_1 + X_2 + \ldots + X_n)$,
$Ri = |X_i - X_{(i-1)}|$ $i = 2,3,\ldots,n$
R_2 = average moving range of two successive points,

$$= [1/(n-1)][\,|X_2 - X_1| + |X_3 - X_2| + \ldots + |X_n - X_{(n-1)}|\,] .$$

Control Chart Parameter Estimation

Parameter	Symbol	Formula
Centerline	CL	$\bar{X}$
Upper control limit	UCL	$\bar{X} + 3R_2/d_2$
Lower control limit	LCL	$\bar{X} - 3R_2/d_2$
Upper warning limit	UWL	$\bar{X} + 2R_2/d_2$
Lower Warning limit	LWL	$\bar{X} - 2R_2/d_2$

(d_2 = 1.128, factor from tables for control charting within n = 2, see American Society for Quality Control)

should include data and supportive statistical evidence. Possible alternate statistical approaches can include using nonparametric techniques, medians instead of averages for the centerlines, identifying sources of variation, using long-term variation instead of short-term variation in setting limits, and transformations of the data.

4.4.8 Example of Setting Control Limits

As an example of setting control chart parameters and a very brief introduction to interpretation of the chart, consider the following:

A sample is obtained from the batch of control soil which has been thoroughly mixed and is stored in a special atmospherically controlled location. It is carefully spiked with known amounts of the constituents of Table 4.2 and sent to sample preparation to be processed with a customer's solid waste samples. It is analyzed along with the other samples. It is subjected to the same types of treatment as the other samples in the batch. This scenario is repeated until 20 control samples have been analyzed.

The data are listed in Table 4.3. Also shown are calculations according to the formulae in Table 4.2. Figure 4.1 displays the results of the initial attempt at sizing the data to the control chart parameters. The point falling above the upper control limit was investigated. It was determined that the sample had received a double spiking and, thus, was deleted from the second iteration calculation of the chart parameters. Figure 4.2 shows the second fitting. This fit appears adequate, and the chart is approved by the LQAC authority. Had no explanation for the high result been found, the first calculations would have been used. The chart would have been placed under a probationary condition and its performance monitored with guarded caution.

4.5 OUT-OF-CONTROL EVENTS

The interpretation of control charts can reveal shifts, trends, biases, and conditions where parts of the analytical system are out-of-control. The contract laboratory should specify in the QA plan its criteria of defining an out-of-control condition related to the different zones on a control chart [e.g., data beyond the rejection limits, data in the zone(s) between the rejection and warning limits, and data inside the warning limits] and different patterns within these zones [e.g., number of consecutive data points on one side of the mean, number of consecutive data points in the middle zone number of monotically changing data points, obviously repetitive patterns (Garfield, 1984)].

The laboratory shall identify what actions will be taken when the warning and/or control limits are exceeded. Warning conditions may only require more frequent observations of a piece of equipment, while rejection conditions require shutting down an instrument.

Any incident that delays sample processing for a period of time, affects holding times, or delays work by more than two days should immediately be reported by phone to the NCR. The NCR should be informed as soon as the problem is solved and an explanation given as to the corrective action taken. An example of this type of event would be the breakdown of a GC/MS system used for VOAs which could not be repaired for several days. If the laboratory could not use another instrument in its laboratory, then provisions for another approved laboratory to analyze the samples would need to be made.

Table 4.3. Data and calculations for control chart example

Order I	Result X	Moving range $\lvert X_I - X_{I-1} \rvert$
1	12.25	
2	7.52	4.73
3	12.29	4.78
4	10.04	2.25
5	8.48	1.56
6	10.89	2.40
7	9.57	1.32
8	11.40	1.83
9	9.28	2.12
10	11.66	2.39
11	12.06	0.40
12	8.52	3.54
13	11.14	2.62
14	19.56	8.42
15	10.48	9.08
16	9.12	1.35
17	12.79	3.66
18	10.30	2.49
19	5.54	4.76
20	8.93	3.39
Sum	211.82	63.0

First calculations (Fig. 4.1)

Average = 211.82/20 = 10.591
Average moving range = 63.09/19 = 3.321

Centerline = 10.591
Upper control limit = 10.591 + 3 × 3.321/1.128 = 19.423
Lower control limit = 10.591 - 3 × 3.321/1.128 = 1.758
Upper warning limit = 10.591 + 2 × 3.321/1.128 = 16.479
Lower warning limit = 10.591 - 2 × 3.321/1.128 = 4.703

Second Iteration after Removing Point #14 (Fig. 4.2)

Average = 192.26/19 = 10.119
Average moving range = 46.26/18 = 2.570

Centerline = 10.119
Upper control limit = 10.119 + 3 × 2.570/1.128 = 16.954
Lower control limit = 10.119 - 3 × 2.570/1.128 = 3.284
Upper warning limit = 10.119 + 2 × 2.570/1.128 = 14.676
Lower warning limit = 10.119 - 2 × 2.570/1.128 = 5.562

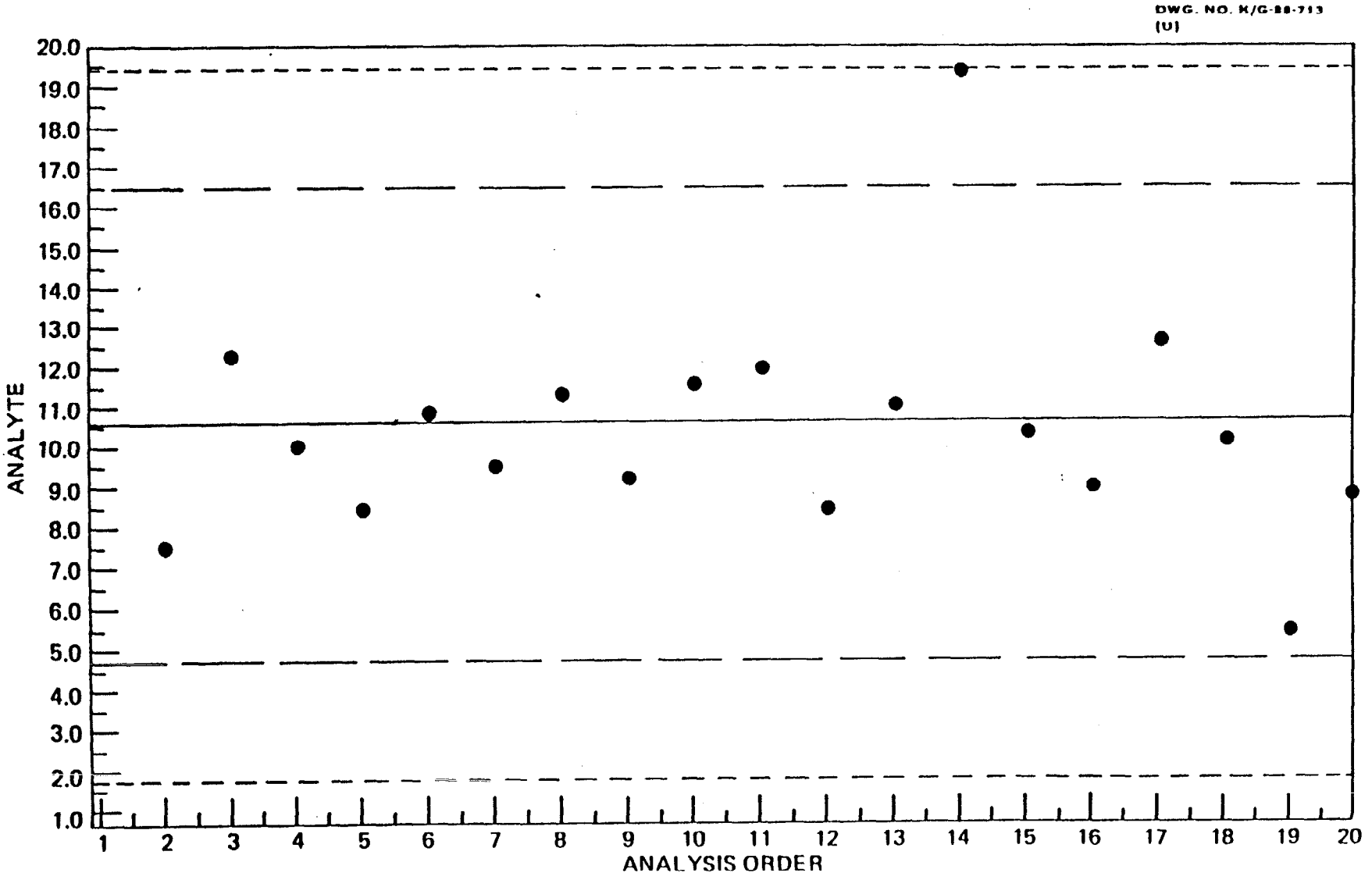

Fig. 4.1. Control Chart Example Data and Control Values of Table 4.3

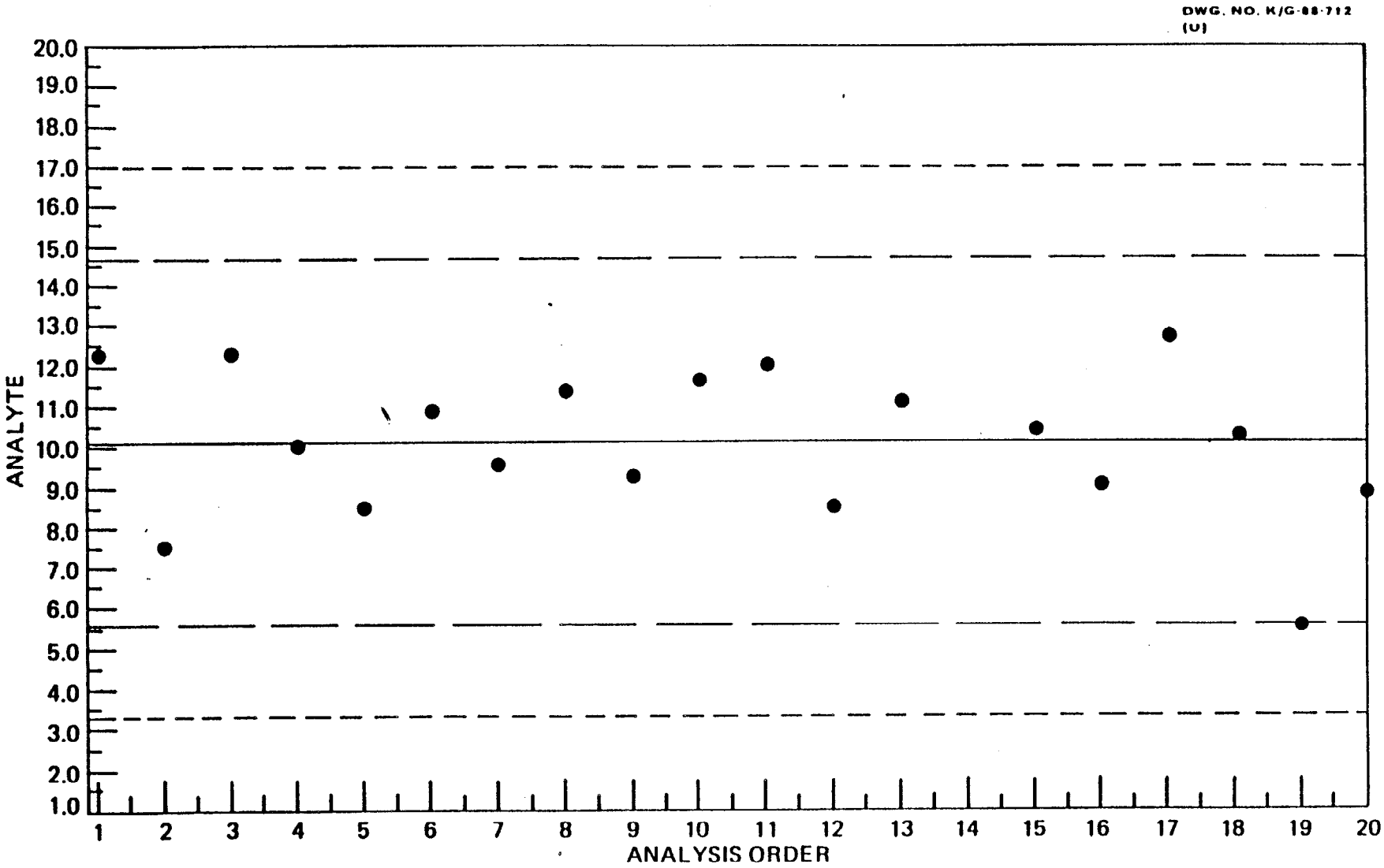

Fig. 4.2. Control Chart Example Data and Second Iteration Control Values of Table 4.3

Many laboratories use forms to aid in rapidly reporting out-of-control events and corrective actions. One way to expedite the more routine out-of-control occurrences, which are frequently corrected by the analyst prior to running samples, is to list these on a form. For instance, a form for the GC/MS laboratory might list events such as continuing check standard outside limits, tune not met, and peak areas for the internal standard outside criteria. The analyst would check the occurrence, note that the item was corrected prior to sample analysis, initial, and date the form. If forms for out-of-control events are made specific to the group using these, time can be saved in documenting events and corrective actions (see Sect. 4.2 for examples of out-of-control events).

4.6 CORRECTIVE ACTION REPORT

For out-of-control incidents, it is essential to document the nature of the incident and the corrective actions taken to set the system back "in control." A corrective action report, to be signed by the laboratory director and the LQAC, should be reported in the MPR to the NCR and discuss the following topics.

1. Where - did the out-of-control incident occur (laboratory name, address, telephone number, section name)?

2. When - did the incident occur?

   - was it corrected?

3. Who - discovered the out-of-control incident?

   - verified the incident?

   - corrected the problem?

4. What - was the name of the test?

   - was the disposition of the test or control and/or instrument?

   - was the nature of the corrective action?

   - will be done to prevent the reoccurrence of the problem?

5. Why - did the incident happen (if scientific explanation is available)?

A copy of the subject control charts and other data describing the out-of-control conditions should be included in the corrective action report.

All out-of-control incident documentation and copies of the corrective action reports sent to the NCR should be

1. placed in the laboratory archive record for the sample(s) in question,
2. placed in the LQAC's file of incidents documentation, and
3. referenced and briefly described in the MPR.

5. PROFICIENCY TESTING

Prior to beginning analysis of field samples, each laboratory must analyze proficiency samples for chemical substances representative of those anticipated in environmental samples. The purpose of proficiency testing is to gage each laboratory's proficiency with samples which are designed to mimic field samples. A second benefit of performance samples is to provide a known material from a source outside the laboratory which can be used to evaluate the laboratory's performance.

5.1 SUBMITTING THE PROFICIENCY SAMPLES

Proficiency samples will be provided to the LQAC within ten working days of receipt of the site work plan. The samples may be soil or water samples or vials of concentrate. The laboratory will be directed as to any required sample reconstitution and the analytes to be determined. If analyses are to be subcontracted to a second laboratory, appropriate proficiency samples must be sent by the NCR to that laboratory as well.

5.2 RESULTS OF PROFICIENCY SAMPLES

Results of proficiency sample analyses are to be received by the NCR within 20 working days after receipt of the samples. The NCR must have the data at least five working days prior to inspection in order to properly evaluate the data. If performance samples are to be subcontracted to a second laboratory, the data report should be sent directly to the primary laboratory by the subcontract laboratory. The entire performance data package is then submitted to the NCR. QC data such as blanks, spikes, EPA controls, daily calibration check standards, sample chromatograms, mass spectra of identified compounds and raw absorbance data for metals shall be provided.

5.3 EVALUATION OF PROFICIENCY SAMPLE RESULTS

The NCR will compare the laboratory's evaluation of proficiency sample results to peer group proficiency sample results.

Performance will always be acceptable if the laboratory results are not statistically different from the peer group results, at 95% confidence, and no procedural problems are found during the laboratory inspection. For nonacceptable results, the records will be reviewed to determine the cause for the nonconformance. The actual limits for a batch of performance samples will be provided only after the batch is discontinued.

6. LABORATORY INSPECTION

The laboratory inspection will occur within 45 days after the laboratory(s) have provided the first edition of the QA plan, the site-specific work plan, and the performance sample data. The inspection will be performed by an experienced chemist from the NCR. The chemist may be accompanied by the EIC.

6.1 PURPOSE OF INSPECTION

The purpose of laboratory inspection is to verify that the Navy QC requirements are being met as reflected by the laboratory's daily operations in adherence to the QC plan received by the NCR.

6.2 INSPECTION PROCEDURE

The laboratory inspection involves four phases.

1. Overview and Orientation

   The inspector meets with the laboratory management, including the laboratory director, the LQAC, and others as the director deems appropriate. The objectives of the visit are reviewed and a schedule established. The inspector discusses the review of the laboratory's QA/QC plan and the results of the proficiency testing.

2. Observation, Examination, and Review

   According to the schedule, the inspector does the following.

   - Witnesses performance of specified analytical procedures.
   - Reviews sample handling and storage procedures. The inspector will follow the trail of the performance samples through the laboratory.
   - Examines the QC records including QC manuals, instrument calibration and maintenance records, control charts, instrument run logs, sample preparation logs, notebooks used to document analysis, corrective action reports for out-of-control events, and performance data generated for other programs such as Superfund CLP and state drinking water.

3. Findings

   The inspector conducts an exit interview with the laboratory director, the LQAC, and any other laboratory personnel the director deems appropriate. The inspector summarizes the findings of the visit and details specific deficiencies to be addressed by corrective action.

Recommendations regarding corrective action may be provided. A written report summarizing the findings is provided to the LQAC, the Navy EIC and NCR, and engineering contractor within ten working days of the inspection.

4. Corrective Action (if required)

Within ten days of receipt of the findings, the laboratory submits to the NCR and the EIC a plan to correct the deficiencies identified in the inspection. The plan should include for each deficiency, a description of the corrective action and a date indicating when the action is to be implemented or completed.

A repeat inspection may be required in instances where the number of deficiencies requiring corrective actions are complex. Repeat inspections will be scheduled for the earliest possible date after the last corrective action plan is received by the NCR.

The laboratory shall send a follow-up report which supplies information indicating the proof that the plan has been carried out. For example, if no control charts exist, then the plan would state that these would be in place by a specific date, and the follow-up report would contain copies of the control charts.

7. ANALYTICAL METHODS

An analytical method is a series of steps or procedures that must be performed to determine the identity and quantity of analyte in a sample. The methods to be employed by the Navy-approved laboratory fall mainly into two categories--those which have been approved by the EPA and those which have been developed by the Army. The former refer primarily to the methods presented in the *Federal Register* of October 26, 1984 (49 FR 43234), where the EPA has listed ~250 pollutants (pp. 43251-43258) or pollutant categories and the method(s) by which each must (by virtue of final or final interim ruling status of the methods) be tested. The acceptance of methods not under either status will be handled on a case-by-case basis among the concerned parties. Non-standard methods shall be submitted to the NCR who will discuss the method with Navy and EPA personnel prior to use on Navy projects. Other applicable EPA methods include the *SW-846* methods which are applicable to Resource Conservation and Recovery Act sites and the Superfund CLPs which are applicable to the CERCLA sites.

Many of the EPA methods are found in the documentation of other organizations (e.g., U.S. Geological Services, ASTM) and are incorporated by reference into the regulations. Such incorporation involves listing the organization, the specific document and its date, the method number assigned by the other organization, and perhaps a page number in the document of the other organization. Technically speaking, to maintain the applicability of the regulation, no deviations from the given citations are allowed by the EPA, even in cases where an organization (ASTM, for example) may have an updated version of the method. However, there are instances where EPA regional offices have granted exceptions to different laboratories for the testing of various substances. If a laboratory has such a variance, in writing, from the EPA (either to use a different ASTM method, for example, than the one cited in the October 26, 1984 *Federal Register* or to use a somewhat modified method, for example, than the one cited in the October 26, 1984 *Federal Register*), a copy of the variance (sent to the NCR) may be used to seek Navy approval of the different or modified method. It must also be shown that the conditions for which the variance was issued by the EPA are similar to the expected conditions (sampling and handling techniques, environmental matrix, concentration range, interferences, etc.) in the IRP.

It is also recognized that the analyst may have some leeway resulting from the regulations themselves. For instance, in the October 26, 1984 *Federal Register*, several methods are listed involving GC. Typically, in paragraph 8.1.2, these methods allow the analyst "certain options," provided various subsequent QC requirements are met. For example, the EPA allows some flexibility in the procedures (and no written permission is needed from the EPA) once a sample has been extracted and placed into the instrument. On the other hand, changes in operations prior to this instrumental analysis (e.g., preparation, storage) would probably require written documentation.

The *Federal Register* of October 26, 1984 (49 FR 43437) also contains a proposed ruling where additional substances and methods are listed: specifically, some proposed modifications to Tables IC and ID (Tables 7.1 through 7.5 of this guide) of the previously mentioned final rule. In those cases where a substance/method does not appear on one of the earlier tables but does occur on one of the proposed listings, the method in the proposed listing is recommended by the EPA (Medz, 1985) but without any regulatory force.

For the analytical method to be used in the case of munition-related substances, the laboratory should consult the NCR who will forward a copy(s) of the appropriate method developed by the Army Toxic and Hazardous Materials Agency.

For biota and air samples, the methods must be evaluated individually by the NCR to determine whether they may be used for the work in question.

A list of references containing methods, statistics, and sampling information is supplied in the Bibliography of this document.

For Level D QC sites, the current CLP methods and documentation must be followed. For methods not covered by CLP and for sites requiring Level D, the latest edition of *SW-846* or other methods listed in Tables 7.1 through 7.5, may be used. For the Levels C and E sites, CLP methods, *SW-846* methods, or other methods listed in Tables 7.1 through 7.5 shall be used. The exception to the Levels C and E method requirement occurs in the volatile and semivolatile area. In any level of QC and for any site where volatiles and semivolatiles are analyzed by GC/MS, the current CLP methods shall be used.

7.1 QC REQUIREMENTS FOR THE LABORATORY

The following are the minimum QC requirements for the laboratory analyses. For Level D QC, the current CLP QC requirements are specified. For methods not defined in the CLP, the blank, blank/spike, matrix spike, and matrix spike duplicate shall be performed for every 20 samples of similar matrix. The batch size for Level D QC is 20 samples.

In Levels C and E, the optimum batch size is determined by the number of samples of similar matrix which can be processed simultaneously through the entire preparation and analysis process. For example, if 5 samples can be extracted and 20 analyzed by the instrument, the batch size is 5. Once this is determined, it is used with the blank/spike control program in the following manner.

In Levels C and E, a blank/spike control shall be analyzed with each batch and shall be plotted on control charts as described in Sect. 4.4. For metals, anions, and other wet chemical analysis, a method blank shall also be processed with each batch and shall contain less than the method detection limit for compounds of interest. In any method using surrogates spiked into the blank, the blank shall serve as both the method blank

Table 7.1. List of approved biological test procedures (40 CFR, Part 136, July 1, 1987)

Parameter and units	Method [1]	EPA [2]	Reference (Method Number or Page)		
			Standard Methods 15th Ed	ASTM	USGS
Bacteria					
1 Coliform (fecal) number per 100 ml	MPN, 5 tube, 3 dilution, or, membrane filter (MF) [4], single step	p 132	908C		
		p 124	909C		B-0050-77
2 Coliform (fecal) in presence of chlorine number per 100 ml	MPN, 5 tube, 3 dilution	p 132	908C		
3 Coliform (total) number per 100 ml	MPN, 5 tube, 3 dilution, or, MF [4] single step or two step	p 114	908A		
		p 108	909A		B-0025-77
4 Coliform (total) in presence of chlorine, number per 100 ml	MPN, 5 tube, dilution, or MF [4] with enrichment	p 114	908A		
		p 111	909 (A→A.5c)		
5 Fecal streptococci, number per 100 ml	MPN, 5 tube, 3 dilution, MF [4], or, plate count	p 139	910A		
	p 136	910B		B0055-77 [5]	
	p 143	910C			

Table 1A Notes

[1] The method must be specified when results are reported

[2] "Microbiological Methods for Monitoring the Environment Water and Wates, 1978", EPA-600/8-78-017, U.S Environmental Protection Agency

[3] Greeson, P.E., *et al*, Methods for Collection and Analysis of Aquatic Biological and Microbiological Samples, "U.S Geological Survey, Techniques of Water-Resources Investigations, Book 5 Chapter A4, Laboratory Analysis, 1977

[4] 0.45 um membrane filter or other pore size certified by the manufacturer to fully retain organisms to be cultivated, and free of extractables which could interfere with their growth and development

[5] Approved only if dissolution of the KF Streptococcus Agar (Section 5.1, USGS Method B-0055-77) is made in a boiling water bath to avoid scorching of the medium

Table 7.2. List of approved inorganic test procedures
(40 CFR, Part 136, July 1, 1987)

Parameter and Units	Method	Reference (Method No. or Page)				
		EPA 1979	Std. Methods 16th Ed.	ASTM	USGS[1]	Other
1. Acidity, as $CaCO_3$ mg/L	Electrometric end point or phenolphthalein end point.	305.1	402(4.a)	D1067-82(E)	—	
2. Alkalinity, as $CaCO_3$, mg/L	Electrometric or colorimetric titration to pH 4.5, manual, or	310.1	403	D1067-82(B)	I-1030-84	33.014[2]
	Automated.	310.2	—	—	I-2030-84	
3. Aluminum—Total[3] mg/L	Digestion[3] followed by AA direct aspiration,	202.1	303C	—	I-3051-84	
	AA furnace,	202.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Eriochrome cyanine R).	—	306B	—	—	
4. Ammonia (as N), mg/L	Manual distillation (at pH 9.5)[5], followed by	350.2	417A	—	—	33.057[3]
	Nesslerization,	350.2	417B	D1426-79(A)	I-3520-84	33.057[3]
	Titration,	350.2	417D	—	—	
	Electrode,	350.3	417E or F	D1426-79(D)	—	
	Automated phenate or	350.1	417G	D1426-79(C)	I-4523-84	
	Automated electrode.	—	—	—	—	Note 6
5. Antimony—Total[3], mg/L	Digestion[3] followed by AA direct aspiration,	204.1	303A	—	—	
	AA furnace, or	204.2	304	—	—	
	Inductively coupled plasma	—	—	—	—	200.7[4]
6. Arsenic—Total[3], mg/L	Digestion[3] followed by	206.5	—	—	—	
	AA gaseous hydride,	206.3	303E	D2972-84(B)	I-3062-84	
	AA furnace,	206.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (SDDC)	206.4	307B	D2972-84(A)	I-3060-84	
7. Barium—Total[3], mg/L	Digestion[3] followed by AA direct aspiration,	208.1	303C	—	I-3084-84	
	AA furnace, or	208.2	304	—	—	
	Inductively coupled plasma	—	—	—	—	200.7[4]
8. Beryllium—Total[3], mg/L	Digestion[3] followed by AA direct aspiration,	210.1	303C	D3654-84(A)	I-3095-84	
	AA furnace,	210.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (aluminon).	—	309B	—	—	
9. Biochemical oxygen demand (BOD_5), mg/L	Dissolved Oxygen Depletion.	405.1	507	—	I-1578-78[7]	33.019[2], p.17[8]
10. Boron—Total, mg/L	Colorimetric (curcumin), or	212.3	404A	—	I-3112-84	
	Inductively Coupled plasma.	—	—	—	—	200.7[4]
11. Bromide, mg/L	Titrimetric.	320.1	—	D1246-82(C)	I-1125-84	p.S44[9]

Table 7.2. (continued)

Parameter and Units	Method	Reference (Method No. or Page) EPA 1979	Std. Methods 16th Ed.	ASTM	USGS[1]	Other
12. Cadmium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration.	213.1	303A or B	D3557-84(A or B)	I-3135-84 or I-3136-84	33.089[2], p.37[9]
	AA furnace.	213.2	304	—	—	
	Inductively coupled plasma.	—	—	—	—	200.7[4]
	Voltametry[10], or	—	—	D3557-84(C)	—	
	Colorimetric (Dithizone).	—	310B	—	—	
13. Calcium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration.	215.1	303A	D511-84(B)	I-3152-84	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Titrimetric (EDTA).	215.2	311C	D511-84(A)	—	
14. Carbonaceous biochemical oxygen demand ($CBOD_5$), mg/L[11]	Dissolved Oxygen Depletion with nitrification inhibitor.	—	507(5.e.6)	—	—	
15. Chemical oxygen demand (COD), mg/L	Titrimetric, or.	410.1, 410.2, or 410.3	508A	D1252-83	I-3560-84 or I-3562-84	33.034[2], p.17[9]
	Spectrophotometric, manual or automated.	410.4	—	—	I-3561-84	Notes 12 or 13
16. Chloride, mg/L	Titrimetric (silver nitrate)	—	407A	D512-81(B)	I-1183-84	
	or (Mercuric nitrate), or	325.3	407B	D512-81(A)	I-1184-84	33.067[2]
	Colorimetric, manual or	—	—	D512-81(C)	I-1187-84	
	Automated (ferricyanide).	325.1, or 325.2	407D	—	I-2187-84	
17. Chlorine—Total residual, mg/L	Titrimetric					
	Amperometric direct.	330.1	408C	D1253-76(A)	—	
	Starch end point direct.	330.3	408A	D1253-76(B)	—	
				Part 18.3		
	Back titration either end point[14], or	330.2	408B	—		
	DPD-FAS;	330.4	408D	—	—	
	Spectrophotometric, DPD,	330.5	408E	—	—	
	or Electrode.	—	—	—	—	Note 15
18. Chromium VI dissolved, mg/L	0.45 micron filtration followed by					
	AA chelation-extraction,	218.4	303B	—	I-1232-84	
	or Colorimetric (Diphenylcarbazide).	—	—	—	I-1230-84	307B[16]
19. Chromium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration.	218.1	303A	D1687-84(D)	I-3236-84	33.089[2]
	AA chelation—extraction.	218.3	303B	—	—	
	AA furnace.	218.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Diphenylcarbazide).	—	312B	D1687-84(A)	—	
20. Cobalt—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration.	219.1	303A or B	D3558-84(A or B)	I-3239-84 or I-3240-84	p.37[9]
	AA furnace, or	219.2	304	—	—	
	Inductively coupled plasma	—	—	—	—	200.7[4]

Table 7.2. (continued)

Parameter and Units	Method	Reference (Method No or Page) EPA 1979	Std. Methods 16th Ed.	ASTM	USGS[1]	Other
21. Color, platinum cobalt units or dominant wavelength, hue, luminance, purity.	Colorimetric (ADMI), or	110.1	204D	—	—	Note 17
	(Platinum cobalt), or	110.2	204A	—	I-1250-84	
	Spectrophotometric.	110.3	204B	—	—	
22. Copper—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	220.1	303A or B	D1688-84(D or E)	I-3270-84 or I-3271-84	33.089[2], p.37[6]
	AA furnace,	220.2	304	—	—	
	Inductively coupled plasma,	—	—	—	—	200.7[4]
	Colorimetric (Neocuproine), or	—	313B	D1688-84(A)	—	
	(Bicinchoninate).	—	—	—	—	Note 18
23. Cyanide—Total, mg/L	Manual distillation with $MgCl_2$ followed by	—	412B	—	—	
	Titrimetric, or	—	412C	—	—	p.22[6]
	Spectrophotometric, manual or	335.2	412D	D2036-82(A)	I-3300-84	
	Automated.[19]	335.3	—	D2036-82(A)	—	
24. Cyanide amenable to chlorination, mg/L	Manual distillation with $MgCl_2$ followed by titrimetric or spectrophotometric	335.1	412F	D2036-82(B)	—	
25. Fluoride—Total, mg/L	Manual distillation[6] followed by	—	413A	—	—	
	Electrode, manual or	340.2	413B	D1179-80(B)	—	
	Automated,	—	—	—	I-4327-84	
	Colorimetric (SPADNS), or Automated	340.1	413C	D1179-80(A)	—	
	complexone.	340.3	413E	—	—	
26. Gold—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	231.1	303A	—	—	
	AA furnace.	231.2	304	—	—	
27. Hardness—Total, as $CaCO_3$, mg/L	Automated colorimetric,	130.1	—	—	—	
	Titrimetric (EDTA), or	130.2	314B	D1126-80	I-1338-84	33.082[2]
	Ca plus Mg as their carbonates, by inductively coupled plasma or AA direct aspiration. (See Parameters 13 and 33.)					
28. Hydrogen ion (pH), pH units	Electrometric, measurement, or	150.1	423	D1293-84(A or B)	I-1586-84	33.006[2]
	Automated electrode.	—	—	—	—	Note 20
29. Iridium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	235.1	303A	—	—	
	AA furnace.	235.2	304	—	—	
30. Iron—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	236.1	303A or B	D1068-84(C or D)	I-3381-84	33.089[2]
	AA furnace,	236.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Phenanthroline).	—	315B	D1068-84(A)	—	Note 21

Table 7.2. (continued)

Parameter and Units	Method	Reference (Method No. or Page) EPA 1979	Std. Methods 16th Ed.	ASTM	USGS[1]	Other
31. Kjeldahl nitrogen—Total, (as N), mg/L	Digestion and distillation followed by	351.3	420A or B	D3590-84(A)	—	
	Titration,	351.3	417D	D3590-84(A)	—	33.051[3]
	Nesslerization,	351.3	417B	D3590-84(A)	—	
	Electrode,	351.3	417E or F	—	—	
	Automated phenate,	351.1	—	—	I-4551-78[7]	
	Semi-automated block digestor, or	351.2	—	D3590-84(A)	—	
	Potentiometric.	351.4	—	D3590-84(A)	—	
32. Lead—Total[2], mg/L	Digestion[2] followed by					
	AA direct aspiration,	239.1	303A or B	D3559-85(A or B)	I-3399-84	33.089[3]
	AA furnace,	239.2	304	—	—	
	Inductively coupled plasma,	—	—	—	—	200.7[4]
	Voltametry[10], or	—	—	D3559-85(C)	—	
	Colorimetric (Dithizone).	—	316B	—	—	
33. Magnesium—Total[2], mg/L	Digestion[2] followed by					
	AA direct aspiration,	242.1	303A	D511-84(B)	I-3447-84	33.089[3]
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Gravimetric	—	318B	D511-77(A)	—	
34. Manganese—Total[2], mg/L	Digestion[2] followed by					
	AA direct aspiration,	243.1	303A or B	D858-84(B or C)	I-3454-84	33.089[3]
	AA furnace,	243.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Persulfate), or	—	319B	D858-84(A)	—	33.126[3]
	(Periodate)	—	—	—	—	Note 22
35. Mercury—Total[2], mg/L	Cold vapor, manual or	245.1	303F	D3223-80	I-3462-84	33.095[3]
	Automated.	245.2	—	—	—	
36. Molybdenum—Total[2], mg/L	Digestion[2] followed by					
	AA direct aspiration,	246.1	303C	—	I-3490-84	
	AA furnace, or	246.2	304	—	—	
	Inductively coupled plasma.	—	—	—	—	200.7[4]
37. Nickel—Total[2], mg/L	Digestion[2] followed by					
	AA direct aspiration,	249.1	303A or B	D1886-84(C or D)	I-3499-84	
	AA furnace,	249.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Heptoxime).	—	321B	—	—	
38. Nitrate (as N), mg/L	Colorimetric (Brucine sulfate), or	352.1	—	D992-71	—	33.063[3], 419D[16], p.28[9]
	Nitrate-nitrite N minus Nitrite N (See parameters 39 and 40).					
39. Nitrate-nitrite (as N), mg/L	Cadmium reduction,					
	Manual or	353.3	418C	D3867-85(B)	—	
	Automated, or	353.2	418F	D3867-85(A)	I-4545-84	
	Automated hydrazine.	353.1	—	—	—	

Table 7.2. (continued)

Parameter and Units	Method	Reference (Method No. or Page) EPA 1979	Std. Methods 16th Ed.	ASTM	USGS[1]	Other
40. Nitrite (as N), mg/L	Spectrophotometric,					
	Manual or	354.1	419	D1254-67	—	Note 24
	Automated (Diazotization).	—	—	—	I-4540-84	
41. Oil and grease—Total recoverable, mg/L	Gravimetric (extraction).	413.1	503A	—	—	
42. Organic carbon—Total (TOC), mg/L	Combustion or oxidation.	415.1	505	D2579-85(A or B)	—	33.044[2], p.4[23]
43. Organic nitrogen (as N) mg/L	Total Kjeldahl N (Parameter 31) minus ammonia N (Parameter 4.)					
44. Orthophosphate (as P), mg/L	Ascorbic acid method,					
	Automated or	365.1	424G	—	I-4601-84	33.116[2]
	Manual single reagent,	365.2	424F	D515-82(A)	—	33.111[2]
	or Manual two reagent.	365.3	—	—	—	
45. Osmium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	252.1	303C	—	—	
	AA furnace.	252.2	304	—	—	
46. Oxygen, dissolved, mg/L	Winkler (Azide modification), or	360.2	421B	D888-81(C)	I-1575-78[7]	33.028[2]
	Electrode.	360.1	421F	—	I-1576-78[7]	
47. Palladium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	253.1	—	—	—	p.S27[9]
	AA furnace.	253.2	—	—	—	p.S28[9]
48. Phenols, mg/L	Manual distillation[25] followed by	420.1	—	D1783-80(A or B)	—	Note 26
	Colorimetric (4AAP) manual, or	420.1	—	—	—	Note 26
	Automated[19].	420.2	—	—	—	
49. Phosphorus (elemental) mg/L	Gas-liquid chromatography.	—	—	—	—	Note 27
50. Phosphorus—Total, mg/L	Persulfate digestion followed by	365.2	424C(III)	—	—	33.111[2]
	Manual or	365.2 or 365.3	424F	D515-82(A)	—	
	Automated ascorbic acid reduction, or	365.1	424G	—	I-4600-84	33.116[2]
	Semi-automated block digestor.	365.4	—	—	—	
51. Platinum—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	255.1	303A	—	—	
	AA furnace.	255.2	304	—	—	
52. Potassium—total[3], mg/L	Digestion followed by					
	AA direct aspiration,	258.1	303A	—	I-3630-84	33.103[2]
	Inductively coupled plasma	—	—	—	—	200.7[4]
	Flame photometric, or	—	322B	D1428-82(A)	—	
	Colorimetric (Cobaltinitrate).	—	—	—	—	317B[14]

Table 7.2. (continued)

Parameter and Units	Method	Reference (Method No or Page) EPA 1979	Std. Methods 18th Ed.	ASTM	USGS[1]	Other
53. Residue—Total, mg/L	Gravimetric, 103-105°C.	160.3	209A	—	I-3750-84	
54. Residue—filterable, mg/L	Gravimetric, 180°C.	160.1	209B	—	I-1750-84	
55. Residue—nonfilterable, (TSS), mg/L	Gravimetric, 103-105°C post washing of residue.	160.2	209C	—	I-3765-84	
56. Residue—settleable, mg/L	Volumetric (Imhoff cone) or gravimetric.	160.5	209E	—	—	
57. Residue—volatile, mg/L	Gravimetric, 550°C.	160.4	209D	—	I-3753-84	
58. Rhodium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	265.1	303A	—	—	
	AA furnace.	265.2	304	—	—	
59. Ruthenium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	267.1	303A	—	—	
	AA furnace.	267.2	304	—	—	
60. Selenium—Total[3], mg/L	Digestion[3] followed by					
	AA furnace,	270.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	AA gaseous hydride.	270.3	303E	D3859-84(A)	I-3667-84	
61. Silica—Dissolved, mg/L	0.45 micron filtration followed by					
	Colorimetric, Manual or	370.1	425C	D859-80(B)	I-1700-84	
	Automated (Molybdosilicate), or	—	—	—	I-2700-84	
	Inductively coupled plasma.	—	—	—	—	200.7[4]
62. Silver—Total[3,6], mg/L	Digestion[3] followed by					
	AA direct aspiration,	272.1	303A or B	—	I-3720-84	33.089[2], p.37[8]
	AA furnace,	272.2	304	—	—	
	Colorimetric (Dithizone), or	—	—	—	—	3198[15]
	Inductively coupled plasma.	—	—	—	—	200.7[4]
63. Sodium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	273.1	303A	—	I-3735-84	33.107[2]
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Flame photometric.	—	325B	D1428-82(A)	—	
64. Specific conductance, micromhos/cm at 25°C	Wheatstone bridge.	120.1	205	D1125-82(A)	I-1780-84	33.002[2]
65. Sulfate (as SO_4), mg/L	Automated colorimetric (barium chloranilate),	375.1	—	—	—	
	Gravimetric, or	375.3	426A or B	D516-82(A)	—	33.124[2]
	Turbidimetric.	375.4	—	D516-82(B)	—	426C[29]

Table 7.2. (continued)

Parameter and Units	Method	Reference (Method No. or Page)				
		EPA 1979	Std. Methods 16th Ed.	ASTM	USGS[1]	Other
66. Sulfide (as S), mg/L	Titrimetric (iodine) or	376.1	427D	—	I-3840-84	228A[30]
	Colorimetric (methylene blue).	376.2	427C	—	—	
67. Sulfite (as SO_3), mg/L	Titrimetric (iodine-iodate).	377.1	428A	D1339-84(C)	—	
68. Surfactants, mg/L	Colorimetric (methylene blue).	425.1	512B	D2330-82(A)	—	
69. Temperature, °C.	Thermometric.	170.1	212	—	—	Note 31
70. Thallium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	279.1	303A	—	—	
	AA furnace, or	279.2	304	—	—	
	Inductively coupled plasma	—	—	—	—	200.7[4]
71. Tin—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	282.1	303A	—	I-3850-78[7]	
	AA furnace.	282.2	304	—	—	
72. Titanium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	283.1	303C	—	—	
	AA furnace.	283.2	304	—	—	
73. Turbidity, NTU	Nephelometric.	180.1	214A	D1889-81	I-3860-84	
74. Vanadium, Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	286.1	303C	—	—	
	AA furnace,	286.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Gallic acid).	—	327B	D3373-84(A)	—	
75. Zinc—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	289.1	303A or B	D1691-84(C or D)	I-3900-84	33.089[3], p.37[9]
	AA furnace,	289.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Dithizone) or	—	328C	—	—	
	(Zincon).	—	—	—	—	Note 32

[1]"Methods for Analysis of Inorganic Substances in Water and Fluvial Sediments," U.S. Department of the Interior, U.S. Geological Survey, Open-File Report 85-495, 1986, unless otherwise stated.

[2]"Official Methods of Analysis of the Association of Official Analytical Chemists," methods manual, 14th ed. (1985).

[3]For the determination of total metals the sample is not filtered before processing. A digestion procedure is required to solubilize suspended material and to destroy possible organic-metal complexes. Two digestion procedures are given in "Methods for Chemical Analysis of Water and Wastes, 1979." One (Section 4.1.3), is a vigorous digestion using nitric acid. A less vigorous digestion using nitric and hydrochloric acids (Section 4.1.4) is preferred; however, the analyst should be cautioned that this mild digestion may not suffice for all sample types. Particularly, *if a colorimetric procedure is to be employed, it is necessary to ensure that all organo-metallic bonds be broken so that the metal* is in a reactive state. In those situations, the vigorous digestion is to be preferred making certain that at no time does the sample go to dryness. Samples containing large amounts of organic materials would also benefit by this vigorous digestion. Use of the graphite furnace technique, inductively coupled plasma, as well as determinations for certain elements such as arsenic, the noble metals, mercury, selenium, and titanium require a modified digestion and in all cases the method write-up should be consulted for specific instruction and/or cautions.

NOTE: If the digestion included in one of the other approved references is different than the above, the EPA procedure must be used.

Dissolved metals are defined as those constituents which will pass through a 0.45 micron membrane filter. Following filtration of the sample, the *referenced procedure for total metals must be followed. Sample digestion for dissolved metals may be omitted for AA (direct aspiration or* graphite furnace) and ICP analyses provided the sample solution to be analyzed meets the following criteria:

Table 7.2. (continued)

a. has a low COD (<20)
b. is visibly transparent with a turbidity measurement of 1 NTU or less,
c. is colorless with no perceptable odor, and
d. is of one liquid phase and free of particulate or suspended matter following acidification.

[4]The full text of Method 200.7, "Inductively Coupled Plasma Atomic Emission Spectrometric Method for Trace Element Analysis of Water and Wastes," is given at Appendix C of this Part 136.

[5]Manual distillation is not required if comparability data on representative effluent samples are on company file to show that this preliminary distillation step is not necessary, however, manual distillation will be required to resolve any controversies.

[6]Ammonia, Automated Electrode Method, Industrial Method Number 379-75 WE, dated February 19, 1976, Technicon AutoAnalyzer II, Technicon Industrial Systems, Tarrytown, NY, 10591.

[7]The approved method is that cited in "Methods for Determination of Inorganic Substances in Water and Fluvial Sediments,"USGS TWRI, Book 5, Chapter A1 (1979).

[8]American National Standard on Photographic Processing Effluents, Apr. 2, 1975. Available from ANSI, 1430 Broadway, New York, NY 10018.

[9]"Selected Analytical Methods Approved and Cited by the United States Environmental Protection Agency," Supplement to the Fifteenth Edition of *Standard Methods for the Examination of Water and Wastewater* (1981).

[10]The use of normal and differential pulse voltage ramps to increase sensitivity and resolution is acceptable.

[11]Carbonaceous biochemical oxygen demand ($CBOD_5$) must not be confused with the traditional BOD_5 test which measures "total BOD." The addition of the nitrification inhibitor is not a procedural option, but must be included to report the $CBOD_5$ parameter. A discharger whose permit requires reporting the traditional BOD_5 may not use a nitrification inhibitor in the procedure for reporting the results. Only when a discharger's permit specifically states $CBOD_5$ is required, can the permittee report data using the nitrification inhibitor.

[12]OIC Chemical Oxygen Demand Method, Oceanography International Corporation, 512 West Loop, P.O. Box 2980, College Station, TX 77840.

[13]Chemical Oxygen Demand, Method 8000, Hach Handbook of Water Analysis, 1979, Hach Chemical Company, P.O. Box 389, Loveland, CO 80537

[14]The back titration method will be used to resolve controversy.

[15]Orion Research Instruction Manual, Residual Chlorine Electrode Model 97-70, 1977, Orion Research Incorporated, 840 Memorial Drive, Cambridge, MA 02138.

[16]The approved method is that cited in *Standard Methods for the Examination of Water and Wastewater*, 14th Edition, 1976.

[17]National Council of the Paper Industry for Air and Stream Improvement, (Inc.) Technical Bulletin 253, December 1971.

[18]Copper, Biocinchoinate Method, Method 8506, Hach Handbook of Water Analysis, 1979, Hach Chemical Company, P.O. Box 389, Loveland, CO 80537.

[19]After the manual distillation is completed, the autoanalyzer manifolds in EPA Methods 335.3 (cyanide) or 420.2 (phenols) are simplified by connecting the re-sample line directly to the sampler. When using the manifold setup shown in Method 335.3, the buffer 6.2 should be replaced with the buffer 7.6 found in Method 335.2.

[20]Hydrogen Ion (pH) Automated Electrode Method, Industrial Method Number 378-75WA, October 1976, Technicon Auto-Analyzer II, Technicon Industrial Systems, Tarrytown, NY 10591.

[21]Iron, 1,10-Phenanthroline Method, Method 8008, 1980, Hach Chemical Company, P.O. Box 389, Loveland, CO 80537.

[22]Manganese, Periodate Oxidation Method, Method 8034, Hach Handbook of Wastewater Analysis, 1979, pages 2-113 and 2-117, Hach Chemical Company, Loveland, CO 80537.

[23]Goerlitz, D., Brown, E., "Methods for Analysis of Organic Substances in Water," U.S. Geological Survey Techniques of Water-Resources Inv., book 5, ch. A3, page 4 (1972).

[24]Nitrogen, Nitrite, Method 8507, Hach Chemical Company, P.O. Box 389, Loveland, CO 80537.

[25]Just prior to distillation, adjust the sulfuric-acid-preserved sample to pH 4 with 1 + 9 NaOH.

[26]The approved method is that cited in *Standard Methods for the Examination of Water and Wastewater*, 14th Edition. The colorimetric reaction is conducted at a pH of 10.0 ± 0.2. The approved methods are given on pp. 576-81 of the 14th Edition: Method 510A for distillation, Method 510B for the manual colorimetric procedure, or Method 510C for the manual spectrophotometric procedure.

[27]R. F. Addison and R. G. Ackman, "Direct Determination of Elemental Phosphorus by Gas-Liquid Chromatography," *Journal of Chromatography*, vol. 47, No. 3, pp. 421-426, 1970.

[28]Approved methods for the analysis of silver in industrial wastewaters at concentrations of 1 mg/L and above are inadequate where silver exists as an inorganic halide. Silver halides such as the bromide and chloride are relatively insoluble in reagents such as nitric acid but are readily soluble in an aqueous buffer of sodium thiosulfate and sodium hydroxide to a pH of 12. Therefore, for levels of silver above 1 mg/L, 20 mL of sample should be diluted to 100 mL by adding 40 mL each of 2 M $Na_2S_2O_3$ and 2M NaOH. Standards should be prepared in the same manner. For levels of silver below 1 mg/L the approved method is satisfactory.

[29]The approved method is that cited in *Standard Methods for the Examination of Water and Wastewater*, 15th Edition.

[30]The approved method is that cited in *Standard Methods for the Examination of Water and Wastewater*, 13th Edition.

[31]Stevens, H. H., Ficke, J. F., and Smoot, G. F., "Water Temperature—Influential Factors, Field Measurement and Data Presentation," U.S. Geological Survey, Techniques of Water Resources Investigations, Book 1, Chapter D1, 1975.

[32]Zinc, Zincon Method, Method 8009, Hach Handbook of Water Analysis, 1979, pages 2-231 and 2-333, Hach Chemical Company, Loveland, CO 80537.

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Table 7.3. List of approved test procedures for nonpesticide organic compounds (40 CFR, Part 136, July 1, 1987)

Parameter [1]	EPA Method Number [2,7]			Other
	GC	GC/MS	HPLC	
1 Acenaphthene	610	625, 1625	610	
2. Acenaphthylene	610	625, 1625	610	
3 Acrolein	603	[4]624, 1624		
4 Acrylonitrile	603	[4]624, 1624		
5 Anthracene	610	625, 1625	610	
6 Benzene	602	624, 1624		
7 Benzidine		[5]625, 1625	605	Note 3, p. 1;
8 Benzo(a)anthracene	610	625, 1625	610	
9 Benzo(a)pyrene	610	625, 1625	610	
10 Benzo(b)fluoranthene	610	625, 1625	610	
11 Benzo(ghi)perylene	610	625, 1625	610	
12 Benzo(k)fluoranthene	610	625, 1625	610	
13 Benzyl Chloride				Note 3, p. 130; Note 6, p. S102.
14 Benzyl Butyl Phthalate	606	625, 1625		
15 Bis(2-chloroethoxy) methane	611	625, 1625		
16 Bis(2-chloroethyl) ether	611	625, 1625		
17 Bis(2-ethylhexyl) phthalate	606	625, 1625		
18 Bromodichloromethane	601	624, 1624		
19 Bromoform	601	624, 1624		
20. Bromomethane	601	624, 1624		
21. 4-Bromophenylphenyl ether	611	625, 1625		
22 Carbon tetrachloride	601	624, 1624		Note 3, p. 130;
23 4-Chloro-3-methylphenol	604	625, 1625		
24 Chlorobenzene	601, 602	624, 1624		Note 3, p. 130
25 Chloroethane	601	624, 1624		
26. 2-Chloroethylvinyl ether	601	624, 1624		
27 Chloroform	601	624, 1624		Note 3, p. 130;
28 Chloromethane	601	624, 1624		
29 2-Chloronaphthalene	612	625, 1625		
30 2-Chlorophenol	604	625, 1625		
31 4-Chlorophenylphenyl ether	611	625, 1625		
32 Chrysene	610	625, 1625	610	
33 Dibenzo(a,h)anthracene	610	625, 1625	610	
34 Dibromochloromethane	601	624, 1624		
35. 1,2-Dichlorobenzene	601, 602, 612	624, 625, 1625		
36. 1,3-Dichlorobenzene	601, 602, 612	624, 625, 1625		
37 1,4-Dichlorobenzene	601, 602, 612	625, 1624, 1625		
38 3,3 -Dichlorobenzidine		625, 1625	605	
39 Dichlorodifluoromethane	601			
40 1,1-Dichloroethane	601	624, 1624		
41 1,2-Dichloroethane	601	624, 1624		
42. 1,1-Dichloroethene	601	624, 1624		
43. trans-1,2-Dichloroethene	601	624, 1624		
44 2,4-Dichlorophenol	604	625, 1625		
45 1,2-Dichloropropane	601	624, 1624		
46 cis-1,3-Dichloropropene	601	624, 1624		
47 trans-1,3-Dichloropropene	601	624, 1624		
48 Diethyl phthalate	606	625, 1625		
49. 2,4-Dimethylphenol	604	625, 1625		
50 Dimethyl phthalate	606	625, 1625		
51 Di-n-butyl phthalate	606	625, 1625		
52. Di-n-octyl phthalate	606	625, 1625		
53. 2,4-Dinitrophenol	604	625, 1625		
54. 2,4-Dinitrotoluene	609	625, 1625		
55. 2,6-Dinitrotoluene	609	625, 1625		
56. Epichlorohydrin				Note 3, p. 130; Note 6, p. S102.
57. Ethylbenzene	602	624, 1624		
58. Fluoranthene	610	625, 1625	610	
59. Fluorene	610	625, 1625	610	
60 Hexachlorobenzene	612	625, 1625		
61 Hexachlorobutadiene	612	625, 1625		
62. Hexachlorocyclopentadiene	612	[5]625, 1625		
63. Hexachloroethane	612	625, 1625		
64 Ideno(1,2,3-cd)pyrene	610	625, 1625	610	
65 Isophorone	609	625, 1625		
66 Methylene Chloride	601	624, 1624		Note 3, p. 130;
67. 2-Methyl-4,6-Dinitrophenol	604	625, 1625		
68 Naphthalene	610	625, 1625		
69 Nitrobenzene	609	625, 1625		
70. 2-Nitrophenol	604	625, 1625		
71. 4-Nitrophenol	604	625, 1625		
72. N-Nitrosodimethylamine	607	625, 1625		
73 N-Nitrosodi-n-propylamine	607	[5]625, 1625		
74. N-Nitrosodiphenylamine	607	[5]625, 1625		
75. 2,2-oxybis(1-chloropropane)	611	625, 1625		
76. PCB-1016	608		625,	Note 3, p. 43;
77. PCB-1221	608		625,	Note 3, p. 43;
78. PCB-1232	608		625,	Note 3, p. 43;
79 PCB-1242	608		625,	Note 3, p. 43;
80 PCB-1248	608		625,	Note 3, p. 43;
81. PCB-1254	608		625,	Note 3, p. 43;
82 PCB-1260	608		625,	Note 3, p. 43;
83. Pentachlorophenol	604	625, 1625		Note 3, p. 140;

Table 7.3. (continued)

Parameter [1]	EPA Method Number [2,3]			Other
	GC	GC/MS	HPLC	
84. Phenanthrene	610	625, 1625	610	
85. Phenol	604	625, 1625		
86. Pyrene	610	625, 1625	610	
87. 2,3,7,8-Tetrachlorodibenzo-p-dioxin		[8] 613		
88. 1,1,2,2-Tetrachloroethane	601	624, 1624		Note 3, p. 130.
89. Tetrachloroethene	601	624, 1624		Note 3, p. 130.
90. Toluene	602	624, 1624		
91. 1,2,4-Trichlorobenzene	612	625, 1625		Note 3, p. 130.
92. 1,1,1-Trichloroethane	601	624, 1624		
93. 1,1,2-Trichloroethane	601	624, 1624		Note 3, p. 130.
94. Trichloroethene	601	624, 1624		
95. Trichlorofluoromethane	601	624,		
96. 2,4,6-Trichlorophenol	604	625, 1625		
97. Vinyl Chloride	601	624, 1624		

Table IC Notes

[1] All parameters are expressed in micrograms per liter (µg/L)

[2] The full text of Methods 601–613, 624, 625, 1624, and 1625, are given at Appendix A, "Test Procedures for Analysis of Organic Pollutants," of this Part 136. The standardized test procedure to be used to determine the method detection limit (MDL) for these test procedures is given at Appendix B, "Definition and Procedure for the Determination of the Method Detection Limit," of this Part 136.

[3] "Methods for Benzidine, Chlorinated Organic Compounds, Pentachlorophenol and Pesticides in Water and Wastewater," U.S. Environmental Protection Agency, September, 1978.

[4] Method 624 may be extended to screen samples for Acrolein and Acrylonitrile. However, when they are known to be present, the preferred method for these two compounds is Method 603 or Method 1624.

[5] Method 625 may be extended to include benzidine, hexachlorocyclopentadiene, N-nitrosodimethylamine, and N-nitrosodiphenylamine. However, when they are known to be present, Methods 605, 607, and 612, or Method 1625, are preferred methods for these compounds.

[6] 625, Screening only.

[7] "Selected Analytical Methods Approved and Cited by the United States Environmental Protection Agency," Supplement to the Fifteenth Edition of *Standard Methods for the Examination of Water and Wastewater* (1981).

[8] Each analyst must make an initial, one-time, demonstration of their ability to generate acceptable precision and accuracy with Methods 601–613, 624, 625, 1624, and 1625 (See Appendix A of this Part 136) in accordance with procedures each in section 8.2 of each of these Methods. Additionally, each laboratory, on an on-going bases must spike and analyze 10% (5% for Methods 624 and 625 and 100% for methods 1624, and 1625) of all samples to monitor and evaluate laboratory data quality in accordance with sections 8.3 and 8.4 of these Methods. When the recovery of any parameter falls outside the warning limits, the analytical results for that parameter in the unspiked sample are suspect and cannot be reported to demonstrate regulatory compliance.

Note.—These warning limits are promulgated as an "interim final action with a request for comments."

Table 7.4. List of approved test procedures for pesticides[1]
(40 CFR, Part 136, July 1, 1987)

Parameter µg/L	Method	EPA[2,1]	Standard Methods 15th Ed	ASTM	Other
1. Aldrin	GC	608	509A	D3086	Note 3, p. 7, Note 4, p. 30.
	GC/MS	625			
2 Ametryn	GC				Note 3, p 83, Note 6, p S68
3 Aminocarb	TLC				Note 3, p. 94, Note 6, p. S16.
4 Atraton	GC				Note 3, p. 83, Note 6, p S68
5 Atrazine	GC				Note 3, p 83, Note 6, p S68
6 Azinphos methyl	GC				Note 3, p. 25; Note 6, p. S51.
7 Barban	TLC				Note 3, p. 104; Note 6, p. S64.
8. α-BHC	GC	608	509A	D3086	Note 3, p. 7.
	GC/MS	[3] 625			
9 β-BHC	GC	608		D3086	
	GC/MS	625			
10. δ-BHC	GC	608		D3086	
	GC/MS	[3] 625			
11 γ-BHC (Lindane)	GC	608	509A	D3086	Note 3, p. 7; Note 4, p. 30
	GC/MS	625			
12 Captan	GC		509A		Note 3, p 7
13 Carbaryl	TLC				Note 3, p. 94, Note 6, p S60
14 Carbophenothion	GC				Note 4, p 30, Note 6, p S73
15 Chlordane	GC	608	509A	D3086	Note 3, p. 7
	GC-MS	625			
16 Chloroprocham	TLC				Note 3, p 104, Note 6, p S64
17 2,4-D	GC		509B		Note 3, p 115, Note 4, p. 35.
18 4,4-DDD	GC	608	509A	D3086	Note 3, p. 7, Note 4, p. 30
	GC-MS	625			
19 4,4-DDE	GC	608	509A	D3086	Note 3, p 7, Note 4, p 30.
	GC/MS	625			
20 4,4'-DDT	GC	608	509A	D3086	Note 3, p 7; Note 4, p. 30.
	GC/MS	625			
21 Demeton-O	GC				Note 3, p. 25, Note 6, p S51
22 Dementon-S	GC				Note 3, p. 25, Note 6, p S51.
23 Diazinon	GC				Note 3, p. 25, Note 4, p 30; Note 6, p S51
24 Dicamba	GC				Note 3, p 115
25 Dichlofenthion	GC				Note 4, p 30; Note 6, p S73
26 Dichloran	GC		509A		Note 3, p 7
27 Dicofol	GC			D3086	
28 Dieldrin	GC	608	509A		Note 3, p 7, Note 4, p 30
	GC/MS	625			
29 Dioxathion	GC				Note 4, p. 30, Note 6, p S73
30 Disulfoton	GC				Note 3, p , Note 6, p S51
31 Diuron	TLC				Note 3, p 104, Note 6, p S64
32 Endosulfan I	GC	608	509A	D3086	Note 3, p 7
	GC/MS	[3] 625			
33 Endosulfan II	GC	608	509A	D3086	Note 3, p 7
	GC/MS	[3] 625			
34 Endosulfan sulfate	GC	608			
	GC/MS	625			
35 Endrin	GC	608	509A	D3086	Note 3, p 7, Note 4, p 30
	GC/MS	[3] 625			
36 Endrin aldehyde	GC	608			
	GC/MS	625			
37 Ethion	GC				Note 4, p. 30, Note 6, p S73
38 Fenuron	TLC				Note 3, p 104, Note 6, p S64
39 Fenuron-TCA	TLC				Note 3, p 104, Note 6, p S64
40 Heptachlor	GC	608	509A	D3086	Note 3, p. 7; Note 4, p 30.
	GC/MS	625			
41 Heptachlor epoxide	GC	608	509A	D3086	Note 3, p 7; Note 4, p 30, Note 6, p S73.
42 Isodrin	GC/MS	625			
	GC				Note 4, p 30; Note 6, p S73.
43. Linuron	TLC				Note 3, p. 104, Note 6, p S64
44 Malathion	GC		509A		Note 3, p. 25, Note 4, p. 30; Note 6, p S51.
45 Methiocarb	TLC				Note 3, p 94, Note 6, p S60
46 Methoxychlor	GC		509A	D3086	Note 3, p 7, Note 4, p. 30.
47 Mexacarbate	TLC				Note 3, p 94, Note 6, p S60.
48 Mirex	GC		509A		Note 3, p. 7
49 Monuron	TLC				Note 3, p 104, Note 6, p S64
50 Monuron-TCA	TLC				Note 3, p 104; Note 6, p S64.
51 Neburon	TLC				Note 3, p 104, Note 6, p S64.
52 Parathion methyl	GC		509A		Note 3, p 25, Note 4, p 30.
53 Parathion ethyl	GC		509A		Note 3, p. 25.
54 PCNB	GC		509A		Note 3, p 7.
55 Perthane	GC			D3086	
56 Prometon	GC				Note 3, p 83, Note 6, p S68.
57. Prometryn	GC				Note 3, p 83; Note 6, p S68.
58 Propazine	GC				Note 3, p 83; Note 6, p. S68.
59 Propham	TLC				Note 3, p 104, Note 6, p. S64.
60 Propoxur	TLC				Note 3, p 94, Note 6, p S60.
61 Secbumeton	TLC				Note 3, p 83, Note 6, p S68.
62 Siduron	TLC				Note 3, p 104; Note 6, p. S64.
63 Simazine	GC				Note 3, p 83, Note 6, p S68.
64 Strobane	GC		509A		Note 3, p. 7.

Table 7.4. (continued)

Parameter (µg/L)	Method	EPA[2,3]	Standard Methods 15th Ed	ASTM	Other
65 Swep	TLC				Note 3, p 104 Note 6, p S64
66 2,4,5-T	GC		509B		Note 3, p 115 Note 4, p 35
67 2,4,5-TP (Silvex)	GC		509B		Note 3, p 115
68 Terbuthylazine	GC				Note 3, p 83 Note 6, p S68
69 Toxaphene	GC	608	509A	D3086	Note 3, p 7, Note 4, p 30
	GC/MS	625			
70 Trifluralin	GC		509A		Note 3, p 7

Table ID Notes

[1] Pesticides are listed in this table by common name for the convenience of the reader. Additional pesticides may be found under Table IC, where entries are listed by chemical name.

[2] The full text of methods 608 and 625 are given at Appendix A, "Test Procedures for Analysis of Organic Pollutants" of this Part 136. The standardized test procedure to be used to determine the method detection limit (MDL) for these test procedures is given at Appendix B, "Definition and Procedure for the Determination of the Method Detection Limit", of this Part 136.

[3] "Methods for Benzidine, Chlorinated Organic Compounds, Pentachlorophenol and Pesticides in Water and Wastewater," U.S. Environmental Protection Agency, September, 1978. This EPA publication includes thin-layer chromatography (TLC) methods.

[4] "Methods for Analysis of Organic Substances in Water," U.S. Geological Survey, Techniques of Water-Resources Investigations, Book 5, Chapter A3 (1972).

[5] The method may be extended to include α-BHC, δ-BHC, endosulfan I, endosulfan II, and endrin. However, when they are known to exist, Method 608 is the preferred method.

[6] "Selected Analytical Methods Approved and Cited by the United States Environmental Protection Agency," Supplement to the Fifteenth Edition of *Standard Methods for the Examination of Water and Wastewater* (1981).

[7] Each analyst must make an initial, one-time, demonstration of their ability to generate acceptable precision and accuracy with Methods 608 and 625 (See Appendix A of this Part 136) in accordance with procedures given in Section 8.2 of each of these methods. Additionally, each laboratory, on an on-going basis, must spike and analyze 10% of all samples analyzed with Method 608 or 5% of all samples analyzed with Method 625 to monitor and evaluate laboratory data quality in accordance with Sections 8.3 and 8.4 of these methods. When the recovery of any parameter falls outside the warning limits, the analytical results for that parameter in the unspiked sample are suspect and cannot be reported to demonstrate regulatory compliance.

Note.—These warning limits are promulgated as an "interim final action with a request for comments."

Table 7.5. List of approved radiological test procedures (40 CFR, Part 136, July 1, 1987)

Parameter and units	Methods	EPA [1]	Reference (method No or page)		
			Standard Methods 15th Ed	ASTM	USGS [2]
1 Alpha-Total pCi per liter	Proportional or scintillation counter	900.0	703	D1943-86	pp 75 and 78 [3]
2 Alpha-Counting error, pCi per liter	Proportional or scintillation counter	Appendix B	703	D1943-86	p 79
3 Alpha-Counting error, pCi per liter	Proportional counter	900.0	703	D1890-66	pp 75 and 78 [3]
4 Beta-Counting error, pCi per liter	Proportional counter	Appendix B	703	D1890-66	p 79
5 (a) Radium-Total, pCi per liter	Proportional counter	903.0	705	D2460-70	
(b) ^{226}Ra, pCi per liter	Scintillation counter	903.1	706	D3454-79	p 81

Table IE Notes

[1] "Prescribed Procedures for Measurement of Radioactivity in Drinking Water." EPA-600/4-80-032 (1980 update). U.S. Environmental Protection Agency. August 1980

[2] Fishman, M.J. and Brown, Eugene. "Selected Methods of the U.S. Geological Survey of Analysis of Wastewaters." U.S. Geological Survey. Open-File Report 76-177 (1976)

[3] The method found on p. 75 measures only the dissolved portion while the method on p. 78 measures only the suspended portion. Therefore, the two results must be added to obtain the "total."

and blank/spike control. In methods not using surrogates such as metals, anions, and wet chemical analysis, a blank and a blank/spike (laboratory control sample) shall be analyzed. For pesticide/PCB methods, surrogates are often used. However, problems have been noted in surrogate recovery for the dibutyl chlorinate typically used. For pesticide/PCB analysis, a blank and a blank/spike shall be analyzed with each batch as separate samples. A pesticide or a PCB shall be used as the spiking compound.

In Level C, when performing analyses for petroleum hydrocarbons; oil and grease; anions such as nitrates, sulfates and chloride; and other wet chemical methods, a matrix spike and matrix spike duplicate are required for every 20 samples of similar matrix. Similar matrix is defined as either soil or water from the same military base.

All methods specified require calibration. In keeping with the method calibration requirements, the following requirements are presented. For all semivolatile and volatile analysis by GC/MS, the current CLP calibration method shall be used. The current CLP criteria shall be used for frequency of calibration, for the system performance check compounds (SPCCs), and for the calibration check compounds (CCCs).

For other methods, a minimum of three different concentration standards for each analyte shall be analyzed for initial calibration. Calibration shall be checked every 12 h of operation and prior to sample analysis. The laboratory shall use the calibration check acceptance criteria specified by the method. The daily calibration acceptance criteria to be used for each method shall be documented in the laboratory QA plan or in the site-specific QA plan. The initial calibration curve shall be plotted and the correlation coefficient and response factors evaluated. The laboratory shall indicate in the laboratory QA plan or in the site-specific QA plan the acceptance criteria to be used for the initial calibration curve. The calibration shall include one standard at a concentration at the method detection limits. The calibration curve shall bracket all samples in the concentration range. If the samples are not within the calibration range, appropriate dilution shall be performed to bring the samples into the calibration range. The aforementioned calibration requirements shall be used for Levels C and E.

In Level C, a matrix spike and matrix spike duplicate are required for volatiles, semivolatiles, and all GC analysis for every 20 samples of similar matrix. For metals analysis, a duplicate and a matrix spike are required for every 20 samples of similar matrix.

For all GC methods used in level C QC, second column confirmation shall be used for all positive responses for the analytes of interest. In Level E, second column confirmation is not required.

In Level E, no matrix spikes or duplicates are required; only the initial and continuing calibration, method blank, and blank/spike are required.

7.2 DELIVERABLES

For Level D QC, a CLP data package shall be delivered. This shall include the summary package and the remainder of the package, which includes initial and continuing calibration, matrix spikes, matrix spike duplicates, blanks, duplicates, surrogate recoveries, chromatograms, mass spectra, and absorbance data. For methods which are not defined by CLP, the calibration information, method blanks, blank/spikes, the chromatograms, absorbance, matrix spikes, and matrix spike duplicates shall be reported. The control charts plotted per Sect. 4 associated with the blank/spikes shall be presented with the data.

For Level C QC, the method blanks, blank/spike, surrogates, matrix spikes, matrix spike duplicates, duplicates, and initial and continuing calibration data shall be reported. Table 7.6 lists the required deliverables. The forms referred to in Table 7.6 are from the current CLP for organics and metals/cyanide. The form numbers will be upgraded as new revisions occur in the CLP, which require changes in form content or numbering.

In Level E, the only information to be submitted is the sample data, method blank data, and the control chart from the blank/spike.

The deliverables shall be presented to the NCR. The forms shall be used when reporting any data in the MPR and in submitting the final data package prior to its inclusion in the appendix and summary tables of the final report. The final data deliverables shall be presented to the NCR at least three weeks prior to issuing the draft of the final report.

7.3 DATA VALIDATION

7.3.1 Level D Validation

At a minimum, the data generated from Level D will be validated per the CLP criteria as outlined in the following documents.

EPA, Hazardous Site Control Division, *Laboratory Data Validation Functional Guidelines for Evaluating Pesticides/PCB's Analyses,* R-582-5-5-01, May 28, 1985.

EPA, Hazardous Site Control Division, *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses,* R-582-5-5-01, May 28, 1985.

EPA, Office of Emergency and Remedial Response, *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses,* 1985.

Table 7.6. Data set deliverables for Level C QA

	Method requirements	Deliverables
Organics	- Method blank spikes with results and control charts. Run with each batch of samples processed.	Control chart
	- Results to be reported on CLP Form 1 or spreadsheet per Sect. 9. Sample results using CLP data flags.	Form 1 or Sect. 9 1/Sample chromatograms/and mass spectra
	- Surrogate recovery from samples reported on CLP Form 2. Surrogates to be used in volatiles, semivolatiles, pesticides/PCB. For volatiles by GC, the names of surrogates should be changed to reflect the surrogate used.	Form 2
	- Matrix spike/spike duplicate 1 spike and spike duplicate per 20 samples of similar matrix reported on Form 3.	Form 3
	- Method blank reported on CLP Form 4.	Form 4 or Sect. 9
	For volatiles by GC, a similar format will be used as CLP Form 4 for blanks.	
	- GC/MS tuning for volatiles/semivolatiles. Report results on Form 5.	Form 5
	- Initial calibration data reported on Form 6.	Form 6
	For volatiles by GC, the initial calibration data with response factors must be reported.	No Form
	For pesticide/PCB data Form 9 must be used for calibration data.	Form 9
	- Continuing calibration GC/MS data reported on Form 7.	Form 7
	For volatiles, GC data, the response factors and their percent differences from the initial must be reported.	No Form
	Internal Standard Area for Volatiles and Semivolatiles.	Form 8

Table 7.6. (continued)

	Method requirements	Deliverables
Organics (cont'd)	- For pesticides/PCB data, the CLP Form 9 must be presented.	Form 9
	No chromatograms or mass spectra are presented for calibration. These data should be filed in the laboratory and available if problems arise in reviewing/validating the data. The calibration information should be available for checking during on-site audits.	
	- Internal standard area for GC/MS analyses CLP Form VIII shall be supplied.	
	- Second column confirmation shall be done for all GC work when compounds are detected above reporting limits. Chromatograms of confirmation must be provided.	Chromatograms
Metals	- Level C, requirements	Deliverables
	- Sample results with CLP flagging system	CLP Form 1 or Sect. 9
	- Initial and continuing calibration	CLP Form 2, Part 1 only
	- Blanks 10% frequency	Form 3
	- Method blank taken through digestion (1/20 samples of same matrix)	Form 3 or Sect. 9
	- ICP interference check sample	Form 4
	- Matrix spike recovery (1 per 20 samples of similar matrix)	Form 5, Part 1
	- Postdigestion spike sample recovery for ICP metals. Only done if predigest spike recovery exceed CLP limits.	Form 5, Part 2 (never used for GFAA work)
	- Postdigest spike for GFAA	Recovery will be noted on raw data
	- Duplicates (1 per 20 samples will be split and digested as separate	Form 6 samples

Table 7.6. (continued)

	Method requirements	Deliverables
Metals (cont'd)	- Method blank spike information will be plotted on control chart, one per batch of samples processed.	Control chart
	- Standard addition. The decision process outlined in CLP page E-3 will be used to determine when standard additions are required.	Form 8
	Holding times	Form 10
Wet Chemistry	Level C	
	- Blank spike 1/batch	Control chart
	- Method Blank 1/batch	Report result No format
	- Sample results	Report result No format
	- Matrix spike/spike duplicate or calibration information	Report result if applicable
	- Calibration check report percent RSD or percent difference from initial calibration	Report percent or percent difference
		No format

7.3.2 Level C Data Validation Guidelines

Listed below are the validation criteria which will be utilized in evaluating the analytical data for a Level C QC site. For methods not listed here, a similar procedure will be submitted by the prime contractor and the laboratory which outlines validation of the holding times, initial calibration, continuing calibration, and blank-vs-sample results. The validation procedure will be approved by the NCR.

1. For Petroleum Hydrocarbons (418.1/SW-3540, EPA 418.1)

   Holding Times - Holding times are 28 days for water samples which are preserved and refrigerated. No holding times are cited for soils.

Calibration - Ensure that a three-to-five point curve bracketing the sample concentration is performed daily.

Blanks - A blank should be run with each batch. If the blank concentration exceeds the reporting limit, the reporting limit shall be raised and the data flagged as estimated (UJ).

2. Target Compound List (TCL) for VOAs (CLP Methods)

Holding Times - Samples must be analyzed within the holding times specified in Sect. 3 or the data should be marked as estimated (J).

GC/MS Tuning - Check that bromofluorobenzene tune is completed each 12-h shift of operation. Check that it meets the CLP criteria. Assure that each sample is associated with a tune.

Initial Calibration - The maximum relative standard deviation [(RSD) percent RSD] shall not be >30% for indicted CLP CCC. The maximum mean relative response factor (RRF) for SPCC shall be >0.300 (0.250 for bromoform). The SPCCs are chloromethane, 1,1-dichloroethane, bromoform, 1,1,2,2-tetrachloroethane, and chlorobenzene. The CCC compounds are vinyl chloride, 1,1-dichloroethene, chloroform, 1,2-dichloropropane, toluene, and ethylbenzene.

Continuing Calibration - The minimum response factor for the SPCC components for VOAs analyses shall not be <0.300 (0.250 for bromoform). The maximum response factor percent deviation for indicated CLP CCC components from the mean initial calibration response factor shall not exceed 25%. If these criteria are exceeded, a new calibration for the compound shall be employed.

Blank/Spike Control Samples - Any control sample which exceeds the internal QC limits set by the laboratory for a given sample matrix shall require all data from the associated batch of samples to be closely inspected. If no analytical problems are found, the data analyzed with the out-of-control point shall be discussed in the QC section of the MPR and final report. If problems are found in the analytical data, the samples associated with the batch shall be reanalyzed and the data from reanalysis reported. If holding times are exceeded in the reanalysis, both sets of data shall be presented.

If the blank/spike results are outside the internal laboratory limits and if the matrix spike results are outside the CLP limits, the laboratory will either reanalyze the samples within the holding times or the data will be flagged with an "R," and the data are not usable.

Surrogates - If surrogates exceed the CLP limits, the data shall be flagged that the surrogates exceeded limits.

Method Blanks - A method blank should be run each day following the Continuing Calibration Standard. Common laboratory solvents should not be found in the blank at levels over five times the detection

limits. Other compounds should not be found in the blank at levels exceeding the detection limits. If common contaminant compounds are detected in samples at a concentration of <10 times the concentration found in the blank, or other compounds at <5 times the concentration in the blank, report those compounds as not detected. Adjust the sample quantitation limit to the value reported in the samples and flag the limit as estimated (UJ).

Matrix Spike/Spike Duplicate - Ensure that 1 out of 20 samples has been spiked in duplicate. The recoveries shall meet the CLP criteria. If the recoveries do not meet the criteria, examine the blank spike data. If the blank spike data exceed the limits and the matrix spikes exceed limits, the data shall be flagged as unusable (R). If the blank spike data from the batch are satisfactory, the data is usable, and the low recovery is discussed in the final report QA/QC and in the QC report sent to the NCR.

Field Trip and Equipment Blanks - If contaminant analytes are detected in samples at concentrations of <5 times the concentration found in the highest associated blank, the results are considered suspect and are reported as estimated.

3. TCL Semivolatile Organics (CLP Methods)

Holding Times - Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction. Any samples which do not meet these requirements must be flagged as estimated.

GC/MS Tune - Make certain that a decafluorotriphenylphosphine tune is completed every 12 h of sample analysis, that each sample is associated with a tune, and that each tune meets CLP requirements. Data are not reported if the instrument does not meet tune.

Initial Calibration - Ensure that a 5-point curve has been completed. The RRF of the BNA compounds shall be a minimum of 0.050 for the SPCC listed in the current revision of the CLP. The maximum RSD for the CCC listed in the CLP procedure is 30.0%. The minimum RRF for the SPCC is 0.050, and the maximum percent difference for the CCC is 25%. If these limits are exceeded, a new calibration curve shall be generated.

Continuing Calibration - The continuing calibration check will be performed once every 12 h during operation. The minimum RRF for the SPCC is 0.05, and the maximum percent difference from the initial calibration shall not exceed 25% for the CCC. If these limits are exceeded, a new calibration curve shall be generated.

Blank/Spike Control Samples - Any control sample which exceeds the internal QC limits set by the laboratory for a given sample matrix shall require all data from the associated batch of samples to be closely inspected. If no analytical problems are found, the data and the out-of-control point shall be discussed in the QC section of

the report. If problems are found in the analytical data, the samples associated with the batch shall be reanalyzed and the data from reanalysis reported. If holding times are exceeded in the reanalysis, both sets of data shall be presented.

If the blank/spike results are outside the internal laboratory limits and if the matrix spike results are outside the CLP limits, the laboratory will either reanalyze the samples or the data will be flagged with an "R," and the data is not usable.

Surrogates - If surrogates exceed the CLP limits, the data shall be flagged that the surrogates exceeded limits.

Blanks - A method blank should be run each day following the Continuing Calibration Standard. Phthalate should not be found in the blank at levels over five times the detection limits. Other compounds should not be found in the blank at levels exceeding the detection limits. If common contaminant compounds are detected in samples at a concentration of <10 times the concentration found in the blank, or other compounds at <5 times the concentration in the blank, report those compounds as not detected. Adjust the sample quantitation limit to the value reported in the samples and flag the limit as estimated (UJ).

Matrix Spike/Spike Duplicate - Ensure that 1 out of 20 samples has been spiked in duplicate. The recoveries should meet the CLP criteria. If the recoveries do not meet the criteria, examine the blank spike data. If the blank spike data exceed the limits and the matrix spikes exceed limits, the data shall be flagged as unusable (R). If the blanks spike data from the batch is satisfactory, the data are usable, and the low recovery is discussed in the final QC report sent to the Analytical Environmental Support Section.

4. Metals

Holding Times - Samples must be analyzed within six months, except mercury shall be analyzed in 28 days from sample collection.

ICP Initial Calibration - A calibration blank and at least one standard must be analyzed daily. An initial calibration verification standard must be within 90 to 110% recovery or the samples should be reanalyzed. If it is not possible to perform reanalysis, the data are rejected and flagged with an "R."

AA Calibration - Calibration blank and at least three standards shall be used in establishing the curve prior to sample analysis. A curve shall be analyzed each day prior to sample analysis.

Calibration Verification - Verification using a standard obtained from a source other than that of the initial calibration shall be used and the result shall be within 90 to 110% of the true value for

both ICP and AA work. Calibration verification shall be done at a minimum frequency of 10% or every 2 h, whichever is more frequent, and shall be done at the end of the analytical run.

Method Blanks - At least one preparation blank shall be prepared with each batch of samples. The blanks shall contain less than the detection limit for all analytes. If the concentration of the associated blanks is above the detection limit and if the lowest analyte concentration is <10 times the blank, reanalysis of the sample must occur. If reanalysis is not done, the data shall be reported and flagged as estimated. The blank shall never be subtracted from the sample.

Field and Equipment Blanks - If contaminant analytes are detected in samples at concentrations of <5 times the concentration found in the highest associated blank, the results are considered suspect and are reported as estimated.

Blank/Spike Laboratory Control Samples - Any laboratory control sample which exceeds the internal QC limits set by the laboratory for a given sample matrix shall require all data from the associated batch of samples to be closely inspected. If no analytical problems are found, the data and out-of-control point shall be discussed in the QC section of the report. If problems are found in the analytical data, the samples associated with the batch shall be reanalyzed and the data from reanalysis reported. If holding times are exceeded in the reanalysis, both sets of data shall be presented. A discussion of data reported when the blank/spike laboratory control sample is out of control shall be presented in the QC section of both the final report and the MPR.

If the blank/spike results are outside the internal laboratory limits and if the matrix spike results are outside the CLP limits, the laboratory will either reanalyze the samples or the data will be flagged with an "R," and the data are not usable.

8. MAINTAINING LABORATORY APPROVAL

Once a laboratory has received Navy approval to begin analysis of samples, maintaining that approval requires adherence to the QA plan and reporting of QA-related information. The performance and reporting requirements outlined below are essential to ensuring that data of known and defensible quality are being generated throughout the course of a site investigation. Topics covered include control samples, control charts, out-of-control events, corrective action reports, significant changes in the QA plan, and other reporting requirements.

8.1 MONTHLY PROGRESS REPORT

The primary means of communication from the laboratories to the NCR will be the MPR to be submitted by the laboratories to the NCR on the 15th of each month in which work for the Navy is performed. The following information is to be included in the MPR.

1. Site name and contract number.

2. Numbers, types and locations of samples collected and analyzed for Navy project only.

3. Data for blanks, spikes, laboratory duplicates and controls related to Navy samples.

4. New methods used for analysis and changes in old methods.

5. Copies of all control charts pertinent to Navy samples and to which results have been added over the reporting period.
6. Summaries of out-of-control incidents during the reporting period, including references to documentation and corrective action reports.

7. Descriptions of and justifications for significant changes in the QA.

8. Changes in LQAC personnel and other key technical personnel; resumes of new personnel must be submitted.

9. Completed sample data.

Much of the information presented in an MPR is incremental in nature and relates to changes and findings since the previous MPR.

1. Control charts from the minimizing control charts program and any additional control charts from monitoring matrix spikes, duplicates, or other QC parameters.

2. Personnel changes relating to QA responsibilities.

3. Method changes (e.g., a minor modification with an attached EPA variance).

4. Procedural changes in establishing control limits and/or the preparation and use of control charts.

Since the first such report for each laboratory has no precedent, more explanation and detail may be necessary; subsequent MPRs will likely not require as much detail in some areas.

8.2 FINAL REPORT

A draft of the final report shall be reviewed by the NCR prior to its release. This report is the final deliverable from the engineering subcontractor. An outline for a typical report is as follows.

1. Site name and Navy contract number.

2. Foreword--signed by those with major responsibilities for the QA program and by project management.

3. Executive Summary--brief review of the report.

4. Table of Contents--with specificity at approximately the same level as the Table of Contents in this Navy document.

5. Introduction--summarize the Navy field sites of interest, when the study occurred (dates of sampling, dates of analysis) and the objectives of the QA plan as they relate to the study.

6. Data Summary--summarize the results on a site-by-site basis.

7. Other Information--present any other information requested in the statement of work such as risk assessment, recommendation to perform more site characterization, or recommend site closure. This information was specified prior to beginning work and is directed by the Navy EIC.

8. The final report shall present the findings from the analytical, geological, and hydrogeological studies. The summary of analytical data will exclude non-detected compounds. No subtraction of blanks is allowed. Data will be flagged if blank contamination occurs. All data flags will follow the result in the summary.

9. QC Summary--the QC summary section will include a discussion of are data which flagged. Flagged data defined as data for which trip, field, or laboratory blanks were contaminated, matrix spike/spike duplicates exceed limits, calibration criteria are not met, and laboratory controls exceed limits. The QC summary will also discuss the results of laboratory blanks, matrix spikes/spike duplicates,

duplicates, control charts, surrogate holding times, field blanks, trip blanks, rinsates, and field duplicates. This section will also discuss precision, accuracy, and completeness.

10. Appendices--the appendices of the report shall include all field and analytical data. One appendix shall contain field logs and forms. A second appendix shall contain the laboratory data of each sample. These data shall be presented in a spreadsheet similar to the Format Section of this report. All trip, field, and laboratory blanks shall be marked so that each sample can be associated with the appropriate blanks.

    A third appendix shall include the method blank spike control charts, surrogate recoveries, matrix spike and duplicate, field, and laboratory duplicates for all spike samples.

8.3 FINAL QC DATA REPORT

A QC data report shall be sent to the NCR. This report shall contain the following.

For Level D QC, the contractor shall submit a subset of data from the CLP data packages. For 20% of the water and 20% of the soil samples, the subcontractor shall submit the full CLP package.

For Level C QC, the deliverables listed in Table 7.7 will be presented.

For Level E QC, the initial and continuing calibration forms, method blank, and blank spike control chart are required.

The report shall indicate the duration and location of storage for the data. The stored data consists of all raw data, QC charts, corrective action, logs, sample lists, COC information, notebooks, work sheets, automated data processing system output, and calibration.

The report shall be delivered to the NCR three weeks prior to the final report.

9. DATA FORMAT

The data format refers to the format in the final report. The contractor may use its own format in the body of the report. However, in the appendices (which contain sample and blank data) a spreadsheet type of format may be used, or the CLP forms for reporting samples and equipment, trip, field, and method blanks may be used. The spreadsheet format allows for more samples per page and for more information on blanks and their association with samples. The spreadsheet format is not meant to be a rigid form. The information listed in Fig. 9.1 must be present. The contractor may add other information which will assist it in review. For calibration, tuning, spikes, surrogates, and duplicates, the current CLP forms are required for data presentation. If any other format is to be used, this shall be discussed with the NCR.

Sample Number	J25019	JS5020
Date Sampled	03-18-87	03-18-87
Sample Prep..Date	11-25-87	11-25-87
Sample Analysis Date	11-26-87	11-26-87
Sample Numbers of Associated Analytes, Field, Trip, and Equipment Blanks	J4455667	L4455667

	Detection limit	Sample	Results
VOLATILE ORGANIC COMPOUNDS (µg/kg)			
TETRACHLOROETHANE	5	50	50
CHLOROBENZENE	5		
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)			
BIS(2-ETHYLHEXYL) PHTHALATE	330		750
2-METHYLNAPTHALENE	330		2500
INORGANIC COMPOUNDS (mg/kg)			
LEAD	10	360	25
HYDROCARBONS (2)			
PETROLEUM HYDROCARBON	1	0.611	0.268
OIL AND GREASE	1		

Sample Results

Analyte

Note: Petroleum hydrocarbon, oil, and grease results recorded in percent.

Fig. 9.1. Example of data format for final report.

GLOSSARY

Accuracy - The nearness of a result or the mean of a set of results to the true or accepted value.

Analyte - A chemical component of a sample to be determined or measured.

Analytical Method - Defines the samples preparation and instrumentation procedures or steps that must be performed to estimate the quantity of analyte in a sample.

Analytical Spike - The furnace postdigestion spike. The addition of a known amount of standard after digestion.

Background Correction - A technique to compensate for variable background contribution to the instrument signal and the determination of trace metals.

Calibration - The establishment of an analytical curve based on the absorbance, emission intensity, or other measured characteristic of known standards. The calibration standards must be prepared using the same type of acid or concentration of acids as used in the sample preparation.

Calibration Blank - A volume of acidified deionized/distilled water.

Comparability - is a qualitative parameter expressing the confidence with which one data set can be compared with another. Sample data should be comparable with other measurement data for similar samples and sample conditions.

Completeness - Completeness is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is to generate sufficient amount of valid data based on project needs.

Continuing Calibration - Analytical standard run every ten analytical samples or every 2 h, whichever is more frequent, to verify the calibration of the analytical system.

Control Limits - A range within which specified measurement results must fall to be compliant. Control limits may be mandatory, requiring corrective action if exceeded, or advisory, requiring that noncompliant data be flagged.

Correlation Coefficient - A number (r) which indicates the degree of dependence between two variables (concentration - absorbance). The more dependent they are, the closer the value to one. Determined on the basis of the least squares line.

Data Quality Objectives - are qualitative and quantitative statements which specify the quality of the data required to support decision during

GLOSSARY (continued)

remedial response activities. Data quality objectives are determined based on the end uses of the data to be collected.

Detection Limit - The minimum concentrations which must be accurately and precisely measured by the laboratory and/or specified in the quality assurance plan.

Dissolved Metals - Analyte elements which have not been digested prior to analysis and which will pass through a 0.45-μm filter.

Duplicates - Identical splits of individual samples which are analyzed by the laboratory to test for method reproducibility. In this case, samples are split in the laboratory.

Equipment Rinsates - The final analyte-free water rinse from equipment cleaning collected daily during a sampling event.

Field Blanks - Blanks are collected and analyzed to determine the level of contamination introduced into the sample due to sampling technique. They may consist of the source water used in decontamination and steam cleaning. At minimum, one sample from each event and each source of water must be collected and analyzed.

Field Duplicates/Splits - Samples that have been divided into two or more portions while in the field. Each portion is then carried through the remaining steps in the measurement process. A sample may be replicated in the field or at different points in the analytical process. For field replicated samples, precision information would be gained on homogeneity, handling, shipping, storage, preparation, and analysis.

Replicate samples divided into two portions and sent to different laboratories and subjected to the same environmental conditions and steps in the measurement process as the split samples.

Instrument Detection Limit - is defined in several ways. For example, (1) that concentration of analyte which produces an output signal twice the root mean square of the background noise may be determined under ideal conditions or (2) determined by multiplying by 3 the standard deviation obtained for the analysis of a standard solution (each analyte in reagent water) at a concentration of 3x-5x instrument detection limit on three nonconsecutive days with seven consecutive measurements per day.

Internal Standards - Compounds added to every standard, blank, matrix spike, matrix spike duplicate, sample (for volatile), and sample extract (for semivolatile) at a known concentration prior to analysis. Internal standards are used as the basis for quantitation of the target compounds.

GLOSSARY (continued)

Laboratory Control Sample - A control sample of known composition. Aqueous and solid laboratory control samples are analyzed using the same sample preparation, reagents, and analytical methods employed for samples received.

Laboratory Quality Assurance Coordinator - An employee of a laboratory with no analysis or production responsibilities and who implements QA and QC. This person is responsible for ensuring all quality problems are resolved.

Matrix - The predominant material comprising the sample to be analyzed. The most common matrices are water, soil/sediment, and sludge.

Matrix Spike - An aliquot of a matrix (water or soil) spiked with known quantities of compounds and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery.

Matrix Spike Duplicate - A second aliquot of the same matrix as the matrix spike that is spiked in order to determine the precision of the method.

Method Blank - A blank sample run to ensure reported analytical results are not the results of laboratory contamination.

Method Blank/Spike - Is the distilled and/or deionized water for soil or sand spiked with known compounds or elements. The method blank as defined by Contract Laboratory Protocol for organics and the laboratory control sample as defined by Contract Laboratory Protocol maybe use as the method blank/spike in the Navy Installation Restoration Program.

Method Detection Limits - Minimum concentrations of a substance that can be measured and reported with 99% confidence that the value is above zero. The sample is carried through the entire method under ideal conditions.

Method of Standard Additions - The addition of three increments of a standard solution (spikes) to sample aliquots of the same size. Measurements are made on the original and after each addition. The slope, x-intercept, and y-intercept are determined by least-squares analysis. The analyte concentration is determined by the absolute value of the x-intercept. Ideally, the spike volume is low relative to the sample volume (~10% of the volume). Standard addition may counteract matrix effects; it will not counteract spectral effects. It is also referred to as standard addition.

Out of Control - One or more of several conditions relating to the plotting of control data and indicating unacceptable results.

GLOSSARY (continued)

Percent Solids - The proportion of solid in a soil sample determined by drying an aliquot of the sample.

Precision - Measure of the reproducibility of a set of replicate results among themselves or the agreement among repeat observations made under the same conditions.

Preparation Blank (Reagent Blank, Method Blank) - An analytical control that contains distilled, deionized water and reagents, which is carried through the entire analytical procedure (digested and analyzed). An aqueous method blank is treated with the same reagents as a sample with a water matrix; a solid method blank is treated with the same reagents as a soil sample.

Purge and Trap - An analytical technique used to isolate volatile (purgable) organics by stripping the compounds from water or soil by a stream of inert gas, trapping the compounds on a porous polymer trap, and thermally desorbing the trapped compounds onto the gas chromatographic column.

Quality Assurance - A planned system of activities (program) whose purpose is to provide assurance of the reliability and defensibility of the data.

Quality Control - A routine application of procedures for controlling the monitoring process. QC is the responsibility of all those performing the hands-on operations in the field and in the laboratory.

Reagent Water - Water in which an analyte is not observed at or above the minimum quantitation limit of the parameters of interest.

Recovery - Usually expressed as a percent. The numerical ratio of the amount of analyte measured by the laboratory method divided by the known amount of analyte added to the matrix (i.e., spiked sample) to be analyzed.

Reporting Detection Limits - The same as method detection limits with consideration given for practical limitation such as sample size, matrix interferences, and dilutions.

Representativeness - Expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter which is most concerned with the proper design of the sampling program.

Sample Holding Times - Times used to ascertain the validity of results based on the holding time of the sample from time of collection to time of analysis or sample preparation. Holding times may vary depending on the analysis, EPA regional preference, etc.

GLOSSARY (continued)

Semivolatile Compounds - Compounds amenable to analysis by extraction of the sample with an organic solvent. Used synonymously with base neutral acid or extractable compounds.

Serial Dilution - The dilution of a sample by a known factor. When corrected by the dilution factor, the diluted sample must agree with the original undiluted sample within specified limits. Serial dilution may reflect the influence of interferents.

Spikes - Known amounts of specific chemical constituents added by the laboratory to selected samples to test the appropriateness and recover efficiencies of specific analytical methods within the actual sample matrices.

Standard Deviation - The square root of the variance of a set of values.

Surrogates - Compounds added to every blank, sample, matrix spike, matrix spike duplicate, and standard and used to evaluate analytical efficiency of the method by measuring recovery. Surrogates are brominated, fluorinated, or isotopically labelled compounds not expected to be detected in environmental media. These are used typically in organic methods.

Tentative Identified Compounds - Compounds detected in samples that are not target compounds, internal standards or surrogate standards. Up to 30 peaks (those greater than 10% of peak areas or heights of nearest internal standards) are subjected to mass spectral library searches for tentative identification.

Total Metals - Analyte elements which have been digested prior to analysis.

Variance - The sum of the squares of the difference between the individual values of a set and the arithmetic mean of the set, divided by one less than the number of values.

Volatile Compounds - Compounds amendable to analysis by the purge and trap techniques. Used synonymously with purgable compounds.

Data Qualifiers' Definitions as defined by the Contract Laboratory Protocol for Organic Analysis

U - Indicates compound was analyzed for but not detected. The sample quantitation limit must be corrected for dilution and for percent moisture.

J - Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1:1 response is assumed, or when the mass spectral data indicate the presence of a compound that meets the identification criteria but the result is less than the sample quantitation limit but greater than zero.

GLOSSARY (continued)

C - This flag applies to pesticide results where the identification has been confirmed by gas chromatography/mass spectrometry. Single component pesticides ≥10 ng/ul in the final extract shall be confirmed by gas chromatography/mass spectrometry.

B - This flag is used when the analyte is found in the associated blank as well as in the sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action. This flag must be used for a TIC as well as for a positively identified TCL compound.

E - This flag identifies compounds whose concentrations exceed the calibration range of the gas chromatography/mass spectrometry instrument for that specific analysis. This flag will not apply to pesticides/PCBs analyzed by GC/EC methods. If one or more compounds have a response greater than full scale, the sample or extract must be diluted and reanalyzed. If the dilution of the extract causes any compounds identified in the first analysis to be below the calibration range in the second analysis, then the results of both analyses shall be reported.

D - This flag identifies all compounds identified in an analysis at a secondary dilution factor. If a sample or extract is reanalyzed at a higher dilution factor, as in the "E" flag above, the "DL" suffix is appended to the sample number on the Form I for the diluted sample, and all concentration values reported on that Form I are flagged with the "D" flag.

A - This flag indicates that a TIC is a suspected aldol-condensation product.

X - Other specific flags and footnotes may be required to properly define the results. If used, they must be fully described and such description attached to the Sample Data Summary Package and the Case Narrative. If more than one is required, use "Y" and "Z," as needed. If more than five qualifiers are required for a sample result, use the "X" flag to combine several flags, as needed. For instance, the "X" flag might combine the "A," "B," and "D" flags for some sample.

R - Quality control indicates that data are not usable (compound may or may not be present). Resampling and reanalysis are necessary for verification.

Q - No analytical result.

GLOSSARY (continued)

Inorganic Data Qualifiers

E - The reported value is estimated because of the presence of interference. An explanatory note must be included under Comments on the cover page (if the problem applies to all samples) or on the specific FORM I-IN (if it is an isolated problem).

M - Duplicate injection precision not met.

N - Spiked sample recovery not within control limits.

S - The reported value was determined by the Method of Standard Additions.

W - Postdisgestion spike for Furnace Atomic Absorption analysis is out of control limits (85-115%), while sample absorbance is less than 50% of spike absorbance.

* - Duplicate analysis not within control limits.

+ - Correlation coefficient for the Method of Standard Addition is less than 0.995.

M (Method) Qualifier

"P" for ICP

"A" for Flame AA

"F" for Furnace AA

"CV" for Manual Cold Vapor AA

"AV" for Automated Cold Vapor AA

"AS" for Semiautomated Spectrophotometric

"C" for Manual Spectrophotometric

"T" for Titrimetric

"NR" if the analyte is not required to be analyzed

BIBLIOGRAPHY

American Public Health Association, American Water Works Association, and the Water Pollution Control Federation, *Selected Analytical Methods Approved and Cited by the United States Environmental Protection Agency.* Supplement to the 15th ed. of *Standard Methods for the Examination of Water and Wastewater,* 1981.

American Public Health Association, American Water Works Association, and the Water Pollution Control Federation. *Standard Methods for the Examination of Water and Wastewater,* 16th ed., Washington, DC, 1985.

American Society for Testing and Materials, *1984 Annual Book of ASTM Standards: Water and Environmental Technology,* Sect. 11, Vols. 11.01 and 11.02, Water, Philadelphia, Pennsylvania, 1984.

Association of Official Analytical Chemists, *Offical Methods of Analysis of the Association of Official Analytical Chemists,* 14th ed., Arlington, Virginia, 1984.

C. F. Bauer, C. L. Grant, and T. F. Jenkins, *Interlaboratory Evaluation of High-Performance Liquid Chromatography Determination of Nitro Organics in Munition Plant Wastewater, Anal. Chem. 58, 176 (1986).*

R. R. Compton, Manual of Field Geology, John Wiley and Sons, Inc., New York, p. 378, 1962.

Federal Register, *Toxicity Characteristic Leaching Procedure,* 40 CFR, 51 FR, Appendix I to Part 268, pp. 40643-40653, November 7, 1986.

Federal Register, *Air and Stack Gas Monitoring,* 40 CFR, Revised, Parts 53-80, July 1, 1985.

Federal Register, Guidelines Establishing Testing Procedures for the Analysis of Pollutants under the Clean Water Act; Final Rule and Interim Final Rule and Proposed Rule, 40 CFR Part 136.3, July 1, 1987.

F. M. Garfield, *Quality Assurance Principles for Analytical Laboratories,* Association of Official Analytical Chemists, Arlington, Virginia, 1984.

B. G. Kratochvil and J. K. Taylor, *A Survey of Recent Literature on Sampling for Chemical Analysis.* National Bureau of Standards Technical Note, 1153, Gaithersburg, Maryland, January 1982.

G. Kulin and P. R. Compton, *A Guide to Methods and Standards for the Measurement of Water Flow.* National Bureau of Standards, Spec. Publication 421, p. 9.

R. D. Morrison, *Groundwater Monitoring Technology,* TIMCO Manufacturing, Inc., Prairie du Sac, Wisconsin, p. 111, 1983.

BIBLIOGRAPHY (continued)

National Bureau of Standards: A Guide to Methods and Standards for the Measurement of Water Flow. National Technical Information Services, SD Catalog No. C13.10:421, NBS Special Publication 421, 1975.

National Institute of Occupational Health and Safety Manual of Analytical Methods, 3rd ed., NIOSH 84-100, May 15, 1985.

RCRA Groundwater Monitoring Technical Enforcement Guidance Document, OSWER-9950.1, September 1986.

Reversed Phase High-Performance Liquid Chromatography Determination of Nitro Organics in Munitions Wastewater, Anal. Chem., 58, 170, (January 1986).

The American Society of Mechanical Engineers, *Quality Assurance Program Requirements for Nuclear Facilities,* ANSI/ASME NQA-1-1986 ed., July 1, 1986.

U.S. Army Toxic and Hazardous Materials Agency, *USATHAMA QA Program,* Aberdeen Proving Ground, MD, December 1985, 2nd ed., March 1987.

U.S. Department of Agriculture, *Soil Survey Manual,* U.S. Government Printing Office, Washington, DC, 1981.

U.S. Department of Agriculture, *Soil Taxonomy: Basic Systems of Soil Classification for Making and Interpreting Soil Surveys,* U.S. Government Printing Office, Washington, DC, 1975.

U.S. Department of Interior, *National Handbook of Recommended Methods for Water-Data Acquisition,* U. S. Geological Survey, Vol. 2, Reston, Virginia, 1977.

U. S. Environmental Protection Agency, *Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses,* R-582-5-01, NUS Corporation, Superfund Division, May 28, 1985.

U. S. Environmental Protection Agency, *Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analysis,* R-582-5-5-01, NUS Corporation, Superfund Division, May 28, 1985.

U.S. Environmental Protection Agency Contract Laboratory Programs, *Statement of Work for Organic Analysis,* Rev., July 1987.

U.S. Environmental Protection Agency Contract Laboratory Programs, *Statement of Work for Organic Analysis,* Rev. 1987.

U.S. Environmental Protection Agency Contract Laboratory Programs, *Statement of Work for Organic Analysis,* September 1983.

BIBLIOGRAPHY (continued)

U.S. Environmental Protection Agency, *Determinations of PCBs in Transformer Fluid and Waste Oils*, EPA-600/4-81-045, September 1982.

U.S. Environmental Protection Agency, *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans.* QAMS 005/80, National Technical Information Service, EPA-600/4-83-004, February 1983.

U.S. Environmental Protection Agency, *Practical Guide for Groundwater Sampling*, EPA-600/2-85-104, p. 169, 1985.

U.S. Environmental Protection Agency, *Handbook - Groundwater*, EPA-625/6-87-016, p. 212, 1987.

U.S. Environmental Protection Agency, *Microbiological Methods for Monitoring the Environment*, National Technical Information Services, EPA-600/-78-017, 1978.

U.S. Environmental Protection Agency, *RCRA Groundwater Monitoring Technical Enforcement Document*, U.S. Government Printing Office, Washington, DC, p. 208, 1987.

U.S. Environmental Protection Agency, *Soil Sampling Quality Assurance User's Guide*, EPA-600/4-84-043, p. 113, 1984.

U.S. Environmental Protection Agency, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories*, EPA-600/4-79-019, Cincinnati, Ohio, March 1979.

U.S. Environmental Protection Agency, *Methods of Benzidine, Chlorinated Organic Compounds, Pentachlorophenol and Pesticides in Water and Wastewater*, Interim Document, Cincinnati, Ohio, September 1978.

U.S. Environmental Protection Agency, *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, Cincinnati, Ohio, March 1983.

U.S. Environmental Protection Agency, *NPDES Compliance Sampling Inspection Manual*, Office of Water Enforcement, MCD-51, Washington, DC, 1985.

U.S. Environmental Protection Agency, *Radiochemistry Procedures Manual*, Office of Radiation Programs, Eastern Environmental Radiation Facility, August 1984.

U.S. Environmental Protection Agency, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, EPA/SW-846, Vols. 1A, B, C, and 2, Rev., November 1986, Washington, DC, 1987.

U.S. Environmental Protection Agency, *Manual on Groundwater Quality Sampling Procedures*, EPA-600/2-81-160, p. 105, 1981.

BIBLIOGRAPHY (continued)

U.S. Environmental Protection Agency, *Data Quality Objectives for Remedial Response Activities*, EPA/540/G-87/003, March 1987.

U.S. Environmental Protection Agency, *Laboratory Data Validation Functional Guidelines for Evaluating Pesticides/PCB's Analyses*, R-582-5-5-01, NUS Corporation, Superfund Division, May 28, 1985.

U.S. Geological Survey, *Methods of Analysis of Inorganic Substances in Water and Fluvial Sediments*, Open File Report 78-679, Reston, Virginia, 1978.

U.S. Geological Survey, "Methods for Determination of Inorganic Substances in Water and Fluvial Sediments," *In Techniques of Water-Resources Investigation*, Book 5, Chapter A1, Marvin W. Skougstad et al., Ed., Reston, Virginia, 1979.

T. P. Whitehead, *Quality Control in Clinical Chemistry*, John Wiley and Sons, New York, 1977.

W. J. Youden and E. H. Steiner, *Statistical Manual of the AOAC*, Association of Official Analytical Chemists, Arlington, Virginia, 1975.

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U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

APPENDIX E
INVESTIGATION DERIVED WASTE PLAN

PHASE II RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared by:
TRC Environmental Corporation
Windsor, Connecticut

Prepared for:
Northern Division - Naval Facilities
Engineering Command
Lester, Pennsylvania

March 1993

TRC-EC Project No. 6760-N81-110
Contract No. N62472-86-C-1282

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TRC

1.0 INTRODUCTION

This plan presents a discussion of the planned management procedures for all field generated or investigation derived waste materials. Investigation derived waste (IDW) materials typically include soil boring drill cuttings, monitoring well development water and purge water, sampling equipment decontamination solutions, and expendable personnel protective equipment. During the field investigation activities, care will be taken to minimize the amount of IDW material which is generated and handled. The following sections provide the planned management and handling procedures for IDW materials during the field investigation activities.

1.1 WASTE MANAGEMENT

Generally, IDW materials will be placed in DOT-approved 55-gallon drums. Drums will be filled to no more than 90 percent of capacity to allow for the potential expansion of the drum contents. Drums will be marked with sticker labels and indelible liquid chalk pens by field investigation personnel. Drum labels will be of a contrasting color (e.g., yellow) relative to the drums (e.g., black). Information recorded on the drums and labels will include:

- generator (US Navy, Naval Education Training Center, Newport, Rhode Island, 02841)
- generator EPA identification number,
- source (e.g., site number and name, well or boring number),
- date(s) of generation,
- matrix (e.g., soil, water, etc.), and
- notes/observations (e.g., odors, non-aqueous phase liquids, etc.)

The handling and disposal of all IDW materials will be the responsibility of the US Navy with assistance provided by TRC-ECI. The RIDEM and EPA - Region I will be consulted regarding the final disposition of all IDW material.

1.2 WASTE HANDLING & DISPOSAL

1.2.1 Soils

Solid material derived from the subsurface exploration program (e.g., auger spoils, split spoon samples, etc.) will be continuously observed for evidence of potential contamination (e.g., discoloration, odors, etc.) and monitored for the presence of VOCs using a photo and/or flame ionization detector (PID or FID).

Drill cuttings produced from test borings will be backfilled into their respective borings and a cement-bentonite grout will be placed in the top one foot of the borehole as described in the Field Sampling Methodology Plan provided as Appendix B. Drill cuttings produced from monitoring well borings will be containerized in 55-gallon drums.

Drummed well boring cuttings will be segregated on pallets and staged on-site at the completion of the drilling activities. The Navy will be responsible for staging all drums. The designated on-site drum staging areas will be established during the field mobilization activities. IDW drums from active open sites (e.g., Site 09) will be staged at one of the other RI sites for temporary storage. Analytical results of soil samples collected from well borings will be used to aid in characterizing the associated drummed cuttings.

If full scan (i.e., TCL organics and TAL inorganics) analytical results of soil samples from the test boring and field observations (odors, discoloration, elevated PID or FID readings, etc.) indicate the absence of contamination, the associated drummed soil will be returned to the ground surface near their respective source well location. So as not to interfere with future well sampling events, IDW material will not be placed closer than ten feet, nor further than twenty feet from its source location. The location(s) where any drill cuttings are placed will be recorded in a field notebook.

If field observations (e.g. stains, odors, or elevated PID or FID readings) or the analytical results of soil samples from the boring indicate that the associated drill cuttings are potentially contaminated, the drum contents will be sampled and appropriately characterized. The waste characterization testing will include that required under the state and federal regulations and by the planned disposal facility.

If characterization of the drums contents indicates the drill cuttings are hazardous, the drummed IDW materials will be transported by a licensed waste hauler for treatment or disposal

in accordance with applicable state and federal regulations established under the Resource Conservation and Recovery Act (RCRA). Drill cuttings that do not exhibit any hazardous characteristics but appear contaminated based upon associated TCL/TAL results will be handled on a case-by-case basis. The EPA Region I and RIDEM will be consulted prior to redepositing any IDW materials on the sites.

1.2.2 Well Water

All well water (e.g., purge and development water) produced from site monitoring wells will be containerized in 55-gallon drums. The presence/absence of a non-aqueous phase liquid will be assessed in each well during well development, purging, and sampling. Any nonaqueous phase liquids or evidence of possible petroleum contamination (i.e., sheen, odor, elevated OVA response) which are detected or observed in the well will be recorded in a field notebook.

Analytical results of the ground water samples collected from the well will be used to aid in characterizing the drum contents. If associated ground water sample TCL/TAL analytical results and field observations (e.g., odors, sheen, elevated OVA response) indicate the absence of contamination, the associated drummed well water will be discharged onto the ground in the vicinity of the respective source well. The well water will not be discharged closer than ten feet, nor further than twenty feet from its source well. The location(s) of the discharged well water will be recorded in a field notebook. The EPA Region I and RIDEM will be consulted prior to discharging any IDW material on the sites.

If field observations and/or associated sample data indicate that the well water is contaminated, the drummed material will be transported for treatment by a licensed hauler in accordance with local, state, and federal regulations. The treatment of wastewaters at a local publically-owned treatment works will be considered, if appropriate.

1.2.3 Decontamination Solutions

Downhole drilling equipment (e.g., augers, rods, cutting heads) will be steam cleaned prior to each use. Steam cleaning will be conducted in a designated heavy equipment decontamination area. Rinse waters from steam cleaning will be recovered and contained in a tank truck located

at the heavy equipment decontamination area for characterization and appropriate off-site treatment.

Sediment/soil generated from steam cleaning operations will be drummed separately at the decontamination area for appropriate characterization and proper disposal.

Chemicals (e.g., hexane, methanol, nitric acid) and water (distilled and tap) used for decontamination of sampling equipment (e.g., split spoons) will be separately collected, containerized, and labelled for proper treatment or disposal. In general, much of the sampling equipment (e.g., stainless steel spoon, bailers) will be laboratory decontaminated, thus reducing the generation of chemical decontamination solutions in the field.

1.2.4 Expendable Equipment

Expendable equipment (e.g., tyvek coveralls, gloves, boot covers, etc.) will be placed into trash bags and disposed of in Newport Naval Base outdoor refuse containers. Refuse containers to be used for such disposal will be designated by the NETC Public Works Department. Expendable equipment which is known or believed to be contaminated (e.g., oily gloves) will not be disposed of in refuse containers. Such equipment will be drummed, labelled, and segregated for disposal.

U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

VOLUME IV
DATA EVALUATION AND ASSESSMENT PLAN

PHASE II RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared by:
TRC Environmental Corporation
Windsor, Connecticut

Prepared For:
Northern Division - Naval Facilities
Engineering Command
Lester, Pennsylvania

March 1993

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1.0 INTRODUCTION

Data evaluation and assessment describes the process of characterizing the site on the basis of background investigations, site observations, and field investigations. The objective of this task is to define the nature and extent of contamination, identify and evaluate potential chemical transport mechanisms and the environmental fate of identified contaminants, and thereby provide the basis for human health risk assessments. Data management and reporting activities are key to conducting the site characterization activities.

2.0 DATA MANAGEMENT PLAN

Data management activities include field sampling documentation, sample management and tracking, analytical reporting, and document control.

2.1 Field Data Collection and Recording

During field sampling, consistent documentation and accurate recordkeeping procedures are critical. Data management procedures for field sampling at NETC-Newport during Phase II investigations will include the following:

Quality Assurance Project Plan (QAPP)-- Provides procedures and protocols for records responsibility; nonconformity events; corrective measures; and data deficiencies. The QAPP for NETC-Newport appears in Appendix D of Volume III of this Work Plan.

Data Security System and Chain-of-Custody--The QAPP describes strict chain-of-custody procedures which will be followed in the field and through sample analysis at the laboratory. Chain-of-custody records and shipping air bills will be maintained in a locked file cabinet at the TRC-EC field office at NETC-Newport. At the completion of field work, chain-of-custody records will be transferred to the central project file at the TRC-EC Windsor, Connecticut office.

Field Notebooks--Field notebooks maintained by field personnel will be the primary record for field investigation activities, as described in the QAPP. Detailed descriptions of the information to be recorded in the field notebooks during site investigation activities as well as presentation of information (including correction of errors) and management of the notebooks is provided in Section 5 of the QAPP.

Driller Logs--The drilling contractor and TRC-EC geologist will maintain boring and well construction logs under direction of the TRC-EC Field Team Leader.

2.2 Sample Management and Tracking

The TRC-EC Project Manager will maintain records of: sample shipments; receipt of analytical results; submittal of preliminary results for QA/QC review; results of the QA/QC review; and evaluation of the QC package from the laboratory. The objective is to ensure only validated data with final approval are used in site analysis.

Preliminary data, clearly identified as such, may be used to prepare internal review documents; to begin data analysis; and to narrow remedial action alternatives. The final Remedial Investigation report, however, will clearly identify all validated data and will be accompanied by a QA/QC discussion and associated data qualifiers.

2.2.1 Sample Identification and Chain-of-Custody

The Field QC Coordinator will coordinate sample analysis with the laboratory. TRC-EC and the laboratory will use standard chain-of-custody procedures for sample tracking which have been approved by EPA (CLP) and the Navy (NEESA). Chain-of-custody procedures are initiated in the laboratory upon sample container shipment to the field and continue with the return shipment of the samples to the laboratory. At the laboratory, a sample custodian continues the chain-of-custody by assigning a laboratory identification number to each sample. This identification number, along with the number assigned in the field, accompanies the sample through analysis, and back to the TRC-EC Project Manager with the analytical results. Chain-of-custody procedures are described in further detail in Section 5 of the QAPP.

2.2.2 Reporting of Analytical Results

Data reporting procedures are described in the CLP analytical Statements of Work (as referenced in the QAPP), in the laboratory's, NEESA-approved QA Manual, and in the QAPP prepared for this project. These procedures yield analytical data in a defined deliverable format. Laboratory data reporting procedures are briefly outlined below.

> Manual Recording--The laboratory's Standard Operating Procedures and CLP protocol describe the QC procedures used for laboratory notebooks and include data worksheets which are routinely used in the reduction of quantitative instrument data to a report format expressed in terms of concentration. Instrumental data are entered on summary worksheets using microcomputers and appropriate software.
>
> Automated Recording--Many analytical measurements at CLP laboratories are automatically recorded; e.g., complex analytical instruments have their own computerized data systems. Instrument checklists include checks on the operation of these data handlers and internal validity checks are used to flag data resulting from electronic interferences.

Calculation of Results--Whenever possible, laboratory calculations are computerized for efficiency and to avoid human error. The analytical data systems mentioned above calculate results as programmed and provide hard copy in the desired format. Computerized data are verified for error control, and careful handling of computer storage peripherals is stressed. Tests are built into the programs to trap transcription errors or missing items. The record of the run contains the calculation results, and the input data. Analytical results are reduced to the correct number of significant figures for the measurement technique.

Data Review--Acceptance limits are provided to help the operator spot questionable data and control charts are used whenever possible to show if the procedure is in control. The laboratory Quality Control Coordinator initiates control charts for instrument performance and specific analytical methods, and reviews routine and specialized QC sample results as they pertain to each project. In the laboratory, data are reviewed promptly to ensure reasonableness and determine if corrective action is needed.

Data Validation--Data validation is the process of reviewing data and accepting, qualifying, or rejecting it on the basis of sound criteria. A detailed discussion of data validation procedures is provided in Section 8 of the QAPP.

2.3 Document Control

A document inventory and filing system has been established for the NETC-Newport RI/FS and will be maintained during Phase II investigations. The TRC-EC Project Manager will hold responsibility for document control. All originals will be maintained in the central file. Project staff will make copies of documents, as needed, and return the originals. The file will have the capability for locking during non-business hours.

3.0 REMEDIAL INVESTIGATION REPORT

The preparation of the Remedial Investigation Report involves the evaluation of analytical data with respect to existing site conditions (e.g., geology, hydrogeology), previous investigation data and background information. This evaluation provides the basis for the determination of the nature and extent of contamination at a given site as well as contaminant fate and transport analyses. The RI Report will present and assess both Phase I and Phase II RI data.

Initially a draft RI report will be prepared and submitted for review. Upon response to any review comments and approval, the final RI report will be prepared and submitted.

A description of the preparation of the Remedial Investigation Report is provided below. An outline of the report format is presented in Table 1. Because of the number of sites to be addressed in the RI Report, the outline as presented will be modified during report preparation. It is anticipated that general descriptions for each of the sections (e.g., overall facility background information, general site investigation activities, physical characteristics of the NETC-Newport facility, etc.) will be presented. Then for each individual site of investigation, site-specific information will be presented, following the same format. By organizing the report in this manner, each site will be completely evaluated within a single section, thereby providing a comprehensive site-by-site evaluation. The individual report sections are described below.

3.1 Introduction

The objectives and scope of the Remedial Investigations will be summarized in this section. Background information, including a site description, site history and summary of previous environmental investigations, will also be presented.

3.2 Site Investigations

The various field investigation methodologies will be described. For each type of field investigation activity, background information pertinent to the site investigations will be briefly summarized. An overview of the investigations will be provided, including the number of samples collected and the analytical methods used for sample analysis. Field observations and measurements, such as geophysical readings, visible contamination, observed odors, etc., will also be provided.

3.3 Physical Characteristics

Physical characteristics of the sites, including physiography, meteorology, surface water hydrology, geology and hydrogeology, will be presented.

3.4 Nature and Extent of Contamination

This section presents the results of the site characterization. Initially, contaminant comparison levels will be defined for use in discussing the relative degree of environmental contamination within a given medium. The nature of chemical contaminants for each medium sampled at a site will be discussed, based on an evaluation of analytical results. The extent of chemical contamination will be evaluated with respect to sample locations, sample depths and density of sample points. As appropriate, figures which aid in presenting detected contamination will be developed for each of the sites.

3.5 Contaminant Fate and Transport

This section evaluates identified contaminants with respect to their chemical characteristics. Chemical characteristics can be used to predict the fate of contaminants within the environment. The persistence of a chemical in a given media will be evaluated and, if determined not to be persistent, potential environmental transport mechanisms and pathways will be identified. This section may be incorporated into the Risk Assessment discussion.

3.6 Risk Assessment

The Risk Assessment will consist of an Human Health and Ecological Evaluation, as described in Volumes V and VI of this Work Plan.

3.7 Summary and Conclusions

The RI Report summary and conclusions will provide a summary of the nature and extent of contamination, contaminant fate and transport mechanisms and potential risks to human health and the environment posed by the sites. Conclusions will consist of a discussion of data limitations and their impact on the site characterization, recommendations for additional site investigations, if any, and recommended remedial action objectives, which will lead into the Feasibility Study process.

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   - 1.1 Objective and Scope
   - 1.2 NETC Background
     - 1.2.1 NETC Description
     - 1.2.2 NETC History
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   - 1.3 Site Background
     - 1.3.1 Site Description
     - 1.3.2 Site History
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2. Site Investigations
   (Includes field activities associated with site characterization on a site-by-site basis. These may include physical and chemical monitoring of some, but not necessarily all, of the following):

   - 2.1 Ambient Air and Radiological Investigations
   - 2.2 Geophysical Investigations
   - 2.3 Soil Gas Investigations
   - 2.4 Surface Soil Investigations
   - 2.5 Test Pit Investigations
   - 2.6 Subsurface Soil Boring Investigations
   - 2.7 Ground Water Investigations
   - 2.8 Surface Water and Sediment Investigations
   - 2.9 Underground Storage Tank Investigations
   - 2.10 Structure Investigations

TABLE 1
(continued)

PLANNED REPORT FORMAT FOR RI REPORT FOR NETC-NEWPORT

---

3. Physical Characteristics of each Study Area
(Includes results of field activities to determine physical characteristics. These may include some, but not necessarily all, of the following):

   3.1 Physiography
   3.2 Meteorology
   3.3 Surface Water Hydrology
   3.4 Geology & Soils
   3.5 Hydrogeology
   3.6 Demography and Land Use
   3.7 Ecology

4. Nature and Extent of Contamination at Each Site
(Presents the results of site characterization, including both natural chemical components and contaminants in some, but not necessarily all, of the following media):

   4.1 Surface Soils
   4.2 Subsurface Soils
   4.3 Ground Water
   4.4 Surface Water and Sediments
   4.5 Underground Storage Tanks
   4.6 Structures

5. Contaminant Fate and Transport at Each Site
   5.1 Potential Routes of Migration
   5.2 Contaminant Persistence
   5.3 Contaminant Migration

TABLE 1
(continued)

PLANNED REPORT FORMAT FOR RI REPORT FOR NETC-NEWPORT

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6. Risk Assessment
   - 6.1 Human Health Evaluation (see Volume V of Work Plan)
     - 6.1.1 Exposure Assessment
     - 6.1.2 Toxicity Assessment
     - 6.1.3 Risk Characterization
   - 6.2 Ecological Assessment (see Volume VI of Work Plan)

7. Summary and Conclusions
   - 7.1 Summary
     - 7.1.1 Nature and Extent of Contamination
     - 7.1.2 Fate and Transport
     - 7.1.3 Risk Assessment
   - 7.2 Conclusions
     - 7.2.1 Data Limitations and Recommendations for Future Work
     - 7.2.2 Recommended Remedial Action Objectives

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U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

VOLUME V
RISK ASSESSMENT PLAN - HUMAN HEALTH EVALUATION

PHASE II RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared By:
TRC Environmental Corporation
Windsor, CT

Prepared For:

Northern Division - Naval Facilities
Engineering Command
Lester, PA

March 1993

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2 SITE 01: MCALLISTER POINT LANDFILL
3 SITE 09: OLD FIRE FIGHTING TRAINING AREA
4 SITE 12: TANK FARM FOUR
5 SITE 13: TANK FARM FIVE

1.0 INTRODUCTION

This document briefly describes the work completed to date and the additional work that will be carried out as part of the Human Health Evaluation portion of the Risk Assessment for the Naval Education and Training Center in Newport, Rhode Island (NETC-Newport). The Ecological Evaluation portion of the Risk Assessment is addressed in Volume VI of this Work Plan.

1.1 Objectives

The overall objective of the Human Health Evaluation is to provide a quantitative and qualitative assessment of the risks associated with current and potential future uses of a site. It takes into consideration chemical contaminants in soil, ground water, surface water, sediments and other media to which humans could be exposed for which chemical data have been developed. The Human Health Evaluation is used to determine the need for remedial action at a site. It also provides a basis for determining the levels of chemicals that can remain on-site and still be adequately protective of human health.

The specific objectives of the Human Health Evaluation for the NETC-Newport facility are to:

- Identify potential receptors, based on current site use as well as potential future site use;
- Identify the potential pathways and routes by which humans may be exposed to the identified contaminants;
- Measure or estimate exposure point concentrations;
- Examine fate and transport processes of contaminants in environmental media;
- Gather information on the toxic effects of the chemicals;
- Characterize the human health risks associated with exposures under current and future conditions;
- Assess the uncertainties associated with the risk estimates; and
- Discuss the significance of the findings.

1.2 Methodology

The Human Health Evaluation will be prepared in accordance with the following documents:

U.S. Environmental Protection Agency, 1989, "Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Volume I, Part A"; Office of Solid Waste and Emergency Response; 9285.701A; July 1989.

U.S. Environmental Protection Agency, 1989, "Region I, Supplemental Risk Assessment Guidance for the Superfund Program, Part 1,2"; EPA/901/5-89-001; June 1989.

U.S. Environmental Protection Agency, 1991, "Human Health Evaluation Manual, Supplemental Guidance: 'Standard Default Exposure Factors'". EPA OSWER Directive 9285.6-03, March, 1991.

U.S. Environmental Protection Agency, 1990, "Guidance for Data Useability in Risk Assessment", Interim Final. EPA/540/G-90/008, October, 1990.

Human Health Evaluations will be prepared for the NETC-Newport sites on the basis of Phase I and Phase II environmental data.

The Human Health Assessment Plan is organized in accordance with the following Human Health Assessment tasks:

Data Collection and Evaluation
Exposure Assessment
Toxicity Assessment
Risk Characterization
Uncertainty Assessment

Prior to discussing the individual project tasks, a summary of background information and previous Human Health Assessment activities is provided. A proposed outline for a Human Health Assessment Report is provided in Table 1. The Human Health Assessment Report and Ecological Evaluation Report will be incorporated into the Phase II Remedial Investigation Report, as described in Volume IV of this Work Plan.

1.3 Background and Site Description

1.3.1 Introduction

The NETC site is approximately 1,063 acres in size, with portions of the facility located in Newport, Middletown, and Portsmouth, Rhode Island. The site is approximately 60 miles south of Boston and 25 miles southeast of Providence. The facility layout is long and narrow, following the shoreline of Aquidneck Island for nearly 6 miles bordering Narragansett Bay. A site location map is provided on Figure 1.

The NETC facility area has been used by the US Navy since the era of the Civil War. Portions of the facility are currently leased by the Navy to the State of Rhode Island and Economic Development Corporation. Some of these areas are subleased to private enterprises.

Previous investigations at the NETC facility include the performance of an Initial Assessment Study (IAS) by Envirodyne Engineers, Inc. (EEI) in 1982 and 1983, and a Confirmation Study (CS), consisting of a Verification Step and Characterization Step, by Loureiro Engineering Associates (Loureiro) over the period from 1983 to 1986. The IAS, which consisted of a background investigation and site visits, was conducted at all five sites addressed within this RI. The CS, which involved environmental sample collection and analysis, was conducted for the McAllister Point and Melville North landfills and for Tank Farm Four. In addition to these comprehensive studies, a Tank Closure Plan has been prepared for Tanks 53 and 56 at Tank Farm Five. Environmental samples were collected at this site as part of these closure activities. The sites that will be evaluated in Phase II are:

Site 01 - McAllister Point Landfill;
Site 09 - Old Fire Fighting Training Area;
Site 12 - Tank Farm Four; and
Site 13 - Tank Farm Five.

1.3.2 Site Description

Descriptions of the individual sites are provided in Section 2. A general discussion of geology, hydrogeology and hydrology is presented below.

The NETC site is located at the southeastern end of the Narragansett Basin. The rocks of the Narragansett Basin are non-marine sedimentary rocks of Pennsylvanian age. The bedrock at the NETC facility is almost entirely of the Rhode Island Formation. Within the Rhode Island Formation, there are a few areas of thick conglomerates. They consist of pebbles, cobbles, and boulders interbedded with sandstone and graywacke. Coasters Harbor Island is mostly covered with this conglomerate material. Overlying the Pennsylvanian rocks of the Narragansett Basin are surficial deposits of Pleistocene sediments. These unconsolidated, glacial sediments range in thickness from 1 to 150 feet and consist of till, sand, gravel and silt.

Many areas on Aquidneck Island, on which the NETC is located, obtain potable water supply from wells. Ground water is obtained from the unconsolidated glacial till deposits and from the underlying Pennsylvanian bedrock. The average depth to ground water is 14 feet. In

the NETC area, glacial till deposits are typically less than 20 feet in thickness. Well yields in these materials range from 1 to 120 gallons per minute. Bedrock well yields range from less than 1 to as much as 55 gallons per minute and are highly dependent on the presence of joints and fractures. Most ground water is soft or moderately hard. In scattered locations, pumping has led to salt water intrusion. No wells were identified within the boundaries of NETC other than on Gould Island.

The NETC facility is located within the Narragansett Bay drainage basin. All surface water drainage from the basin is into Narragansett Bay. Throughout the majority of the facility surface drainage is toward Narragansett Bay, with drainage provided by several brooks and streams.

2.0 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

2.1 Data Collection and Evaluation

Data Collection and Evaluation involves the gathering of site data and its analysis relevant to human health. Both Phase I and Phase II analytical data will be used in conducting the Human Health Assessments. This data will be evaluated to determine the applicability of the various analytical methods used in preparing the Human Health Assessment. Evaluation activities will include a review of the following in accordance with EPA's guidance document "Guidance for Data Useability in Risk Assessment":

Analytical methods used;
Quantitation and detection limits;
Qualified and coded data;
Blank concentrations;
Tentatively identified compounds; and
Background sample results.

TRC will also incorporate EPA's comments regarding data collection and the evaluation process in the Phase I RI to the Phase II Risk Assessment. Volume III of the Phase II RI/FS Workplan, NETC-Newport, RI Field Sampling Plan discusses the proposed sampling and analytical program to be conducted in Phase II. Upon completion of the data evaluation, a list of chemicals of potential concern by medium will be developed for use in the quantitative risk assessment. Based on guidance criteria presented in "Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Volume I, Part A", and in Region I's "Supplemental Risk Assessment Guidance for the Superfund Program", the number of chemicals to be carried through the risk assessment may be reduced at this point. Lists of Phase I risk assessment contaminants of concern (COCs) are provided in Tables 2 through 5.

A review of Phase I analytical data and the scope of Phase II field investigations has been conducted to ensure the adequate characterization of the investigation sites with respect to Human Health Evaluation assessment. Background samples have been included in the Phase II Field Sampling Plan (Volume III), for both surface soil and ground water. These background samples will be used in the Human Health Evaluation as reference points for comparison to site contamination levels and as indicators of naturally occurring conditions.

A summary of the results of the Phase I Risk Assessment data collection and evaluation task for each site is presented by geographic location below.

Phase I cancer risk estimates were compared with the acceptable excess lifetime cancer risk range for a single medium as described in the National Oil and Hazardous Substances Pollution Contingency Plan (FR 55, No. 46, March 8, 1990). This guidance states that the acceptable risk range is 1E-06 up to 1E-04, with 1E-06 considered the point of departure for evaluating the need for determining remediation goals in cases where APARs are not suitable for determining remediation needs.

2.1.1 Site 01 - McAllister Point Landfill

- Site Description

The McAllister Point Landfill is located in the central portion of the NETC facility. The site is approximately 11.5 acres in size and is located between Defense Highway and Narragansett Bay. The site is characterized by a mounded area in the central to north-central portion of the site, with flat areas at the northern and southern ends. Along the western edge of the site, the elevation drops significantly to the shoreline. The site is covered with grass, weeds and small trees, with more mature wooded areas near the northern site border. The McAllister Point Landfill was operated as a landfill over a twenty year period, from 1955 until the mid-1970's. Reportedly barrels containing liquid wastes, including paints and oils, and at least two transformers containing PCBs were disposed of at the site, along with general domestic refuse. A waste incinerator operated at the site from 1965 until the early 1970's, with ash residue disposed of on-site. The landfill was reportedly extended into Narragansett Bay, with wastes used as fill material. Following landfill closure, a soil cap was reportedly placed over the site. A site map is provided on Figure 2.

- Previous Environmental Investigations

The CS conducted at this site involved the collection and analysis of sediment, mussel, landfill leachate, surface soil and ground water samples. The surface soil samples indicated that low levels of contamination may be associated with the landfill cap material. The leachate spring samples exhibited metals, cyanide, phenol and some organic constituents. The sediment and mussel samples indicated the presence of inorganic contaminants in samples collected

adjacent to the site, especially near the southern end of the landfill, with levels decreasing with distance from the site. However, PCB contamination detected in mussels sampled appeared to be attributable to area-wide contamination, on the basis of background samples. Ground water samples exhibited elevated levels of metals. Screen placement in existing monitoring wells may limit detection of floating or sinking contaminants.

- Field Investigation Areas and Scope

Areas of potential concern investigated at this site include the historic landfill areas, and areas of incinerator operation. Historic aerial photos also indicate that materials, potentially including aboveground storage tanks, were stored on the surface of the site.

- Phase I - Field Investigation Findings Summary

Soil Assessment - VOCs, BNAs, pesticides, PCBs and inorganics were all detected in on-site soils. The major areas of the site where contaminants were detected in the soil at elevated levels include the following:

Northern area - CaPAHs;
North-central area - BNAs, CaPAHs, and inorganics;
Central landfill area - VOCs, BNAs, PCBs and inorganics;
South of access road - BNAs, CaPAHs, and inorganics; and
Shoreline - BNAs, CaPAHs, and inorganics.

Significant VOC contamination (i.e., greater than 1 ppm total VOCs) was detected in soils and fill in the central portion of the landfill area but VOC levels were not consistently high throughout the depth of the soil horizons sampled. BNAs were detected at elevated levels (i.e., greater than 10 ppm total BNAs) throughout the site, with the highest levels (i.e, greater than 100 ppm total BNAs) detected at spot locations in the central and southern portions of the site. Elevated levels of total carcinogenic PAHs (i.e., greater than 1 ppm) were also detected at locations where total BNA concentrations were less than 10 ppm. These locations were generally in the northern portion of the site, with smaller areas identified in the southern portion of the site and along the shoreline. Pesticides were detected at low levels (i.e., 10's of ppb) in surface soil samples across the site, while PCBs were detected in surface and subsurface soils. PCBs were detected in surface soils along the shoreline and in subsurface soils in the

north-central and southern portions of the site. One soil boring sample exceeded the 1 ppm RIDEM PCB soil action level. Inorganic levels in the soils and fill were compared to off-site background surface soil levels. Inorganics were detected in soil and fill samples collected from across the site at levels exceeding background levels. The highest inorganic levels were detected in soils from the central and south-central portions of the landfill, in the northern portion of the site (ash materials), in the southern portion of the site, and along the shoreline.

Ground Water Assessment - VOCs, BNAs, PCBs and inorganics were all detected in ground water samples. The major areas of the site where contaminants were detected at levels exceeding action levels include the following:

Northern area - inorganics;
North-central area - inorganics;
Central landfill area - VOCs, and inorganics; and
South of access road - VOCs, PCBs, and inorganics.

VOC detections, consisting mostly of petroleum-related VOCs (e.g., xylene, benzene) were limited to wells located in the central and southern portions of the site. VOCs were also detected in soil boring samples collected at the depth of the water table from the north-central to southern portions of the site, indicating the potential for ground water contamination throughout this area. Oil was observed in one well (MW-5S) in the southern portion of the site five months after it was sampled. No BNAs were detected above ground water action levels and no pesticides were detected in ground water samples. A PCB concentration of 150 ppb was detected in the well in the southern portion of the site (MW-5S) in which oil was subsequently observed. The highest levels of inorganic analytes were detected in wells from the north-central to southern portions of the site.

- Human Health Assessment

The exposure scenarios considered in the evaluation of the McAllister Point landfill site included a trespassing/current use scenario, a recreational/future use scenario, a construction/future use scenario, an industrial/future use scenario, and a residential/future use scenario. The estimated risks, in terms of cancer risk (carcinogenic) and hazard risk

(non-carcinogenic) estimates associated with each scenario evaluated and the exposure pathway(s) driving the calculated risks are summarized below:

- Trespassing Scenario (Scenario 1) - Total cancer risk range and total hazard index ratio range are within target values.

- Recreational Use Scenario (Scenario 2) - The maximum cancer risk value slightly exceeded the acceptable risk range. The mean risk value and total hazard index ratio range are within target values.

- Construction Scenario (Scenario 3) - The total cancer risk range and the mean hazard index ratio are within target values. The maximum hazard index ratio exceeded the target value.

- Commercial/Industrial Use Scenario (Scenario 4) - The total cancer risk range and the hazard index ratio range exceed target values.

- Residential Use Scenario (Scenario 5) - The total cancer risk range and the hazard index ratio range exceed target values for both children and adult receptors.

For Scenarios 1, 2, and 3, the major contributing factor to the calculation of cancer risk is ingestion of caPAHs in soil. The pathway of primary concern associated with Scenarios 4 and 5 with respect to cancer risk is ingestion of ground water containing inorganics (arsenic, beryllium) and caPAHs. The primary contributor to the total hazard index ratio for Scenarios 1, 2, and 3 is ingestion of inorganics in soil. Ingestion of inorganics (antimony, arsenic, cadmium, chromium, copper, manganese, mercury and zinc) in ground water drove the total hazard index ratio for Scenarios 4 and 5.

2.1.2 Site 09 - Fire Fighting Training Area

- Site Description

The Old Fire Fighting Training Area site occupies approximately 5.5 acres at the northern end of Coasters Harbor Island. Current site uses include a child care facility, picnic area, playground and baseball field. The site is characterized by two mounds: a 15-foot high mound in the center of the site and a 6-foot high mound at the western end of the site. The Old Fire Fighting Training Area site was used for fire fighting training exercises from World War II to 1972. A historic (1943) construction drawing indicates that a water/oil mixture may have been piped to two structures referred to as "carrier compartments", where the mixture was

ignited. Underground piping also led from the buildings to an oil/water separator. In 1987, geotechnical borings being completed in anticipation of an expansion of the on-site child-care facility identified the presence of oily subsurface soils at the site. A site map is provided on Figure 3.

- Previous Environmental Investigations

No previous environmental investigations have been conducted at this site. As discussed above, geotechnical borings identified the presence of oil at a depth of 5 feet below the surface in two of these borings.

- Field Investigation Areas and Scope

Areas of potential concern include areas used for former fire fighting training, where residuals of the materials used in the training exercises may exist. Determination of the extent of subsurface contamination, as was previously identified during geotechnical borings completed on-site, was also a priority of these investigations. A site map is provided on Figure 3.

- Phase I - Field Investigation Findings Summary

Soil Assessment - VOCs, BNAs, pesticides, PCBs, and inorganics were all detected in on-site soils. The major areas of the site where contaminants were detected in the soils at elevated levels including the following:

Northern area - VOCs, BNAs, and inorganics;
Central area - VOCs, and inorganics;
Western area - BNAs;
Eastern area - BNAs, caPAHs, and inorganics; and
Southern area (off-site) - BNAs.

Significant VOC contamination (i.e., greater than 1 ppm total VOCs) was detected in subsurface soils at the depth of the water table in the central portion of the site (B-6) and in the north central portion of the site (M-2). In the central portion of the site, detected contaminants were petroleum-related VOCs, while in the northern area, only 2-butanone was detected. Soil samples collected at both of these locations generally exhibited petroleum odors and/or visible oil contamination. BNAs were detected at elevated levels (i.e., greater than 10 ppm total BNAs)

in the northern, western, and eastern portions of the site. The subsurface samples collected from the western portion of the site (at B-7) exhibited a strong petroleum odor. BNAs were also detected at levels greater than 10 ppm at the off-site well boring (M-5). Carcinogenic PAHs were detected at levels greater than 1 ppm, but total BNA concentrations were less than 10 ppm in samples collected from the eastern portion of the site. Pesticides were detected at low levels (i.e., 10's of ppb) in surface soil samples across the site. One surface soil sample exhibited PCBs at 80 ppb, well below the 1 ppm RIDEM PCB soil action level. Inorganics were detected at levels exceeding background levels in soil samples collected throughout the central and eastern portions of the site. The highest inorganic levels were generally detected in subsurface soils collected at well location M-2, in the northern portion of the site, although background inorganic levels were also exceeded at boring B-1.

Ground Water Assessment - VOCs, BNAs, and inorganics were detected in ground water samples. The major areas of the site where contaminants were detected at levels exceeding action levels include the following:

Northern area - BNAs and inorganics;
Central area - inorganics;
Western area - inorganics;
Eastern area - inorganics; and
Southern area (off-site) - inorganics.

VOCs were not detected at concentrations exceeding ground water action levels in any ground water samples. However, at well location MW-4, elevated soil gas readings in the soil, petroleum odors in the soil and ground water samples, and a sheen on the ground water sample indicate a potential for subsurface VOC contamination in this area. Elevated soil gas readings, petroleum odors and/or sheens were also observed in association with other well locations at this site. Four BNA compounds were detected above ground water action levels in one well (MW-2) in the northern portion of the site. A strong petroleum odor and sheen were observed during ground water sampling at this well. No pesticides or PCBs were detected in ground water samples. While inorganic concentrations exceeded ground water action levels in all wells, including the background well, the highest levels of inorganic analytes were detected in wells in the central to northern portions of the site.

- Human Health Assessment

The exposure scenarios considered in the evaluation of the Fire Fighting Training Area included a child care/current use scenario, a recreation/current use scenario, a construction/future use scenario, an industrial/future use scenario, and a residential/future use scenario. The estimated risks, in terms of cancer risk (carcinogenic) and hazard risk (non-carcinogenic) estimates associated with each scenario evaluated and the exposure pathway(s) driving the calculated risks are summarized below:

- Child Care Scenario (Scenario 1) - The mean cancer risk and the hazard index ratio range are within target values. The maximum cancer risk exceeds the target values.

- Recreational Use Scenario (Scenario 2) - The total cancer risk range and total hazard index ratio range are within target values.

- Construction Scenario (Scenario 3) - The total cancer risk range and total hazard index ratio are within target values.

- Commercial/Industrial Use Scenario (Scenario 4) - The total cancer risk range and the hazard index ratio range exceed target values.

- Residential Use Scenario (Scenario 5) - The total cancer risk range and the hazard index ratio range exceed target values for both children and adult receptors.

For Scenarios 1, 2 and 3, the major contributing factor to the calculation of cancer risk is ingestion of arsenic and carcinogenic PAHs in soil. Inhalation of dust and vapor-phase VOCs were not incorporated into the risk calculation for Scenario 1. The pathway of primary concern associated with Scenarios 3 and 4 with respect to cancer risk is ingestion of ground water containing carcinogenic PAHs and inorganics (arsenic). It should be noted that some of the data for both the PAHs and arsenic upon which these risks were calculated was qualified data. Ingestion of soil and house dust and/or inhalation of vapor phase VOCs also contribute to the overall cancer risk for children and adults, while ingestion of 1,1-dichloroethene and beryllium contributes significantly to the ground water ingestion scenario for adults only.

The primary contributor to the total hazard index ratio for Scenarios 1, 2 and 3 is ingestion of soil contaminants. Ingestion of inorganics (arsenic, cadmium, copper, manganese and zinc) in ground water drove the total hazard index ratio for Scenarios 4 and 5. Other

pathways of concern, specifically applicable to exposure of children in the residential use scenario, are ingestion of chemicals in soil and inhalation of vapor phase VOCs.

2.1.3 Site 12 - Tank Farm Four

- Site Description

Tank Farm Four covers approximately 88 acres in area and is located in the northern portion of the NETC facility. The site is located east of Narragansett Bay, with Defense Highway lying between the site and the bay. The site is characterized by the presence of twelve 60,000-barrel underground storage tanks (USTs) and associated pump/valve houses. A paved road provides access to the site, passing between the tank locations in a loop. Other facilities on-site include a small metal building, which was used as an electrical substation, a wooden pole barn currently used for hay storage, and a concrete structure apparently used as an oil-water separator. A brook, Normans Brook, crosses the western corner of the site. Topography generally slopes to the west. The site is vegetated with grass, brush and some trees and is used as a grazing land for cows. Diesel and fuel oil were historically stored at the site in the USTs. Tank bottom sludges totaling 100,000 to 190,000 gallons in volume were reportedly disposed of at the site. A site map is provided on Figure 4.

- Previous Environmental Investigations

The CS conducted at this site included the collection of a near-surface composite soil sample, a surface water sample (expected to be representative of shallow ground water quality), a stream sediment sample, ground water samples, and water samples from six of the twelve USTs. The near-surface soil sample indicated the presence of oil and grease. Petroleum hydrocarbons were detected in the surface water and sediment samples. The water samples collected from the USTs exhibited low concentrations of petroleum hydrocarbons and varied levels of total suspended solids and biochemical oxygen demand. The ground water samples indicated the presence of lead and petroleum hydrocarbons in the ground water. The monitoring wells do not appear to be located directly downgradient of the USTs. Therefore, the full impact of the tanks on ground water quality has not been defined.

- Field Investigation Areas and Scope

Areas of potential concern include the areas surrounding the individual storage tanks, the oil/water separator area, and a demolished unknown structure area, referred to as the ruins.

- Phase I - Field Investigation Findings Summary

Soil Assessment - VOCs, BNAs, pesticides, and inorganics were detected in on-site soils. In general, minimal soil contamination was detected at the site, with the exception of elevated TPH levels detected in surface soils adjacent to the oil/water separator and in a soil boring sample collected along the site access road.

VOCs were detected in three subsurface soil samples at very low levels (i.e., less than 5 ppb) and are not considered to represent significant subsurface VOC contamination. BNAs were not detected at levels greater than the contaminant-comparison level (i.e., greater than 10 ppm total BNAs). Only one soil sample exhibited BNAs at a concentration greater than 1 ppm (3.3 ppm) and that concentration consisted entirely of di-n-butylphthalate. Therefore, BNA soil contamination at this site is not considered to be significant. Pesticides were detected at low levels (i.e., less than 10 ppb) in one surface soil and one subsurface soil sample and are not considered to be significant soil contaminants. No PCBs were detected in soil samples. Inorganics were generally detected at levels less than or slightly exceeding (1 to 7 ppm above) background levels in soil samples. Therefore, there does not appear to be significant inorganic soil contamination at this site. Total petroleum hydrocarbons (TPH) analysis of soil samples identified the presence of TPH across the site, ranging in concentration from 3 to 270 ppm. The highest TPH levels were detected in a subsurface soil sample collected along the site access road (boring M-1) and in a surface soil sample collected from adjacent to the oil/water separator.

Ground Water Assessment - BNAs, and inorganics were detected in ground water samples. Inorganics were detected at levels exceeding action levels in all wells on-site.

VOCs were not detected in any ground water samples, which coincides with their absence in soil samples. One BNA compound, bis(2-ethylhexyl)phthalate (a common laboratory contaminant) was detected in two on-site wells. No ground water action levels were exceeded for BNAs. No pesticides or PCBs were detected in ground water samples. While inorganic concentrations exceeded ground water action levels in both shallow and deep wells, including

the background well, the highest levels of inorganic analytes were detected in wells in the northeast to southwest portions of the site.

Surface Water and Sediment Assessment - VOCs, BNAs, pesticides, and inorganics were detected in sediment samples and VOCs and inorganics were detected in surface water samples.

One VOC, carbon disulfide, was detected in one sediment sample at 21 ppb, which is not considered to be a significant level of sediment contamination. Three BNAs were detected in sediment samples, with a maximum total BNA concentration of 780 ppb, well below the contaminant-comparison level of 1 ppm. One pesticide, 4.4'-DDT was detected in three sediment samples at concentrations of 2.8 to 5.9 ppb. No PCBs were detected in sediment samples. Arsenic, cobalt and iron were the only inorganic analytes detected in soils at levels exceeding background. Higher inorganic concentrations were generally detected in the 0-1 foot sediment sample interval than the 1-2 foot interval.

Two VOCs, carbon disulfide and carbon tetrachloride, were detected in surface water samples. No surface water quality criteria for VOCs were exceeded. No BNAs, pesticides or PCBs were detected in surface water. Cadmium, lead and zinc were the only inorganic analytes detected at levels exceeding surface water quality criteria. The highest levels of inorganic analytes were detected in the surface water sample collected closest to the mouth of Normans Brook, as it enters Narragansett Bay.

Structure Sample Assessment - The distribution of contaminants within the oil/water separator and demolished unknown structure (referred to as the ruins) was as follows:

Oil/water separator -
- Soil: VOCs, BNAs, and inorganics; and
- Sludge: BNAs, PCBs and inorganics.

Ruins -
- Soil/sediment: inorganics; and
- Water: inorganics.

VOCs were detected in the soil/sediment and sludge samples collected from the oil/water separator and from the ruins on-site, although total VOC levels were less than the contaminant-comparison level of 1 ppm. The soil/sediment sample collected from the ruins

exhibited the greatest VOC concentration (680 ppb tetrachloroethene). This sample was visibly contaminated (e.g., odor, sheen). BNAs were detected in the soil/sediment and sludge samples. The sludge sample was the only sample with a total BNA concentration greater than the contaminant-comparison level of 10 ppm and a carcinogenic PAH concentration greater than the contaminant-comparison level of 1 ppm. No pesticides were detected in soil/sediment or sludge samples. A PCB compound was identified in the sludge sample at a concentration of 12 ppb, well below the RIDEM soil action level of 1 ppm. Cobalt and iron were the only inorganics detected at levels exceeding background levels and were only detected in the ruins sample.

No VOCs, BNAs, pesticides, or PCBs were detected in the surface water sample collected from the ruins. Lead and zinc were the only inorganic analytes which were detected in the water sample at levels exceeding surface water quality criteria.

Tank Contents Assessment - The distribution of contaminants within the oil and water samples collected from the on-site tanks was as follows:

Oil: VOCs, BNAs, and inorganics; and
Water: VOCs, BNAs, and inorganics.

VOCs were detected in the oil samples collected from the on-site tanks at very elevated levels. The VOCs consisted of benzene, toluene, ethylbenzene, and xylene. Total VOC levels exceeded 10 ppm in a majority of the tanks. EP Toxicity extraction and analysis of oil samples detected no EP Toxicity analytes; low levels of toluene, ethylbenzene and xylene in a TCL/TAL analysis of the EP Toxicity extraction leachate from one sample. A TCL/TAL analysis of the TCLP extraction leachate from the same oil sample detected concentrations of these compounds at levels three orders of magnitude greater than the EP Toxicity results. BNAs were detected in the oil samples and consisted primarily of PAHs. Total BNA levels in excess of 1,500 ppm were detected in four of the oil samples. Oil samples were not analyzed for pesticides. No PCBs were detected in the oil samples, although detection limits ranged from 12 to 24 ppm. Iron, lead and zinc were the only inorganics detected in greater than 50% of the oil samples. TAL metals analysis of EP Toxicity and TCLP oil leachates identified inorganic analytes. The EP Toxicity extract analyses detected silver and arsenic, analytes which were not detected in the CLP method extract.

VOCs were detected in all of the tank water samples, with total VOC concentrations ranging from 13 to 346 ppb. The main VOC compounds detected included the same VOCs detected in the oil samples. BNAs detected in the water samples consisted of PAH compounds, phenols, phthalate esters and dibenzofuran. Total BNA concentrations ranged from 10 to 202 ppb. Tank water samples were not analyzed for pesticides or PCBs. The inorganics detected in greater than 50% of the tank water samples include barium, calcium, iron, potassium, magnesium, manganese, sodium, lead and zinc. The analyte concentrations in the water samples were typically higher than those detected in the oil samples.

- Human Health Assessment

The exposure scenarios considered in the evaluation of the Tank Farm Four included a trespassing/current use scenario, a construction/future use scenario, an industrial/future use scenario, and a residential/future use scenario. The estimated risks, in terms of cancer risk (carcinogenic) and hazard risk (non- carcinogenic) estimates associated with each scenario evaluated and the exposure pathway(s) driving the calculated risks are summarized below:

- Trespassing Scenario (Scenario 1) - The total cancer risk range and the hazard index ratio range for both adults and children are within target values.
- Construction Scenario (Scenario 2) - The total cancer risk range and total hazard index ratio range are within target values.
- Commercial/Industrial Use Scenario (Scenario 3) - The total cancer risk range and the hazard index ratio range exceed target values.
- Residential Use Scenario (Scenario 4) - The total cancer risk range and the hazard index ratio range exceed target values for both children and adult receptors.

TFM

For Scenarios 1 and 2, the major contributing factor to the calculation of cancer risk is ingestion of soil contaminants (arsenic and PAHs). The pathway of primary concern associated with Scenarios 3 and 4 with respect to cancer risk is ingestion of ground water containing arsenic and beryllium.

The primary contributor to the total hazard index ratio for Scenarios 1 and 2 is ingestion of soil contaminants (arsenic, thallium and antimony). Thallium was not actually detected in the soil but was included in the analysis on the basis of "UJ" data. Ingestion of inorganics (arsenic,

thallium and manganese) in ground water drove the total hazard index ratio for Scenarios 3 and 4. As for soils, thallium was not detected in ground water but was included in the assessment due to "UJ" data.

2.1.4 Site 13 - Tank Farm Five

- Site Description

Tank Farm Five is located in the north-central portion of the facility and is approximately 73 acres in area. The site is located east of Narragansett Bay, with Defense Highway lying between the site and the bay. The site is characterized by the presence of eleven 60,000-barrel USTs and associated pump/valve houses. A paved road provides access to the site, passing between the tank locations in a loop. Other facilities on-site include the new Fire Fighting Training Area, a small metal building, which was used as an electrical substation, and a concrete structure apparently used as an oil-water separator. The Fire Fighting Training Area occupies approximately 3 acres in the northwest portion of the site and is surrounded by a chain-link fence. A brook, Gomes Brook, crosses the northeastern portion of the site. Topography generally slopes to the north. The site is vegetated with grass, brush and some trees. Diesel and fuel oil were historically stored at the site. Tank bottom sludges were reportedly burned on-site in a burning pit. In addition, oil sludge totaling 100,000 to 175,000 gallons in volume was reportedly disposed of at the site. Two of the USTs, Numbers 53 and 56, were used for waste oil storage after the other tanks at the site were taken out of service. A site map is provided on Figure 5.

- Previous Environmental Investigations

While a CS was not conducted at this site, studies of the contents of the USTs and ground water quality adjacent to the USTs during closure investigations provide site information. Sampling of the tank contents included the collection of water samples, surficial floating oil samples, bottom sludge samples and samples of an intervening oil-water emulsion (Tanks 53 and 56). The sample results indicated the presence of aromatic and chlorinated compounds and some metals in the oils contained within Tanks 53 and 56. The sludge samples from these two tanks also exhibited high metals levels. Water samples collected from other tanks indicated that tanks which were not used for waste oil storage also contain water contaminated with chlorinated and

aromatic organic compounds, copper and zinc. Ground water samples collected from wells located adjacent to Tanks 53 and 56 indicated the presence of low levels of metals and high levels of volatile organics. Petroleum product was also identified in the ground water around Tank 53. Downgradient migration of contaminants as well as movement of chlorinated contaminants downward through the water column is indicated by the analytical results.

- Field Investigation Area and Scope

Areas of potential concern include the areas surrounding the individual storage tanks and the oil/water separator area.

- Phase I Field Investigation Findings Summary

Soil Assessment - VOCs, BNAs, pesticides, and inorganics were detected in on-site soils. In general, minimal soil contamination was detected at the site, with the exception of elevated TPH levels detected in surface soils adjacent to the oil/water separator and in a soil boring sample collected along the site access road.

VOCs were detected in surface and subsurface soil samples at very low levels (i.e., less than 10 ppb) and are not considered to represent significant subsurface VOC contamination. BNAs were not detected at levels greater than the contaminant-comparison level (i.e., greater than 10 ppm total BNAs). Only two soil samples exhibited BNAs at a concentration greater that 1 ppm (4.6 and 1.3 ppm) and those concentrations consisted entirely of phthalate esters and PAHs, respectively. Therefore, BNA soil contamination at this site is not considered to be significant. Pesticides were detected at low levels (i.e., 10's of ppb) in two surface soil and one subsurface soil sample and are not considered to be significant soil contaminants. No PCBs were detected in soil samples. Inorganics were generally detected at levels exceeding background levels in subsurface soil samples. Lead was detected above background in one surface soil sample collected from adjacent to the oil/water separator. Total petroleum hydrocarbons (TPH) analysis of soil samples identified the presence of TPH across the site, ranging in concentration from 4 to 60,000 ppm. The highest TPH levels were detected in visibly oily samples collected at Tank 50. Significantly elevated levels of TPH (TPH greater than 100 ppm) were detected in surface soil samples collected at Tanks 49, 50, 51 and 55.

Ground Water Assessment - VOCs, BNAs, and inorganics were detected in ground water samples. VOCs and inorganics were detected at levels exceeding ground water action levels.

VOCs were detected at levels exceeding ground water action levels in only one on-site well (MW-53W) and consisted mainly of petroleum-related VOCs. Petroleum product was also observed in wells MW-53W and MW-53E, both located in the ring drain of Tank 53. The presence of low VOC levels in downgradient well MW-4 indicates the potential migration of the ground water contamination observed adjacent to Tank 53. BNAs were only detected in well MW-53W and consisted entirely of PAHs. Detected levels did not exceed ground water action levels. No pesticides or PCBs were detected in ground water samples. While inorganic concentrations exceeded ground water action levels in all wells, including the background well, the highest levels of inorganic analytes were detected in wells in the central portion of the site.

Surface Water and Sediment Assessment - Lead and TPH were detected in sediment samples; no PCBs, lead or TPH were detected in surface water.

No PCBs were detected in sediment samples. Lead was detected in all sediment samples but at levels less than background soil levels. TPH was detected in sediment samples at concentrations ranging from 4 to 155 ppm, with detected levels increasing with distance downstream.

Structure Sample Assessment - The distribution of contaminants within the oil/water separator was as follows:

Soil: VOCs, BNAs, and inorganics; and
Water: inorganics.

One VOC was detected in one soil sample collected from the oil/water separator at a very low (2 ppb) level. Low levels of two BNAs were detected in one soil sample collected from the oil/water separator. No pesticides or PCBs were detected in soil samples and no inorganics were detected in the soil samples at levels exceeding background levels.

No VOCs, BNAs, pesticides, or PCBs were detected in the surface water sample collected from the oil/water separator. Cadmium was the only inorganic analyte which was detected in the water sample at levels exceeding surface water quality criteria.

Tank Contents Assessment - The distribution of contaminants within the oil and water samples collected from the on-site tanks was as follows:

Oil: VOCs, BNAs, and inorganics; and
Water: VOCs, BNAs, and inorganics.

VOCs were detected in the oil samples collected from the on-site tanks at very elevated levels. The VOCs consisted of petroleum-related hydrocarbons and chlorinated hydrocarbons. Total VOC levels exceeded 100 ppm in a majority of the tanks. BNAs were detected in the oil samples and consisted primarily of PAHs and bis(2-ethylhexyl)phthalate. Total BNA levels in excess of 1,000 ppm were detected in six of the oil samples. Only PAHs were detected in the oil sludge sample. Oil samples were not analyzed for pesticides. No PCBs were detected in the oil samples. Iron and lead were the only inorganics detected in greater than 50% of the oil samples. The EP Toxicity extract analysis detected barium at a level which exceeds the EP Toxicity federal standard.

VOCs were detected in all of the tank water samples, with total VOC concentrations ranging from 2 to 4,917 ppb. The main VOC compounds detected included the same VOCs detected in the oil samples. BNAs detected in the water samples consisted of PAH compounds, phenols, and dibenzofuran. Total BNA concentrations ranged from 31 to 895 ppb. Tank water samples were not analyzed for pesticides or PCBs. The inorganics detected in greater than 50% of the tank water samples include barium, calcium, iron, potassium, magnesium, manganese, and sodium. The analyte concentrations in the water samples were typically higher than those detected in the oil samples.

- Human Health Assessment

The exposure scenarios considered in the evaluation of the Tank Farm Five included a trespassing/current use scenario, an industrial/current use scenario (based on presence of new fire fighting training area on-site), a construction/future use scenario, and a residential/future use scenario. The estimated risks, in terms of cancer risk (carcinogenic) and hazard risk (non-carcinogenic) estimates associated with each scenario evaluated and the exposure pathway(s) driving the calculated risks are summarized below:

- Trespassing Scenario (Scenario 1) - The total cancer risk range and the hazard index ratio range for both adults and children are within target values.

- Commercial/Industrial Use Scenario (Scenario 2) - The total cancer risk range and the hazard index ratio range are within target values.

- Construction Scenario (Scenario 3) - The total cancer risk range and total hazard index ratio range are within target values.

- Residential Use Scenario (Scenario 4) - The total cancer risk range and the hazard index ratio range exceed target values for both children and adult receptors.

For Scenarios 1, 2 and 3, the major contributing factor to the calculation of cancer risk is ingestion of soil contaminants (arsenic and PAHs). The pathway of primary concern associated with Scenario 4 with respect to cancer risk is ingestion of ground water containing VOCs, arsenic, and beryllium.

The primary contributor to the total hazard index ratio for Scenarios 1, 2 and 3 is ingestion of soil contaminants (thallium, arsenic, antimony and/or mercury). Thallium was not actually detected in the soil but was included in the analysis on the basis of "UJ" data, while arsenic was detected at only one location. Ingestion of inorganics (arsenic, chromium and manganese) in ground water drove the total hazard index ratio for Scenario 4. BNAs also contributed to the total hazard index but their presence was based solely on "UJ" data.

2.2 Summary of Data by Medium

All analytical data will be initially sorted by media (surface soil, subsurface soil, ground water, etc.). Background sampling data will be included in the data tables and used to identify naturally occurring levels of inorganics in environmental media. These data will indicate whether concentrations of inorganics found on-site are elevated.

2.3 Selection of Chemicals of Concern

Chemicals of potential concern (COCs) from Phase I will be re-evaluated in light of Phase II data, and based on presence in a matrix, frequency of detection, concentration, location of detected samples, chemical fate and transport considerations, and the chemical's potential to produce toxic effects. COCs will be selected qualitatively, with the goals being to include those chemicals which could contribute most to the overall risk while at the same time keeping the size of the assessment manageable. Exclusion of any chemicals from the list of COCs will be clearly justified and based upon USEPA guidance.

3.0 CONTAMINANT FATE AND TRANSPORT

This section of the risk assessment will re-evaluate the fate and transport of contaminants as described in Phase I and provide an indication of future contaminant movement.

3.1 Potential Routes of Migration

To determine the fate of contaminants of potential concern at the NETC-Newport sites, information on the physical/chemical and environmental fate properties provided in Phase I will be updated when appropriate. Evaluation of off-site migration pathways will also be provided.

3.2 Contaminant Distribution and Observed Migration

This section of the contaminant fate and transport analysis will examine the presence of contaminants across each site in combination with migration pathways to provide an understanding of contaminant persistence and migration at each site.

4.0 EXPOSURE ASSESSMENT

4.1 Development of Exposure Scenarios (General)

The Exposure Assessment initially involves the characterization of the exposure setting of the site, including the physical environment and the potentially exposed populations. Exposure pathways are then identified. Included in this assessment is a consideration of both existing and potential future exposure scenarios based on current and potential future land use. Contaminant sources, receiving media, the fate and transport of the contaminants within the receiving media, and exposure points and exposure routes are evaluated and the information integrated in the development of potential exposure scenarios. Exposure concentrations are estimated for the various media included in the potential exposure pathways. Chemical intakes are estimated by exposure medium and exposure route based on equations provided in the guidance documents.

4.2 Exposure Scenarios Addressed in the Health Assessment

Based on information contained within the Phase I Risk Assessment document, potentials for human exposure exist via the following media:

surface soils;
subsurface soils;
ground water;
sediments;
seeps/leachate;
surface water;
air; and
shellfish.

Surface and subsurface soil exposure pathways at the NETC-Newport sites are limited to direct contact exposures (dermal exposure and incidental soil ingestion). Ground water exposures are limited by the absence of drinking water wells at the NETC-Newport facility. Off-site potable wells have not been identified in areas thought to be downgradient of NETC-Newport sites.

While ground water does not pose a current exposure pathway, potential future residential use of the ground water will be considered where ground water data has been collected during

either Phase I or II investigations and where the designated best beneficial use of the ground water is as a drinking water source.

Sediments and/or seep samples were collected during the Phase I RI. Exposure to these media were evaluated on a site-specific basis. A similar approach will be used in the Phase II Human Health Evaluation. Sampling of surface water bodies will be conducted during the Phase II Remedial Investigations. The analytical results will be reviewed for potential inclusion in the Phase II Human Health Evaluation exposure scenarios.

No air sampling will be conducted during the Phase II RI. The presence of pavement or vegetation over most of the areas under investigation limit potential exposures to wind-blown particles and the length of time wastes have been in-place minimize potential contaminant volatilization. Exposure to contamination during future excavation activities will be considered through modeling exercises, if appropriate to the future site uses evaluated. Also indoor air will be evaluated with respect to dust or volatilization of contaminants during bathing, showering or cooking, if applicable under future site use scenarios.

Exposure to contaminants via shellfish ingestion was not evaluated in the Phase I Risk Assessment. The potential for exposure to contaminated shellfish will be reevaluated within this assessment. Bivalves will be collected from Narragansett Bay to determine tissue burden, while modeled bioconcentration will be determined for fish and lobster. This information will be available for use in the Human Health Evaluation to establish exposures to contaminants in shellfish.

Potential receptors will be identified on the basis of current site use, surrounding land use, the presence or absence of site access restrictions and/or field observations of site use. Potential future receptors will be identified on the basis of future land use expectations. The expansion of residential development onto Navy property will be considered.

The following potential routes of exposure will be evaluated to determine their applicability to the sites under investigation and the associated exposure scenarios:

Dermal contact with soil/sediments;
Incidental ingestion of soil/sediments;
Dermal contact with surface water;
Incidental ingestion of surface water;
Ingestion of ground water;
Inhalation of airborne (vapor phase) contaminants;
Inhalation of particulate phase contaminants; and

Ingestion of contaminated shellfish.

Exposure scenarios will be developed on a site-specific basis. Typical scenarios which are considered include current site use/base worker; current site use/trespasser; future site use/construction; future site use/industrial; future site use/residential. Receptors will be identified for each scenario (e.g., current site use/base worker would consider adult receptors; future site use/residential would consider adult and child receptors). Exposure parameters will be based on EPA Region I Risk Assessment Guidance and USEPA's Human Health Evaluation Manual - Supplemental Guidance: "Standard Default Exposure Factors" (OSWER Directive 9285.6-03) in combination with site-specific exposure considerations.

4.3 Estimating Environmental Concentrations

All exposure point concentrations used to assess receptor dose will be calculated as specified in "Supplemental Risk Assessment Guidance for the Superfund Program, Part 1 and 2" (EPA/901/5-89-001; June 1989). Specifically, the exposure point concentration will be calculated using the geometric or arithmetic mean method, depending on the distribution of site data.

4.4 Estimating Exposure Doses

The equations used in the Phase I risk assessment to estimate exposure doses via the modeled exposure pathways, will be incorporated into the Phase II assessment. The basic parameters common to all pathways in calculating the exposure dose are chemical concentration in the medium contacted, amount of medium contacted (e.g., ingested, adhered to skin) per day of exposure, frequency of exposure, duration of exposure, absorption factor specific for the pathway and chemical, body weight of the human receptor, and the time period over which exposure is averaged. Both the mean and maximum detected concentrations will be used as exposure point concentrations in estimating exposure doses.

4.5 Evaluating Uncertainty

Uncertainty associated with contaminant concentrations, exposure point concentrations and exposure assumptions will be discussed. The exposure estimates for each receptor in each

scenario will be based on numerous variables with varying degrees of uncertainty. This discussion will focus on these parameters and the associated range of uncertainty.

5.0 TOXICITY ASSESSMENT

Conducted simultaneously with the Exposure Assessment, the Toxicity Assessment evaluates the toxicity of the chemicals of concern through hazard identification and dose-response evaluation. Hazard identification is the process of determining if exposure to a chemical can cause an increase in the incidence of a particular adverse effect (e.g., cancer) and whether the adverse effect is likely to occur in humans. EPA uses a dose-response evaluation to derive toxicity values. This evaluation is the process of quantitatively evaluating the toxicity information and characterizing the relationship between the dose of the contaminant and the incidence of adverse health effects in the exposed population. This evaluation allows the derivation of toxicity values (e.g., reference doses and slope factors) that can be used to estimate the incidence or potential for adverse health effects as a function of human exposure.

Toxicity information will be obtained from scientific literature and EPA's Integrated Risk Information (IRIS) on-line data base. Health criteria will be obtained from the following sources, listed in descending order of use:

- IRIS;
- Health Effects Assessment Summary Tables;
- EPA Criteria Documents;
- Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profiles; and
- Communication with EPA's Environmental Criteria and Assessment Office (ECAO) via EPA Region I Risk Assessment contact.

5.1 Carcinogenic Effects

Carcinogenic human health risks will be estimated using the slope factor (or cancer potency factor), if available, for each contaminant of concern. The slope factor is generally defined as the upper 95 percent confidence limit of the slope of the dose-response curve and is the result of the application of a low-dose extrapolation procedure. A no threshold linear dose-response model is assumed. Certain compounds, such as PAHs and PCBs, may be grouped together for evaluating health risks. This method assumes that the carcinogenic effects are additive and that structurally similar compounds have the same potency.

5.2 Noncarcinogenic Effects

Noncarcinogenic human health risks will be evaluated by analyzing exposures as either being chronic (7 years to lifetime duration) or subchronic (2 weeks to 7 years duration). The chronic or subchronic reference dose (RfD) is used depending upon the estimated period of exposure. An example of an exposure utilizing a subchronic RfD is future construction or development of the site. Workers are expected to be exposed for less than a six year period. The reference dose is defined as an estimate of a daily exposure concentration for the human population over a lifetime, including sensitive subpopulations, that is likely to be without an adverse health effect. The RfD is commonly derived from the No Observable Adverse Effects Level (NOAEL) or the Lowest Observable Adverse Effects Level (LOAEL). No dermal RfDs currently exist, therefore, for dermal exposure calculations, oral RfDs will be applied, when appropriate.

5.3 Toxicity Information

For each of the COCs, a brief summary of the known toxic effects will be presented. These summaries will include the effects associated with exposure to the chemical and the concentrations at which adverse effects are expected to occur in humans, if available. Additional information will also be presented, including but not limited to the following: the chemical and physical properties of the chemical; fate and transport characteristics; and a discussion of critical studies which describe the noncarcinogenic and carcinogenic effects of the chemical.

6.0 RISK CHARACTERIZATION

Risk Characterization integrates all information previously developed in the Human Health Evaluation to characterize potential risks posed by the site. The exposure pathways are evaluated with respect to the toxicity information and pathway risks are quantified for each substance and are totalled for each pathway. Based on available toxicity and exposure information, cancer risks and noncancer hazard quotients are estimated. Risks are combined across pathways to estimate the total risk posed to a receptor over a given time period. Because there are many uncertainties involved in the estimation of cancer and non-cancer risks, an assessment of site-specific factors and toxicity factors which contribute to the uncertainty of the evaluation is presented.

6.1 Quantitative Risk Assessment

Carcinogenic Risk

The incremental carcinogenic risk associated with exposure to a given contaminant will be calculated by multiplying the slope factor by the dose. Cancer risk is unitless and is expressed in scientific notation. For example, a risk of 1E-06 indicates that an individual has one chance in 1,000,000 of developing cancer over a lifetime.

Incremental carcinogenic risks will be calculated for each contaminant of concern and exposure pathway. Risk values will be summed by pathway to provide total pathway-specific risks. Risk estimates will be compared against the NCP's cleanup goal for Superfund sites, set at a target risk range of 1E-04 to 1E-06.

Noncarcinogenic Risks

Potential noncarcinogenic effects are expressed as the Hazard Index, the ratio of the exposure dose to the reference dose. A Hazard Index that exceeds unity suggests a greater likelihood of developing an adverse effect.

Hazard quotients will be calculated for each contaminant and will then be summed to provide an indication of the pathway-specific exposure hazard. If hazard indices exceed unity, contaminants will be grouped by target organ (systemic effect) to further analyze potential for an adverse effect.

6.2 Qualitative Analysis of Risks

Selected compounds will be addressed qualitatively rather than quantitatively because these compounds lack cancer slope factors or RfD values. The potential impact associated with the omission of these compounds from the quantitative risk assessment will be discussed.

6.3 Uncertainty Assessment

Uncertainties associated with the risk characterization may include uncertainty surrounding cancer or non-cancer risk. Site-specific factors might include uncertainty associated with conditional land usage, activity patterns or exclusion of contaminants from the risk assessment. For the risk estimation of cancer and of chronic non-cancer health effects, risk are summated across pathways to yield total pathway risk. This may well be a conservative approach, since, in general, different chemicals do not have the same target organ or mechanism of action. This uncertainty will be provided in the Phase II risk assessment.

7.0 UNCERTAINTIES/LIMITATIONS

Uncertainties and/or limitations inherent in the risk assessment will be presented in the Phase II assessment. Potential areas of uncertainty include, but may not be limited to:

- Site specific uncertainty. Site-specific factors might include uncertainty associated with conditional land usage, activity patterns or exclusion of contaminants from the risk assessment.

- Uncertainty in the derivation of toxicity factors. In numerous cases in which a toxicity value is available for one exposure route but not another, a dose route extrapolation will be performed, leading to a source of uncertainty in the risk characterization.

TABLES

TABLE 1

PLANNED HUMAN HEALTH ASSESSMENT REPORT FORMAT
NETC - NEWPORT

EXECUTIVE SUMMARY

1.0 Introduction
- 1.1 Objectives
- 1.2 Methodology

2.0 Identification of Chemicals of Potential Concern
- 2.1 Data Collection
- 2.2 Data Evaluation
- 2.3 Summary of Data by Medium
- 2.4 Selection of Chemicals of Concern

3.0 Contaminant Fate and Transport
- 3.1 Potential Routes of Migration
- 3.2 Contaminant Distribution and Observed Migration

4.0 Exposure Assessment
- 4.1 Development of Exposure Scenarios (General)
- 4.2 Exposure Scenarios Addressed in the Health Assessment
- 4.3 Estimating Environmental Concentrations
- 4.4 Evaluating Uncertainty

5.0 Toxicity Assessment

6.0 Risk Characterization
- 6.1 Quantitative Risk Assessment
- 6.2 Qualitative Analysis of Risks
- 6.3 Uncertainty Assessment

7.0 Uncertainties/Limitations

8.0 References

APPENDICES

A. Risk Assessment Methods and Results
B. Toxicological Profiles
C. Physical/Chemical and Environmental Fate Properties

TABLE 2

SITE 01 - PHASE I

CONTAMINANTS OF CONCERN[1]

SOIL	GROUNDWATER
Semivolatiles	Semivolatiles
Carcinogenic PAHs	Carcinogenic PAHs (UJ)
3,3-Dichlorobenzenidine (UJ)	Naphthalene
	3,3-Dichlorobenzenidine (UJ)
	2-Methylnaphthalene
	1,4-Dichlorobenzene
Inorganics	Inorganics
Antimony	Antimony
Arsenic	Arsenic
Beryllium	Beryllium
Copper	Cadmium
Lead	Chromium
Zinc	Copper
	Lead
	Manganese
	Mercury
	Zinc
Volatiles	Volatiles
	Benzene
	Bromodichloromethane (UJ)
	Carbon Tetrachloride (UJ)
	Chloroform (UJ)
	Dibromochloromethane (UJ)
	1,1-Dichloroethene (UJ)
	1,2-Dichloroethene (UJ)
	1,2-Dichloropropane (UJ)
	Ethylbenzene
	Styrene (UJ)
	1,1,2,2-Tetrachloroethane (UJ)
	Tetrachloroethene (UJ)
	Toluene

[1] Chemicals placed on the Contaminant of Concern list as a result of the UJ data and lacking confirmed detected concentrations, are indicated by UJ.

TABLE 2
(Continued)

SITE 01 - PHASE I

CONTAMINANTS OF CONCERN

SOIL	GROUNDWATER
Volatiles	Volatiles
	1,1,2-Trichloroethane (UJ)
	Vinyl Chloride (UJ)
	Xylene

TABLE 3

SITE 09 - PHASE I

CONTAMINANTS OF CONCERN[2]

SOIL	GROUND WATER
Volatiles	Volatiles
	Benzene (UJ) Chloroform Chloromethane (UJ) 1,1-Dichloroethene (UJ) Styrene (UJ) 1,1,2,2-Tetrachloroethane (UJ) Tetrachloroethene (UJ) Vinyl Chloride (UJ)
Semivolatiles	Semivolatiles
Carcinogenic PAHs	Acenaphthylene(UJ) Carcinogenic PAHs Dibenzofuran Naphthalene (UJ) Phenanthrene
Inorganics	Inorganics
Arsenic Beryllium	Antimony Arsenic Beryllium Cadmium Chromium Copper Manganese Mercury Zinc

[2] Chemicals placed on the Contaminant of Concern list as a result of the UJ data and lacking confirmed detected concentrations, are indicated by UJ.

TABLE 4

SITE 12 - PHASE I

CONTAMINANTS OF CONCERN[3]

SOIL	GROUND WATER
Semivolatiles	Semivolatiles
Carcinogenic PAHs	3,3-Dichlorobenzenidine (UJ)
Inorganics	Inorganics
Arsenic	Arsenic
Beryllium	Beryllium
	Chromium
	Copper
	Manganese
	Selenium
	Silver
	Thallium (UJ)
	Vanadium
	Zinc

[3] Chemicals placed on the Contaminant of Concern list as a result of the UJ data and lacking confirmed detected concentrations, are indicated by UJ.

TABLE 5

SITE 13 - PHASE I

CONTAMINANTS OF CONCERN[4]

SOIL	GROUND WATER
Semivolatiles	Semivolatiles
Carcinogenic PAHs	Bis(2-chloroethyl)ether (UJ) Carcinogenic PAHs (UJ) 1,4-Dichlorobenzene (UJ) 3,3-Dichlorobenzenidine (UJ) 2,4-Dinitrotoluene (UJ) 2,6-Dinitrotoluene (UJ) Hexachlorobenzene (UJ) Hexachlorobutadiene (UJ) Hexachloroethane (UJ) N-nitroso-di-n-propylamine (UJ)
Inorganics	Inorganics
Arsenic Antimony Mercury	Arsenic Beryllium Chromium Manganese Thallium
Volatiles	Volatiles
	1,2-Dichloroethene Ethylbenzene Tetrachloroethene Trichloroethene Toluene Xylene

[4] Chemicals placed on the Contaminant of Concern list as a result of the UJ data and lacking confirmed detected concentrations, are indicated by UJ.

FIGURES

RISK ASSESSMENT PLAN -
HUMAN HEALTH EVALUATION

FIGURE 1 NETC - SITE LOCATION MAP

FIGURE 2 SITE 01: MCALLISTER POINT LANDFILL

FIGURE 3 SITE 09: OLD FIRE FIGHTING TRAINING AREA

FIGURE 4 SITE 12: TANK FARM FOUR

FIGURE 5 SITE 13: TANK FARM FIVE

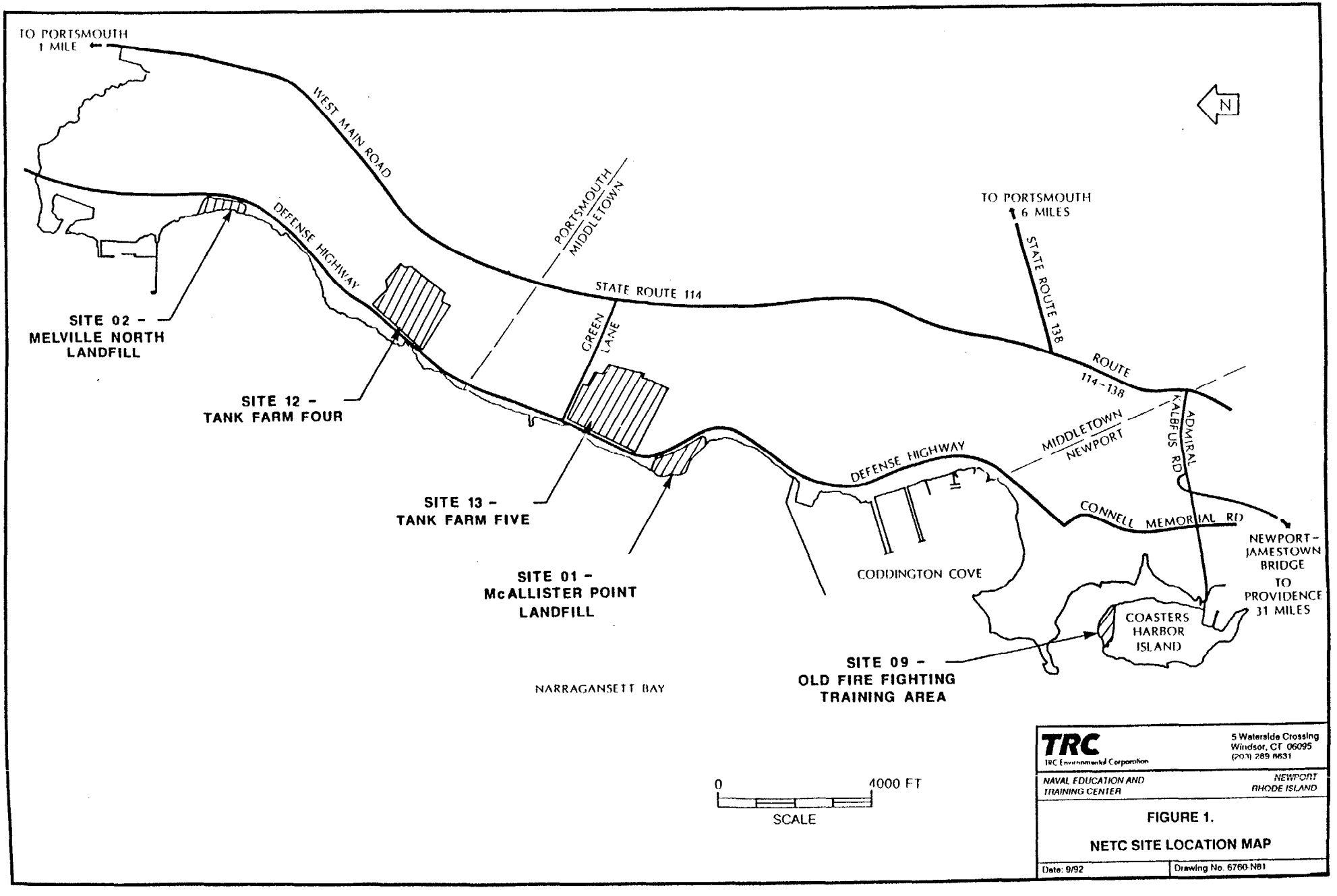

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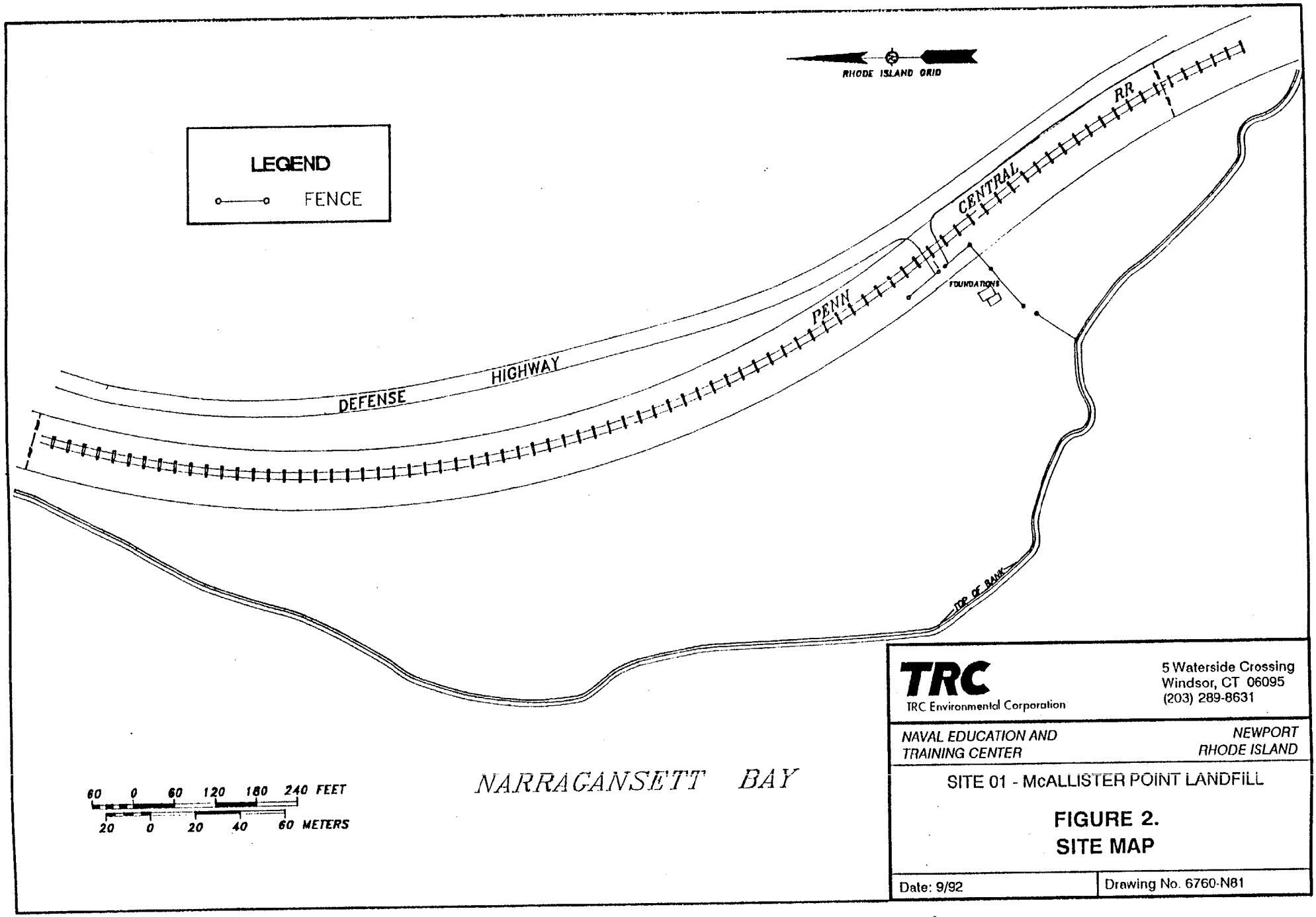
FIGURE 1.

NETC SITE LOCATION MAP

Date: 9/92
Drawing No. 6760-N81


RHODE ISLAND GRID
LEGEND
FENCE
DEFENSE HIGHWAY
PENN CENTRAL RR
FOUNDATIONS
TOP OF BANK
NARRAGANSETT BAY
60 0 60 120 180 240 FEET
20 0 20 40 60 METERS
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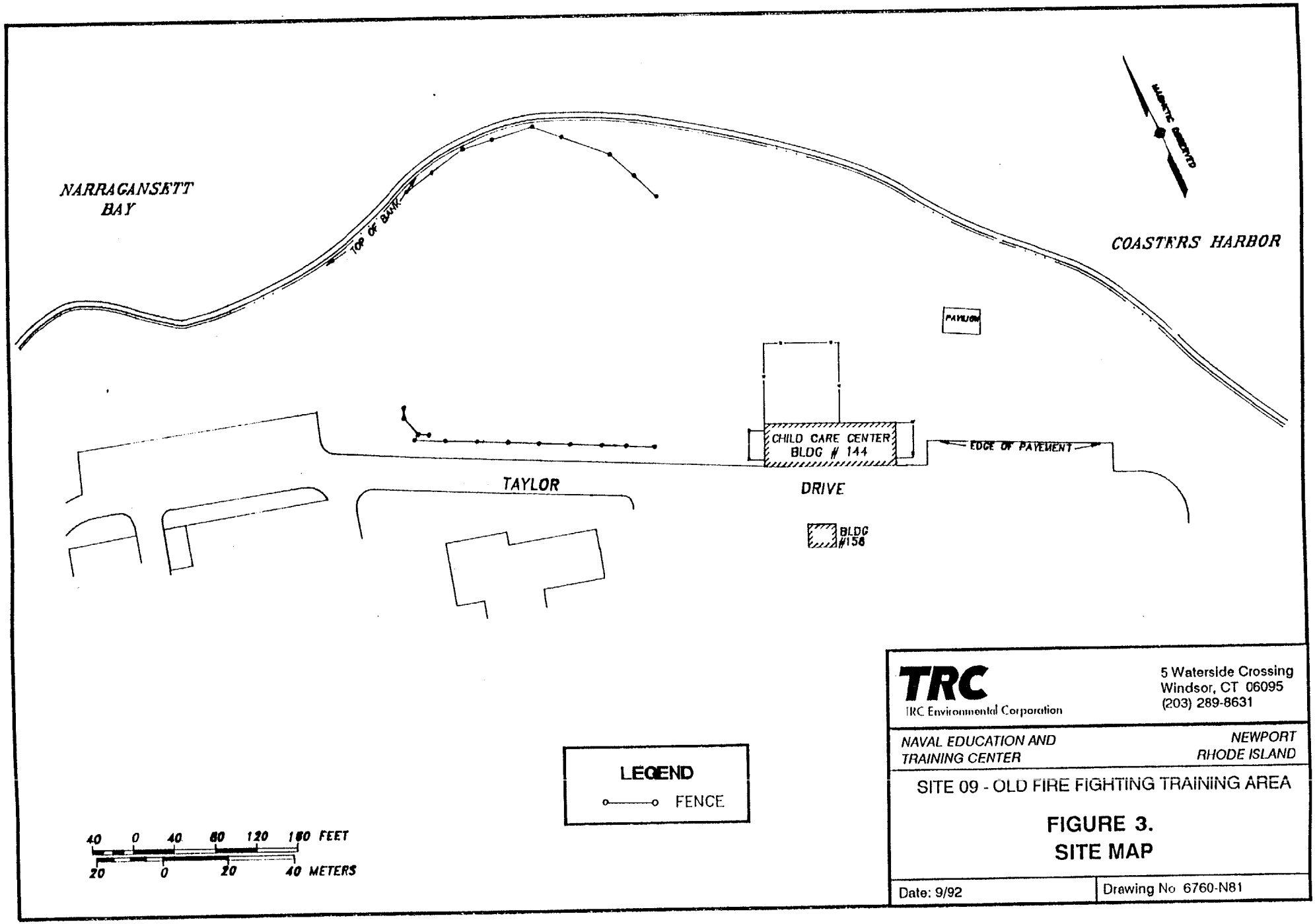
Windsor, CT 06095
(203) 289-8631
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT RHODE ISLAND
SITE 01 - McALLISTER POINT LANDFILL
FIGURE 2.
SITE MAP
Date: 9/92
Drawing No. 6760-N81


NARRAGANSETT BAY
TOP OF BANK
COASTERS HARBOR
MAGNETIC DIRECTION
PAVILION
CHILD CARE CENTER
BLDG # 144
EDGE OF PAVEMENT
TAYLOR
DRIVE
BLDG #158
LEGEND
FENCE
40 0 40 80 120 160 FEET
20 0 20 40 METERS
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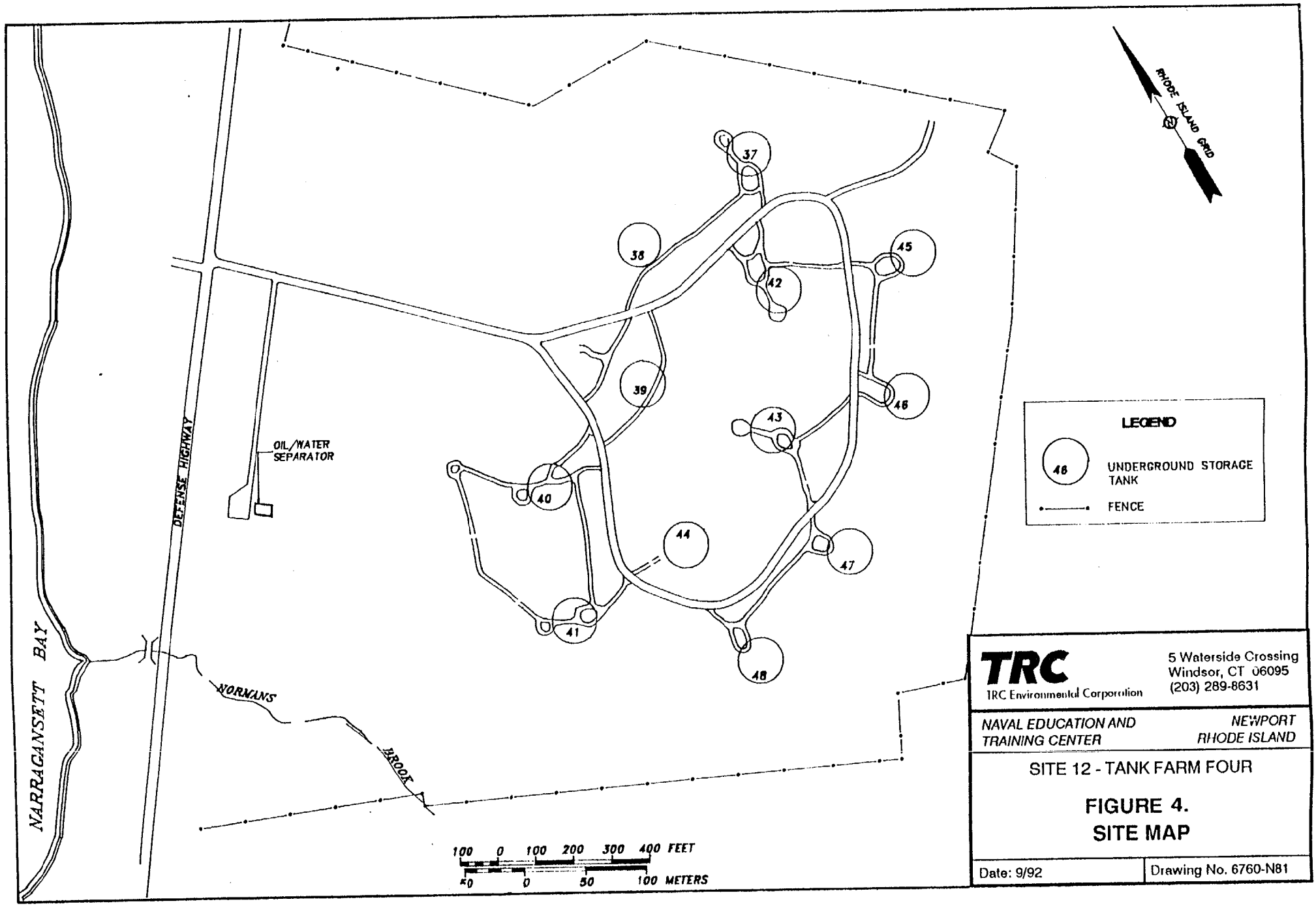
SITE 09 - OLD FIRE FIGHTING TRAINING AREA
FIGURE 3.
SITE MAP
Date: 9/92
Drawing No 6760-N81


NARRAGANSETT BAY
DEFENSE HIGHWAY
OIL/WATER SEPARATOR
NORMANS BROOK
37
38
39
40
41
42
43
44
45
46
47
48
RHODE ISLAND GRID
LEGEND
UNDERGROUND STORAGE TANK
FENCE
100 0 100 200 300 400 FEET
50 0 50 100 METERS
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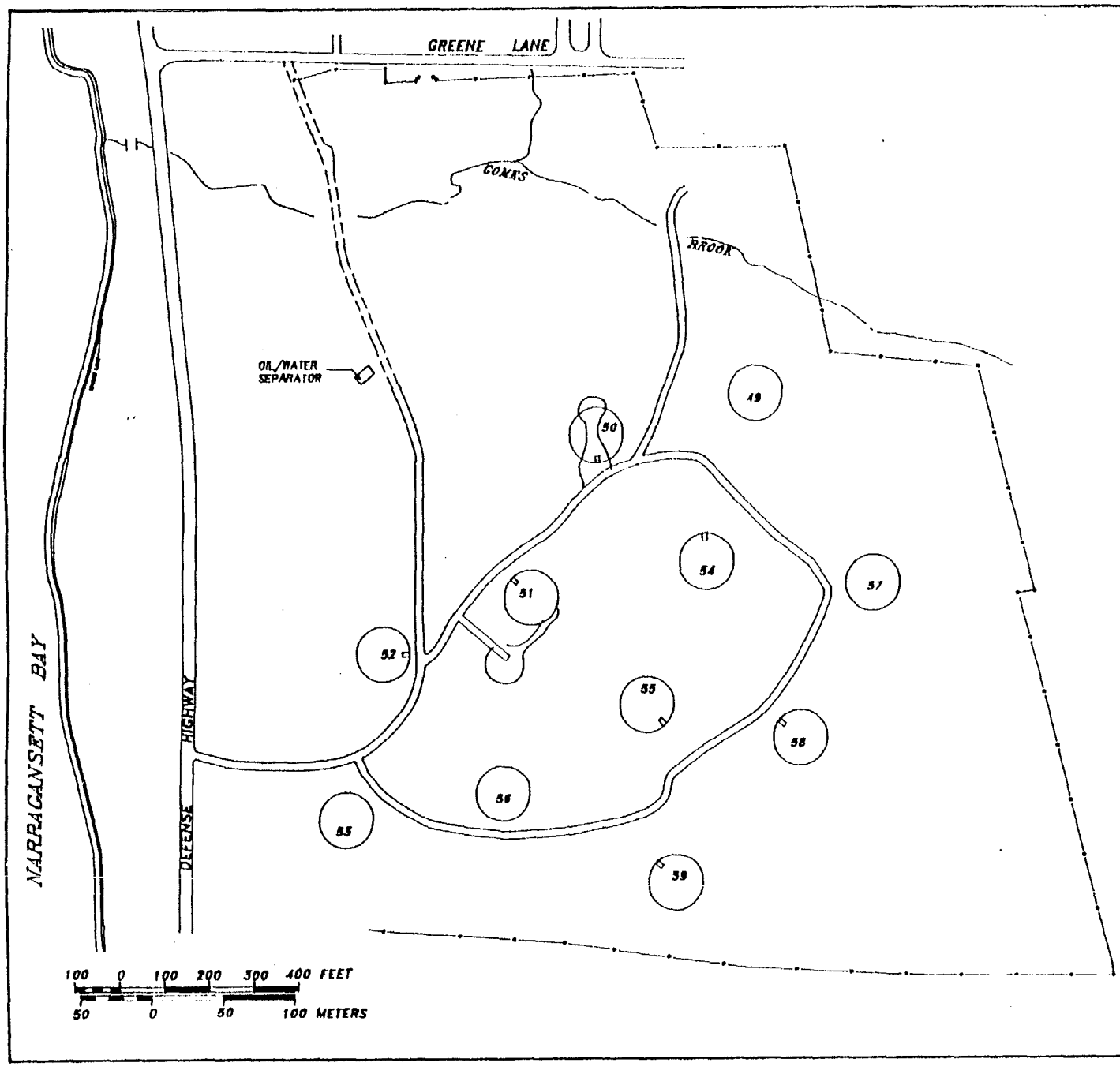
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT RHODE ISLAND
SITE 12 - TANK FARM FOUR
FIGURE 4.
SITE MAP
Date: 9/92
Drawing No. 6760-N81



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SITE 13 - TANK FARM FIVE

FIGURE 5.
SITE MAP

Date: 9/92

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U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

VOLUME VI
RISK ASSESSMENT PLAN - ECOLOGICAL EVALUATION

PHASE II RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared by:
TRC Environmental Corporation
Windsor, Connecticut

Prepared for:
Northern Division - Naval Facilities
Engineering Command
Lester, Pennsylvania

March, 1993

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Contract No. N62472-86-C-1282

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1.0 INTRODUCTION

This document is an Ecological Assessment Plan for four RI/FS sites at the Naval Education and Training Center (NETC) in Newport, Rhode Island. These sites are: Site 01 - McAllister Point Landfill; Site 09 - Old Fire Fighting Training Area; Site 12 - Tank Farm Four; Site 13 - Tank Farm Five. This plan briefly describes the work completed to date and the additional work planned as part of the Environmental Evaluation. The Environmental Evaluation will be conducted according to the EPA guidance document Risk Assessment Guidance for Superfund, Volume II Environmental Evaluation Manual (U.S. EPA, 1989), guidance developed by EPA Region I in their Supplemental Risk Assessment Guidance for the Superfund Program, and ECO Update - Ecological Assessment of Superfund Sites: An Overview (U.S. EPA, 1991). The recent ECO Update provides an overview of the structure of an Ecological Assessment (Figure 1) and the role of the assessment in the RI/FS Process (Figure 2).

The overall objective of the planned Ecological Assessment is to provide a qualitative and quantitative assessment of the environmental risks and/or impacts associated with conditions at the four NETC sites (collectively referred to as "the sites" for the purposes of this document). These conditions include the presence of chemical contaminants in soil and groundwater and the potential that some of these chemicals are reaching adjacent streams, wetlands, or marine environments (Narrangansett Bay). Thus, the assessment will consider ecological components within freshwater, marine, wetland, and terrestrial environments.

The specific objectives of the overall assessment will be to:

- Identify ecological components or species (e.g., birds, mammals, wetland vegetation, marine organisms) that may be exposed to chemicals associated with existing conditions at the site;
- Select endpoints of concern (e.g., reproduction, survival);
- Identify the pathways and routes by which ecological components may be exposed to the chemicals;
- Measure or estimate exposure point concentrations;

- Develop information on the toxic effects of the chemicals;
- Characterize the environmental risks associated with the exposure under current and future conditions;
- Assess the uncertainties associated with the estimates; and,
- Discuss the ecological significance of the findings.

The Ecological Assessment will use a "weight of evidence" approach which includes direct field observations, selected field and laboratory studies, and evaluation of chemical analytical data relative to environmental benchmarks. When integrated into the overall assessment, these methods will provide a perspective on the nature of ecological risks at the site.

This document follows the organization suggested in with the recent Eco Update (U.S. EPA, 1991) but, also includes all elements of an assessment as identified in the U.S. EPA Region I Supplemental Risk Assessment Guidance for the Superfund Program. The Region I guidance includes: definition of objectives, site characterization, and potential receptors, selection of chemicals, species, and endpoints for risk assessment, exposure assessment, toxicity assessment, and risk characterization.

This Ecological Assessment Plan has six major sections.

- Background and Site Description - This section provides a brief overview of the site and describes what is known concerning the extent of contamination in relation to ecological components. It is a basis for identifying important aspects of the site and data needed to complete the assessment.

- Plan for Site Characterization - This section describes how the site will be characterized relative to ecological components (receptors), presence of contaminants in media to which the components may be exposed, and potential for migration of contaminants. Such information is important for all parts of the Ecological Assessment but specifically will be used in the *Problem Formulation* component (Figure 1).

  The site characterization section also describes the surveys that will be carried out to provide information on the non-marine habitats located at the site.

- Plan for Problem Formulation - This part of the assessment plan describes the activities that will identify: contaminants of ecological concern; ecological components (receptors) for evaluation; endpoints of concern; exposure pathways; and, known effects. The *Problem Formulation* will provide the basis for proceeding with the subsequent portions of the Ecological Assessment.

- Plan for Exposure Assessment - This section of the assessment plan describes the general approach to be used to complete the exposure assessment. Specific methods will depend on the results of the Site Characterization and Problem Formulation.

- Plan for Ecological Effects Assessment - This section describes the approach that will be used to develop Information on the toxicity of the contaminants to environmental components.

- Plan for Risk Characterization: This section describes the general methods that will be used to make qualitative and quantitative characterizations of risk. This section will also indicate how uncertainties will be characterized.

2.0 BACKGROUND AND SITE DESCRIPTION

2.1 Introduction

The Naval Education and Training Center (NETC) occupies approximately 1,431 acres on the west shore of Aquidneck Island in Narragansett Bay. The NETC is spread out along nearly six miles of the shoreline in the towns of Newport, Middletown and Portsmouth, Rhode Island.

Navy operations at the site began during the Civil War. Activities at the base have fluctuated over the years, and recent consolidation of Naval forces has lead to reductions in numbers of on-site Navy personnel and in the size of the base itself. Much of the original acreage has been excessed or leased.

Environmental investigations at the NETC began under the Navy Assessment and Control of Installation Pollutants (NACIP) program with an Initial Assessment Study (IAS) conducted in 1982 and 1983 by Envirodyne Engineers. Six potentially contaminated areas were identified during this study, and investigated during the subsequent Confirmation Study conducted over the period from 1983 to 1986 by Loureiro Engineering Associates. Additional environmental investigations at the site have been completed in conjunction with tank closure plans.

A Remedial Investigation (RI) of the site has recently been completed by TRC Environmental Consultants working under the Department of Defense Installation Restoration (IR) Program. The four areas studied during the RI and which are addressed in this work plan are the following:

- Site 01 - McAllister Point Landfill
- Site 09 - Old Fire Fighting Training Area
- Site 12 - Tank Farm Four
- Site 13 - Tank Farm Five

The locations of these sites and the overall layout of the NETC are shown on Figure 3.

2.2 Site Description

2.2.1. Hydrogeology

The local geology is characterized by an overburden of glacial deposits which range from 1 foot to 50 feet thick. Most of the glacial deposits are till, but some isolated outwash areas are present.

Surface elevations range from near mean sea level to 175 feet. Many areas have low elevations which are susceptible to flooding during storm surges. Ninety percent of the land has slopes of 0 to 9 percent.

The site is located within the Narragansett Bay drainage basin. All surface water drainage from the basin is into the Bay. At the site, drainage is provided by several brooks and streams.

Groundwater is found at depths from less than 1 foot to about 30 feet. The average depth to groundwater is 14 feet. Groundwater at the site flows toward streams or directly into the Bay.

2.2.2 Regional Habitats

Terrestrial Systems

Review of site history indicates that there are no areas on the site that have not been at one time or another disturbed by base operations.

Upland vegetation in much of the site is restricted primarily to perennial weeds and grasses. Upland trees occur near residences, drainageways and around the tank farms and on McAllister Point landfill.

Stream And Wetland Systems

There are two freshwater streams and associated wetland systems within the boundaries of the four sites addressed in this workplan and one salt marsh wetland system. The two freshwater systems are: Normans Brook (Tank Farm Four) and Gomes Brook (Tank Farm Five).

Offshore Marine Systems

The NETC is located along the shoreline of Narragansett Bay. The boundaries of the McAllister Point Landfill and the Old Fire Fighting Training Area extend right to the shoreline. The western boundaries of Tank Farm Four and Tank Farm Five are separated from the shoreline by Defense Highway.

2.3 Contaminant Characterization

The following sections describe the four sites addressed in this workplan and summarize the results of the previous investigations completed at them.

2.3.1 Site 01 - McAllister Point Landfill

The McAllister Point Landfill is approximately 11.5 acres and is between Defense Highway and Narragansett Bay in the central portion of the NETC facility. The site is mounded in its central to north-central portion and is flat at the northern and southern ends. The site elevation is approximately 15 to 35 feet above mean low water level. The western edge of the site drops steeply to the shoreline.

The area is vegetated with grass, weeds and some small trees. A small, lightly wooded areas is present at the northern end of the mounded area. A more mature wooded area is present near the northeastern edge of the site between the railroad tracks and Defense Highway.

Groundwater flow direction at the site is from east to west, toward Narragansett Bay. The groundwater is tidally influenced.

The site generally slopes in an east-west direction. During periods of heavy rain, ponded water forms in a small depression in the north-central portion of the site. The western edge of the site bordering Narragansett Bay is characterized by a steep slope to the shoreline. Springs have been observed discharging from the bottom of the landfill bank into the Bay.

The landfill was in operation for twenty years from 1955 to the mid-1970's. Historically, the landfill received barrels containing liquid wastes, including paints and oils, and at least two transformers containing PCBs, along with domestic wastes. A waste

incinerator operated at the site from 1965 into the early 1970's, with ash residue disposed of on site. Wastes were placed on top of the bedrock. Throughout the period of its use, the landfill was extended into the Bay using wastes as fill. The site was subject to periodic flooding until the elevation of the site was increased with the fill. The total depth of waste materials at the landfill varies in depth from 3-24 feet. The landfill was closed (1973) with a three-foot thick soil cap. This cap currently varies from 0-4 feet in thickness over the site.

The site was investigated in the IAS and the CS. Results indicated that low levels of contamination may be associated with the landfill cap material. Samples from the leachate springs exhibited metals, cyanide, phenol, and some organic constituents.

Sediment and mussel samples indicated the presence of inorganic contaminants in areas adjacent to the site, especially near the southern end of the landfill, with levels decreasing with distance from the site. However, PCB contamination detected in mussel samples appeared to be attributable to area-wide contamination, on the basis of background samples. Ground water samples exhibited elevated levels of metals.

The RI investigations included ambient air and radiological surveys, a geophysical survey, surface soil sampling, test borings, and groundwater monitoring well installation and sampling. Sediment and mussel sampling was originally proposed but abandoned due to lack of approved analytical methods. No surface water or sediment samples were collected at this site during the RI.

RI results indicated significant VOC contamination in soils and fill in the central portion of the landfill area, although no consistent area-wide pattern was evident. The most frequently detected VOCs were 1,2-dichloroethene, 1,1,1-trichloroethane, trichloroethene, tetrachloroethylene and the BTEX compounds. BNAs were elevated throughout the site. PAHs were detected at elevated concentrations in the northern portion of the site. Pesticides (4,4'-DDE, 4,4,'-DDD and 4,4'-DDT) were detected at low levels in surface soils. PCBs were detected in surface soils along the shoreline and in subsurface soils in the north-central and southern portions of the site. Various inorganics were detected at elevated levels across the site, with the highest levels in soils from the central and south-central portions of the landfill and in ash materials in the northern portion of the site. Soils along the shoreline in

the southern portion of the site had elevated cadmium, copper, nickel, lead and zinc concentrations.

Results indicated elevated levels of VOCs (BTEX), an oil product, and PCBs in the ground water in the southern portion of the site, and elevated VOC levels in the groundwater in the central portion of the site. Several inorganics were detected at elevated levels throughout the site, with the highest levels detected in wells from the north-central and southern portions of the site. Low levels of BNAs (PAHs, phenols) were detected in the central and southern portions of the site. No pesticides were detected in groundwater samples.

2.3.3 Site 09 - Old Fire Fighting Training Area

The Old Fire Fighting Training Area site occupies approximately 5.5 acres at the northern end of Coasters Harbor Island. A child care center, picnic area, playground and baseball field are at the site. Two soil mounds are present: a 15 foot high mound in the center of the site, and a 6 foot high mound in the western corner of the site. The topography slopes slightly from south to north, with the northern edge of site slightly higher in elevation than the shoreline of the Bay. Small ponded areas occur on the site during periods of heavy rain.

The site was used for fire fighting training from the 1940's until 1972. A network of underground piping was used to carry a water/oil mixture to the site. The mixture was sprayed onto the training buildings and set on fire.

This site was not investigated in detail during the IAS and was not studied in the CS. In 1987, oily subsurface soils were discovered during completion of geotechnical borings for a building expansion. Environmental investigations during the RI included ambient air and radiological surveys, a geophysical survey, a soil gas survey, surface soil sampling, test borings and groundwater monitoring well installations and sampling.

The overburden materials consist of up to four feet of fill over till deposits. Bedrock is encountered at depth of 5.5 to 10.2 feet below the surface. Groundwater is found at a depth of approximately six feet below the surface, and flows north toward the Bay.

Pesticides and PCBs were detected at low levels in surface soils. VOCs (2-butanone, toluene, ethylbenzene and xylene) were detected in the subsurface soils in the central portion of the site. BNAs (PAHs and phthalates) were detected over most of the site, with elevated levels in the northern, western and eastern portions of the site.

Low levels of BNAs were detected in the groundwater in the central and north-central portion of the site. Inorganics were detected at elevated levels in surface and subsurface soils and in groundwater. The highest concentrations were detected in the northern portion of the site. Analysis of the groundwater data indicates that inorganics may be migrating off-site. No pesticides or PCBs were detected in groundwater samples.

Although elevated VOCs levels were not detected in groundwater, the presence of elevated soil gas readings, petroleum odors and sheens in wells indicates the potential for VOC contamination of the groundwater.

2.3.4 Site 12 - Tank Farm Four

Tank Farm Four occupies approximately 88 acres in the northern part of the NETC site. The topography generally slopes gradually to the west. The steepest surface gradients are located near Normans Brook, a perennial stream, which crosses the southwestern corner of the site. During heavy rains, water collects in a small ditch which runs between the site and Defense Highways and in low-lying areas in the northern corner of the site.

The central portion of the site is vegetated with grass and weeds and is used as a grazing land for cows. Other areas of the site are covered with dense brush and some trees. An area of mature pine trees is located along the eastern edge of the site.

Twelve 60,000-barrel underground storage tanks and associated piping are located at the site. Diesel and fuel oil were stored at the site. Between 100,000 and 190,000 gallons of tank bottom sludges were reportedly disposed of on the ground between the 1940's and the 1970's.

In the 1950's Norman's Brook was dammed and a reservoir formed at the point where the brook exits the site. Recent observations indicate that the reservoir no longer exists.

Tank Farm Four was first studied in the IAS and the CS. Oil and Grease were detected in surface soil, and petroleum hydrocarbons were detected in a surface water and a sediment sample from Normans Brook. Lead and petroleum hydrocarbons were detected in groundwater.

The RI investigation at the site included ambient air and radiological surveys, a soil gas survey, surface soil sampling, groundwater monitoring well installations and sampling, surface water and sediment sampling in Normans Brook, and sampling of materials from the USTs, the former oil/water separator and the "ruins.".

No fill materials were encountered in borings at the site. The overburden materials consist of 12 to 29 feet of sand and silt and glacial till. Groundwater generally flows to the southwest, towards the Bay, but is the flow is affected by Normans Brook. Groundwater springs have been observed along the land slope east of Normans Brook.

No significant levels of contamination were detected during the RI at this site. Total petroleum hydrocarbons were detected in soils at elevated levels near the oil/water separator and in one location along the access road. VOCs, BNAs and pesticides were detected in a few samples at low levels. Inorganics were generally detected at background levels in soils, but were somewhat elevated in groundwater samples. No VOCs, BNAs, pesticides or PCBs were detected in groundwater.

VOCs (carbon disulfide), BNAs and pesticides (4,4'-DDT) were detected at low levels in sediment samples. Three inorganics (arsenic, cobalt, and iron) were detected at elevated levels in sediment samples. The highest concentrations were detected in the 0-1 foot sample intervals.

VOCs (carbon disulfide and carbon tetrachloride) were detected at low levels and inorganics (cadmium, lead and zinc) were detected at elevated levels in surface water samples. The highest levels of inorganics were detected in a surface water sample collected near the mouth of Normans Book. No BNAs, PCBs or pesticides were detected in surface water.

Low levels of various contaminants were detected in samples from the oil/water separator. Elevated VOCs (BTEX), PAHs and inorganics (iron, lead, zinc) were detected in samples from the tanks.

Exposures to contaminants in surface soils and to contaminants in surface water and sediments in Normans Brook are possible.

2.3.5 Site 13 - Tank Farm Five

Tank Farm Five occupies approximately 73 acres in the north-central portion of the site. The topography generally slopes to the north. The central portion of the site is gradually sloping and well drained. The steepest surface gradients are located near Gomes Brook, a perennial stream, which flows across the northeastern portion of the site. A marshy area is located near the brook in the eastern corner of the site. The brook flows off-site and into the Bay.

The site is vegetated with grass, weeds, brush and trees. Most of the site is covered with very dense scrub shrubs and low brush. An area around the new Fire Fighting Training area is grassy with new sod. Mature trees are located in the northern and southern corners of the site.

Eleven 60,000-barrel underground storage tanks and associated piping are on the site. Like Tank Farm Four, diesel and fuel oil were stored at the site. Between 100,000 and 175,000 gallons of sludge was reportedly burned in a pit at the site.

This site was studied during the IAS but not investigated in the CS. However, prior to the RI, some environmental sampling was done in conjunction with tank closure investigations in 1985 and 1986. Low levels of metals, elevated VOCs, and a petroleum product were detected in groundwater samples collected from wells near the tanks. Analysis of the data indicated the downgradient migration of contaminants, and the movement of chlorinated contaminants downward through the water column.

RI investigations at the site included ambient air and radiological surveys, a geophysical survey, a soil gas survey, surface soil sampling, groundwater monitoring well installation and sampling, surface water and sediment sampling in Gomes Brook, and sampling of materials from the USTs and the oil/water separator.

The overburden deposits at the site consist of 1 to 21 feet of glacial till.

VOCs, BNAs and pesticides were detected at low levels in soils. Inorganics were detected at elevated levels in subsurface soils. Petroleum hydrocarbons were detected in soils across the site, at levels ranging from 4 to 60,000 ppm. The highest TPH levels were detected in stained samples collected near Tank 50. No PCBs were detected in soils.

VOCs (1,2-dichloroethene, 1,2-dichloroethane, trichloroethene, tetrachloroethene, ethylbenzene and xylene) at elevated levels and BNAs at low levels were detected in groundwater samples from wells near Tank 53. Elevated inorganics were detected in all wells at the site, with the highest concentrations from wells in the central portion of the site. No pesticides or PCBs were detected in groundwater.

Lead was detected at low levels in all sediment samples from Gomes Brook. Petroleum hydrocarbons were detected in sediment samples at concentrations ranging from 4 to 155 ppm. The highest concentrations were detected in downstream samples. PCBs were not detected in sediment samples. No contaminants were detected in surface water samples.

Low levels of VOCs, BNAs and inorganics were detected in samples from the oil/water separator. VOCs, BNAs and inorganics were detected at elevated levels in samples from the tanks.

3.0 PLAN FOR SITE CHARACTERIZATION

3.1 Objectives

Site characterization is an important part of the Problem Formulation step of an Ecological Assessment as well as for other steps in the process. The primary objectives of the site characterization are to:

- identify the kinds and spatial extent of habitats that are present on and around the site;
- identify the species and biological communities that may use these habitats and that may be potential receptors with regard to contaminants present in soils, sediments, and surface waters at the site;
- determine, through direct observation, the general functional condition of wetlands on the site;
- determine the extent and nature of contamination of environmental media with regard to potential exposure of species and biological communities.

The site characterization portion of the RI will contain some of this information. Every effort will be made to integrate information from the RI in a manner that is specifically relevant to the ecological assessment while minimizing redundancy.

3.2 Characterization of Terrestrial Habitats

3.2.1 Overview

The objective of the habitat survey is to identify the nature and composition of aquatic and terrestrial animal and plant communities in the vicinity of the site to provide a basis for identifying potential receptors. Section 3.3 of this plan outlines the approach that will be used to evaluate wetland systems. Offshore marine systems will be characterized in a separate study.

To characterize the habitats at and in the vicinity of the site, biologists will provide: descriptions of the nature and composition of plant and animal communities in the immediate vicinity of the site; descriptions emphasizing wildlife species, their habitat, and key food organisms; selection of species or groups of species for evaluation of potential risks or

impacts; a description of significant habitat; information on federal or state threatened or endangered species.

These tasks will be accomplished by conducting a literature search; a review of threatened and endangered species; a field assessment (a qualitative survey of the flora and fauna), and a stressed vegetation analysis.

3.2.2 Literature Review

The purpose of the literature review is to provide background information on the species of plants and animals expected to occur on the site and in proximate areas; the use of the general area by migrating or overwintering species; and the general distribution and abundance of species in the area. The review will include an examination of data bases as well as files at the RIDEM and the agencies listed in Subsection 3.3 on wetland delineations and functional assessment. The primary literature will be consulted for pertinent information.

3.2.3 Review Of Threatened And Endangered Species

Rhode Island Department of Environmental Management and US Fish and Wildlife Service, Office of Endangered Species lists for the endangered or threatened species which may inhabit or use the Newport area and the environments associated with the base specifically will be reviewed. This information will be checked with RIDEM and the US Fish and Wildlife Service and maps will be provided at appropriate scales to show important habitat or nesting sites for these species. These maps will be at the same scale and on the same base map as the wetland delineations. Potential effects on endangered or threatened species will receive special consideration, taking into account the potential for direct organismal and habitat effects, while keeping in mind the reasons for the preexisting threats to these species.

3.2.4 Field Assessments

The purpose of this task is to provide qualitative field verification of the types of habitat and wildlife on and near the site. Field biologists will conduct field assessments of the various terrestrial wetland and aquatic habitat types on site and in nearby areas. This will require coordination with the team of wetland specialists conducting the wetland delineations. One or more of these specialists will also be among the field team doing the field assessments.

A qualitative reconnaissance survey will be performed at the site to identify habitat and the local wildlife. The effort will focus on the known disposal sites and on stream/river, wetland, marsh, and upland areas in the less developed portions of the NETC. A senior field naturalist will be responsible for these surveys.

The surveys require walkovers of the site. Positioning will be by "line of site" and will therefore be approximate. A field map will be used to guide the survey and for recording observations. The walkover path will be planned and modified as appropriate in the field. The path will be dictated by the types of environments encountered and their extent as based upon visual observations. Obvious habitat features which may be of particular value to wildlife will be examined closely (for example, a large stand of trees which may provide cover for a wide variety of wildlife may be walked over more slowly and with closer spacing between "transects" than open meadow areas). The exact course of the walkover will be determined by the biologist in the field. The course of the walkover will be based on such observations as nesting sites, physical signs of wildlife, audible signs of birds, changes in vegetation patterns, obvious changes in hydrologic conditions, changes in slope, and physical accessibility.

During the survey observations will be made on:

- major flora in wetland and upland areas;
- bird, amphibian, and mammal sightings or physical evidence of these (e.g., nesting sites, tracks). We will initially identify bird species by their songs. It has been our experience that once a species has been noticed and identified by its song, follow-up visual confirmation is usually possible. For example in a recent visual bioassessment at a state superfund site (New York State), we

were able to identify 68 bird species by song in approximately one hour. Of these 68 species first noted by their song, we were able to make visual confirmation of 64 species.

- the presence/absence of soil invertebrates by qualitative sampling (digging and sieving on-site);

As the walkover occurs, the biologist will take samples of soil and sediment using a shovel or a petite ponar grab sampler if necessary for sediments. The soil or sediment will be examined in the field for a qualitative assessment of soil or sediment invertebrates and a course classification of sediment and soil as silt, clay, or sand/gravel.

Observations will be recorded in several ways:

- a rough field map will be used to mark the locations of major habitat types,
- observations and notes will be recorded by the biologist in a field log book
- videotaping will occur during the survey to record the observations and to record the comments of the wildlife biologists as they conduct the survey. On other Superfund sites, we have found that the use and subsequent review of videotape is a useful and complementary adjunct to ecological field notes. It also allows other biologists who were not in the field at the time to provide additional comment on site conditions.

The survey will be qualitative rather than quantitative since the objective is to provide an inventory of terrestrial fauna on-site. The goal is to provide site specific observations concerning the diversity (i.e. number and type) of species rather than data for assessment of population structure or community analyses. These data will be used to provide an informed site-specific basis for selection of ecological components (receptors) for the overall Ecological Assessment.

3.2.5 On-site Stressed Vegetation Analysis

During the survey, observations will be made on the occurrence of stressed vegetation at the site. Possible indicators of stressed vegetation include: discoloration, low (relative to expected) population density, monospecific stands, low species diversity, invasion of opportunistic species, abundance of species indicative of "primary succession". Such conditions may not always indicate toxic effects inasmuch as substrate, hydrologic, meteorologic, and physical disturbances may also cause such symptoms. Therefore, stressed vegetation data must be interpreted
cautiously.

If encountered, areas of stressed vegetation will be recorded on field notes; photographed or videotaped; and flagged for subsequent surveying onto maps at the same scale as the wetland delineation maps (see subsection 3.3).

3.2.6 Assessment of Freshwater Systems

As discussed previously in Section 2, Background and Site Description, several streams run through the site including Normans Brook (Tank Farm Four) and Gomes Brook (Tank Farm Five). In addition, there are several areas on the sites where water ponds on a temporary basis. A qualitative assessment of the freshwater aquatic environments will be made during the habitat survey. Seines or dip nets will be used nearshore in several of the major surface water bodies to sample fish and larger invertebrates. Kick net and/or ponar grab samples will be obtained and sieved on-site to determine the general composition of benthic invertebrates. These samples will be examined using a rapid benthic assessment methodology.

3.2.7 Data Products

The data products from the habitat survey will include tables and maps which will allow a qualitative biological characterization of the site and proximate areas. These will be provided in a report which will include:

Descriptions of the nature and composition of plant and animal communities in the immediate vicinity of the site using a combination of maps (for major vegetation and habitat types) and tables for species composition of the communities - much of this data will be generated during the wetlands delineation and functional assessment described in subsection 3.3;

Descriptions emphasizing wildlife species, their habitat, and key food organisms; important features of the biology of these species, such as migrations into and out of the area and nesting;

Selection of species or groups of species for evaluation of potential risks or impacts, based on the information gathered from available literature and the planned field survey. This list will include: terrestrial vegetation, soil invertebrate community, amphibians, reptiles, mammals, and birds, depending on the nature of the environment;

A description of significant habitat, wetlands, regulated streams, lakes, and other resources in the immediate vicinity of the site. As suggested by US EPA (1989) guidance, we will describe habitats that "are unique or unusual or necessary for continued propagation of key species". The U.S. Fish and Wildlife Service and State Of Rhode Island Department Of Environmental Management are primary sources of this information;

Information on federal or state threatened or endangered species. We will provide maps at the appropriate scales to show the locations of habitats or nesting sites for such species.

The final report will integrate this information with the results of the wetland delineation. These data products will be used in the exposure assessment and characterization of risk to help select appropriate receptors and describe the existing environment.

3.3 Wetland Delineation and Functional Assessment

3.3.1 Overview

The purpose of the wetland delineation and functional assessment is to identify on-site and adjacent wetlands and their boundaries; provide maps of the wetland boundaries relative to the site; assess the functional value of the identified wetlands based on standard method; contribute to the habitat descriptions of the site and nearby areas; provide input to the exposure assessment and risk characterization.

A wetlands delineation will be conducted based upon the State and Federal Methods in accordance with R.I.G.L. Section 2-1-18 and the Federal Manual For Identifying And Delineating Jurisdictional Wetlands, 1987. The wetland functional analysis will use the Wetland Evaluation Technique (WET) model developed by the Army Waterways Experiment Station.

A wetlands delineation establishes the wetland boundary based upon the three essential characteristics of wetlands: hydrophilic vegetation, hydric soils, and wetland hydrology. The 1987 Federal Manual describes technical criteria for identification of these characteristics. (Appendix A provides the descriptions of these criteria.) The criteria for all three characteristics must be met for an area to be identified as a wetland. The State of Rhode Island uses a vegetational approach to establish the limits of a wetland. Both wetlands methods will be employed to assess whether a particular area meets either set of criteria. This is done by conducting a field survey of the plants, soils, and general hydrology of on-site and adjacent areas. The wetland scientist will augment the WET analysis with an interpretation of results combining the vegetative, soils, and hydrology aspects of the study.

The wetland functional assessment evaluates three general aspects of a wetland: social significance, effectiveness of the wetland, and habitat suitability for species and species groups. The WET model uses data from the wetlands delineation field survey, and appropriate agency files, maps, and photographs.

The wetland delineations will focus on the following wetland areas:

- Bordering freshwater wetlands associated with Normans Brook (Tank Farm Four)

- Bordering freshwater wetlands associated with Gomes Brook (Tank Farm Five)
- Tidal wetlands around McAllister Point Landfill
- Tidal wetlands around Old Fire Fighting Training Area

3.3.2 Preparation for Wetlands Delineation And Functional Assessment

In preparation of the Wetlands Delineation, wetland specialists will review various maps and surveys, as available. These will include: aerial photographs, U.S. Fish and Wildlife (USFW) Wetland Inventory maps, United States Soils Conservation Service soil survey maps, Rhode Island State wetland and Coastal Resource maps, United States Geological Survey maps, and Site maps compiled by previous and current consulting companies.

In preparation for the Functional Analysis, the data sources which will be generated and reviewed include:

- Maps and surveys as specified above for the wetland delineation;
- The size of the assessment area indicated on a site map;
- The input zone ("area surrounding the assessment area which may have significant impact on the assessment area in terms of sediments, nutrient, or contaminant input") which will be identified on a map;
- The watershed which will be delineated on a topographic map;
- Identification of service areas including delineations of service area watershed ("Services are wetland functions or values which have a fairly well defined, off-site delivery point. The service area is the point to which the service is delivered." An example of a service area is a downstream reservoir which is protected by an upstream wetland which removes toxics);
- The locality of the site and region of Rhode Island will be defined (The WET Manual defines locality as a relatively small political or hydrologic area such as a township, county, section, watershed, or similar hydrologic division; region is a larger political, ecological, hydrologic, or jurisdictional area such as a state, a region, flyway, Corps District, EPA Region, or hydrologic unit

which is relatively homogeneous in terms of topography and landscape pattern); and,

- Form A: Site Documentation will be completed (according to the WET Manual, Form A documents general information about the wetland being evaluated; it serves as a useful reference throughout the evaluation procedure and as a documentation of the evaluation following completion. Appendix B includes an example of Form A).

3.3.3 Wetlands Delineation Field Program

The field portion of the wetlands delineation will be performed coincident with the qualitative field assessment (see subsection 3.2). The discrete steps which will be used to delineate wetlands are described below. The wetlands delineation will be based on the Federal Manual For Identifying And Delineating Jurisdictional Wetlands, 1987, unless the 1991 Unified Federal Manual is finalized by the time of the survey. In that case, we will amend the plan to use this more recent manual. Locations where the State and Federal boundaries differ will be noted.

The field work will involve wetland delineation by placing flags along the wetland-non-wetland boundary close enough for accurate surveying and mapping (about every 50 feet). The flags will be surveyed by a surveying service which will be engaged under separate contract. Field notes will be recorded on field logs. Field notes will be transferred to approved data sheets (examples of these are included in Appendix A) and included in an appendix of the final report.

Detailed descriptions of methodology for wetland delineation are included in Appendix A. In general, the field delineation on the site and off-site areas will begin at the property boundary or other convenient (i.e. easily surveyed) location. The wetland boundary will be approximated through visual observations and professional judgement exercised in the field. A transect will be established extending from within the wetland perpendicular to the approximated boundary and into the non-wetland area. A quadrant will be established on the lower (i.e. wetland) end of the transect and observations of vegetation, soils, and hydrology will be made. These observations will document the presence of the vegetative, soil, and hydrologic criteria (see Appendix A) necessary to define a wetland. A second

quadrant will be established just upgradient of the estimated wetland boundary (in the estimated non-wetland) which should allow documentation of non-wetland conditions. A third quadrant will be established on the estimated boundary. Data from these quadrants will be used to refine the location of the boundary as needed.

Once the boundary has been determined in this way, it will be walked and flagged about every 50 feet using visual observations (concerning vegetation, soils, topography, and hydrology) and professional judgement. Additional documentation transects will be established as described above when different cover types are encountered. A minimum of three documentation transects will be utilized on the site.

As part of the wetlands delineation, a map will be prepared by a local surveyor (contracted separately) and the information obtained at transect locations will be transferred to data sheets (examples of these are included in Appendix A).

Appropriate keys and text in identifying wetland plants and hydric soils will be used. These will include but not be limited to:

Reed, Porter, 1988. National List Of Plant Species that occur in wetlands; Northeast (Region I)

Fernald, Linden. Gray's Manual Of Botany

Tiner, Ralph W. Jr. 1988. Field Guide To Non-Tidal Wetland Identification, Maryland Department of Natural Resources, Annapolis, MD and USFWS, Newton Corner, MA

County Soil Conservation Service Publications (the specific publications will depend upon information acquired during the literature review and interviews with the County Soil Service).

The specific step-by-step field activities for the wetland delineation will include the following:

1. A general reconnaissance survey of delineation area will be completed.

2. Cover types present within the study area will be identified.

3. Starting points will be established for wetland boundary delineations.

4. A transect perpendicular to site contour will be established.

5. Wetlands will be located according to the Federal Manual For Identifying And Delineating Jurisdictional Wetlands, 1987 based on vegetation, soils, and hydrologic criteria as well as by state criteria.

6. A sampling quadrant will be established within the wetland. As indicated in the material in Appendix A, the quadrant will be of such a size that its center will be within 5 to 15 feet of a similar upgradient (i.e. non-wetland) quadrant across the estimated wetland boundary. The wetland hydrology, soils, and vegetation will be documented. (The Mandatory Technical Criteria For Wetland Identification as described in the 1987 Federal Manual are included in Appendix A. Some of the specific observations which will be documented include the following material: Hydrology will be documented based on field observations such as digging a hole in a wetland area to estimate groundwater levels; squeezing soils to estimate saturation; and looking for evidence of flooding such as discolored leaf litter. For soils, the first 18 inches will be profiled by visual observations including estimates of soil structure, texture, and horizon; estimates of whether the soils are organic; and, for mineral soils estimates of color using the Munsell Soil Color Chart, and looking for low chroma, mottling, and gleying. Documenting vegetation will include identifying species in each vegetative layer, estimating floral abundance, identifying dominant species, and classifying the dominants as hydrophilic or not.

7. Work will proceed by moving upgradient along the transect to the nearest estimated upland quadrant. Non-wetland hydrology, soils, and vegetation will be documented as described in step 6.

8. Work will proceed by moving to the estimated wetland boundary and a establishing an additional sampling quadrant. Conditions will be documented as described in step 6.

9. Work will proceed by flagging the wetland boundary about every 50 feet. As described above, the placement of these flags will be based upon information obtained from the quadrants, visual observations such as a break in the slope of the land or changes in vegetation, and professional judgement.

10. A new transect will be established within every cover type and steps 4 through 9 will be repeated.

11. A minimum of 3 transects and at least one transect in each cover type will be established. Transect intervals should not exceed 0.5 mile as dictated by the 1987 Federal Manual.

Immediately after completion of field work, the field biologists will prepare documentation data forms which include: recording soils, vegetation, and hydrology data, and locating transects on a base map. The specific type of data is described in Step 6 above and elaborated upon in The Mandatory Technical Criteria For Wetland Identification as described in the 1987 Federal Manual which is included in Appendix A.

3.3.4 Wetland Delineation And Functional Assessment Report

The wetland delineation and functional assessment report will include a wetland map and observations necessary to substantiate professional opinions as to wetland functional values such as Ground Water Recharge, Production/Export, Ground Water Discharge, Wildlife Diversity/Abundance, Flood-flow Alteration, Aquatic Diversity/Abundance, Sediment Stabilization, Recreation, Sediment/Toxicant Retention, Uniqueness/Heritage, and Nutrient Removal/Transformation.

The report preparation will require: entering records into WET 2.0 computer program (the records are those as defined in Wetland Evaluation Technique Volume 2, Methodology, by Paul Adamus, E.J. Clairain, Jr., R.D. Smith, and R.E. Young, October 1987, Department of the Army Waterways Experiment Station); identifying key conditions which lead to a particular functional rating; correlating conclusions with professional opinions; and rectifying differences between computer output and professional opinions.

The functional wetlands analysis will use the WET model. The WET evaluates three aspects of wetland functions:

Social significance which WET defines as an assessment of the value of a wetland to society due to special designation, potential economic value, or strategic location;

Effectiveness and opportunity; and,

Habitat suitability for species and species groups.

3.4 Characterization of Marine Environment

Studies on Narragansett Bay generated through the Narraganset Bay Estuaries Program will be reviewed. The primary literature will be searched for recent articles related to this region of Narragansett Bay. In addition, some of the more recent information of the Bay has been presented at various symposia and these will be checked.

3.5 Sampling of Environmental Media

This section describes the sampling that will be done under Phase II to provide additional data for the Ecological Assessment.

3.5.1 Sampling Locations

Freshwater Wetland Systems

Sampling locations within each freshwater wetland system have been selected to provide data on upstream (upgradient) conditions, and on-site conditions upstream and downstream of major site features (roads, culverts, etc.). Depositional areas downstream of major site features have been preferentially selected for sampling. Stream samples will be collected in the order of downstream to upstream. Both sediment (SD) and surface water (SW) will be sampled at most locations.

Gomes Brook

Gomes Brook drains the northern portion of Tank Farm Five. The Brook is culverted under two access roads on the site and then under Defense Highway near its mouth.

The following stations were selected to characterize Gomes Brook and to identify any impact from Tank Farm Five:

SW-5, SD-5	Existing station; upstream, off-site
SW-4, SD-4	Existing station; downgradient of tank access road, in relatively flat area
SW-T1, SD-T1	New station; in tributary (stormwater ditch)

SW-4A, SD-4A	New station; downstream of tributary
SW-3, SD-3	Existing station; near French Drain system
SW-3A, SD-3A	New station; upstream of dirt access road
SW-2, SD-2	Existing station, moved upstream to be within deposition area; downstream of dirt access road
SW-1A,SD-1A	New station; upstream of Defense Highway
SW-1B, SD-1B	New station; in depositional area downstream of Defense Highway
SW-1, SD-1	Existing station, moved downstream to be closer to mouth of brook

Normans Brook

Normans Brook drains the southeastern corner of Tank Farm Four. The brook is culverted under Defense Highway.

SW-6, SD-6	Existing station; upstream, off-site
SW-5, SD-5	Existing station; upstream of concrete pipe
SW-4, SD-4	Existing station; downstream of concrete pipe
SW-3, SD-3	Existing station; depositional area
SW-2, SD-2	Existing station, moved downstream to be closer to Defense Highway
SW-1, SD-1	Existing station; downstream of railroad bridge and Defense Highway
SW-1A, SD-1A	New station; flat area near mouth of brook

At station SW-1/SD-1 it is recognized that the railroad bridge and Defense Highway may act as potential sources of contamination and will be taken into consideration during data

evaluation. At station SW-1/SD-1A an attempt will be made to collect samples at outgoing tides to minimize dilution effects of sea water.

McAllister Point

SW-11	Springs at the base of the landfill (if flowing)
SW-12	Temporary ponded water on Landfill surface (if available)

Tank Farm Four

SW-13	Low lying areas in northern corner of site where water collects

Marine Sampling

Marine sediment and biota (clams and mussels) samples will be collected in Narragansett Bay near the two sites that are adjacent to the Bay. The sampling will be conducted by Battelle under separate contract. The sampling stations in the Bay are as follows:

McAllister Point Landfill

15 near-shore and 5 far-shore sampling stations

Old Fire Fighting Training Area

5 near-shore and 3 far-shore sampling locations

Infaunal/Epibenthic Study

An infaunal/epibenthic survey will be conducted in Narragansett Bay. Sampling will be conducted separately. The sampling will include approximately ten stations for collection of infaunal samples and subsequent quantitative laboratory analysis. In addition, the proposed work will include a broad benthic reconnaissance survey for qualitative biological analysis of infauna and general sediment type (rapid benthic analysis). Divers will also conduct a semi-quantitative assessment of epibenthic fauna and flora.

3.5.2 Methods And Analysis - Stream and Wetland Sediments

As described in Section 2.2 there are two freshwater habitats addressed into the current investigation. The proposed sampling program will provide additional data on the distribution of contaminants within these areas.

Sediments will be sampled with a Ponar Grab or with a hand corer depending on the nature of the sediment. Because contaminants will tend to be associated with fine grained or organic material, the sampling effort will focus on identifying depositional areas within the freshwater habitats. Sampling will be conducted at locations most likely to receive surface runoff or groundwater discharge. In addition locations that are "upstream" of such areas will be sampled to provide a reference.

Sediment samples from the areas will be analyzed for BTEX and chlorinated VOCs, BNAs, pesticides and metals.

In addition, the samples will be analyzed for total organic carbon, grain size (percent fines), and acid volatile sulfides (AVS). Recent EPA research suggests that measures of AVS and bulk metals can provide a better estimate of bioavailability and risk than can sediment metals alone.

Depending on sediment type and stream depth, samples will be collected either with 2 to 3 inch diameter stainless steel tubes, a petite ponar grab sampler, or with a shovel or hand trowel. Organic sediments will be collected by pushing a tube into the top eight inches of sediment. The tube will either be capped and labelled, or the tube contents will be extruded into a labelled sample bottle provided by the analytical laboratory. In either case, a separate clean tube will be used for each sample. Granular sediments in shallow streams will be collected with a hand trowel or shovel and deposited directly into a sample container provided by the analytical laboratory. In deeper stream sections, we will collect sediment samples with a petite ponar grab sampler. Sediment will be transferred to sample bottles supplied by the analytical laboratory using a hand trowel. We will decontaminate the sampling equipment between samples with an Alconox detergent solution and water followed by a distilled water rinse. The information on the sample labels will include sample station number, date and time of sampling, and type of analysis to be performed. Samples will be

placed in coolers and kept at approximately 4C until delivery to the analytical laboratory under chain-of-custody procedures.

3.5.3 Methods And Analysis - Surface Water

Surface water samples will be collected during each of two different hydrologic periods. One sample event will occur in the Spring when freshwater flow is expected to be greatest. Stream flow measurements will be taken at appropriate points during each sampling round. The second will occur in late Summer when flow is expected to be low. Surface waters will be sampled directly into appropriate sampling containers or using a stainless steel bucket.

Surface water samples will be analyzed for BTEX and chlorinated VOCs, BNAs, pesticides and metals. The temperature, Ph, dissolved oxygen level, and alkalinity level will be measured at the time of sampling.

Surface water samples will be collected by submerging samples bottles obtained from the analytical laboratory into the stream at midpoint. Where surface water and sediment samples will be collected at the same station, we will collect the water sample first to avoid collecting sediment particles disturbed by sediment sampling. Surface water samples will be labelled and in a similar manner to sediment samples and will be kept in coolers at approximately 4C until delivery to the analytical laboratory under chain-of-custody procedures.

3.5.5 Methods And Analysis - Narrangansett Bay Sediments and Biota

The sediment and biota samples that will be collected by Battelle will be analyzed for PAHs, TAL metals and PCBs.

The infaunal samples will be analyzed for species composition and abundance. Epibenthic observations will include species composition and approximate density of sessile epibenthic organisms.

4.0 PLAN FOR PROBLEM FORMULATION

During the Problem Formulation stage of the Ecological Assessment, the overall objectives and scope will be established. This has already been accomplished to a large extent. In fact, the work that has gone into preparation of this workplan is part of Problem Formulation. This section describes the components of the Problem Formulation to be developed further and finalized during execution of the work plan.

4.1 Identification of Contaminants of Concern

This task will identify Contaminants of concern relative to ecological components of the system for the Ecological Assessment. Factors that will be considered in identifying these contaminants include:

- Environmental concentration in surface soils, sediments, surface waters, and groundwater that may discharge to marine or aquatic habitats;
- Frequency of occurrence in these various media;
- Background levels and the extent to which contaminants exceed these levels;
- Bioavailability of the contaminants in soils and sediments; this will consider the site-specific factors (e.g., total organic carbon) that may affect bioavailability;
- Physical-chemical properties such as solubility, partitioning to lipids, and volatility that may affect the behavior, transport, and accumulation of the contaminant;
- Potential for bioaccumulation or bioconcentration;
- Potency of the chemical with regard to identified toxicological endpoints;
- The kinds of effects that the contaminant may have and the potential that these effects may be additive or synergistic with those associated with other contaminants.

Based on a review of existing information there are a number of candidate contaminants of concern at the base. These include: selected volatile organic compounds

(chlorinated and aromatic), semivolatile organic compounds (in particular polycyclic aromatic hydrocarbons), pesticides (in particular DDT and its residues), PCBs (in the landfill), and metals.

4.2 Identification of Exposure Pathways

An exposure pathway describes the links between the sources of contaminants and the ecological components (receptors) that may be exposed. Potential exposure pathways will be identified by considering the source locations, the media through which the contaminants may be transported, the potential for bioaccumulation, and the characteristics of the receptors. Animals and plants can come into contact with contaminants in different ways. Exposure routes can include direct contact and uptake with soils, sediment, or water, ingestion of food, incidental ingestion of soil, and inhalation.

4.3 Identification of Ecological Components (Receptors)

Ecological components including species, faunal types, and communities will be selected for evaluation. The identification of potential receptors (species) will be based on literature review and field observations conducted during the site characterization.

A list of ecological components to be assessed will be developed. This list will include species of animals and plants associated with aquatic, wetland, terrestrial, and marine environments as well as functional groups and communities. The list will include those species, groups, and communities which are likely to occur at the site or (in the absence of toxicological data on such species) are phylogenetically or trophically similar to species likely to occur. The candidate species, groups, and communities will represent a reasonable cross section of the major functional and structural components of the ecosystem under study. Consideration will be given to the inclusion of species or groups that represent different trophic levels (e.g. saprophytes, herbivores, primary and secondary carnivores), a variety of feeding types (detritivores, scavengers, filter feeders, active predators, forage fish), and several habitats (aquatic, wetland, upland and marine).

The assessment will focus on selected ecological components appropriate to each habitat type. Selection will be based on relative abundance and ecological importance within

the wetland, terrestrial, aquatic, and marine habitats, availability and quality of applicable toxicological literature, relative sensitivity to the contaminants of concern, trophic status, relative mobility, and local feeding ranges, ability to bioaccumulate contaminants of concern, economic importance or federal/state endangerment status, and any observed visible evidence of stress.

5.0 PLAN FOR EXPOSURE ASSESSMENT

5.1 Objectives And Overview

The purpose of this section is to describe the steps in the development of an exposure assessment. According to recent EPA Guidance (ECO Update, December, 1991), an Exposure Assessment should quantify "the magnitude and type of actual and/or potential exposures of ecological receptors to site contaminants". The key elements include: quantification of contaminant release, characterization of receptors, and measurement or estimation of exposure point concentrations.

5.2 Quantification Of Release, Migration, And Fate

The purpose of this task will be to estimate current and future contaminant levels of all affected media. These estimates will be used to estimate exposure point concentrations.

To accomplish this task the ecological assessment will rely upon direct measurements from completed or planned sampling and estimated concentrations from modeling. The direct measurements include results from the analysis of groundwater, soil, surface water, sediment, and tissue samples. The assessment will include summaries of this data in all relevant media. These summaries will include maps of contaminant distribution and/or tabulated summaries, or statistical summaries as appropriate to present a clear sense of the current distribution of contaminants by media.

EPA guidance suggests that fate and transport models be used to assess future contaminant levels or to predict the movement of contaminants from the source or between media. The ecological assessment will use fate models to assess the concentration of contaminants in sediment pore water or wetland soils. These models will include predictions based upon either Equilibrium Partitioning in which total organic carbon controls the distribution of contaminants or distribution of certain inorganic compounds based upon EPA's recent use of Acid Volatile Sulfide.

The ecological assessment will also use fate models to estimate exposures in Narranganset Bay.

5.2.1 Estimating Exposure In Soils From Organic Contaminants - Equilibrium Partitioning

With regard to chemicals in wetland soils or saturated soils and sediments we are interested in the "available fraction" of the compounds and not only the bulk concentrations. In the case of non-polar organic compounds (e.g. PAHs, PCBs) we will be using the Equilibrium Partitioning (EP) method for estimating concentrations of compounds that may exist in soil moisture or pore water and to which invertebrates and plants will be exposed. The method takes into account the organic fraction of the soil, sediment or wetland environment.

The Equilibrium Partitioning (EP) method establishes relationships between non-ionic organic compounds present in the sediment, interstitial water, and aquatic biota. These relationships are then used to develop sediment levels which would provide an adequate level of safety for aquatic communities.

The EP method assumes an organic compound in sediment and interstitial pore water achieves equilibrium over a short period of time. This equilibrium is governed by the extent of sediment adsorption. It has been established through numerous studies that for non-ionic organic compounds, adsorption occurs mainly via organic carbon. This sorption process can be quantified for a particular compound based upon its individual water/organic carbon partition coefficient. This organic carbon based sorption model has been found to be valid for sediments containing at least 0.1 percent organic carbon.

Since, in general, the toxicity of a compound to benthic invertebrates, is correlated to the interstitial water concentration, the EP method assumes that sediment criteria can be derived based upon pore water concentrations which have been shown to produce no effects in a variety of aquatic organisms (i.e. Ambient Water Quality Criteria). Thus by setting the equilibrium concentration equal to an appropriate Water Quality Criteria we can calculate a Sediment Quality Criteria which represents a sediment concentration whose predicted pore water concentration would not pose risk to the majority of an aquatic community. This criteria can then be compared to existing concentrations to determine whether or not a significant risk is present.

This approach is valid only for non-ionic compounds. For ionic compounds or for inorganic elements, the EP approach is not valid. However, the approach may be valid for

ionic compounds in their associated form (e.g., phenol below a Ph of 9). This method is valid for any type of sediment which contains more than approximately 0.1 to 0.5 percent organic carbon. The method assumes that ingestion of sediment is not a significant pathway of exposure.

The EP method allows for the establishment of a sediment criterion based upon organic carbon normalized values. Only organic carbon and the sediment concentration(s) must be measured to compare the SQC to site-specific values and thereby determine possible risk.

We will use the estimated pore water (or in the case of soil moisture) the estimated exposure point concentrations for individual organic compounds and calculate theoretical organism (soil or sediment invertebrate) concentrations at assumed equilibrium where field data are unavailable.

5.2.2 Estimating Exposure In Sediments From Inorganic Contaminants - Acid Volatile Sulfides

The Acid Volatile Sulfide (AVS) approach addresses sediment criteria for metals. The method is similar in idea to the EP method, in that both model the interstitial water concentration as a function of a limiting component of the sediment. The AVS approach was developed relatively recently, and is currently under review by EPA.

DiToro et al. (1990) have shown that insoluble metal sulfides (typically iron and manganese sulfide) are the controlling parameter in anoxic sediments reacting with available divalent metals such as cadmium and copper.

Since toxicity tests for metals have shown that toxicity correlates with divalent metal activity in interstitial water, it is assumed under the AVS method that if all of the divalent metal is bound to AVS, no toxicity to aquatic biota will result. By measuring both the amount of sulfide available in the sediment, as well as the amount of divalent metal (otherwise referred to as Simultaneously Extracted Metal, or SEM), one can determine stoichiometrically if all of the SEM is bound to AVS. If results indicate that SEM is less than AVS, then no metal is available to cause toxicity in organisms. However, if SEM

exceeds AVS then toxicity may or may not occur. Other adsorption processes may bind otherwise free metal to prevent bioavailability.

This method can only predict only at what concentrations toxicity will not occur in anaerobic sediments, but provides no information as the toxicity of sediments whose levels of SEM exceed AVS. Such sediments may or may not present a risk to biota, dependent upon other contemporaneous adsorption processes.

Since AVS is present only under anaerobic conditions, AVS concentrations have been observed to decrease dramatically near the upper few centimeters of sediment where bioturbation and scour are present. AVS has also been shown to vary seasonally- lowest concentrations in the winter, and highest in the summer. DiToro (personal communication, 1991) has suggested that a winter minimum AVS concentration may be used as a conservative value.

Currently, AVS has been shown to be valid only for acute exposures, although initial indications suggest that a protection against chronic exposures may be valid as well. Cadmium, copper, mercury, nickel, lead, silver and zinc are the inorganic elements which are considered valid using the AVS methodology.

5.2.3 Estimating Exposures in Marine Systems

One major objective of the ecological assessment is to assess the potential links between contaminants in the two sites bordering Narrangansett Bay (McAllister Point Landfill and the Old Fire Fighting Training Area) and the sediment, surface water and biota in the Bay. Our approach is to attempt to provide answers to three basic questions:

1. What are the transport mechanisms operating between the three sites and their associated near-shore and coastal marine environments?

2. What are the potential loadings of contaminants from the three sites to the near-shore and coastal marine environments?

3. What is the ecological fate of these loadings in the Bay?

The transport of contaminants into the Bay will be assessed with the following data: stream flow and water quality data from the current sampling program, estimates of groundwater flow, and, if possible, estimates of erosion and "springs" from the landfill sites. These are the primary physical linkage between the sites and the coastal marine environments.

Ranges of estimates of the potential mass of materials which reach the shores of the Bay from each of the sites will be calculated. The assessment will also address: the partioning of contaminants upon entering the Bay from the sites, biological uptake and degradation, the potential effect of tidal dilution and advection from the nearshore area, and sedimentation. The partitioning estimates will rely upon equilibrium partitioning calculations or availability based on AVS measurements. The likelihood of biological uptake or degradation within the coastal marine environment will be assessed based on literature values for and observed body burdens in Bay organisms. The probability of sedimentation within the Bay will also be based on literature estimates of sedimentation in near-shore areas of Narragansett Bay as appropriate. The potential for tidal dilution and subsequent transport from near-shore environments will be based upon calculations.

The assessment will describe the likely fate of contaminants entering the near-shore environments from the sites based on this analysis. Estimates of the range of incremental increases in contaminant concentrations in Bay water and sediment from the sites will be made.

5.3 Characterization Of Receptors

As EPA guidance indicates, most sites contain many species, populations, and communities, and evaluating risk to each is practically impossible. Therefore, Ecological Assessment focuses upon a limited number of receptors. The selection of receptors is part of the problem formulation (Section 4).

The characterization of receptors will include information on the species' feeding habits, life histories, habitat preferences, and other attributes which could affect their exposure or sensitivity to contaminants. The characterization of receptors (species) for this site will derive from: the literature review (Section 6); the reviews of existing studies;

results of surveys described in Section 3; and field observations made during site characterization (Section 3).

Categories of receptors are expected to include the following:

- terrestrial vegetation,
- soil biota,
- mammals and birds,
- benthic invertebrates within the on-site streams and nearshore areas and,
- fish within the streams and nearshore areas.

For each receptor, the assessment will include a characterization in the form of a species profile. These profiles will be text descriptions of the relevant ecological and physiological characteristics and taxonomic relationships of the receptors. The profiles will include but not be limited to descriptions of: trophic status, feeding type, food preferences, ingestion rates, range, prey, predators, migratory habits, breeding habits, likely habitats, population estimates, reproductive strategies, substrate and habitat preferences, and life history. The profiles will also include any particular vulnerabilities or status of the species as rare or endangered.

5.4 Estimation of Exposure Point Concentrations

According to EPA guidance, Exposure Point concentration is an estimate of the concentration of contaminants in the media to which the receptors are exposed. This is either measured in the environmental medium or estimated using assumptions and/or fate and transport modeling. The estimates of exposure point concentrations in each medium will generally follow EPA Guidance (Section 6.5, "Risk Assessment Guidance For Superfund Volume I, Human Health Evaluation Manual (part A)", EPA/540/1-89/002). This guidance indicates that: direct use of monitoring data is normally applicable where exposure involves direct contact with the monitored medium as in the case of soils; modeling is appropriate when exposure point are spatially separate from monitoring pints, where spatial distribution of data is lacking, or where monitoring data are restricted by the limit of quantitation; and

that the objective is to provide a conservative estimate of the average concentration contacted at the exposure point over a the period of exposure.

We will estimate exposure point concentrations based upon field data or where such data are unavailable, upon modeled concentrations. We expect the on-site and off-site data base to be sufficient for this purpose. However, as indicated in section 5.2, we will apply appropriate analytical models for deriving exposure point concentrations in several cases.

Estimates of exposure concentrations will either be discrete measurements assessed on a sampling station by sampling station basis or will be a calculated statistic. An example of the former would include an assessment of exposure from soil or sediment. Each discrete measurement would be considered an exposure point for the purpose of assessing risk at that point. In other media, such as the water column or groundwater, an appropriate statistic such as the mean or maximum value will be used. This will vary with exposure pathway and media.

Exposure point concentrations will be presented in tables which include the pathway, receptor, estimate of exposure point concentrations, and comments summarizing the source or derivation of the estimate.

6.0 PLAN FOR ECOLOGICAL EFFECTS ASSESSMENT

6.1 Overview

Ultimately, the ecological risk characterization will be used to identify, compile, and evaluate the data necessary to relate exposure point concentrations to effects (appropriate biological endpoints). This requires the development of toxicological information related to the selected biological endpoints. Such information will be obtained from the literature on the effects of site-related contaminants. Additional information on ecological effects will be drawn from site-specific field observations and toxicity testing.

This effects assessment will identify the range of toxic endpoints and discuss potential biological effects of site related contaminants within various concentration ranges. The endpoints may include: lethality, reproductive impairment, behavioral modifications, or various sublethal toxic effects. Endpoints may also include secondary effects such as loss of habitat. This analysis is used to select toxic endpoints for eventual risk characterization.

6.2 Literature Review

Much of the information for this part of the analysis will be drawn from the scientific literature. Computerized literature searches and reviews of the recent primary literature will be used to supplement information that is currently readily available for the contaminants of concern. With regard to effects on aquatic organisms, a search will be made for recent data in EPA's AQUIRE data base. Recent publications in the Society of Environmental Toxicology and Chemistry (SETAC) journal and at recent SETAC symposia are helpful for identifying the most recent research.

The review of data sources will include the Rhode Island Department Of Environmental Management and the US Fish and Wildlife Service. In addition, an on-line literature search will be performed to develop background information concerning any recent publications regarding wildlife habitats in the general geographic area.

The following data bases are used to obtain information on wildlife, fish and benthic invertebrates: Bios Previews; Life Sciences Collection; Zoological Record Online; Enviroline; Pollution Abstracts; Oceanic Abstracts; and CAB Abstracts. These are available

through the DIALOG Information Services. The TOXNET (TOXicological NETwork), Aquire, and IRIS (Integrated Risk Information System) databases are accessed via the National Library of Medicine's MEDLARS system.

The output from the searches will be stored on file, reviewed at the end of the search, and the relevant material will then be printed. The material will be incorporated into the appropriate files of biological, chemical, and toxicological data, endpoints, or results of acute and chronic studies in EXCEL databases for use in the final report.

6.3 Use of Terrestrial, Aquatic, and Wetland Field Studies

Field observations and the wetlands functional analysis will be used to help characterize conditions at the site. Such direct observations may reveal ecological effects such as stressed vegetation, reduced species diversity, presence of opportunistic species, or pathologies. This information will be evaluated with regard to the potential effects of contaminants of concern.

7.0 PLAN FOR RISK CHARACTERIZATION

7.1 Potential Habitat Modification

Potential risks associated with habitat modification will be evaluated. These may be related to physical alterations of soil, sediment, or freshwater flow environments as well as other alterations which would impact the quality of the habitat.

7.2 Risks Due to Toxic Effects of Contaminants

A qualitative and quantitative assessment of risks to ecological receptors will be performed with regard to toxic effects. This analysis will use information generated from the Exposure and Ecological Effects Assessments and will rely upon the Toxicity Quotient approach as well as on direct observations of conditions in the field to provide an overall weight of evidence concerning the nature of risks.

The Quotient approach involves comparing an exposure concentration to an effects level NOAEL value. Values that exceed "1" (exposure/effects level) are considered to be indicative of potential risk. Such values do not necessarily indicate that an effect will occur but only that a lower threshold has been exceeded. Because the NOAEL values typically have uncertainty (safety) factors of 10 built into them, evaluation of the significance of the Toxicity Quotients will be as follows:

> Toxicity Quotient Exceeds "1" but less than "10" - some small potential for environmental effects;
>
> Toxicity Quotient Exceeds "10" - significant potential that greater exposures could result in effects based on experimental evidence;
>
> Toxicity Quotient Exceeds "100" - effects may be expected since this represents an exposure level at which effects have been observed in other species.

Note that this risk characterization method provides some insight into general effects upon animals in the local population. However, they do not indicate if population-level effects will occur. Such an assessment requires careful consideration

of the local factors affecting populations. If effects are judged to be insignificant at the average individual level they are probably insignificant at the population level. However, if risks are present at the individual level they may or may not be important at the population level.

If the modelled risk characterization results indicate that significant ecological risks exist on-site, field observations gathered during wetlands functional analyses, freshwater and marine aquatic and sediment sampling, and stressed vegetation analyses, will be used to determine whether field evidence supports the modelled effects. Comparisons between upstream versus downstream and on versus off-site communities will be evaluated to determine whether the contaminants of concern are associated with ecological impacts such as decreased species numbers and diversity, stressed vegetation, or the presence of opportunistic species or pathologies.

7.3 Presentation Of Risk

Comparisons will be made between analytical data for sediments and water and published or estimated water quality criteria and sediment quality criteria or reference values. In the case of water quality criteria, the USEPA and RIDEM published values will be used.

In addition, contaminant values in sediments will be compared to reference values within the freshwater and marine systems as well as to the general reference values reported in Long and Morgan (1990).

For example, contaminant concentrations in sediments will be compared to NOAA sediment criteria. Contaminants concentrations in shellfish will be compared to data from the national Status and Trends Program. Biological composition of the infauna and eipfauna will be compared to data in the literature on similar habitats in Narrangansett Bay.

U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

VOLUME VII
ARARs AND PRELIMINARY REMEDIAL ACTION ALTERNATIVES

PHASE II RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

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1.0 INTRODUCTION

A preliminary identification of potential Applicable or Relevant and Appropriate Requirements (ARARs) in the scoping phase can assist in the initial identification of remedial alternatives and in the identification of additional data needs. This document provides a preliminary assessment of ARARs as they apply to the NETC-Newport sites and provides a preliminary identification of potential remedial action alternatives. The Feasibility Study process, which will build upon this information, is discussed in detail in Volume VIII.

2.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS(ARARs)

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA, 1986), and the NCP (1990) require that all remedial response actions attain or exceed applicable or relevant and appropriate requirements of Federal and more stringent promulgated requirements of State environmental statute(s). The NCP defines applicable requirements as "those cleanup standards, standards of control, other substantive environmental protection requirements, criteria or limitations promulgated under federal environmental or state environmental facility siting law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site." Relevant and appropriate requirements are defined in the NCP as "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at the CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site."

Current EPA CERCLA guidance calls for a preliminary identification of potential ARARs during the RI scoping phase to assist in initial identification of remedial alternatives. Early identification also facilitates communications with support agencies to evaluate ARARs, and may help planning of field activities. Because of the iterative nature of the RI/FS process, ARAR identification continues throughout the RI/FS as better understanding is gained of the site conditions, site contaminants, and remedial action alternatives. Findings of the Phase I RI have aided in the selection of ARARs identified within this document.

ARARs may be categorized as: 1) ambient or chemical-specific requirements, which may define acceptable exposure levels and, therefore, be used in establishing preliminary cleanup goals; 2) location-specific, which may set restrictions on activities within specific locations such as floodplains or wetlands; and 3) performance, design or other action-specific requirements, which may set controls or restrictions for particular treatment and disposal activities related to the management of hazardous wastes. The documents, "CERCLA Compliance With Other Laws Manual" (U.S. EPA, 1988), and "CERCLA Compliance with Other Laws Manual: Part II.

Clean Air Act and Other Environmental Statutes and State Requirements" (U.S. EPA, 1989), contain detailed information on identifying and complying with ARARs.

Preliminary lists of Federal and State of Rhode Island ARARs have been compiled for NETC-Newport, as presented in Tables 1 through 6. Refinement of ARARs will continue throughout the RI/FS.

To-Be-Considered Materials (TBCs) are non-promulgated advisories or guidance issued by Federal or State government that are not legally binding and do not have the status of potential ARARs. However, in many circumstances TBCs will be considered along with ARARs as part of the site risk assessment and may be used in determining the necessary level of cleanup for protection of health or the environment.

3.0 PRELIMINARY REMEDIAL ACTION ALTERNATIVES

EPA's CERCLA guidance calls for the identification of potential remedial action objectives for each contaminated medium. Candidate technologies are also identified to help ensure data needed to conduct the technical evaluation of the technologies can be collected as early as possible during RI activities. Early identification of potential technologies also helps determine whether treatability studies will be required. The approach to conducting a Feasibility Study is discussed in Volume VIII. A list of general response actions appears in Table 7.

EPA guidance calls for identifying a range of remedial alternatives which address site cleanup to varying degrees and meet the criteria set forth in the NCP for the types of remedial alternatives which must be considered. These criteria include the following:

For alternatives which provide control of the source of contamination, the range of alternatives should include the following:

- A range of alternatives in which treatment that reduces the toxicity, mobility, or volume of the hazardous substance is a principle element. This range should include an alternative that removes or destroys hazardous substances to the maximum extent feasible, eliminating or minimizing the need for long-term management.

- One or more alternatives that involve little or no treatment, but provide protection of human health and the environment primarily by preventing or controlling exposure to hazardous substances through engineering controls and/or institutional control.

- For ground water response actions, a limited number of remedial alternatives should be developed that attain site-specific remediation levels within different restoration time periods utilizing one or more different technologies.

- The development of one or more innovative treatment technologies for further consideration.

- The no action alternative.

Based on an evaluation of site-specific problems and the proposed cleanup criteria, master lists of potentially feasible remedial technologies have been developed for soil/sediment and ground water, as presented in Tables 8 and 9. The cleanup methods include both on-site and off-site remedies and include treatment technologies to permanently reduce toxicity, mobility, and volume to the maximum extent practicable.

TABLES

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TABLE 1

PRELIMINARY IDENTIFICATION OF FEDERAL CHEMICAL–SPECIFIC ARARs AND TBCs

NETC – NEWPORT

FEDERAL STATUTE	REGULATION/GUIDANCE	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Ground Water– –			
Safe Drinking Water Act (40 CFR 141.11–.16)	Max Contaminant Levels (MCL's)	MCL's directly apply to "public water systems", defined as systems with at least 15 connections which service a minimum of 25 persons.	ARARs due to presence of contaminants in ground water.
	Lifetime Health Advisories	Guidelines developed based on toxicity for non–carcinogenic compounds	TBC criteria due to the presence of contaminants in ground water.
Surface Water – –			
Clean Water Act (Section 304)	Ambient Water Quality Criteria (AWQC)	Non–enforceable guidelines established for the protection of human health and/or aquatic organisms.	TBC criteria due to the presence of contamination in surface water and sediments. May affect remedial actions involving discharge to surface water.
Clean Water Act (40 CFR 401.15)	Effluent Discharge Limitations	Regulates the discharge of contaminants from an industrial point source.	Potential ARARs for remedial alternatives involving discharge to area surface waters.
Air– –			
Clean Air Act (40 CFR 50)	National Ambient Air Quality Stardards (NAAQS)	Establishes maximum concentrations for particulates and fugitive dust emissions.	Potential ARARs for alternatives involving remedial actions which impact ambient air.
Clean Air Act (40 CFR 60)	New Source Performance Standards (NSPS)	Establishes emissions limitations for new sources.	Potential ARARs for alternatives involving treatment actions which emit pollutants.
Clean Air Act (40 CFR 61)	Emissions Standards for Hazardous Air Pollutants (NESHAPS)	Establishes emissions limitations for hazardous air pollutants.	Potential ARARs for alternatives involving treatment actions which emit hazardous air pollutants.

TABLE 2
PRELIMINARY IDENTIFICATION OF STATE CHEMICAL–SPECIFIC ARARs AND TBCs
NETC – NEWPORT

STATE STATUTE	REGULATION/GUIDANCE	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
RI Ground Water Protection Act (RIGL, Title 46, Chapter 13)	Public Drinking Water Regulations	Establishes provisions for the protection and management of potable drinking waters, including the development of ground water classifications and associated standards which specify maximum contaminant levels for each classification	Potential ARARs due to the presence of contaminants in ground water.
Surface Water --			
RI Water Pollution Control Law (RIGL, Title 46, Chapter 12)	RI Water Quality Standards	Establishes water use classification and water quality criteria for all waters of the state. Also establishes acute and chronic water quality criteria for the protection of aquatic life.	Potential ARARs due to the potential presence of contaminants in surface water.
Soils --			
RIDEM	Soil Cleanup Levels (Guidance)	Establishes soil cleanup levels for PCBs.	Potential ARAR due to presence of PCBs in soils.
Air --			
RI Clean Air Act (RIGL Title 23, Chapter 23)	Air Pollution Control Regulation Standards	Establishes maximum ambient levels for criteria pollutants.	Potential ARARs for alternatives involving treatment actions which emit criteria pollutants.

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TABLE 3
PRELIMINARY IDENTIFICATION OF FEDERAL LOCATION–SPECIFIC ARARs AND TBCs
NETC – NEWPORT

FEDERAL STATUTE	REGULATION/GUIDANCE	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Wetlands ––			
Executive Order 11990	Protection of Wetlands	Regulates activities conducted in a wetland area to minimize the destruction, loss or degradation of the wetlands.	Potential ARARs due to presence of wetlands adjacent to sites.
Wetlands Construction and Management Procedures (40 CFR 6, Appendix A)	Protection of Wetlands	Sets forth EPA policy for carrying out the provisions of Executive Order 11900 (see above).	Potential ARARs due to presence of wetlands adjacent to sites.
Clean Water Act, Section 404 (40 CFR 230; 33 CFR 320–330)	Prohibition of Wetland Filling	Prohibits the discharge of dredged or fill material to a wetland without a permit issued by the Corp of Engineers.	Potential ARARs due to presence of wetlands adjacent to sites.
Coastal Areas––			
Coastal Zone Management Act of 1972 (16 U.S.C. Sect. 1451)	Protection of Coastal Areas	Regulates land use along coastal areas of the U.S.	Potential ARARs as two sites are located along Narragansett Bay.
Floodplains ––			
Executive Order 11988	Protection of Floodplains	Regulates activities conducted in a floodplain to minimize adverse affects to the floodplain and ensure that consideration has been taken of flood hazards.	Potential ARARs as sites are located within the 100–year floodplain zone.

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TABLE 3 (Continued)
PRELIMINARY IDENTIFICATION OF FEDERAL LOCATION–SPECIFIC ARARs AND TBCs
NETC – NEWPORT

FEDERAL STATUTE	REGULATION/GUIDANCE	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Flood Disaster Protection Act of 1973	Disaster Prevention	Regulates development in flood prone areas under FEMA.	Potential ARAR as sites are located within the 100–year floodplain zone. Applicable to remedial alternatives conducted within floodplain zones.
National Flood Insurance Act of 1968 (24 CFR 1909 .1–.24)		Provides flood insurance for disaster relief and establishes flood control methods.	Potential ARAR as sites are located within the 100–year floodplain zone. Applicable to remedial alternatives conducted within floodplain zones.
Rivers–– Fish and Wildlife Coordination Act (16 U.S.C. 661)	Protection of Wildlife Habitats	Prevents the modification of a stream or river that affects fish or wildlife.	Potential ARARs as sites are located adjacent to streams.
Wildlife–– Endangered Species Act of 1973 (16 U.S.C. 1531)	Protection of Endangered Species	Restricts activities in areas inhabited by registered endangered species.	Potential ARAR as surrounding wetlands may sustain endangered or threatened wildlife species.
Historic Places–– National Historic Preservation Act of 1966 (16 USC 470, et seq.)	Protection of Historic Places	Requires actions to take into account effects on properties included in or eligible for the National Register of Historic Places and minimizes harm to National Historic Landmarks.	Potential ARAR for activities which could impact historic places.
Archeological and Historic Presevation Act of 1974 (132 CFR 229 & 229.4, 43 CFR 7 & 7.4)	Protection of Archeological and Historic Lands	Restricts the use of land of known archeological or historical significance.	Potential ARAR for activities which could impact archeological or historic places.

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TABLE 3 (continued)
PRELIMINARY IDENTIFICATION OF FEDERAL LOCATION–SPECIFIC ARARs AND TBCs
NETC – NEWPORT

FEDERAL STATUTE	REGULATION/GUIDANCE	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Flood Disaster Protection Act of 1973	Disaster Prevention	Regulates development in flood prone areas under FEMA.	Potential ARAR as sites are located within the 100–year floodplain zone. Applicable to remedial alternatives conducted within floodplain zones.
National Flood Insurance Act of 1968 (24 CFR 1909 .1–.24)		Provides flood insurance for disaster relief and establishes flood control methods.	Potential ARAR as sites are located within the 100–year floodplain zone. Applicable to remedial alternatives conducted within floodplain zones.
Rivers––			
Wild and Scenic Rivers Act (16 U.S.C. 1271)	Protection of Riverways	Regulates activities in vicinity of designated rivers.	Potential ARARs as site is located in close proximity of Hunt's River.
Fish and Wildlife Coordination Act (16 U.S.C. 661)	Protection of Wildlife Habitats	Prevents the modification of a stream or river that affects fish or wildlife.	Potential ARARs as sites are located adjacent to streams.
Wildlife––			
Endangered Species Act of 1973 (16 U.S.C. 1531)	Protection of Endangered Species	Restricts activities in areas inhabited by registered endangered species.	Potential ARAR as surrounding wetlands may sustain endangered or threatened wildlife species.
Historic Places––			
National Historic Preservation Act of 1966 (16 USC 470, et seq.)	Protection of Historic Places	Requires actions to take into account effects on properties included in or eligible for the National Register of Historic Places and minimizes harm to National Historic Landmarks.	Potential ARAR for activities which could impact historic places.
Archeological and Historic Presevation Act of 1974 (132 CFR 229 & 229.4, 43 CFR 7 & 7.4)	Protection of Archeological and Historic Lands	Restricts the use of land of known archeological or historical significance.	Potential ARAR for activities which could impact archeological or historic places.

TABLE 4
PRELIMINARY IDENTIFICATION OF STATE LOCATION–SPECIFIC ARARs AND TBCs
NETC – NEWPORT

STATE STATUTE	REGULATION/GUIDANCE	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Wetlands --			
RI Wetlands Law (RIGL Title 2, Chapter 1)	Regulation of Activities In and Around Wetlands	Provides for classification of coastal wetlands and freshwater wetlands and establishes permit requirements for activities which impact freshwater wetlands.	Potential ARARs if a remedial action is proposed within a wetland area (wetland areas exist adjacent to some of the NETC sites).
Coastal Areas--			
RI Coastal Resources Management Law (RIGL, Title 46, Chapter 23)	Protection of Coastal Areas	Regulates land use in or adjacent to coastal resources.	Potential ARARs as two of the sites are located along Narragansett Bay.

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TABLE 5
PRELIMINARY IDENTIFICATION OF FEDERAL ACTION–SPECIFIC ARARs AND TBCs
NETC – NEWPORT

FEDERAL STATUTE	REGULATION/GUIDANCE	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
CERCLA (Title I Section 101,111)	National Contingency Plan (40 CFR 300)	Establishes funding and provisions for the cleanup of hazardous waste sites.	ARARs as NETC is included on the National Priorities List.
Superfund Amendments and Reauthorization Act (42 U.S.C. 9601)	Cleanup Standards/ Response Action	Treatments must provide permanent reductions in volume, toxicity and mobility of wastes and satisfy ARARs.	ARARs as NETC is included on the National Priorities List.
Hazardous and Solid Waste Amendments of 1984 (HSWA)	Land Disposal Restrictions	Prohibits placement of hazardous wastes in locations of vulnerable hydrogeology and lists certain wastes, which will be evaluated for prohibition by EPA under RCRA.	Potential ARARs which may limit the use of land disposal in remediating certain hazardous wastes.
Resource Conservation and Recovery Act (40 CFR 264 and 265)	Requirements for Hazardous Waste Treatment Facility Design and Operating Standards for Treatment and Disposal Systems	Outlines specifications and standards for design, operation, closure and monitoring of performance for hazardous waste storage, treatment and disposal facilities.	Potential ARARs for alternatives which utilize a surface impoundment, waste pile, landfill, land treatment or incineration for on–site disposal/ treatment of wastes.
RCRA (40 CFR 264) Subpart F	Ground Water Protection	Ground water monitoring/corrective action requirements; dictates adherence to MCLs and establishes points of compliance.	Potential ARARs for alternatives which utilize a landfill for the ultimate disposal of hazardous waste materials and/or free liquids.
RCRA (40 CFR 264) Subpart G	Closure/Post Closure Requirements	Establishes requirements for the closure and long–term management of a hazardous disposal facility.	Potential ARARs for alternatives which utilize a landfill for the ultimate disposal of hazardous waste materials and/or free liquids.
RCRA (40 CFR 264) Subpart I	Use and Management of Containers	Outlines use and management standards applicable to owners and operators of all hazardous waste facilities that store containers of hazardous waste.	Potential ARARs for remedial actions which require storage of hazardous waste in containers.

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TABLE 5 (continued)
PRELIMINARY IDENTIFICATION OF FEDERAL ACTION–SPECIFIC ARARs AND TBCs
NETC – NEWPORT

FEDERAL STATUTE	REGULATION/GUIDANCE	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
RCRA (40 CFR 264) Subpart L	Waste Piles	Regulates owners and operators of facilities that store or treat hazardous waste in piles.	Potential ARARs for remedial alternatives which utilize a waste pile for on–site storage/treatment of waste.
RCRA (40 CFR 264) Subpart O	Incinerator Restrictions	Outlines specifications and standards for incinerating hazardous waste.	Potential ARARs for alternatives which utilize incineration for on–site treatment of wastes.
RCRA (40 CFR 262)	Generator Requirements for Manifesting Waste for Off–Site Disposal	Standards for manifesting, making and recording off–site waste shipments for treatment/disposal.	Potential ARARs for alternatives which utilize an off–site treatment/disposal method.
RCRA (40 CFR 263)	Transporter Requirements for Off–Site Disposal	Standards for transporters of hazardous waste materials.	Potential ARARs for alternatives which utilize an off–site treatment/disposal method.
RCRA (40 CFR 268)	Land Disposal Restrictions	Identifies hazardous wastes that are restricted from land disposal and sets treatment standards for restricted wastes.	Potential ARARs which may limit the use of land disposal in remediating certain hazardous wastes.
Toxic Substance Control Act (TSCA) (40 CFR 761, Subpart D)	Storage and Disposal Requirements for PCB–contaminated Materials	Establishes treatment and disposal requirements for PCB–contaminated materials.	Potential ARARs for alternatives which involve treatment or disposal of PCB–contaminated materials, including soils.
Safe Drinking Water Act (40 CFR 144 and 146)	Underground Injection Control Requirements	Establishes the general requirements, technical criteria and standards for underground injection wells.	Potential ARARs for alternatives which utilize underground injection as a remedial method.
Clean Water Act (40 CFR 122–125)	National Pollutant Discharge Elimination System (NPDES) Permit Requirements	Permits contain applicable effluent standards (i.e., technology–based and/or water quality–based), monitoring requirements, and standards and special conditions for discharge.	ARARs for alternatives involving treatment methods which discharge effluents to area water bodies.

TABLE 5 (continued)
PRELIMINARY IDENTIFICATION OF FEDERAL ACTION–SPECIFIC ARARs AND TBCs
NETC – NEWPORT

FEDERAL STATUTE	REGULATION/GUIDANCE	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Clean Water Act (40 CFR 403)	Discharge to Publicly–Owned Treatment Works (POTW)	A national pretreatment program designed to protect municipal wastewater treatment plants and the environment from damage that may occur when hazardous, toxic or other non–domestic wastes are discharged into a sewer system.	ARARS for alternatives involving treatment actions which discharge effluents to POTWs.
Clean Water Act (40 CFR 404)	Requirements for Discharge of Dredged or Fill Material	Prohibits activities that impact a wetland unless no other practical alternatives are available.	ARARs for alternatives conducted in or around adjacent wetlands.
Fish & Wildlife Coordination Act (16 U.S.C. 661)	Protection of Wildlife Habitats	Regulates actions which cause the impoundment, diversion or modification of a body of water, or affects fish and wildlife.	ARARs for alternatives conducted around wetlands and adjacent streams.
Clean Air Act (40 CFR 50)	National Ambient Air Quality Standards (NAAQS)–Particulates	Establishes maximum concentrations for particulates and fugitive dust emissions.	ARARs for alternatives involving treatment methods which impact ambient air (i.e. incineration, soil venting, etc.).
Clean Air Act (40 CFR 50)	New Source Performance Standards (NSPS)	Requires Best Available Control Technology (BACT) for new sources, and sets emissions limitations.	ARARs for alternatives involving treatment methods which impact ambient air (i.e., incineration, soil venting, etc.).
Clean Air Act (40 CFR 61)	Emissions Standards for Hazardous Pollutants (NESHAPS)	Establishes emissions limitations for hazardous air pollutants.	Potential ARARs for alternatives using treatments (i.e., incineration, etc.) which result in emissions to the air.
Hazardous Materials Transportation Act (49 CFR 170, 171)	Rules for Transportation of Hazardous Materials	Procedures for packaging, labelling, manifesting, and off–site transport of hazardous materials.	ARARs for alternatives involving the off–site shipment of hazardous materials or waste.
Occupational Safety and Health Act (29 CFR 1904)	Recordkeeping, Reporting and Related Regulations	Outlines recordkeeping and reporting requirements.	ARARs for all contractors/subcontractors involved in hazardous activities.

TABLE 5 (*continued*)
PRELIMINARY IDENTIFICATION OF FEDERAL ACTION–SPECIFIC ARARs AND TBCs
NETC – NEWPORT

FEDERAL STATUTE	REGULATION/GUIDANCE	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Occupational Safety and Health Act (29 CFR 1910)	General Industry Standards	Establishes requirement for 40–hour training and medical surveillance of hazardous waste workers. Establishes Permissible Exposure Limits (PELs) for workers at hazardous waste operations and during emergency response.	ARARs for workers and the workplace throughout the implementation of hazardous activities.
Occupational Safety and Health Act (29 CFR 1926)	Safety and Health Standards	Regulations specify the type of safety equipment and procedures for site remediation/excavation.	ARARs for workers and the workplace throughout the implementation of hazardous activities.

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TABLE 6
PRELIMINARY IDENTIFICATION OF STATE ACTION–SPECIFIC ARARs AND TBCs
NETC – NEWPORT

STATE STATUTE	REGULATION/GUIDANCE	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
RI Water Pollution Control Act (RIGL, Title 46, Chapter 12)	RI Water Quality Regulations	Requirements for discharging to area waters.	Potential ARARs for alternatives which involve the discharge of treated water to surface water or ground water.
	RI Pollutant Discharge Elimination Systems	Permits and regulates discharge to area surface waters.	Potential ARARs for alternatives which involve the discharge of treated water to surface water.
	RI Pretreatment Regulations	Rules concerning pretreatment of water prior to discharge to a POTW.	Potential ARARs for alternatives involving the use of Publicly Owned Treatment Works (POTW).
	RI Underground Injection Control Regulations	Rules concerning the reinjection of treated ground water.	Potential ARARs for alternatives involving the reinjection of treated ground water.
Public Drinking Water Laws (RIGL, Title 46, Chapter 14)	Protection of Public Drinking Water	Establishes rules concerning discharge to any source of water supply for drinking purposes.	Potential ARARs for alternatives which affect public public drinking water supplies.
RI Ground water Protection Act (RIGL, Title 46, Chapter 13.1)	Protection of Ground Water	Establishes ground water classifications and maximum contaminant levels for each classification.	Potential ARARs for alternatives involving the treatment of contaminated ground water. Will establish cleanup levels.
RI Hazardous Waste Management Act of 1978 (RIGL, Title 23, Chapter 19.1)	Hazardous Waste Management	Rules and regulations for hazardous waste generation, transportation, treatment, storage, and disposal.	ARARs for alternatives involving the hazardous waste management or on–site or off–site disposal activities.
RI Refuse Disposal Law	Solid Waste Management	Rules and regulations for solid waste management facilities.	ARARs for alternatives involving the on–site storage and disposal of solid wastes.
RI Underground Storage Tanks Act (RIGL, Title 46, Chapter 12.1)	Regulations for Underground Storage Facilities used for Petroleum Products and Hazardous Materials	Permits and regulates installation, operation and closure of underground storage tanks.	ARARs for alternatives involving closure of existing underground storage tanks.

TABLE 6 (continued)
PRELIMINARY IDENTIFICATION OF STATE ACTION–SPECIFIC ARARs AND TBCs
NETC – NEWPORT

STATE STATUTE	REGULATION/GUIDANCE	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
RI Clean Air Act (RIGL, Title 23, Chapter 23)	General Air Quality and Air Emissions Requirements	Sets emmissions limitations for particulates and visible air contaminants.	ARARs for alternatives involving remedial actions which impact ambient air.
RI Hazardous Substance Community Right to Know Act (RIGL, Title 23, Chapter 24.4)	Public Right–to–Know Requirements	Establishes rules for the public's right–to–know concerning hazardous waste storage and transportation.	ARARs for alternatives involving handling of hazardous waste materials, and transportation off–site.

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TABLE 7

GENERAL RESPONSE ACTIONS FOR NETC-NEWPORT SITES

Operable Unit	*General Response Actions*
Soil	• No Action • Institutional Control • Containment • Source Removal • Off-site Disposal • On-site Disposal • Off-site Treatment • On-site Treatment • In Situ Treatment
Ground Water	• No Action • Institutional Control • Containment • Off-site Treatment • On-site Treatment • In Situ Treatment • Extraction/Discharge
Surface Water	• No Action • Institutional Control • Collection • Diversion • Off-site Treatment • On-site Treatment
Sediment	• No Action • Institutional Control • Containment • Source Removal • Off-site Disposal • On-site Disposal • Off-site Treatment • On-site Treatment • In Situ Treatment

TABLE 8

PRELIMINARY ACTION ALTERNATIVES SOIL/SEDIMENT

RESPONSE ACTION	*REMEDIAL ALTERNATIVE*	*DATA REQUIREMENTS*
NO ACTION	Fence/Warning Signs	Risk Assessment
INSTITUTIONAL CONTROL	Deed Restrictions	Risk Assessment
CONTAINMENT	Capping	Risk assessment
	Vertical Barrier	Hydrogeologic data
SOIL DISPOSAL	On-site	Regulatory requirements
	Off-site	Regulatory requirements, Disposal facility availability
SOILS TREATMENT*	On-site Treatment	Treatability studies/pilot testing
	Volatiles -	
	Thermal Treatment	Ash content, moisture content
	Plasma Arc Pyrolysis	Moisture content
	Semivolatiles -	
	Dechlorination	Particle size distribution
	Soil Washing	Particle size distribution
	Incineration	Ash content, moisture content
	Inorganics -	
	Soil Stabilization	Moisture content
	Soil Washing	Particle size distribution
	Thermal Immobilization	Moisture content
	In Situ Treatment -	
	Biodegradation (organics)	BOD/COD, TOC, pH
	Stabilization	Moisture content
	Soil Venting (organics)	Particle size distribution
	Vitrification	Contaminant depth, geology
	Off-site Treatment	
	Incineration	Incinerator availability
	Various others	

* A risk assessment may also be a data requirement for establishing levels of treatment.

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TABLE 9

PRELIMINARY ACTION ALTERNATIVES GROUND/SURFACE WATER

RESPONSE ACTION	REMEDIAL ALTERNATIVE	DATA REQUIREMENTS
NO ACTION	Fence/Warning Signs	Risk assessment
	Continued Monitoring	Risk assessment
INSTITUTIONAL CONTROL	Ground Water Use Restrictions	Risk assessment
CONTAINMENT	Capping	Risk assessment
	Vertical Barrier	Hydrogeologic data
EXTRACTION/ COLLECTION	Extraction Wells	Hydrogeologic data
	Well Points	Hydrogeologic data
	French Drains	Hydrogeologic data
	Diversion Structures	Hydrologic data
OFF-SITE TREATMENT*	POTW	Administrative/technical requirements
	RCRA Facility	Location/capacity/unit processes
ON-SITE TREATMENT*		Treatability studies/pilot testing
	Organics -	
	Bioreactor	BOD/COD
	PACT™	BOD/COD
	Air Stripping	Henry's Law constants
	Steam Stripping	Henry's Law constants
	Carbon Adsorption	Adsorption isotherms
	Resin Adsorption	Suspended solids
	UV Oxidation	pH, temperature, TDS
	Inorganics -	
	Reverse Osmosis	pH, suspended solids
	Ion Exchange	Suspended solids
	Precipitation	TDS, suspended solids
	Membrane Microfiltration	Suspended solids
	Electrochemical	pH
IN SITU TREATMENT*	Biodegradation	BOD/COD, pH
DISCHARGE	Injection Wells	Hydrogeologic data
	Infiltration Galleries	Hydrogeologic data
	Surface Water	Regulatory requirements
	Storm Sewer	Location
	Sanitary Sewer	Location

* A risk assessment may also be a data requirement for establishing levels of treatment.

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U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

VOLUME VIII
TREATABILITY STUDY AND FEASIBILITY STUDY PLAN

PHASE II RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

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1.0 INTRODUCTION

This document describes the tasks associated with conducting treatability studies, pilot testing, and Feasibility Studies (FS) at the NETC-Newport sites. A plan for conducting treatability studies is presented initially. A discussion of the FS process follows.

2.0 TREATABILITY STUDY/PILOT TESTING PLAN

While treatability study/pilot testing may be appropriate for some of the NETC-Newport sites, initiation of the Feasibility Study process, specifically the initial development and screening of remedial alternatives, allows for a more focused application of such testing. Currently, no sites are considered to be adequately characterized to allow for the identification of applicable treatability studies. Additional environmental sampling will provide added information on ambient or background conditions or the extent of contamination. This additional information, along with the preliminary scoping of remedial alternatives within the Feasibility Study process, will allow for a better definition of applicable technologies. Since treatability studies for certain technologies can be costly, it is essential to limit the number of technologies being considered prior to the initiation of such studies. As part of this task, TRC-EC project team members will meet with Navy/NETC-Newport representatives including Technical Review Committee Members to discuss the need for and suggested scope of the treatability studies. The meeting will be scheduled once the preliminary Phase II analytical results are available and preliminary remedial alternative scoping activities have been conducted.

This section will discuss in a preliminary nature those sites which may require treatability study/pilot testing in the future, and potential remedial technologies which may require treatability study/pilot testing to demonstrate their applicability at a given site. A review of Phase I RI analytical data and the results of the Phase I Risk Assessment with respect to chemical-specific, enforceable ARARs (e.g., MCLs) and acceptable risk levels (e.g., 1×10^{-6} for carcinogenic risks and a hazard index of less than 1 for noncarcinogenic risks) provides a preliminary indication of the types of contaminants which may require treatment at the various NETC-Newport sites.

For soil contaminants, no enforceable chemical-specific ARARs have been identified. Therefore, for this preliminary evaluation, the results of the Phase I Risk Assessment are used to identify potential sites and contaminants requiring remediation. The soil contaminants which were detected at all four sites at levels associated with risk estimates which exceed acceptable risk levels include arsenic and PAHs. Antimony, cadmium, chromium, copper, manganese, mercury, thallium, and zinc were all detected at levels which pose risks in excess of acceptable levels.

For ground water, the MCLs for aluminum, beryllium, cadmium, iron, manganese, and lead were the most commonly exceeded MCLs at the various sites (exceeded at all four sites, respectively). The following analytes were also detected at levels exceeding MCLs, although less frequently: chromium, nickel, arsenic, xylene, antimony, mercury, zinc, benzene, ethylbenzene, PCBs, and BNAs. At all five sites, estimated risks exceeded the acceptable risk levels associated with ground water exposure/ingestion for arsenic. Analytes which were detected more infrequently at levels which result in excess risks include chromium, manganese, mercury, thallium, PAHs, 1,1-dichloroethane, trichloroethene and vinyl chloride.

Site 01 has the greatest number of contaminants detected at levels exceeding MCLs (17 compounds/metals), acceptable ground water-based risk levels (3 compounds/metals) and acceptable soil-based risk levels (9 compounds/ metals). Sites 13, and 09 follow in terms of exceedances of acceptable regulatory or risk-based levels.

Based on this preliminary analysis, remedial technologies which offer inorganic treatment of soils and/or ground water appear to be the most applicable to NETC-Newport sites. Treatability studies could be performed for technologies which are innovative and relatively unproven or for technologies which have a proven record but which require testing to ensure remedial action objectives can be achieved. Examples of soil treatment technologies which could be applicable to inorganic contaminants and which may require treatability study testing include such technologies as soil stabilization, soil washing, or in-situ vitrification. Examples of ground water treatment technologies which could be applicable to inorganic contaminents and which require treatability study testing include steam stripping, membrane microfiltration, and powdered activated carbon treatment (PACT™).

3.0 FEASIBILITY STUDY PLAN

The Feasibility Study (FS) will draw upon existing site characterization data, existing remedial treatment process data, existing treatability study data, where available, and baseline risk assessment findings to evaluate potential remedial options appropriate to the specific site. The methodology to be followed in conducting the FS will conform with the requirements of CERCLA, SARA, and the National Contingency Plan (NCP). The U.S. Environmental Protection Agency (EPA) interim final guidance document entitled, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, dated October 1988, provides a basis for conducting Feasibility Studies in accordance with these requirements. The Feasibility Study plan presented below is based upon this guidance.

To date, the Confirmation Study and the Phase I Remedial Investigation (RI) activities have been conducted, providing an understanding of existing site conditions. The proposed Phase II RI will attempt to eliminate present data gaps and provide a more comprehensive understanding of each site under the Feasibility Study process. Feasibility Studies will be site-specific and will be based on the findings of each of the site investigations. They will include a systematic evaluation and screening of possible remedial technologies, allowing the definition and development of a focused range of comprehensive remedial alternatives, which will provide the basis for the selection of a recommended remedial alternative. The overall approach for conducting Feasibility Studies is shown in Figure 1. A proposed outline for a Feasibility Study is presented in Table 1. Major components of an FS are described below.

3.1 Identification and Screening of Technologies

Candidate remedial alternatives will be developed through an identification and screening process. This process consists of development of goals of remediation, identification of general categories of remedial actions (e.g., treatment, containment, etc.) to be considered, estimation of volumes or areas of media to which these general kinds of actions may be applied, identification of the technologies applicable to each of the general kinds of actions, and then the screening of these technologies on the basis of technical implementability. Each of these process steps is discussed in more detail below.

3.1.1 Remedial Action Objectives

For each medium or operable unit, remedial action objectives will be established for protection of human health and the environment. Remediation goals will be derived from identified Applicable or Relevant and Appropriate Requirements (ARARs) or from the baseline risk assessment and/or ecological assessment. In this way, remedial action objectives will be developed on the basis of an integrated analysis of contaminant concentrations, exposure routes, and receptor populations.

3.1.2 General Response Actions

Once remedial action objectives are defined, qualitative general response actions which are capable of meeting these objectives will be identified for each medium. General response actions are generic in nature and include such broad measures as treatment, containment, and extraction.

3.1.3 Estimation of Quantities of Media to be Remediated

The volumes and areas of media to which the general response actions are to be applied will be estimated. Estimates will be based upon the data defining the nature and extent of site contamination, as well as the site geology and hydrogeology.

3.1.4 Identification and Screening of Remedial Technologies

The universe of technology types and process options that are potentially applicable to the identified general response actions and corresponding estimated quantities of media to be remediated will be identified and evaluated.

The range of identified remedial technologies will be reduced by screening the technology types on the basis of technical implementability. The types of contaminants and existing site conditions will provide the basis on which to assess the technical implementability of technology types. For instance, the physical or chemical nature of the identified contaminants may preclude the use of certain remedial technologies.

3.1.5 Selection of Representative Technology Process Options

Upon completion of the technology screening, the process options associated with each remaining technology type will be evaluated with respect to effectiveness, implementability and cost. On the basis of this evaluation, a representative process option will be chosen for each technology type. This representative process option is then used in the development and evaluation of remedial alternatives.

3.2 Development and Screening of Alternatives

A range of remedial alternatives will be developed by combining representative process options in a manner which addresses remediation of the site as a whole. Upon development of a preliminary range of remedial alternatives, the alternatives are screened in order to reduce the number of alternatives which will undergo detailed analysis. This alternative development and screening process is discussed in further detail below.

3.2.1 Assembly of Remedial Alternatives

Representative process options will be used to develop a range of remedial alternatives that will address human health and environmental risks on a site-wide basis. It is expected that approximately eight to twelve preliminary remedial alternatives will be developed. As required under SARA, the range of alternatives will include the following categories:

- Alternatives relying primarily on treatment which will reduce the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants, including an alternative which, through treatment, eliminates or minimizes the need for long-term management at the site;
- Alternatives that involve little or no treatment but provide protection of human health and the environment, primarily by preventing or controlling potential exposures to contaminants;
- For alternatives involving ground water response actions, alternatives that attain remedial goals within different restoration periods;
- One or more alternatives which involve the use of innovative technologies; and
- The no-action alternative.

A general definition of the remedial alternatives is developed at this point to provide a basis for the preliminary alternative screening. A description of each alternative is provided which includes the following items, as appropriate:

- Locations of areas to be remediated;
- Approximate volumes of each media to be subject to remediation by each technology type;
- Sizing and general configuration of extraction and treatment systems or containment structures;
- Preliminary treatment process flow rates;
- Spatial requirements for treatment or containment systems;
- Transport distances for discharge or disposal technologies;
- Degree of attainment and general time frames for attainment of site-wide remedial action objectives; and
- Institutional restrictions and requirements such as permit requirements.

Definition of the alternatives also requires an evaluation of potential inter-media impacts, since at this point media-specific technologies are combined into alternatives which address multiple exposure pathways.

3.2.2 Alternative Evaluation and Screening

Once the range of alternatives has been developed, the individual alternatives will be evaluated on the basis of effectiveness, implementability, and cost, as discussed below.

Effectiveness Evaluation

Each alternative will be evaluated on the basis of the degree of human health and environmental protection it offers and the reductions in toxicity, mobility, or volume it is expected to provide both in the short-term and the long-term. Short-term effectiveness relates to the construction and implementation periods while long-term effectiveness pertains to the period following implementation.

Implementability Evaluation

The criterion of implementability serves as a measure of the feasibility of constructing, operating, and maintaining an alternative and is dependent on the technical feasibility and

administrative feasibility of the alternative. Technical feasibility relates to the ability to construct, operate, maintain, and monitor the performance of the remedial components. Administrative feasibility relates to the ability to obtain the requisite permits and/or approvals from agencies of the government with jurisdiction over the activities involved and the ability to obtain the equipment and technical services needed to implement the technologies involved.

Cost Evaluation

Preliminary cost estimates will be developed for each alternative by discounting projected capital and O&M costs to a common base year. Estimates of projected costs will be based on cost curves, generic unit costs, vendor information, conventional cost estimating guides, prior estimates for similar configurations of remedial technology, and engineering judgement. Emphasis will be given to establishing relative costs of comparative accuracy due to the relatively unrefined nature of the alternatives at this point in the FS process.

Alternative Screening

Those alternatives that receive the most favorable composite evaluation on the basis of the three factors described above will be retained for detailed analysis. Where practicable, the retained alternatives will also preserve the range of treatment and containment technologies originally developed. Innovative technologies will be carried through the screening process if there is a reasonable belief that the innovative technology offers significant advantages over conventional technologies. It is expected that the total number of alternatives to be carried through the screening process will be in the range of five to eight.

3.3 Detailed Analysis of Alternatives

The alternatives that have been carried through the screening process will undergo detailed analysis in order to support the remedy selection process in accordance with CERCLA requirements. The results of these analyses will be summarized in an array format to facilitate comparisons among the alternatives. Final selection of a remedial alternative will be made subsequent to the preparation of the Feasibility Study and will be documented in the Record of Decision (ROD).

3.3.1 Evaluation Criteria for Detailed Analysis

Detailed analysis of alternatives in the feasibility study will be based upon evaluation of the following seven criteria:

1) Overall protection of human health and the environment;
2) Compliance with ARARs;
3) Long-term effectiveness and permanence;
4) Reduction of toxicity, mobility, or volume;
5) Short-term effectiveness;
6) Implementability; and
7) Cost.

Two additional criteria, state acceptance and community acceptance, will also be taken into consideration following completion of the Feasibility Study and associated public comment period, and will be addressed in the ROD.

3.3.2 Further Definition of Alternatives

Alternatives will be further defined as necessary to enable the evaluation criteria to be applied consistently and to enable cost estimates to be developed within the desired accuracy range of +50 percent to -30 percent.

3.3.3 Individual Detailed Analysis of Alternatives

Each alternative will undergo detailed evaluation relative to the seven criteria listed above. For each evaluation criterion, the general scope of the evaluation is described below.

Overall Protection of Human Health and the Environment

This criterion provides an overview of whether the alternative is protective of human health and the environment. It is based on other evaluation criteria, including long-term effectiveness and permanence, short-term effectiveness and compliance with ARARs. The way in which an alternative addresses the previously identified site risks through the use of treatment, engineering, or institutional controls is evaluated. In addition, consideration is given to any

short-term risks and/or cross media impacts that may be associated with the implementation of an alternative.

Compliance with ARARs

This evaluation criterion addresses the manner in which the alternative complies with contaminant-specific, location-specific, and action-specific ARARs. The ARARs that apply to each alternative will be identified, and the manner in which the alternative meets the requirements of the ARAR will be described. When an ARAR will not be met, justification for a waiver that satisfies the requirements of CERCLA will be presented.

Long-Term Effectiveness and Permanence

This criterion addresses the degree of long-term risk that will be posed by treatment residuals, contaminated media, and/or untreated wastes remaining at the site after remedial response objectives have been met and the effectiveness and reliability of controls, if any, used to manage these risks.

Reduction of Toxicity, Mobility, or Volume Through Treatment

This element of the detailed analysis focuses on the extent to which the alternative employs treatment technologies that permanently or significantly reduce toxicity, mobility, or volume of contaminated media as a principal element. The degree of treatment provided by the alternative, the irreversibility of the treatment, and the type and quantity of residuals remaining after treatment are discussed.

Short-Term Effectiveness

Short-term effectiveness relates to the human health and/or environmental impacts which result during the construction and implementation phases of the remediation, and the degree to which such impacts are controlled. This evaluation will encompass short-term impacts on the surrounding community, occupational impacts on workers engaged in construction and/or implementation activities, and short-term impacts on the environment. The time period required to meet remedial action objectives will also be estimated.

Implementability

This criterion considers the technical and administrative feasibility of implementing the alternative. As in the preliminary alternative screening, the technical feasibility of construction and operation, the administrative feasibility of obtaining permits and coordination with regulatory agencies, and the availability of the remedial services, materials, and personnel experienced in providing the services will be considered.

Cost

Cost estimates will be developed in conformance with the procedures contained in the U.S. EPA guidance document entitled, Remedial Action Costing Procedures Manual, dated September 1985. Estimates of the magnitude and timing of direct capital, indirect capital, and O&M costs will be made and future costs will be discounted to the present in order to calculate a present worth cost estimate for each alternative. The detailed and comprehensive information base available from the RI are expected to enable the formulation of cost estimates that fall within a range of accuracy of +50 percent to -30 percent. Factors which may limit the accuracy of the cost estimates, such as conflicting field data or uncertainties in the time required to reach remedial objectives, will be identified. A cost sensitivity analysis will be performed in which the impact of variations in design assumptions will be evaluated. Where there is sufficient uncertainty associated with the basic assumptions used to develop an individual cost, the assumptions will be varied and the overall impact on the total estimated cost will be calculated.

3.3.4 Comparative Analysis of Alternatives

Upon completion of the individual analyses of alternatives, a comparative analysis of alternatives will be conducted. Thus the relative performance of each alternative in relation to each of the seven evaluation criteria will be assessed. In this way the major tradeoffs to be weighed in the alternative selection process will be identified.

TABLES

TABLE 1

PLANNED FS REPORT FORMAT
NETC-NEWPORT

EXECUTIVE SUMMARY

1.0 Introduction
- 1.1 Purpose and Organization
- 1.2 Background Information (summarized from the RI Report)
  - 1.2.1 Site Location and Description
  - 1.2.3 Site History
  - 1.2.4 Site Investigation Summary
  - 1.2.5 Geology and Hydrogeology
  - 1.2.6 Nature and Extent of Contamination
  - 1.2.7 Contaminant Fate and Transport
  - 1.2.8 Baseline Risk Assessment

2.0 Identification and Screening of Technologies
- 2.1 Introduction
- 2.2 Remedial Action Objectives and Cleanup Criteria
- 2.3 General Response Actions
- 2.4 Identification and Screening of Technologies and Process Options
  - 2.4.1 Technology Screening
  - 2.4.2 Process Option Screening

3.0 Development and Screening of Alternatives
- 3.1 Development of Alternatives
- 3.2 Screening of Alternatives
  - 3.2.1 Description - Alternative 1
  - 3.2.2 Description - Alternative 2
- 3.3 Selection of Alternatives for Detailed Analysis
  - 3.3.1 Effectiveness
  - 3.3.2 Implementability
  - 3.3.3 Cost
  - 3.3.4 Selection of Alternatives for Further Consideration

4.0 Detailed Analysis of Alternatives
- 4.1 Introduction
- 4.2 Individual Analysis of Alternatives
  - 4.2.1 Alternative 1
    - Description/Definition
    - Analysis
  - 4.2.2 Alternative 2

TABLE 1

(continued)

PLANNED FS REPORT FORMAT
NETC-NEWPORT

4.3 Comparative Analysis of Alternatives
- 4.3.1 Short-Term Effectiveness
- 4.3.2 Long-Term Effectiveness
- 4.3.3 Implementability
- 4.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment
- 4.3.5 Compliance with ARARs
- 4.3.6 Overall Protection of Human Health and the Environment
- 4.3.7 Cost

5.0 References

Appendices

A Detailed Cost Estimates
B Risk Assessment Methods

FIGURES

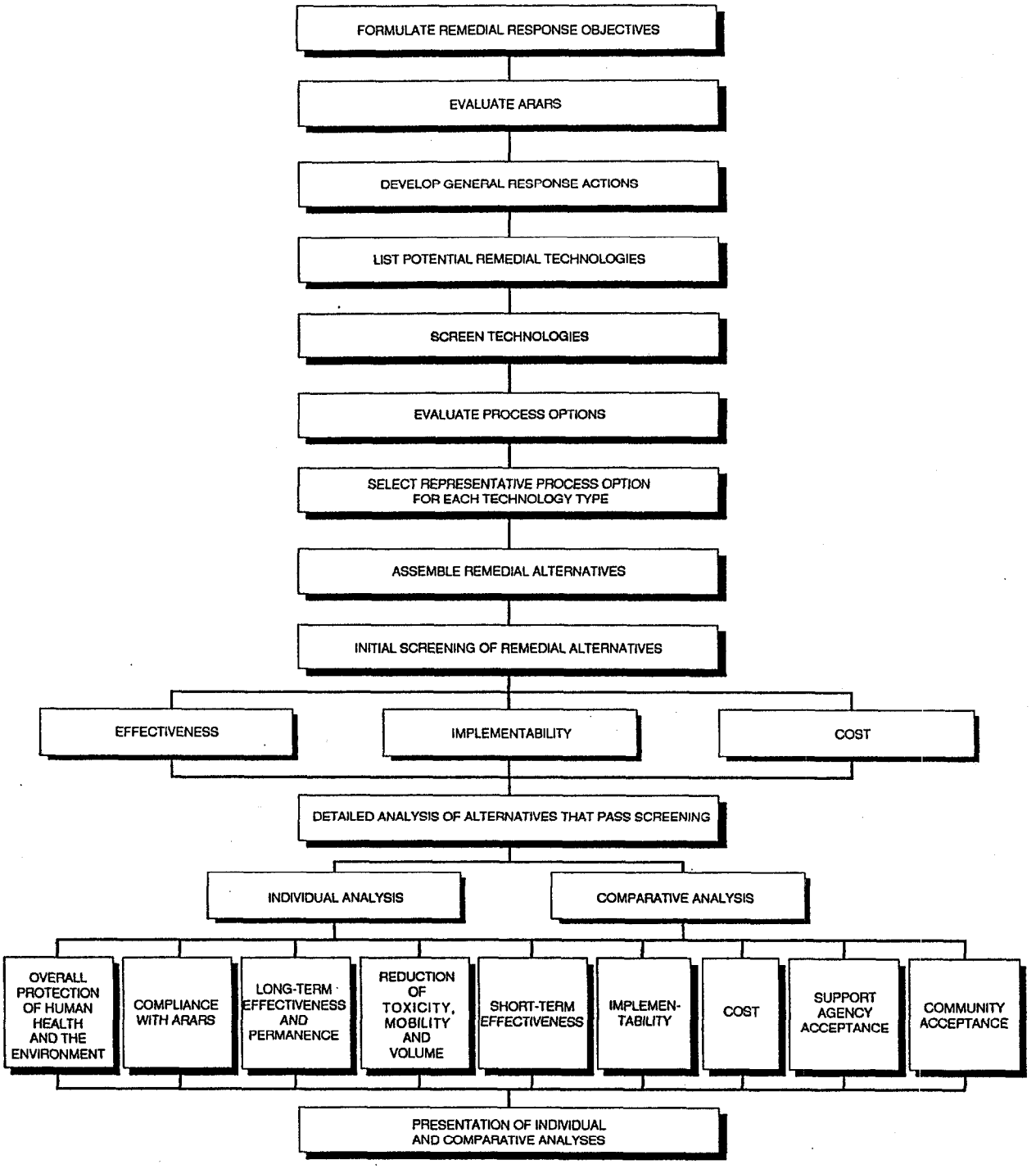

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FIGURE 1.

FEASIBILITY STUDY APPROACH

Date: 9/92 | Drawing No. 6760-N81