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TANK CLOSURE INVESTIGATION
TANKS 53 AND 56
TANK FARM 5
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

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1.0 INTRODUCTION

As part of an on-going underground storage tank closure on Tank Farm 5 on the Naval Education Training Center (NETC) in Newport, Rhode Island, TRC Environmental Consultants, Inc. (TRC) was retained by the U.S. Department of Navy-Northern Division to investigate the area around Tanks 53 and 56 on the tank farm. The investigation was directed at determining if petroleum hydrocarbons had migrated from the tanks into the surrounding soils and/or ground water. The investigation consisted of the installation of monitor wells and the collection of soil and ground water samples. Information from a 1990 remedial investigation of the entire site conducted by TRC was also used in this assessment. Included in this report is a brief history of Tank Farm 5 (Section 2.0), a description of the TRC field investigation and findings (Sections 3.0 and 4.0), a discussion of the significance of the findings with regard to contaminant migration, regulatory considerations, and public health (Section 5.0), and a presentation of potential remedial alternatives (Section 6.0).

2.0 BACKGROUND/OVERVIEW

2.1 Site History

Tank Farm 5 is located approximately one mile north of the NETC in the town of Middletown, RI (see Figure 1). Tank Farm 5 is bordered to the north and northwest by Defense Highway, to the southwest by a cemetery, to the east by residences and to the north and northeast by Greene's Lane and Gomes Brook. Tanks 53 and 56 are located in the western portion of the 85-acre tank farm (see Figure 2).

Eleven underground storage tanks, numbered 49 through 59, comprise Tank Farm 5. Each tank is constructed of prestressed concrete and has a capacity of 60,000 barrels (ERA, 1988). The tanks were constructed in 1942 and 1943. The tanks are approximately 116 feet in diameter and 33.5 feet deep. The tanks are covered by approximately 4 feet of soil. Each tank is surrounded by a ring drain area which consists of 12 inch reinforced concrete drain pipe located within an permeable backfill approximately 4 feet wide. The drain is connected to a sump pump to remove the ground water from the backfill area, reportedly to prevent tank drainage or tank flotation (ERA, 1988).

The underground storage tanks in Tank Farm 5 were used for fuel storage from World War II to 1974. In 1975, the Navy began using Tanks 53 and 56 for used oil storage as part of an oil recovery program. Between 1975 and 1982, Tanks 53 and 56 were utilized to contain used oil for alternate use as heating fuel for Building 86 (ERA, 1988). In 1982, The State of Rhode Island

Department of Environmental Management (RIDEM) adopted hazardous waste regulations which were applicable to the waste oils in the tanks. In 1984, the Navy decided to discontinue use of the tanks. In 1988, a tank closure plan addressing Tanks 53 and 56 was prepared for the Navy by Environmental Resource Associates, Inc. (ERA, 1988). Currently the portion of the tank farm bound by Tank 52, an old burning pit, and Defense Highway is occupied by a recently constructed fire fighting training center.

2.2 Previous Investigations

Sampling of the water, oil, and sludge in Tanks 53 and 56 was conducted in 1983 by Environmental Resources Associates, Inc. (ERA, 1988). The presence of three phases in the tanks was a result of the tanks being filled with water for ballast after their use was discontinued. According to the ERA report, the sample analyses results indicated that the oil phase in both tanks was determined to be hazardous due to the concentration of lead in the oil. Similarly, the sludge layer in both tanks was also determined to be hazardous by ERA due to the presence of significant concentrations of lead, cadmium, chromium, barium, mercury and silver. In addition, the water in Tank 56 was found to contain hydrocarbon compounds.

In 1985, a total of four ground water monitor wells (MW-53E, MW-53W, MW-56E, and MW-56W) were installed in the ring drains of Tanks 53 and 56 (see Figure 3). The results of ground water sample analyses are summarized in tables from the ERA report in Appendix

A. The ground water sample results indicated the presence of several chlorinated and aromatic hydrocarbons in the samples from wells in the Tank 53 ring drain. In addition, trace concentrations of mercury (MW-53E - 1.2 ppb, MW-56W - 1.4 ppb, and MW-56E - 0.8 ppb) were detected in wells in both tank ring drains. Cadmium (7 ppb) was also detected in one ground water sample from the ring drain of Tank 56. No other metals were detected in the ground water samples from the four wells. Split spoon soil samples collected from the Tank 53 ring drain borings showed fuel oil staining and odor.

Six additional monitor wells were installed around the tanks and sampled by ERA in 1986; five to the north and west of Tank 53 and one 300 feet south of Tank 56. The analytical results of the ground water samples from these wells (summarized in Appendix A) confirmed the presence of organic compounds in the Tank 53 ring drain. The sample results also indicated the presence of organic compounds in the ground water at a distance of 150 feet to the north of Tank 53 (at well MW86-2). At the time of sampling, a floating oil layer was present in the Tank 53 ring drain wells (wells MW-53E and MW-53W). The hydraulic gradient data developed for the well network indicated a ground water flow direction to the northwest across Tank 53 and a downward vertical hydraulic gradient at nested well pair (MW86-3) installed to the northwest of Tank 53.

In 1986, the four ring drain monitor wells (MW-53E, MW-53W, MW-56E, and MW-56W) were resampled by ERA. The results of the volatile organic analysis of these samples confirmed the presence

of several volatile organic compounds in the ground water in the Tank 53 ring drain, and the absence of VOCs in the ground water in the Tank 56 ring drain. The boring logs and the well construction information from the ERA investigations are presented in Appendix B.

In 1990, the tank samples were characterized and surface soil samples were collected from above each of the tanks under a remedial investigation of the entire site by TRC. The findings of this investigation with respect to Tanks 53 and 56 are presented in this report.

3.0 FIELD INVESTIGATION ACTIVITIES

3.1 Purpose/Approach

The purpose of the TRC 1990 tank closure investigation was three-fold: 1) to install additional monitor wells and collect soil and ground water samples to determine the presence and extent of contamination near Tanks 53 and 56; 2) to replace monitor wells which were damaged by contractors working adjacent to the new Fire Fighting Training Center; and 3) to install a large-diameter well near Tank 53 for possible free-product recovery.

As directed by the Navy, a total of five new wells were installed near the two tanks. Two additional monitor wells, MW-9 and MW-10, were installed northwest of Tank 56. These wells were installed to provide information on the ground water quality downgradient of Tank 56. Based on the information presented in the ERA tank closure plan (ERA, 1988), ground water in this area of the site flows to the west or northwest. Two monitor wells were also installed near Tank 53 to replace wells damaged during the construction of the adjacent Fire Fighting Training Center. The replacement wells are as follows: MW-7 in place of damaged well MW86-3; and MW-8 in place of damaged well GHR. In addition, one 8-inch diameter well (RW-1), suitable for free-product recovery, was installed adjacent to the north side of Tank 53. Soil and ground water samples were collected for laboratory analysis to assess the nature and extent of contamination around each tank.

In addition to the new soil boring and monitor well sample results, this assessment considered the analytical results of tank

and surface soil samples previously collected by TRC at the site. The tank contents were sampled during TRC's 1990 remedial investigation of the entire tank farm under the Navy's Installation Restoration Program. The tanks were sampled to characterize the tank contents. Surface soil samples were also collected under that investigation to assess the general surface soil quality around the tanks. A summary of the samples and corresponding sample analyses used in this assessment is provided in Table 1.

3.2 Tank Sampling Procedures

Oil and water samples were collected from both Tanks 53 and 56 as a part of the remedial investigation being conducted at Tank Farm 5. Floating oil samples were collected by fastening a dedicated laboratory sample container to a stainless-steel extension rod and lowering the container through the tank fill pipe to the depth of the floating oil layer. The container was then submerged into the oil layer and the oil was allowed to flow into the container. The oil sample was then raised to the surface and transferred into the appropriate sample container.

The water samples were collected by use of a discrete interval liquid sampler or teflon bailer. To prevent the contamination of the water sampling device as it passed through the floating oil layer, a section of 3" diameter, ASTM grade PVC piping (with parafilm wrapped around the lower end) was first lowered through the oil layer to the desired water sampling depth. The water sampling device was then lowered down through the PVC piping and

pushed through the parafilm cap to a depth of approximately five feet below the floating oil layer and a water sample was collected. The sampler was then raised to the surface and the water was transferred to the appropriate sample container through a bottom check valve on the sampler.

The oil and water samples were analyzed for the full list of TCL parameters (oil samples less pesticides and water samples less pesticides/PCBs).

3.3 Surface Soil Sampling Procedures

Two surface soil samples were collected at both Tanks 53 and 56 as part of the remedial investigation being conducted at the NETC site. The two surface soil samples from around each tank consisted of one composite sample from the tank area and one discrete sample from the center of each tank area. The discrete surface soil samples are designated as SS-53D and SS-56D; wheras the composite samples are designated as SS-53 and SS-56 (see Figure 5). Descriptions of the surface soil samples are provided in Table 2.

All surface soil samples were collected with a decontaminated, dedicated stainless-steel spoon. Surface soil samples to be analyzed for total petroleum hydrocarbons and volatile organics were collected from a depth of at least 6 inches below grade. These samples were transferred directly to the appropriate sample container to minimize the loss of volatile compounds from the sample. All other surface soil samples were collected from between

the 0- to 6-inch depth. When composite soil samples were collected, the compositing of the soil samples was performed by collecting an equal amount of sample from each location and placing the samples into a decontaminated stainless-steel bowl, and mixing them thoroughly with a dedicated stainless-steel spoon. Each composite sample consisted of four aliquots collected from four adjoining quadrants of approximately equal area above a tank.

The composite surface soil sample collected at Tank 56 was analyzed for the full target compound list (TCL) and total petroleum hydrocarbons (TPH). This one surface soil sample was collected and analyzed separately as a split sample with the US EPA during the site remedial investigation. The remaining surface soil samples were analyzed for TPH and lead.

3.4 Drilling and Soil Sampling Procedures

The five new wells (MW-7, MW-8, MW-9, MW-10, and RW-1) were installed as a part of the TRC tank closure investigation between September 11 and 20, 1990 at the locations shown on Figure 4. The drilling contractor was Construction Drilling Services Inc., of Chelmsford, MA. The borings for the monitor wells and recovery well were drilled using hollow stem augers; 6-1/4 inch inside diameter (ID) augers were used at monitor well locations and 10-1/4 inch ID augers were used at the recovery well location. Competent rock was encountered at two of the monitor well locations (MW-8 and MW-9). At well location MW-8, the bedrock borehole was advanced using the standard rotary drilling method with a pure bentonite and

potable water mixture as the drilling fluid. At well location MW-9, the bedrock borehole was advanced by Nx rock coring using potable water as the drilling fluid.

Split spoon soil samples were collected from the overburden soils in advance of the augers at all well locations. The sampling interval varied from continuous to five-foot intervals. Upon opening the split-spoon sampler, the samples were scanned with an organic vapor analyzer (OVA) and HNu (PI-101) to identify the presence of organic vapors. All visual observations and instrument readings were noted in the boring logs.

Generally, one soil sample was selected for chemical analyses from each boring based upon OVA/HNu readings and field observations (e.g., depth to water table, odors, staining). Given the presence of visually observed soil contamination in the recovery well boring and the lack of sufficient sample recovery for the MW-7 well boring sample, two soil samples were collected for analysis from the recovery well boring. The soil samples were collected directly from the split spoon sampler and placed in laboratory-supplied jars using a decontaminated, dedicated stainless-steel spoon. All samples were preserved after collection for holding and overnight shipment by storing on ice in a cooler.

The boreholes were advanced into bedrock at all locations. As noted above, at well locations MW-8 and MW-9 competent shale bedrock was encountered below a layer of weathered rock. At well locations MW-7, RW-1, and MW-10 weathered bedrock was encountered.

Geologist's logs and well construction diagrams for the five new wells are presented in Appendix C.

3.5 Well Construction

Upon completion of each of the respective well borings, a well was installed in the borehole. The four monitor wells are constructed of four-inch diameter, Schedule 40, threaded, flush-joint PVC casing and slotted (10-slot, 0.010-inch) screen. The recovery well is constructed of eight-inch diameter, steel casing and steel, wire-wrapped (10-slot, 0.010-inch) screen. The casing and screen assemblies were placed into the borehole through the augers and set to the desired depth. The borehole annulus adjacent to and extending to approximately two feet above the top of each well screen was backfilled with clean silica sand. A two-foot thick bentonite pellet seal was placed above the sand pack and the remainder of the borehole annular space was filled with a bentonite/cement grout. A protective steel casing with locking cap was cemented in place to secure the well head. The well construction diagrams are provided in Appendix C.

Following installation, the monitor wells were developed using a Waterra pump. Fine-grained material around the well screen was drawn into the well and removed by the agitation and pumping action of the Waterra pump. The pump utilized dedicated, ASTM drinking water-grade polyethylene tubing and check valves. The water was removed from the well with the pump and check valve assembly at a low rate. All wells were pumped for a minimum of one hour or until

the water achieved visual clarity. All water produced during the well development was contained in 55-gallon drums.

The well locations and top of casing and ground elevations were surveyed by SAI Surveying of Jamestown, RI. The well elevation and depth data is summarized in Table 3.

3.6 Ground Water Sampling Procedures

Two rounds of ground water samples were collected by TRC in the area of Tanks 53 and 56 as part of this investigation and TRC's remedial investigation of the site. The first round of ground water samples was collected on July 20, 1990 under the remedial investigation, prior to the installation of the five new wells. At that time, samples were also collected from seven existing monitor wells: MW-53W, MW-53E, MW-56W, MW-56E, MW86-1, MW86-2, and MW86-4. Monitor well MW86-5 was dry on this sampling date and thus was not sampled. Two of the ground water samples (MW-53W and MW-56W) were analyzed for the full target compound list (TCL) (by USEPA CLP methods) and total petroleum hydrocarbons (TPH, EPA Method 418.1). All but one of the remaining well samples (MW86-2) were analyzed for TPH and lead. The ground water sample from MW86-2 was only analyzed for TPH due to insufficient water in the well for a sample for lead analysis.

The second round of ground water samples was collected by TRC on October 25, 1990 under the TRC tank closure investigation, and included eleven wells: MW-53E, MW-53W, MW-56E, MW-56W, MW86-1, MW86-2, MW86-4, MW-7, MW-9, MW-10 and RW-1. Monitor wells MW86-5

and MW-8 were dry on this sampling date. The samples from wells MW-56E, MW-56W, MW86-1, MW86-2, MW-7, MW-9, MW-10, and RW-1 were analyzed for volatile organic compounds (VOCs, EPA Method 8240), base/neutral/acid extractable compounds (BNAs, EPA Method 8270), priority pollutant metals (arsenic, chromium, copper, nickel, lead, zinc), oil and grease, and total suspended solids (TSS). Due to a insufficient sample volume (i.e., low volume of water in well and a very slow well recovery), the ground water samples from wells MW-53E and MW86-4 were only analyzed for VOCs and BNAs, and VOCs and TSS, respectively. There was insuffient water in well MW-53 for sampling; however, an oil layer present in the well was sampled and analyzed for VOCs.

Prior to sampling, the water levels in the wells were measured to the nearest 0.01 foot using an electronic water level indicator. The volume of water in each well was calculated, and three times the standing volume of water was purged from each well using a teflon bailer. When the wells did not recharge quickly enough to permit removal of three times the standing water volume, the wells were bailed until nearly dry and allowed to recover.

Ground water samples were collected in dedicated, decontaminated teflon bailers connected to dedicated teflon leader and polyethylene rope. The teflon bailers were decontaminated in the laboratory using protocols outlined in the QA/QC plan. The teflon bailers were wrapped in aluminum foil for transport to the site prior to their use. During the collection of a ground water sample, the bailer was slowly lowered in a well to a depth of

approximately five feet below the water level in the well. The bailer was then retrieved from the well and the water sample slowly transferred to the appropriate sample containers.

3.7 Quality Assurance/Quality Control

To check the quality of the data, blanks and duplicate samples were submitted with the environmental samples for laboratory analysis. Field blanks were used during the soil and ground water sampling programs as a check on proper sampling equipment decontamination and sample handling. The field blanks consisted of laboratory-supplied, analyte-free water which was poured over the decontaminated sampling equipment and collected for laboratory analysis. The field blanks were analyzed for the same compounds as the environmental samples. Trip blanks were used to as a quality control check on blank water quality and sample container and sample contaminant influence during container shipment and sample collection. The trip blanks were prepared at the laboratory and accompanied the bottles from the laboratory to the field, and the samples from the field to the laboratory. The trip blanks were analyzed for VOCs. Field blanks and trip blanks were subjected to the same chain-of-custody and handling as the environmental samples.

4.0 OBSERVATIONS AND FINDINGS

4.1 Geology/Hydrogeology

Tank Farm 5 is located along the east shore of Narragansett Bay. Land surface slopes generally to the north and west across the tank farm site, from an elevation of over 90 feet above mean low water (mlw) to less than 10 ft mlw along the eastern portion of Gomes Brook on the northern edge of the tank farm. The average slope of the land surface in the tank farm area is 0.04 ft/ft, slightly less to the north-northeast, and greater to the west.

Site specific geologic data gathered during the site remedial investigation and from previous investigations indicates that the bedrock surface slopes generally to the north and west across the site from an elevation of over 70 feet above mlw near Tank 59 (Boring B-9, Fahlquist, 1945) to approximately 40 feet above mlw near Tank 49 (Boring B-7, Fahlquist, 1945). It should be noted that bedrock was excavated at most, if not at all, of the underground storage tank locations during the tank construction/installation. This may have required excavation 10 to 30 feet into bedrock, to a total depth of approximately 40 feet below grade at the tank locations. As a result, the existing bedrock surface at the tank farm is very irregular.

The bedrock underlying the tank farm consists of brown to gray shale. At some locations quartz lenses were observed, and core descriptions vary from shale to schist. Zones of weathered rock were observed above the more competent bedrock. The observed

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F-M SAND W/ SOME SILT.

thickness of the zones of weathered rock range up to 27 feet (MW86-3; ERA, 1988).

The native unconsolidated soil on the site consists of brown to black fine sand and silt. In many locations the fine sand and silt are mixed with angular shale rock fragments, suggesting disturbance during construction and grading. Surficial soils in many locations consists of similar regraded silts and sands with rock fragments. Observed overburden thickness ranges from 11 to 40 feet, based on the investigations around Tanks 53 and 56.

Background information indicates the presence of ring drains around the tanks. The geologic information from borings in the Tank 53 and 56 ring drains (T53E, T53W, T56E, T56W; ERA, 1988) indicates that the ring drain fill is composed of fine to medium sand with some silt.

Ground water levels in the Tank Farm 5 monitor wells were measured on July 17, 1990 and October 25, 1990, in conjunction with ground water sampling activities. The ground water level measurements and elevations are summarized in Table 4.

Figure 6 shows the ground water level elevation contour map developed from water levels measured at site monitoring wells on July 17, 1990. This map shows that water level contours over the Tank Farm 5 area generally mimic the land surface contours with ground flow directions to the north and north west directions. The ground water level elevations contours in the area of Tanks 53 and 56 on July 17, 1990 are shown on Figure 7. Figure 7 includes ground water level data from wells installed by ERA in 1985 and

1986. The ERA wells installed in the tank ring drains were not used in developing the ground water contour maps for reasons discussed later in this section. In general, the ground water gradient near the tanks is to the west-northwest, towards Narragansett Bay, at a slope similar to that of the land surface. Wells installed in the ring drains around Tanks 53 and 56 show that the presence of tank excavations and ring drains (high permeability backfill) appear to influence the water levels near the tanks.

Figure 8 shows the ground water level elevations in the vicinity of Tanks 53 and 56 on October 25, 1990. The new monitor wells were available for water level measurement on this date; as a result, there was more water level data available in the vicinity of each tank. The general water level trend shows a gradient to the west.

Generally, water level elevations obtained from the wells in the areas of Tanks 53 and 56 describe a smooth, east-to-west sloping water table around these tanks. However, water level elevations from those wells near the tanks appear to suggest minor gradient reversals from the east-to-west trend. This phenomenon may be caused by the excavation of portions of bedrock around the tanks during their construction and the subsequent backfilling of the tank ring drains with more permeable sands. The appearance of gradient reversals may also be caused by the use of ground water elevation data from wells completed to different depths which intersect geologic units having different hydraulic heads. Given these reasons, the ground water levels from the tank ring drain

wells (MW-53E, MW-53W, MW-56E, MW-56W, and RW-1) were not used in preparing the ground water level contour maps for the tank area (Figures 7 and 8).

4.2 Analytical Results

Samples of soil and ground water were collected to aid in determining the soil and ground water quality in the vicinity of Tanks 53 and 56. The sample results are presented below, and are discussed in greater detail in Section 5.0 of this report.

Tank Contents

Samples were collected of oil and water contained within Tanks 53 and 56. The positive analytical results (i.e., those with detected concentrations) are summarized in Tables 5 and 6, respectively.

The product samples contained high concentrations of chlorinated and aromatic hydrocarbons, base/neutral/acid extractable compounds and several metals. The oil sample from Tank 56 also contained a detectable (but not quantifiable) concentration of PCB Aroclor 1016 (estimated 1.6 ppm).

Water samples from both tanks contained detectable concentrations of chlorinated and aromatic hydrocarbons, semi-volatile organics, and several metals. The tank water samples were not analyzed for pesticides/PCBs.

Surface Soil Samples

Composite and discrete surface soil samples were collected from soils above Tanks 53 and 56. One near-surface soil sample was also collected from an upgradient site location away from any tanks on the site. The surface soil analytical results are summarized in Tables 7, 8, and 9. Surface soil samples from above both Tanks 53 and 56 show detectable, but low, concentrations of petroleum hydrocarbons (9.5-31 ppm) and lead (8.6-17.9 ppm). One surface soil sample, SS-56, was also analyzed for TCL volatile and semi-volatile organics compounds, pesticides/PCBs, and metals. A trace concentration of one volatile organic compound, tetrachloroethene (2 ppb), and several semi-volatile organics and polynuclear aromatic hydrocarbons were detected in the sample. In addition, the pesticide 4,4-DDT was detected along with 4,4-DDE, a DDT degradation product at low concentrations. No PCBs were detected in the surface soil sample. Several metals were detected in sample SS-56; however, most of the metals detected are naturally occurring in soils.

Subsurface Soil Samples

Subsurface soil samples were collected in conjunction with the test boring and well installation program. The soil boring sample analytical results are summarized in Table 10.

Of the six soil boring samples submitted for laboratory analysis, only three samples contained detectable concentrations of volatile organic compounds, (excluding those compounds also

detected in the trip, field and lab blanks). One sample from the recovery well boring, RW-1, contained both aromatic and chlorinated hydrocarbons. The recovery well is located in the ring drain of Tank 53.

Five of the six soil boring samples were also analyzed for base/neutral/acid extractable compounds (BNAs) and total petroleum hydrocarbons (TPH). All five samples contained detectable concentrations of both BNAs and TPH, with the greatest concentration of each in the two soil samples from the recovery well boring. The lowest concentrations of BNAs was found in borings for wells MW-9 and MW-10 near Tank 56. The BNAs in these soil boring samples consisted soley of phthalates which were also detected in quality control blanks.

Four of the six soil boring samples were analyzed for metals. Metals were detected in all four of the soil samples.

Ground Water

Two rounds of ground water samples were collected from monitor wells in the vicinity of Tanks 53 and 56. The first round of ground water samples was collected on July 20, 1990 during the site remedial investigation. The second round was collected on October 25, 1990 during the tank closure investigation. The analytical results from the July and October 1990 sampling rounds are presented in Tables 11 and 12, respectively. Both data sets show the presence of volatile and base/neutral/acid extractable organic compounds the in ground water samples from wells around Tank 53.

The highest concentrations of contaminants were observed in ground water samples from wells installed in the Tank 53 ring drain (MW-53W and MW-53E).

5.0 DISCUSSION OF RESULTS

5.1 Contaminant Occurrence and Migration

Samples of oil and water from Tanks 53 and 56 indicate the presence of several chlorinated and aromatic hydrocarbons as well as several polynuclear aromatic hydrocarbons, phenols and metals. The distribution of these analytes in soil and ground water surrounding the tanks is discussed below.

Surface Soils

The samples of soil above the tanks show low concentrations of total petroleum hydrocarbons and lead, which were the indicator parameters used on all samples. The highest total petroleum hydrocarbon concentration observed was 24 ppm (sample SS-56). Lead was detected in all surface soil samples. The highest lead concentration detected in the surface soil samples from these tank areas was 56.6 ppm in sample SS-56. This samples lead concentration ranges from 3 to 9 times greater than the background near-surface soil sample lead concentration (6.2 ppm) or other surface soil samples collected from soils above Tanks 53 (SS-53 @ 16.2/17.9 ppm and SS-53D @ 9 ppm) and 56 (SS-56D @ 8.6 ppm).

One surface soil sample, SS-56, was analyzed for volatile organics, base/neutral/acid (BNA) extractables, PCBs/pesticides, and metals (see Table 7). Only a trace concentration (estimated 2 ppb) of one volatile organic compound (VOC), tetrachloroethane, was detected in the sample. Although the surface soil samples were collected from 6 inches below grade, it is possible that any other

VOCs once present in the surface soils were not detected and are not longer present as a result of natural volatilization of the VOCs. Heavier hydrocarbons, specifically the polynuclear aromatic hydrocarbons (a subgroup of the BNA compounds), were also detected in low concentrations. The PAHs are persistent and generally have low water solubility and a high affinity for organic carbons in soils, so leaching and water transport of the PAHs is unlikely (except in the presence of solvents). The only other BNA compounds detected in surface soil sample SS-56 were phthalate esters. Phthalates are common laboratory contaminants (common in lab blanks) and were also detected at similar concentrations in the background near-surface soil sample.

Although PCBs were detected in the oil sample from Tank 56, PCBs were not detected in the composite soil sample from above Tank 56. The pesticide DDT and its metabolite, DDE, were detected in the soil above Tank 56 (pesticides were not analyzed for the oil or water). As with the PAHs, PCBs and DDT/DDE have low water solubility and high organic carbon partition coefficients.

Several other metals (besides lead) were also detected in surface soil sample SS-56. Most metals were reported as having concentrations at or below those reported in the background soil sample (Table 9). Nearly all of the metals detected in sample SS-56 were reported at concentrations greater than the background sample. Several of metals were detected at concentrations at or greater than 2 times background levels. These metals include chromium, copper, mercury, lead, and zinc. All but the levels

detected for mercury (54 ppm) fall within typical range of concentrations for these metals in soil (USGS, 1984). Further discussion on the metals levels in the tank area soils is presented in the risk assessment section of this report.

Subsurface Soils

A total of six soil samples were collected from the soil borings for the four new monitor wells and the recovery well. The volatile organic compounds methylene chloride and acetone were reported in all of the samples. Both compounds are common laboratory contaminants and were also reported at varying concentrations in trip and field blanks. Only a soil sample from the recovery well boring (RW1-1) had methylene chloride and acetone levels significantly greater than those detected in the blanks. Very low levels of trichloroethene (estimated 2 ppb) and tetrachloroethane (estimated 1 ppb) were detected in well boring soil samples M8-1 and M10-1, respectively. In the absence of the other volatile organic compounds detected in the tank water and oil samples, these findings are not considered significant.

The shallow soil sample (5-7 ft below grade) from the boring for recovery well RW-1, which is installed in the Tank 53 ring drain, showed the highest concentrations of contaminants. Both volatile organic (chlorinated and aromatic hydrocarbons) and base/neutral/acid extractable compounds (PAHs and phthalates) were reported present in the soil sample (RW1-1). Soil samples from this boring were observed to have petroleum-like odors and

staining. The odors and staining decreased with depth in the boring. These observations are consistent with the analytical results of a second sample collected from the boring at a depth of 33-35 feet below grade in the RW-1. This sample had no detectable volatile organics (other than methylene chloride and acetone), and only limited concentrations of PAHs and phthalates.

As presented previously, trace concentrations of chlorinated hydrocarbons were detected at distance from the tanks in each of the samples from borings for wells MW-8 and MW-10. Phthalates were also detected in soil samples from borings for wells MW-8, MW-9, MW-10, and RW-1. The three samples from the monitor well borings (M8-1, M9-1, and M10-1) were collected at or near the water table. These sample results suggest that significant organic compound soil contamination has not occurred as a result of ground water transport.

The analytical results for metals indicate the presence of a numerous metals at all soil boring sample locations. Metals are typical in any soils analysis, and their significance is usually determined by comparison of the detected levels to concentrations in background samples and national averages. In most cases, the reported metals concentrations were greater than those reported in area background soil samples; however, the levels were typically within national ranges for these metals in soil (USGS, 1984; USEPA, 1983). One soil boring sample (M9-1) had a lead level of 850 ppm reported. This level is considerably greater than the concentration observed in other site soil samples and greater than

referenced typical published lead background concentrations. Many metals will adsorb to soils, particularly clay soils which have a high cation exchange capacity. Metals are generally resistant to leaching except under very low pH conditions. At this particular site, this appears to be exemplified by the absence of unusually high metals concentrations in the ground water samples collected from wells downgradient of the tanks.

Ground Water

Two rounds of ground water samples were collected from wells around Tanks 53 and 56. The first round of samples was collected on July 20, 1990 and included only limited analyses (petroleum hydrocarbons and lead on most samples; VOCs, BNAs, pesticides/PCBs and metals on samples from wells MW-53W and MW-56W). The second round of samples was collected on October 25, 1990 and included several additional analyses (VOCs, BNAs, metals, and oil and grease on most samples) as well as samples from additional monitoring wells. A summary of the sample analyses performed on the ground water samples is presented in Table 1. Since Tank 56 is hydraulically upgradient of Tank 53, the below discussion will proceed from the Tank 56 area, using nearby upgradient monitor well MW86-1 as background, to the Tank 53 area.

The first round of ground water samples showed the following from wells installed in the ring drain of Tank 56: no detectable VOCs or BNA compounds in the water sample from well MW-56W, and no detectable petroleum hydrocarbons in the water samples from wells

MW-56E and MW-56W. The second round of sample results for ground water samples from wells in the ring drain of Tank 56 did not indicate the presence of volatile organics or base/neutral/ acid extractable compounds (other than those detected in the field, trip, and method blanks). The levels of questionable VOCs (methylene chloride and acetone) detected in the samples were also generally consistent with the VOC results of the background ground water sample from upgradient monitor well MW86-1. Samples collected from wells downgradient of Tank 56 (monitor wells MW-9 and MW-10) showed no significant concentrations of volatile organics, or base/neutral/acid extractables as compared with background and the quality control blanks.

Inorganic analyses of the first round ground water samples showed lead concentrations in the Tank 56 ring drain wells (80.5 ppb in MW-56E and 44.5 ppb in MW-56W) at levels slightly elevated over background (21.6 ppb in MW86-1). During the second well sampling round, the detected concentrations of most metals in the Tank 56 ring drain wells and other downgradient well samples (from wells MW-9 and MW-10) were less than those reported in the upgradient, background ground water sample (MW86-1). Chromium was detected in one ring drain well sample (15.8 ppb in MW-56E) at a concentration slightly above the detection limit (10 ppb) at which chromium was not detected in the background well MW86-1.

The first round of ground water samples from the Tank 53 ring drain wells (MW-53E and MW-53W) both showed the presence of petroleum hydrocarbons. Oil was present in both ring drain wells

during the sampling. Aromatic hydrocarbons, chlorinated hydrocarbons, and polynuclear aromatic hydrocarbons were also present in the ground water sample from well MW-53W. Sample MW-53E showed lead concentrations (115 ppb) elevated over background (21.6 ppb). The sample from well MW-53W was also analyzed for priority pollutant metals, and several metals were detected at concentrations considerably elevated over background.

The second round of ground water samples collected from wells in the ring drain of Tank 53 showed the presence of several volatile organics and base/neutral/acid extractable compounds. Oil was still present in both of the ring drain wells during the sampling; however, insufficient water was present in well MW-53W for sampling. An oil sample collected from this well had high concentrations of volatile organic compounds. The ground water sample from nearby downgradient monitor well MW-7 showed concentrations of volatile organic compounds and oil and grease, but only trace concentrations of base/neutral/acid extractable compounds.

Two additional monitor wells generally downgradient of Tank 53 (MW86-2 and MW86-4) were also sampled. The first round sample results showed no detectable concentrations of petroleum hydrocarbons in both wells. Lead was detected at slightly less than background concentrations (21.6 ppb) in well MW86-4 (20.2 ppb), and was not analyzed for in the sample from well MW86-2 (insufficient water in well). Trace concentrations of several chlorinated hydrocarbons were detected in the MW86-2 sample in the

second round; none were detected in the MW86-4 sample. Base/neutral/ acid extractable compounds and oil and grease were not detected in the MW86-2 sample in the second round, and were not analyzed for in the MW86-4 sample (insufficient water volume in well).

Reported metals concentrations of second round ground water samples from monitor wells RW-1, MW-7, and MW86-2 were less than the concentrations reported in the sample from background well MW86-1 for nearly all analytes. The one exception was chromium which was detected in the sample from well MW86-2 at a concentration (12.4 ppb) slightly above the detection limit reported for the background sample (10 ppb).

Discussion/Summary

Comparison of analytical results for samples collected as part of this sampling program to available background soil and ground water quality information indicates areas near the tanks have been affected by on-site activities.

Surface soils above the tanks have been affected to some small degree, based on the results of a limited soil sampling program. PAH compounds and petroleum hydrocarbons were detected in surface soil samples, but at low concentrations. It should be noted that the surface soil samples were collected from grade to a depth of six inches below grade. Since there may be two or more feet of soil above the tanks, the soils below 6 inches and immediately above the tank may have higher concentrations of oil residuals.

This is dependant upon how any oil may have been deposited in the areas (e.g., spills or tank overflow), and upon what natural processes (e.g., biodegradation) may have occurred to reduce any contaminant concentrations.

Subsurface soil samples collected from borings (M-9 and M-10) downgradient of Tank 56 did not show oil residues. In the absence of oil residues, the apparently elevated concentrations of lead and a few other metals in the soil sample from boring M-9 cannot be clearly attributed to discharges from Tank 56. Soil sample analyses results and field observations (i.e., stains and odors) indicate the presence of oil residues in the RW-1 boring samples. The RW-1 boring samples were collected from the ring drain located around Tank 53. Soil samples from boring for nearby downgradient wells, MW-7 and MW-8, show no significant impacts from the tank or site activities. This suggests that the area of contaminated soil beyond the Tank 53 ring drain may be limited. At locations such as well MW-53W, where product has been observed in the well, some soil contamination beyond the ring drain should be expected.

Ground water sample results from wells in the vicinity of Tank 56 show no significant indications of contamination. However, in the vicinity of Tank 53 free product has repeatedly been observed in the two ring drain monitor wells (MW-53W and MW-53E) and some dissolved hydrocarbons have been detected in ground water samples from these wells and other nearby downgradient wells (RW-1 and MW-7). Other ground water sample results from the Tank 53 area

indicate that some dissolved hydrocarbons were observed in the ground water at least as far downgradient as well MW86-2.

5.2 Comparison to Regulatory Standards

Table 13 provides a summary of ground water sample analytical results which exceeded developed action levels. No applicable action levels are available for the soil matrix. Soil cleanup levels are typically decided by the regulators on a case-by-case basis, taking into consideration factors such as human health risk, land use, toxicity, and feasibility of cleanup.

5.3 Risk Assessment

A qualitative health risk assessment was performed by TRC to determine the potential impacts on human health associated with the use of Tanks 53 and 56 on Tank Farm 5. The complete risk assessment report is provided in Appendix D of this report. The primary objectives of the risk assessment were to examine exposure pathways and to estimate the potential adverse effects associated with the contaminants of concern at the site under current conditions. The conclusions of the risk assessment indicated that while a variety of toxic agents have been found on-site, including arsenic, lead, mercury, polycyclic aromatic hydrocarbons, and the pesticides DDT and DDE, the potential for an adverse effect on human health is low. This was based on the levels of contaminants detected and the current uses of the site.

6.0 REMEDIAL ALTERNATIVES

Review of the data from the sampling programs indicates that surface soil, subsurface soil, and ground water have been impacted by oil storage and releases at the site. In addition these environmental media outside the tanks, oil and water from within the tanks will need to be removed and properly handled as part of any tank closure.

Tank Contents

Free product from within the tanks could be pumped off and removed from the site for proper disposal. Water from within the tanks could be pumped and treated using air stripping technology and, if necessary, activated carbon to satisfy discharge requirements. Any sludges from within the tanks would need to be collected and stabilized for either off-site disposal or incineration.

Surface Soil

Surface soil sample results show the presence of petroleum hydrocarbons, base/neutral/acid extractable compounds, and metals. No significant concentrations of volatile organic compounds were detected in the one surface soil sample analyzed for these compounds. Shallow soils show only minor impacts from oil storage operations. If hydrocarbon concentrations increase with depth in the near-surface soils above the tanks, remediation may be required for these soils. Remedial measures may include soil vapor

extraction for volatile compounds, to removal and off-site disposal of contaminated soils or destruction of heavy hydrocarbons. Under certain circumstances, asphalt plants may be willing to accept oil-contaminated soils to be used in the production of asphalt. If chlorinated hydrocarbons are present, the disposal options may be limited. Biological destruction may also be useful for either in-place or accumulated soils.

Subsurface Soil

The subsurface soil sample results indicate the presence of chlorinated and aromatic hydrocarbons and heavier polynuclear aromatic hydrocarbons. As with the surface soil samples, technology is available to extract and vaporize the volatile compounds either in-place or upon excavation. The heavier hydrocarbons, such as the PAHs, would not be amenable to vapor extraction. If remediation of the PAHs is required, off-site disposal or destruction and asphalt plant use could be considered. In-place or above-ground biological destruction may also be feasible.

Ground Water

Ground water sample results indicate the presence of free hydrocarbon product and ground water contaminated with chlorinated and aromatic hydrocarbons and polynuclear aromatic hydrocarbons in the vicinity of Tank 53. Ground water remediation could include free product recovery and ground water treatment. Water table

depression could be used to enhance free product recovery by creating a cone of depression. The ground water could be treated in the same manner as the tank water, using air stripping technology and, if necessary, activated carbon to satisfy discharge requirements.

The highest concentrations of hydrocarbons were observed in the ring drain well samples, with concentrations in monitor wells MW-7 and MW86-2 only slightly elevated over action levels. Based on these results, the area would likely limit the area from which ground water would need to be recovered would be limited. Pumping the existing recovery well, RW-1, would depress water levels in the ring drain and produce some reversal of the natural ground water gradient near Tank 53.

Metals concentrations are elevated above action levels in ground water at several locations, including the upgradient background monitor well location. This is attributed either to natural ground water conditions (i.e., not related to Tanks 53 and 56 or any other tanks on the site) or to the collection, preservation and analysis of <u>unfiltered</u> ground water samples. In either case, metals concentrations in ground water are probably not sufficient enough to drive the remedial program or to require additional ground water treatment.

7.0 REFERENCES

Environmental Resources Associates, Inc., "Tank Closure Plan for Tanks 53 and 56, Tank Farm 5, Naval Education and Training Center Newport, Rhode Island", April 15, 1988.

Fahlquist, Frank E., Plate 12 "Drilling, Test Pumping & Appurtenant Work Area 5 - Geologic Sections U.S. Naval NET & Fuel Depot, Melville, RI.", April 10, 1945.

USEPA, "Hazardous Waste Land Treatment", April 1983.

USGS, "Elemental Concentrations in Soils and Other Surficial Materials of the Conterminous United States", US Geological Survey Professional Paper 1270, 1984.

APPENDICES

APPENDIX A

PREVIOUS SITE INVESTIGATION DATA

TABLE 1

GROUNDWATER ANALYSES FOR VOLATILE ORGANIC COMPOUNDS

SAMPLE LOCATION	MW 53E		MW 53W		MW 56E		MW 56W	
SAMPLE DATE	10-22-85	11-26-86	10-22-85	10-26-86	10-22-85	10-26-86	10-22-85	10-26-86
methylene chloride	178	ND	54	ND	ND	ND	304	ND
trans-1,2-dichloroethylene	166	1100	46	400	ND	ND	ND	ND
chloroform	401	ND	353	ND	12	ND	18	ND
1,2-dichloroethane	211	ND	229	ND	ND	ND	ND	ND
1,1,1-trichloroethane	4400	930	4400	330	ND	ND	17	ND
trichloroethylene	1400	800	785	24	ND	ND	ND	ND
tetrachloroethylene	262	25	14	16	ND	ND	ND	ND
benzene	300	330	155	ND	ND	ND	ND	ND
toluene	ND	1400	ND	ND	ND	ND	ND	ND
ethylbenzene	374	150	ND	ND	ND	ND	ND	ND
xylenes	1620	600	140	65	ND	ND	ND	ND
1,1 dichloroethane	ND	32	ND	14	ND	ND	ND	ND
1,1 dichloroethylene	ND	170	ND	57	ND	ND	ND	ND
trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND	ND
bromodichloromethane	ND	470	ND	49	ND	ND	ND	ND

Concentrations are reported in parts per billion, (ppb).

ND indicates that trace amounts, below reportable detection limits or no amounts were found.

TABLE 2

GROUNDWATER ANALYSES FOR TOXIC METALS

PARAMETER	MW 53E	MW 53W	MW 56E	MW 56W
Arsenic	<0.01	<0.01	<0.01	<0.01
Barium	<0.5	<0.5	<0.5	<0.5
Cadmium	0.007	<0.005	<0.005	<0.005
Chromium	<0.05	<0.05	<0.05	<0.05
Lead	<0.05	<0.05	<0.05	<0.05
Mercury	<0.0005	0.0014	0.0012	0.0008
Selenium	<0.01	<0.01	<0.01	<0.01
Silver	<0.01	<0.01	<0.01	<0.01

Concentrations are reported in mg/l

Samples taken 10-22-85

TABLE 3

SAMPLE ANALYSES

SAMPLE LOCATION	ERA 86-1	ERA 86-2	ERA 86-3D	ERA 86-3S	ERA 86-4	ERA 86-5
SAMPLE DATE	10-01-86	10-01-86	10-06-86	10-01-86	10-01-86	12-06-86
methylene chloride	ND	ND	ND	ND	ND	ND
trans-1,2-dichloroethylene	ND	3	26	1	ND	ND
chloroform	ND	10	ND	3	12	ND
1,2-dichloroethane	ND	ND	18	ND	ND	ND
1,1,1-trichloroethane	ND	5	101	5	ND	ND
trichloroethylene	ND	1	35	2	ND	ND
tetrachloroethylene	ND	ND	2	ND	ND	ND
benzene	ND	ND	ND	ND	ND	ND
toluene	ND	ND	2	ND	ND	ND
ethylbenzene	ND	ND	3	ND	ND	ND
xylenes	ND	ND	39	ND	ND	ND
1,1 dichloroethane	ND	2	2	4	ND	ND
trichlorofluoromethane	ND	ND	1	ND	ND	ND

Concentrations are reported in parts per billion, (ppb).

ND indicates that trace amounts, below reportable detection limits or no amounts were found.

APPENDIX B

TEST BORING LOGS FROM PREVIOUS INVESTIGATIONS

100 WATER STREET EAST PROVIDENCE, R. I.

TO Goldberg-Zoino & Assoc., Inc.
PROJECT NAME USN Fuel Storage Area
REPORT SENT TO above
SAMPLES SENT TO "

ADDRESS Providence, R.I.
LOCATION Middletown, R.I.
PROJ. NO.
OUR JOB NO. 87-185

DATE
HOLE NO. W 86-1
LINE & STA.
OFFSET
SURF. ELEV.

GROUND WATER OBSERVATIONS
At 26' after 16 Hours
At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type	HW-NW		NVD
Size I.D.	4" 3"		
Hammer Wt.	300#		BIT Dia.
Hammer Fall	24"		

	Date	Time
START	9/16/86	
COMPLETE	9/16/86	
TOTAL HRS.		
BORING FOREMAN	D. Green	
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING:

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	12-18	Moisture Density or Consist.	Strata Change Elev.	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc.	SAMPLE No.	Pen	R
									Brown Sand & Gravel			
								7'				
									Black to Gray Glacial TILL			
								15'				
								16'6"	Boulder (Granite)			
								17'	Glacial TILL			
		20'-25'	C				Min/Ft					
							2		Gray Graphitic SHALE, very weathered	C1	60'	36
							2					
							1					
							1					
							1					
		25'-30'	C				2					
							1			C2	60'	48
							1					
							2					
							1					
		30'-35'	C				1					
							1			C3	60'	48
							1					
							1					
							1					
							1	35'				
									Bottom of Boring 35'			
									Installed Observation Well at 35'			
									20' of 1½" Sch. 80 Screen			
									17' of 1½" Sch. 80 Solid			
									One Bag of Ottawa Sand			
									½ Pail of Bentonite Balls			
									One 3"x5' Guard Pipe			
									One Bag of Cement			
									0' to 11' - Grouted Hole			
									Pressure Tested Hole			
									Two Tests			

GROUND SURFACE TO 9' USED HW "CASING: THEN NW to 19'

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used	
trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency		
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M/Stiff	
30-50	Dense	8-15	Stiff	
50 +	Very Dense	15-30	V-Stiff	

SUMMARY:
Earth Boring 20'
Rock Coring 15'
Samples 0

HOLE NO. W 86-

TOWN PRESS - EAST PROV.

SOILS DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R. I.

TO Goldberg-Zoino & Assoc., Inc.
PROJECT NAME USN Fuel Storage Area
REPORT SENT TO above
SAMPLES SENT TO "

ADDRESS Providence, R.I.
LOCATION Middletown, R.I.
PROJ. NO.
OUR JOB NO. 87-185

SHEET ___ OF ___
DATE
HOLE NO. W 86-2
LINE & STA.
OFFSET
SURF. ELEV.

GROUND WATER OBSERVATIONS
At 28' after 56 Hours
At ___ after ___ Hours

	CASING	SAMPLER	CORE BAR.
Type	HW-NW		NVD
Size I.D.	4" 3"		
Hammer Wt.	300#		
Hammer Fall	24"		BIT Dia.

	Date	Time
START	9/12/86	
COMPLETE	9/15/86	
TOTAL HRS.		

BORING FOREMAN D. Green
INSPECTOR
SOILS ENGR.

LOCATION OF BORING: Bunker Oil Storage Area

DEPTH	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	12-18	Moisture Density or Consist.	Strata Change Elev.	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc.	SAMPL No.	Pen
								9'	Brown Sand & Gravel		
								17'6"	Gray to Black Goacial TILL		
		20'-25'	C				Min/Ft		Gray Graphitic SHALE very weathered		
							1				
							1			C1	60'
							1½				
							2				
		25'-30'	C				1				
							1				
							1			C2	60'
							1				
							2				
		30'-35'	C				2				
							2				
							1			C3	60'
							1½				
							1				
							1	35'			
									Bottom of Boring 35'		
									Installed Observation Well at 35'		
									20' of 1½" Sch. 80 Screen		
									17' of 1½" Sch. 80 Solid		
									One Bag of Ottawa Sand		
									½ Pail of Bentonite Balls		
									One 3"x5' Guard Pipe		
									One Bag of Cement		
									Grouted Hole 0' to 15'		
									Pressure Tested Hole		
									3 Tests in Hole		

GROUND SURFACE TO 15' USED HW CASING: THEN NW to 20' then Cored

Sample Type
D: Dry C: Cored W: Washed
UP: Undisturbed Piston
TP: Test Pit A: Auger V: Vane Test
UT: Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density
0-10 Loose
10-30 Med. Dense
30-50 Dense
50 + Very Dense

Cohesive Consistency
0-4 Soft
4-8 M/Stiff
8-15 Stiff
15-30 V-Stiff
30 + Hard

SUMMARY
Earth Boring 20'
Rock Coring 15'
Samples 0

HOLE NOW 86-

TOWN PRESS — EAST PROV.

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R. I.

SHEET 1
DATE
HOLE NO. W 86
LINE & STA.
OFFSET
SURF. ELEV.

TO Goldberg-Zoino & Assoc., Inc.
PROJECT NAME USN Fuel Storage Area
REPORT SENT TO above
SAMPLES SENT TO "

ADDRESS Providence, R.I.
LOCATION Middletown, R.I.
PROJ. NO.
OUR JOB NO. 87-185

GROUND WATER OBSERVATIONS
At 31' after Hours
At after Hours

	CASING	SAMPLER	CORE BAR.
Type	HW-NW		NVD
Size I.D.	4" 3"		
Hammer Wt.	300#		BIT Dia.
Hammer Fall	24"		

	Date	Time
START	9/22/86	
COMPLETE	9/23/86	
TOTAL HRS.		
BORING FOREMAN	D. Green	
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING: Edge of Fuel Tank

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	12-18	Moisture Density or Consist.	Strata Change Elev.	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc.	SAMPLE No.	P
								9'	Brown Sand & Gravel (Fill)		
								21'6"	Brown to Black Glacial Till		
		24'-29'	C					29'	Gray SCHIST, very weathered	C1	60
		29'-34'	C					34'	Dark Gray SHALE weathered	C2	60
		34'-39'	C						Gray SCHIST & Quartz very weathered	C3	60
		39'-44'	C							C4	60
		44'-49'	C					49'		C5	60
									Bottom of Boring 49'		
		Installed Observation Well at 49'					2 Wells		Installed Observation Well at 33'		
		10' of 1¼" Sch. 40 Screen							20' of 1¼" Sch. 40 Screen		
		40' of 1¼" Sch. 40 Solid							15' of 1¼" Sch. 40 Solid		
		One Bag of Ottawa Sand							3 Bags of Ottawa Sand		
		½ Pail of Bentonite Balls							½ Pail of Bentonite Balls		
									One 5'x4" Guard Pipe		
		Pressure Tested Hole --					4 Tests		One Bag of Cement		

GROUND SURFACE TO 24' USED HW CASING: THEN NW to 24' then Cored

Sample Type
D: Dry C: Cored W: Washed
UP: Undisturbed Piston
TP: Test Pit A: Auger V: Vane Test
UT: Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler
Cohesionless Density: 0-10 Loose; 10-30 Med. Dense; 30-50 Dense; 50 + Very Dense
Cohesive Consistency: 0-4 Soft; 4-8 M/Stiff; 8-15 Stiff; 15-30 V-Stiff; 30 + Hard

SUMMARY
Earth Boring
Rock Coring
Samples

HOLE NO. W 8

TOWN PRESS — EAST PROV.

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R. I.

TO Goldberg-Zoino & Assoc., Inc.
PROJECT NAME USN Fuel Storage Area
REPORT SENT TO above
SAMPLES SENT TO "

ADDRESS Providence, R.I.
LOCATION Middletown, R.I.
PROJ. NO.
OUR JOB NO. 87-185

SHEET 1
DATE
HOLE NO. W 86-
LINE & STA.
OFFSET
SURF. ELEV.

GROUND WATER OBSERVATIONS
At 25.5' after 16 Hours
At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type	HW-NW		NVD
Size I.D.	4" 3"		
Hammer Wt.	300#		
Hammer Fall	24"		BIT Dia.

	Date	Time
START	9/17/86	
COMPLETE	9/18/86	
TOTAL HRS.		

BORING FOREMAN D. Green
INSPECTOR
SOILS ENGR.

LOCATION OF BORING:

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	12-18	Moisture Density or Consist.	Strata Change Elev.	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc.	SAM No.	Pe
								5'	Brown Sand & Gravel		
								11'	Black to Brown Glacial TILL		
		19'-24'	C				Min/Ft				
							1		Gray Graphitic SHALE very weathered		
							½			C1	60
							½				
							1				
		24'-29'	C				½				
							1				
							1			C2	60
							1				
							½				
		29'-34'	C				½				
							½				
							½			C3	60
							½				
							½				
							1	34'			
									Bottom of Boring 34'		
									Installed Observation Well at 34'		
									20' of 1½" Sch. 80 Screen		
									16' of 1½" Sch. 80 Solid		
									One Bag of Ottawa Sand		
									¼ Pail of Bentonite Balls		
									One 3"x5' Guard Pipe		
									One Bag of Cement		
									Grouted Hole		
									Pressure Tested Hole		
									2 Tests		

GROUND SURFACE TO 9' USED HW "CASING: THEN NW to 19' then Cored

Sample Type
D: Dry C: Cored W: Washed
UP: Undisturbed Piston
TP: Test Pit A: Auger V: Vane Test
UT: Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density
0-10 Loose
10-30 Med. Dense
30-50 Dense
50 + Very Dense

Cohesive Consistency
0-4 Soft
4-8 M/Stiff
8-15 Stiff
15-30 V-Stiff
30 + Hard

SUMMARY:
Earth Boring 1
Rock Coring 1
Samples 0

HOLE NO. W 8

TOWN PRESS – EAST PROV.

... DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R. I.

TO Goldberg-Zoino & Assoc., Inc.
PROJECT NAME USN Fuel Storage Area
REPORT SENT TO above
SAMPLES SENT TO "

ADDRESS Providence, R.I.
LOCATION Middletown, R.I.
PROJ. NO.
OUR JOB NO. 87-185

SHEET 1 OF
DATE
HOLE NO. W 86-
LINE & STA.
OFFSET
SURF. ELEV.

GROUND WATER OBSERVATIONS
At 23' after Comp Hours
At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR
Type	HW-NW		NVD
Size I.D.	4" 3"		
Hammer Wt.	300#		
Hammer Fall	24"		BIT Dia.

	Date	Time
START	9/18/86	
COMPLETE	9/19/86	
TOTAL HRS.		
BORING FOREMAN	D. Green	
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING:

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev.	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc.	SAMP No.	Per
								10'	Brown Sand & Gravel		
								12'	Brown to Black Glacial TILL		
		16'-21'	C				Min/Ft				
							1		Gray SCHIST with Quartz Seams, very weathered & broken (@ 18' - lost water)	C1	60"
		21'-26'	C				1				
							1			C2	60"
							1	24'			
							1	26'	Gray SCHIST & Shale very weathered		
								30'	Very weathered Rock (Ran Button Bit from 26' to 30').		
									Bottom of Boring 30'		
									Installed Observation Well at 26'		
									20' of 1½" Sch. 80 Screen		
									8' of 1½" Sch. 80 Solid		
									2 Bags of Ottawa Sand		
									½ Pail of Bentonite Balls		
									One 3"x5' Guard Pipe		
									One Bag of Cement		
									Try to Pressure Test Hole but rock kept falling back in hole. Didn't want to lose packer.		

GROUND SURFACE TO 9' USED HW "CASING: THEN NW to 16' then Cored

Sample Type
S=Dry C=Cored W=Washed
P=Undisturbed Piston
P=Test Pit A=Auger V=Vane Test
T=Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density
0-10 Loose
10-30 Med. Dense
30-50 Dense
50 + Very Dense

Cohesive Consistency
0-4 Soft
4-8 M/Stiff
8-15 Stiff
15-30 V-Stiff
30 + Hard

SUMMARY
Earth Boring 20'
Rock Coring 10'
Samples 0

HOLE NO. W 86-

TOWN PRESS - EAST PROV.

GOLDBERG-ZOINO & ASSOCIATES, INC.
255 SOUTH MAIN ST., PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
USN Tank Farm Study
Middletown, RI

REPORT OF BORING No. 533E
SHEET 1 OF 2
FILE No. C-5527
CHKD. BY 53E

BORING Co. East Coast Drilling, Inc.
FOREMAN Bill Kennedy
GZA ENGINEER Mike Sherrill

BORING LOCATION East Perimeter, Tank 53
GROUND SURFACE ELEVATION ____ DATUM ____
DATE START 10/16/85 DATE END 10/16/85

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140lb HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300lb HAMMER FALLING 24 in.

CASING SIZE: OTHER: HS Auger

GROUNDWATER READINGS

DATE	TIME	DEPTH TO WATER (ft)	DEPTH TO CASING (ft)	STABILIZATION
10/16/85	11:00	28	35	0

DEPTH (ft)	CASING (blows/ft)	SAMPLE No.	PEN./REC (in)	DEPTH (ft)	BLOWS/6"	SAMPLE DESCRIPTION (Burmister CLASSIFICATION)	REMARKS	HNu	STRATUM DESCRIPTION
		1	24/14	0-2	4-7-9-11	1) Medium dense brown medium to fine SAND, little + coarse to fine Gravel, little Silt. FILL	1.	<1ppm	loose, ver loose and Medium den FILL: Silty medi fine SAND fragmented
5		2	24/15	5-7	6-5-7-6	2) Medium dense, brown and grey medium to fine + SAND, some Silt, little coarse to fine grey Shaly Gravel, Moist, FILL		11ppm	
10		3	24/12	10-12	2-2-3-3	3) Loose, brown, medium to fine + SAND, Some Silt, trace fine Gravel; moist; organic solvent odor.		40 ppm	
15		4	24/11	15-17	3-2-9-5	4) Medium dense to loose, brown, medium to fine SAND, little + Silt, trace fine Gravel, moist to wet; diesel fuel odor FILL		50 ppm	
20		5	24/6	20-22	2-1-2-3	5) Very loose, brown, medium to fine SAND, some Silt, trace coarse to fine shaley Gravel; moist to wet; FILL		30 ppm	
25		6	24/8	25-27	2-7-9-5	6) Medium dense, brown & grey medium to fine + SAND & SILT, little - shaley coarse to fine Gravel; moist to wet; slight plasticity; slight odor. FILL		6 ppm	
30		7	24/7	30-32	2-2-4-5	7) Loose, brown Silt, some medium to fine SAND, trace shaley Gravel, moist to wet FILL		7 ppm	
35									

GRANULAR SOILS BLOWS/FT.	DENSITY	COHESIVE SOILS BLOWS/FT.	DENSITY
0-4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
1) An HNu photoionization detector was used to screen samples for volatile organic compounds.
2) Ambient air HNu monitoring recorded 0 to 0.2 ppm.

GZA

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

BORING No. 533E

GOLDBERG-ZOINO & ASSOCIATES,
255 SOUTH MAIN ST., PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
USN Tank Farm Study
Middletown, RI

REPORT OF BORING No. T
SHEET 2 OF 2
FILE No. C-5527
CHKD. BY

53

DEPTH (ft)	CASING (blows/ft)	SAMPLE No.	PEN. (in)/REC	DEPTH (ft)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	REMARKS	STRATUM DESCRIPT
35		8	18/9	35.5-37	2-1-2	8) Very loose, grey medium to fine SAND, trace + Silt, changing to grey fine Sand, some Silt, little - fine shaley Gravel: wet; oily: FILL	3. 4.	500 ppm Very loose, me to fine SAND F Perimeter drai
40		9	7/7	40-40.7	18-50/2"	9) Dense Brown coarse to medium SAND, trace Silt, changing to fine SAND & SILT, changing to grey, very soft, weathered shale at 40.5	5.	50 ppm -------40.5'------- SHALE. Boring Terminated at 40.

REMARKS:

3. Tool recovery - A rods wet to 28' depth with oil sheen and trace black/brown fuel product at top
4. HNu offscale on 0-20 & 0-200 ppm.
5. Observation well installed consisting of 1.5-inch ID slotted PVC screen (0.01 - inch slot size) from 4.5 - 39.5 ft; Ottawa sand from 4- to 39.5 ft; Bentonite seal; steel guard casing and concr surface seal.

GZA

BORING No. T53E

GOLDBERG-ZOINO & ASSOCIATES, INC.
255 SOUTH MAIN ST., PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
USN Tank Farm Study
Middletown, RI

REPORT OF BORING No. 753
SHEET 1 OF
FILE No. C-5527
CHKD. BY

BORING Co. East Coast Drilling Inc.
FOREMAN Bill Kennedy
GZA ENGINEER Michael Sherrill

BORING LOCATION 25' N of stake, 63'+ off center 1
GROUND SURFACE ELEVATION DATUM
DATE START 10/16/85 DATE END 10/16/85

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140lb HAMMER FALLING 30in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER: HS Auger

GROUNDWATER READINGS

DATE	TIME	WATER (ft)	CASING (ft)	STABILIZAT
10/16	1500	25	30	0

DEPTH (ft)	CASING (blows/ft)	SAMPLE No.	PEN./REC (in)	DEPTH (ft)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	REMARKS	STRATUM DESCRIPT HNu
		1	24/17	0-2	4-5-15-15	1) Loose fine SAND & SILT, topsoil to 0.5 to Brown, medium fine + SAND, some - Silt, little coarse to fine shaley Gravel; FILL	2.	1.8 ppm Loose Fill: Gravelly mediu fine SAND to medium to fine SILT with shale fragments
5		2	24/14	5-7	11-4-5-5	2) Loose, brown & grey medium to fine + SAND, some shaley Gravel to coarse Sand, little - Silt; moist; odor; FILL		60 ppm
10		3	24/15	10-12	14-4-3-3	3) Loose, brown medium to fine + SAND, little + coarse to fine Shaley Gravel, little + Silt; fuel on spoon, odor.		34 ppm
15		4	24/8	15-17	2-2-3-3	4) Very loose, to loose, brown medium to fine SAND & SILT, little Shaley Gravel odor; moist.		52 ppm
20		5	24/11	20-22	6-3-5-2	5) Loose, brown & gray fine SAND & SILT, little Shaley Gravel; moist; slight odor.		0.8 ppm
25		6	24/10	25-27	2-3-2-3	6) Loose, brown, medium to fine SAND & SILT, little grey Shaley Gravel, moist to wet; slight odor.	3.	2.8 ppm
30		7	18/6	30.5-32	3-3-3	7) Loose, brown fine SAND, some Silt, little shaley Gravel; wet; oily sheen & odor. Brown fuel staining.		6 ppm
35		8						

GRANULAR SOILS BLOWS/FT.	DENSITY	COHESIVE SOILS BLOWS/FT.	DENSITY
0-4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
1) An HNu photoionization detector was used to screen samples for volatile organic compound content. Ambient air readings varied f 0 to 0.2 ppm.
2) Driller reports odor in auger return from 0-5 ft.
3) A-rods wet at 25 ft when pulled to sample 5-7 at 30 ft.

GZA

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

BORING No. 753W

GOLDBERG-ZOINO & ASSOCIATES, INC.
255 SOUTH MAIN ST., PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
USN Tank Farm Study
Middletown, RI

REPORT OF BORING No. 753W
SHEET 2 OF 2
FILE No C-5527
CHKD. BY

DEPTH (ft)	CASING (bl/ft)	SAMPLE No.	PEN./REC (in)	DEPTH (ft)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	REMARKS	STRATUM DESCRIPTI
35		8	21/8	35-36.8'	9-19-20/0"	8) Medium dense, brown & grey coarse to fine SAND, little - coarse Gravel, trace Silt	4.	1.6 ppm COARSE TO FINE FILL
					-1/9"			36.8'
								Boring Terminated
40								

REMARKS:
4) Sample spoon free fall from 36 to 36.8 ft. Probably penetrated drain pipe.
5) Observation well installed consisting of 1.5-inch ID slotted PVC screen (0.01-inch slot size) from 5 ft. to 35 ft; Ottawa sand from 3.5 ft. to 35 ft. Bentonite seal 3- to 3.5 ft: steel guard casing and concrete surface seal.

GZA

GOLDBERG-ZOINO & ASSOCIATES, INC
255 SOUTH MAIN ST., PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
USN Tank Farm Study
Middletown, RI

REPORT OF BORING No 756E
SHEET 1 OF 2
FILE No. C-5527
CHKD. BY

BORING Co. East Coast Drilling
FOREMAN Bill Kennedy
GZA ENGINEER Michael Sherrill

BORING LOCATION East perimeter, Tank 56
GROUND SURFACE ELEVATION
DATUM
DATE START 10/15/85
DATE END 10/15/85

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140lb HAMMER FALLING 30in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300lb. HAMMER FALLING 24 in.

CASING SIZE:
OTHER: HS Auger

GROUNDWATER READINGS

DATE	TIME	WATER (ft)	CASING (ft)	STABILIZATIO
10/15	1130	24-25	25	0

DEPTH (ft)	CASING (blows/ft)	SAMPLE No.	PEN. (in) / REC	DEPTH (ft)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	REMARKS	HNu	STRATUM DESCRIPTIO
		1	24/18	0-2	3-6-5-4	1) Dark brown fine SAND, some Silt, trace roots - topsoil; Change at 0.5 ft. to: Brown, medium to fine + SAND, little fine shaley Gravel, little Silt	1.	7.8 ppm	Medium dense to loose FILL; Silty medium to fine SAND to SANDY SILT with Shale Fragments
5		2	24/14	5-7	5-8-8-8	2) Medium dense, grey fine SAND & coarse to fine shaley Gravel, little + Silt		0.2 ppm	
10		3	24/14	10-12	10-7-11-10	3) Medium dense, grey Silt, and fine Shaley Gravel, little medium to fine Sand; moist; FILL		0.6 ppm	
15		4	24/8	15-17	2-3-4-4	4) Loose, grey fine SAND, some - Silt, little fine Shaley Gravel; moist; FILL		ND	
20		5	24/16	20-22	7-7-6-6	5) Medium dense, grey and brown fine SAND & SILT, little - fine Shaley Gravel, moist		0.6 ppm	
25		6	24/11	25-27	5-2-3-2	6) Loose, grey fine SAND, some Silt, little - fine Shaley Gravel; moist to wet.	2.	7.2 ppm	
30		7	24/10	30-32	3-2-3-3	7) Loose, brown to grey medium to fine SAND, little Silt; to fine SAND, some + Silt, trace fine Gravel; trace medium Sand; wet.		9.8 ppm	

GRANULAR SOILS BLOWS/FT.	DENSITY	COHESIVE SOILS BLOWS/FT.	DENSITY
0-4	V. LOOSE	< 2.	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
1. An HNu photoionization detector was used to screen samples for volatile organic compound content.
2. Water encountered in 25- to 30-ft. zone - Spoon sample No. 6 indicated water at 24 ft.

GZA NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No 756E

GOLDBERG-ZOINO & ASSOCIATES, Inc
255 SOUTH MAIN ST., PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
USN Tank Farm Study
Middletown, RI

REPORT OF BORING No 756E
SHEET 2 OF
FILE No C-5527
CHKD. BY

DEPTH (ft)	CASING (blows/ft)	SAMPLE No.	PEN. (in)/REC	DEPTH (ft)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	REMARKS	STRATUM DESCRIPT
35		8	18/6	35.5-37	3-4-5	8) Loose, brown and grey medium to fine + SAND, and SILT, little fine shaley Gravel; wet;FILL		44 ppm
		9	24/11	37.5-39.5	15-14-31-5	9) Dense brown coarse to fine GRAVEL, little fine Sand, trace Silt	3.	36: Sandy GRAVEL FILL Peri drain
40								13 ppm
								39.5 ft Borehole Terminated

REMARKS: 3) Observation well installed consisting of 1.5 inch ID slotted PVC screen (0.01 inch slot size) from 8.5 ft. to 38.5 ft. depths; Ottowa sand from 3 ft. to 38.5 ft; Bentonite seal from 2.5- to 3 ft; st guard casing and concrete surface seal.

BORING No. 756E

GOLDBERG-ZOINO & ASSOCIATES, I.
255 SOUTH MAIN ST., PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
USN Tank Farm Study
Middletown, RI

REPORT OF BORING No. 7561
SHEET ___ OF ___
FILE No. C-5527
CHKD. BY ___

BORING Co. East Coast Drilling Inc.
FOREMAN Bill Kennedy
GZA ENGINEER Michael Sherrill

BORING LOCATION West perimeter of Tank 56
GROUND SURFACE ELEVATION ___ DATUM ___
DATE START 10/15/85 DATE END 10/15/85

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140lb HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300lb HAMMER FALLING 24 in.

CASING SIZE: OTHER: HS Auger

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZAT
10/15	1400	26	25	0

DEPTH (ft)	CASING (blows/ft)	SAMPLE No.	PEN./REC (in)	DEPTH (ft)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	REMARKS	HNu	STRATUM DESCRIPT
		1	24/11	0-2	6-7-10-9	1) Medium dense, brown medium to fine SAND, some coarse to fine shaley Gravel, little Silt; dry; FILL	1. 2.	7.8 ppm	
5		2	24/14	5-7	5-6-5-6	2) Medium dense brown and grey, fine SAND, some + Silt, little coarse to fine shaley Gravel, moist. FILL		13.8 ppm	Loose and medium dense Silty SAND and Shaley Gravel FILL
10		3	24/10	10-12	3-2-3-6	3) Loose, grey medium to fine + SAND, and SILT, little coarse to fine shaley Gravel, moist FILL		17.2 ppm	
15		4	24/12	15-17	2-4-4-5	4) Loose, grey coarse to fine Shaley GRAVEL, little + medium to fine SAND, little Silt; moist. FILL		2.2 ppm	
20		5	18/15	20.5-22	9-4-5	5) Loose, brown and grey medium to fine SAND, little + Silt, trace fine Gravel, moist FILL		2.2 ppm	
25		6	24/13	25-27	3-4-14-13	6) Medium dense, brown medium to fine SAND, some Silt, little - grey coarse to fine shaley Gravel; moist to wet FILL	3.	ND	
30		7	18/8	30-31.5	5-6-6	7) Medium dense, brown medium to fine SAND, some + Silt, little + grey coarse to fine shaley Gravel; wet. FILL	4.	ND	
35									

GRANULAR SOILS BLOWS/FT.	DENSITY	COHESIVE SOILS BLOWS/FT.	DENSITY
0-4	V. LOOSE	< 2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
1) Located boring 1 ft. west of stake
2) An HNu photoionization detector was used to screen soil samples for volatile organic compounds.
3) Wet sample tip of recovery S-6 26. ft.
4) Two feet of material in augers when sample S-8 at 35 ft. attempt Will wash out and attempt sample.

GZA

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

BORING No. 7561

GOLDBERG-ZOINO & ASSOCIATES, IN
255 SOUTH MAIN ST, PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
USN Tank Farm Study
Middletown, RI

REPORT OF BORING No 75
SHEET 2 OF
FILE No. C-5527
CHKD. BY

DEPTH (ft)	CASING (bl/ft)	SAMPLE No.	PEN. (in)/REC	DEPTH (ft)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	REMARKS	STRATUM DESCRIP
35		8	24/17	35-37	11-11-12-13	8) Medium dense grey coarse to fine SAND, little Silt change to weathered Shale at 36.5 ft.	5.	ND Coarse to fi FILL Shale
								Borehole terminated a

REMARKS: 5) Observation well installed consisting of 1.5-inch ID slotted PVC screen (0.01 inch slot size) from 5- to 35-ft.: Ottowa sand from 4.5- to 35-ft: Bentonite seal from 3.5- to 4.5 ft: steel guard casing and concrete surface seal.

GZA

BORING No. 75

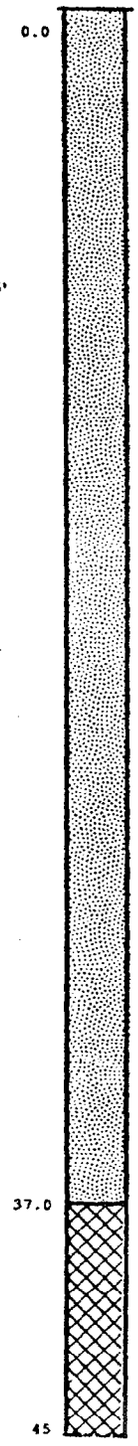
APPENDIX C

TEST BORING LOGS AND WELL CONSTRUCTION DIAGRAMS

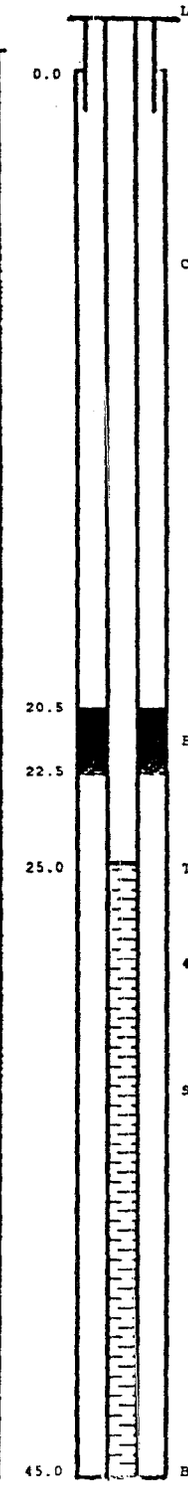
BORING NO.:	MW-7	CONTRACTOR:	CDS	DATE STARTED:	9/11/90
PROJECT NO.:	6760-N81	DRILLERS:	QUINN/SCOTT	DATE COMPLETED:	9/11/90
PROJECT:	U.S. NAVY-NETC	TRC INSPECTOR:	SMITH	WATER TABLE LEVEL:	33.8 FT
LOCATION:	NEWPORT, RI	DRILLING METHOD:	6-1/4" HOLLOW STEM AUGERS	LOCATION:	N 169,836.034
SITE:	13-TANK FARM FIVE	GROUND ELEVATION:	69.04 Mean Low Water		E 552,582.617
BORING DEPTH:	45 FT	CASING ELEVATION:	71.81 Mean Low Water		

DEPTH (FT)	BLOWS	OVA/HNu (PPM)	SOIL DESCRIPTION
0 - 2	18 23 21 11	0.5	FINE SAND AND SILT, LITTLE M. SAND, TRACE CLAY, BROWN/BLACK MOIST (20")
2 - 4	12 14 10 9	11	F - M SAND, SOME SILT, DARK BROWN, MOIST (18")
4 - 6	4 2 7 9	10	SAME AS ABOVE (10")
6 - 8	13 11 10 11	30/2	F - M SAND, SOME SILT, LITTLE WEATHERED SHALE, BROWN, MOIST (12")
8 - 10	11 17 13 9	10	F - M SAND, SOME SILT, TRACE CLAY, METHANE-LIKE ODOR, BROWN/BLACK, MOIST (6'
10 - 12	4 5 5 11	5	SAME AS ABOVE, SLIGHT METHANE-LIKE ODOR (12")
12 - 14	8 9 6 4	>1000/1	SAME AS ABOVE, NO ODOR (8")
14 - 16	8 7 3 4	30	SAME AS ABOVE, SLIGHT METHANE-LIKE ODOR
16 - 18	6 4 5 5	25	F - M SAND, SOME SILT, SOME WEATHERED SHALE, TRACE CLAY, BROWN/BLACK, MOIST (12")
18 - 20	4 4 3 4	9	SAME AS ABOVE, VERY MOIST (12")
20 - 22	3 5 5 5	3	SAME AS ABOVE, BROWN, WET (10")
25 - 27	4 3 4 4	3	SAME AS ABOVE, MOIST (4")
30 - 32	5 5 4 6	3	SAME AS ABOVE (8")
35 - 37	11 8 13 13	3	SAME AS ABOVE, WET, PETROLEUM ODOR (6")
40 - 42	100/6"	0	WEATHERED SHALE, GRAY/BROWN, WET (8")
			END OF BORING = 45 FT
			SAMPLE TF5-M07-1 COLLECTED FROM 12-14 FEET

LITHOLOGY



WELL CONSTRUCTION

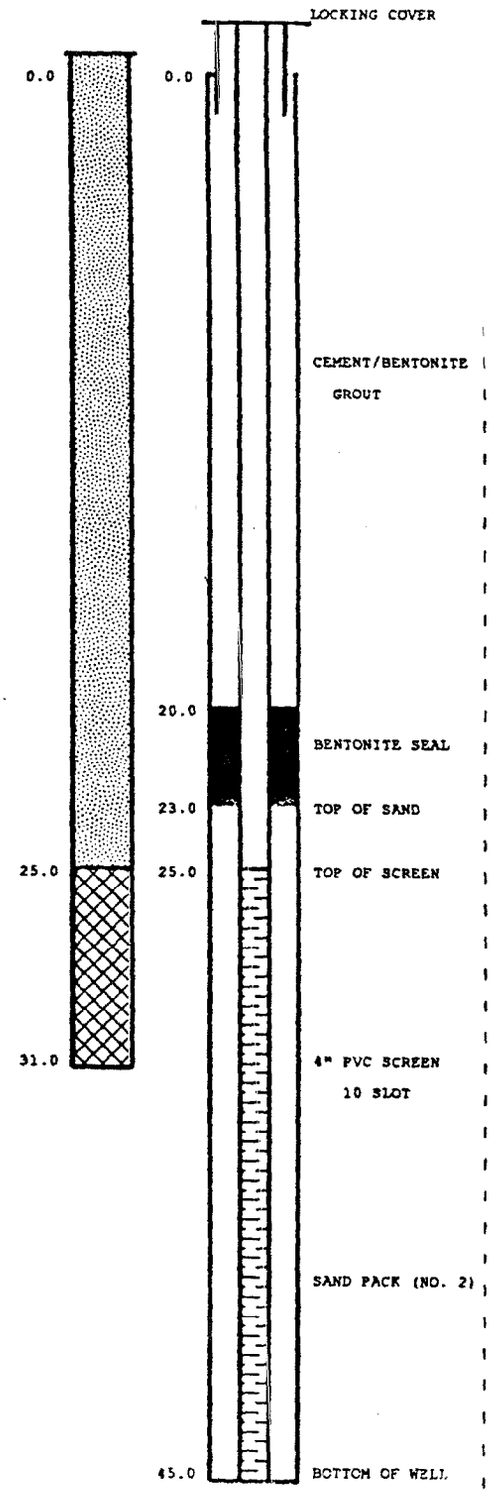


BORING NO.:	MW-8	CONTRACTOR:	CDS	DATE STARTED:	9/18/90
PROJECT NO.:	6760-N81	DRILLERS:	QUINN/SCOTT	DATE COMPLETED:	9/19/90
PROJECT:	U.S. NAVY-NETC	TRC INSPECTOR:	SMITH	WATER TABLE LEVEL:	35.0 FT
LOCATION:	NEWPORT, RI	DRILLING METHOD:	6-1/4" HOLLOW STEM AUGERS	LOCATION:	N 169,889.678
SITE:	13-TANK FARM FIVE	GROUND ELEVATION:	66.59 Mean Low Water		E 552,561.775
BORING DEPTH:	46.7 FT	CASING ELEVATION:	69.81 Mean Low Water		

DEPTH (FT)	BLOWS	OVA/HNu (PPM)	SOIL DESCRIPTION
0			
5 - 7	6 23 15 12	0	FINE SAND AND SILT, TRACE CLAY, BROWN/GRAY (10") WEATHERED SHALE, GRAY (14")
10 - 12	3 7 10 16	0	FINE SAND AND SILT, BROWN (14") FINE SAND, SOME SILT, TAN (4")
15 - 17	11 17 28 40	0	SAME AS ABOVE, MOIST (24")
20 - 22	10 22 38 35	0	FINE SAND AND SILT, BLACK (6") WEATHERED SHALE, BROWN, MOIST (14")
25 - 27	18 21 56 131/6"	0	WEATHERED SHALE, BROWN, MOIST (12")
27 - 29	36 100/3"	0	SAME AS ABOVE (4")
29 - 31	10 100/5"	0/5	SAME AS ABOVE (8")

ENCOUNTERED COMPETENT ROCK AT 33.5 FEET
SWITCHED TO MUD ROTARY DRILLING
DRILLED TO 46.7 FEET
ADDED SAND TO RAISE WELL TO 45 FEET

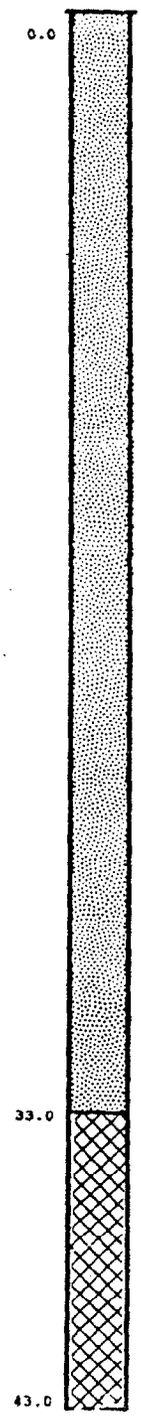
SAMPLE TF5-M08-1 COLLECTED FROM 29-31 FEET



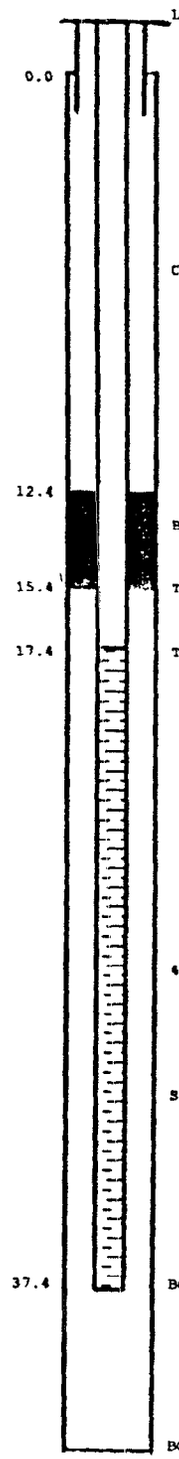
BORING NO.:	MW-9	CONTRACTOR:	CDS	DATE STARTED:	9/11/90
PROJECT NO.:	6760-N81	DRILLERS:	QUINN/SCOTT	DATE COMPLETED:	9/11/90
PROJECT:	U.S. NAVY-NETC	TRC INSPECTOR:	SMITH	WATER TABLE LEVEL:	27.1 FT
LOCATION:	NEWPORT, RI	DRILLING METHOD:	6-1/4" HOLLOW STEM AUGERS	LOCATION:	N 169,740.518
SITE:	13-TANK FARM FIVE	GROUND ELEVATION:	78.94 Mean Low Water		E 552,856.146
BORING DEPTH:	43 FT	CASING ELEVATION:	82.26 Mean Low Water		

DEPTH (FT)	BLOWS	OVA/HNu (PPM)	SOIL DESCRIPTION
0 - 2	5 6	0	SILT AND FINE SAND, TRACE CLAY, BROWN (12")
	6 13		
2 - 4	2 13	0	SAME AS ABOVE (8")
	11 12		WEATHERED SHALE, GRAY (8")
4 - 6	3 9	0	SILT, SOME FINE SAND, LITTLE ANGULAR WEATHERED SHALE, BROWN (8")
	43/0"		
6 - 8	4 6	0	SAME AS ABOVE (16")
	7 8		
8 - 10	7 11	0	SAME AS ABOVE (10")
	8 7		
10 - 12	5 6	0	SAME AS ABOVE (10")
	8 6		
12 - 14	8 11	0	SAME AS ABOVE (4")
	12 17		M - F SAND, SOME SHALE FRAGMENTS, RED/BROWN, MOIST (12")
14 - 16	11 10	0	FINE SAND AND SILT, SOME GRAY SHALE FRAGMENTS, BROWN (8")
	11 10		
16 - 18	21 12	0	SAME AS ABOVE (16")
	24 10		
18 - 20	5 11	0	SAME AS ABOVE (8")
	10 8		
25 - 27	5 53	0	SAME AS ABOVE, WET (6")
	13 11		WEATHERED SHALE, GRAY, DRY (8")
27 - 29	13 100/3"	0	M - F SAND, SOME SHALE FRAGMENTS, LITTLE SILT, GRAY, WET (6")
	CORE TIMES (MIN.)		
33	3		1ST CORE RUN
	3		GRAY SLIGHTLY METAMORPHOSED SHALE WITH A FEW QUARTZ LENSES
	3		IN LOWER END. UPPER 1.5' HIGHLY WEATHERED SHALE.
	3		RECOVERY = 3.5 FT. CORING RATE = 3 MIN/FT
	3		
38	5		2ND CORE RUN
	5		SAME AS ABOVE
	5		RECOVERY = 5' CORING RATE = 5 MIN/FT
	5		
43	5		END OF BORING = 43.0 FT
			SAMPLE TF5-M09-1 COLLECTED FROM 27-29 FEET

LITHOLOGY



WELL CONSTRUCTION



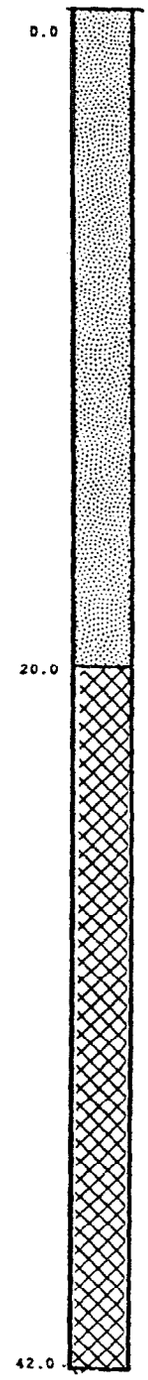
BORING NO.:	MW-10	CONTRACTOR:	CDS	DATE STARTED:	9/14/90
PROJECT NO.:	6760-N81	DRILLERS:	QUINN/SCOTT	DATE COMPLETED:	9/17/90
PROJECT:	U.S. NAVY-NETC	TRC INSPECTOR:	SMITH	WATER TABLE LEVEL:	23.4 FT
LOCATION:	NEWPORT, RI	DRILLING METHOD:	6-1/4" HOLLOW STEM AUGERS	LOCATION:	N 169,767.020
SITE:	13-TANK FARM FIVE	GROUND ELEVATION:	80.84 Mean Low Water		E 552,907.343
BORING DEPTH:	42 FT	CASING ELEVATION:	83.53 Mean Low Water		

DEPTH (FT)	BLOWS	OVA/HNu (PPM)	SOIL DESCRIPTION
0			
5 - 7	1 1 3 4	0	FINE SAND AND SILT, TRACE CLAY, BROWN, MOIST (6")
10 - 12	10 16 14 9	0.2/20	SAME AS ABOVE, BROWN/GRAY (12")
15 - 17	8 1 3 14	0	SAME AS ABOVE WITH LITTLE GRAVEL (4")
17 - 19	23 48 50/1"	0	SAME AS ABOVE (16")
20 - 22	15 28 100/3"	0	WEATHERED SHALE, LITTLE FINE SAND AND SILT, BLACK (12")
22 - 24	22 100/2	0/250	SAME AS ABOVE (8")
24 - 26	27 60/1	0	WEATHERED SHALE, SOME SILT, LITTLE FINE SAND, GRAY (8")
26 - 28	34 65 38 70/3"	0/200	SAME AS ABOVE (18")
28 - 30	18 69 35/2"	0/150	SAME AS ABOVE (12")
30 - 32	21 100/	0/20	SAME AS ABOVE, MOIST (8")
32 - 34	26 75/3	0/17	SAME AS ABOVE, MOIST (6")
40 - 42	23 75/4"	0/80	FINE SAND AND SILT, BROWN (6") WEATHERED SHALE, GRAY (2")

END OF BORING - 42 FT

SAMPLE TF5-M10-1 COLLECTED FROM 26-28 FEET

LITHOLOGY



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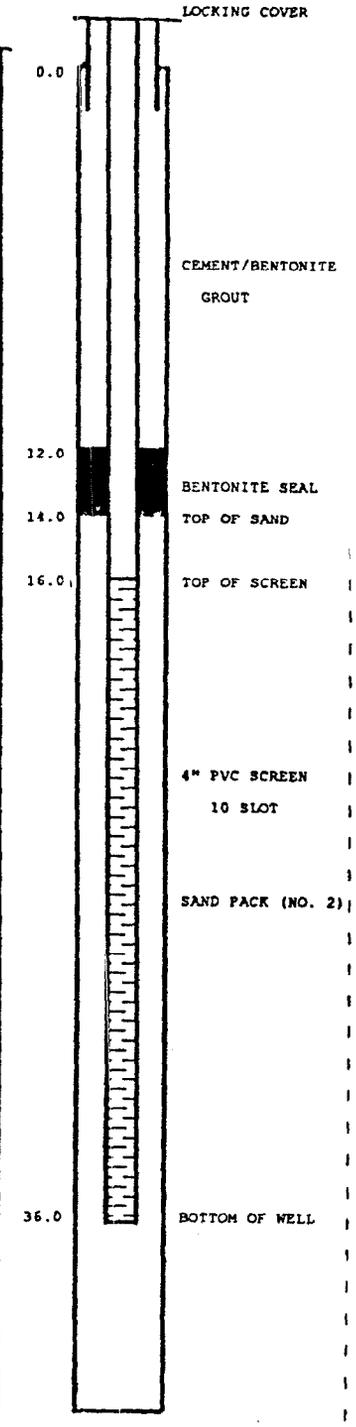
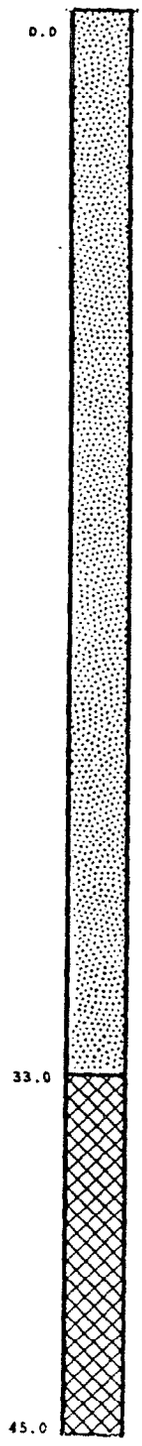


BORING NO.:	RW-1	CONTRACTOR:	CDS	DATE STARTED:	9/19/90
PROJECT NO.:	6760-N81	DRILLERS:	QUINN/SCOTT	DATE COMPLETED:	9/20/90
PROJECT:	U.S. NAVY-NETC	TRC INSPECTOR:	SMITH	WATER TABLE LEVEL:	31 FT
LOCATION:	NEWPORT, RI	DRILLING METHOD:	10-1/4" HOLLOW STEM AUGERS	LOCATION:	N 169,850.215
SITE:	13-TANK FARM FIVE	GROUND ELEVATION:	68.59 Mean Low Water		E 552,610.869
BORING DEPTH:	45 FT	CASING ELEVATION:	72.52 Mean Low Water		

DEPTH (FT)	BLOWS	OVA/HNu (PPM)	SOIL DESCRIPTION (RECOVERY)
0			
5 - 7	8 8 7 6	360/35	FINE SAND AND SILT, TRACE CLAY, TRACE GRAVEL, BROWN, STRONG PETROLEUM ODOR, MOIST (18")
10 - 12	6 5 4 4	280/65	F - M SAND, SOME SILT, TRACE CLAY, TRACE WEATHERED SHALE, BROWN, PETROLEUM ODOR, MOIST (12")
15 - 17	6 6 6 14	54/8	FINE SAND AND SILT, LITTLE SHALE FRAGMENTS, DARK BROWN, SLIGHT PETROLEUM ODOR, MOIST (16")
20 - 22	6 3 4 3	30/10	SAME AS ABOVE (6")
25 - 27	2 2 2 1	3/5	SAME AS ABOVE (3")
31 - 33	3 3 3 3	12/4	SAME AS ABOVE (3")
33 - 35	6 4 3 5	4/5	WEATHERED SHALE, BROWN/GRAY, SLIGHT ODOR, WET (6")
37 - 39		18/5	SAME AS ABOVE, OILY SHEEN AND ODOR, WET
			DRILLED TO 45 FT
			END OF BORING - 45 FEET
			SAMPLE TF5-RW1-1 COLLECTED FROM 5-7 FEET
			SAMPLE TF5-RW1-2 COLLECTED FROM 33-35 FEET

LITHOLOGY



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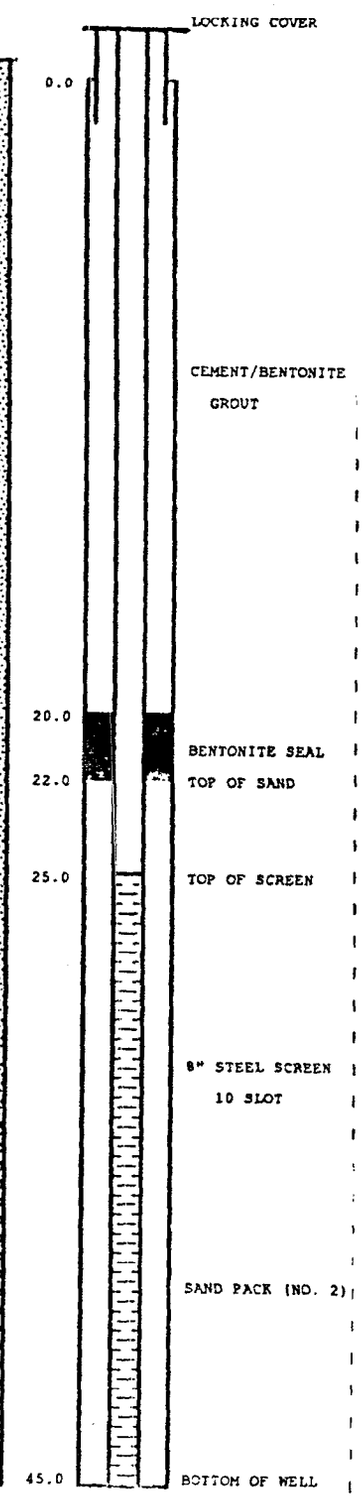

APPENDIX D

QUALITATIVE HUMAN HEALTH EVALUATION

QUALITATIVE HUMAN HEALTH EVALUATION
TANK FARM 5
TANKS 53 AND 56
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared For:

US Navy - Northern Division
Naval Facility Engineering Command
Philadelphia, PA

Prepared By:

TRC Environmental Consultants, Inc.
East Hartford, Connecticut

TRC Project No. 6760-N81

June 1991

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1.0 QUALITATIVE HEALTH RISK ASSESSMENT

1.1 Objectives

This qualitative health risk assessment provides an assessment of potential impacts on human health associated with Tank Farm 5 at the Naval Education and Training Center (NETC) in Newport, Rhode Island following closure of Tanks 53 and 56. Tank Farm 5 is actually just north of the NETC in Middletown, Rhode Island. The primary objectives are to examine exposure pathways and to estimate the potential for adverse effects (cancer and non-cancerous effects) associated with the contaminants of concern at the site under current conditions (baseline risk assessment).

For this assessment, two site-specific exposure scenarios have been considered and developed to represent potential situations in which humans may be exposed to contaminants originating from the site.

Human health risks associated with the site are presented with regard to potential effects from the contaminants of concern. These effects may include potential risks of cancer or non-cancerous (systemic) effects.

Ultimately, the risk assessment presented in this report is expected to be used within a risk management framework. In making decisions concerning what, if anything, should be done at a site (including, for example, the collection of additional data or implementation of a remedial program), the results of the risk assessment should be used in concert with other information on the site. The risk assessment should also identify site or land use conditions that present unacceptable risks. The results of the risk assessment identify contaminants and exposure pathways contributing the greatest risk to the receptor population. From this information, recommendations for future activities at the site can be made such that public health and the environment are protected.

1.2 Methodology

The methodology for this qualitative assessment is structured around the methods accepted by the U.S. EPA in the Interim Final Risk Assessment Guidance for Superfund, Volume I (Human Health Evaluation Manual - Part A) (1989). Where assumptions are made, they are realistic but conservative, i.e., protective of public health. In keeping with accepted practices for conducting such assessments, all assumptions are carefully discussed and an assessment made of the uncertainty associated with potential health risks.

Following the guidelines accepted by the EPA, the basic components of the public health risk assessment are organized as follows:

- Data Collection;
- Data Evaluation;
- Exposure Assessment;
- Toxicity Assessment; and
- Risk Characterization.

Data collection has been presented in the TRC report "Results of Soil and Ground Water Sampling, Tank Farm 5, Tanks 53 and 56, Naval Education and Training Center, Newport, RI" (TRC, 1991). The remaining components are discussed below in relation to the site.

1.3 Identification of Chemicals of Potential Concern

1.3.1 Data Evaluation

Due to the qualitative nature of this assessment associated with the tank closure, detailed data evaluation following EPA guidelines involving the application of statistical criteria (EPA, 1989) was not necessary. Rather, the specific methods used in this report include the following, which conform with published guidelines:

- All analytical data was initially sorted by media (surface soil, subsurface soil and ground water);

- Data validation qualifiers were assessed during the data evaluation process. As indicated in EPA guidance (EPA, 1989), data qualified with U or J qualifiers were considered for use in the risk assessment when appropriate;

- Field and laboratory blanks were used to segregate actual site contamination from cross contamination from field or laboratory procedures. As indicated in EPA (1989) sample results were considered positive only if concentrations exceeded ten times the concentration of a common laboratory contaminant in a blank, or five times the concentration of a chemical that is not considered a common laboratory contaminant. For example, methylene chloride, a common laboratory contaminant, was detected in blanks associated with ground water at concentrations less than ten times the blank concentration. For this reason, methylene chloride was not assumed to be a site contaminant, and was not included in the risk assessment;

- Three background sampling locations were available for the site. These data, together with national background levels, were used as a screening method to evaluate non-site related chemicals (that is, compounds present on site due to natural, background conditions) or commonly encountered naturally occurring chemicals.

1.4 Summary of Chemicals of Potential Concern

Chemicals of potential concern were selected based on a screening level evaluation of the chemical, physical, and toxicological properties of the identified contaminants and associated concentrations in environmental media. Inorganic compounds detected in surface soil were compared to U.S. background levels (USGS, 1984) to determine if elevated concentrations were reported. Of the inorganics detected, only mercury and lead exceeded national background levels. Arsenic, a known carcinogen by the oral route, did not exceed background soil concentrations but was included as an indicator compound based on toxicity data.

DDE and DDT were the only pesticides/PCBs detected in surface soils. Based on the carcinogenicity of these pesticides, the fact that they are not normal background constituents of surface soil, both were selected as chemicals of potential concern.

Base neutral/acid extractable compounds were analyzed for in surface soils. Of these compounds, eight PAHs were detected, 5 of which are carcinogens. Based on toxicity characteristics, PAHs as a group were selected as contaminants of concern. Volatile organic compounds (VOCs) were assayed for but not detected in surface soils. This indicates that any previous VOC-related contamination of the surface soil has been dissipated, likely due to volatilization.

1.5 Exposure Assessment

1.5.1 Development of Exposure Scenarios

The most critical aspect of a technically sound exposure assessment is the identification of exposure routes, together with the identification of human receptors. Based on findings from the field investigation and discussions with field personnel, the following potential human exposure scenarios were identified:

- Persons (children) trespassing on site.
- Use of an adjacent portion of the site for the NETC Firefighting Training Center with possible exposure of employees or visitors to contaminants.

Assessment of the impacts from exposure to contaminants in ground water were not addressed as all area potable water is supplied from surface impoundments. Similarly, exposure to contaminants in subsurface soils was not addressed as no subsurface construction plans for the area have been defined. The scenarios include a potential "receptor population", and a consideration of the pathways by which those receptors may encounter contaminants of concern.

1.5.2 Exposure Scenarios Addressed in the Health Assessment

Any person having access to Tank Farm 5 may be a potential receptor for contaminants detected around Tanks 53 and 56. Two basic receptor populations can be identified:

1. Children trespassing onto Tank Farm 5 for recreational play. Children have been seen riding bikes and at play on the site. Children at play during warm weather months would be expected to have exposed arms, legs and hands, allowing dermal contact, incidental ingestion of surface soil (contaminants), and inhalation of dust.

2. Workers at the newly constructed Firefighting Training Center on the site could potentially be exposed through incidental ingestion and dermal contact to contaminants in the soil. It is assumed that the location of the Fire Training Center at a scenic site on Narragansett Bay would encourage the workers to spend some time each working day, during seasonable weather, outdoors. While outside, the workers could potentially sit on the ground to eat lunch or snack, and thereby be exposed to soil contaminants. Employees are not expected to work in the vicinity of Tanks 53 and 56 and therefore exposure to soils other than during non-working hours is not expected.

1.6 Toxicity Assessment

This section of the report presents a short description of the toxic effects of each chemical of concern including concentrations at which such effects may be expected to occur, when available.

Inorganics

Arsenic

Symptoms of arsenic intoxication consist of fever, anorexia, hepatomegaly, melanosis and cardiac arrhythmia. Other features include upper respiratory tract symptoms, peripheral neuropathy and gastrointestinal, cardiovascular and hematopoietic effects. Liver injury is characteristic of longer term or chronic exposure (Goyer, 1986).

The chronic oral RfD is 1E-03 mg/kg/day (EPA, 1991a). The critical effects associated with arsenic ingestion are keratosis and hyperpigmentation at a dose of 1 ug/kg/day in humans.

The EPA weight of evidence classification for the carcinogenicity of this compound is "A" - a human carcinogen. Exposure to arsenic by the oral route is known to produce skin cancer, while inhalation will cause lung cancer. The slope factors for these carcinogenic effects are 1.4E-09 mg arsenic/kg body weight/day (mg/kg/day) and 1.2E-06 mg/kg/day, respectively (EPA, 1991).

Lead

The health effects of lead have been well characterized through decades of medical and scientific observation. Some of these effects include cognitive and motor defects in children, lead-induced anemias, increased susceptibility to viral infections and, in chronic adult lead poisoning, peripheral neuropathies and hypertension. It appears that some of these effects, particularly the changes in the levels of certain blood enzymes and in aspects of children's neurobehavioral development, may occur at blood lead levels so low that to date, no threshold has been demonstrated. Therefore, the EPA has considered it inappropriate to develop an RfD for inorganic lead (Goyer, 1986; EPA, 1991).

The EPA weight of evidence classification for the carcinogenicity of this compound is "B2" - a probable human carcinogen (sufficient animal evidence, inadequate/no human evidence). Lead has been shown to produce renal tumors.

Mercury

High level exposure to mercury vapor may produce an acute, corrosive bronchitis and interstitial pneumonitis resulting in either death or symptoms of central nervous system effects such as tremor or increased excitability.

Ingestion of mercuric salts results in corrosive ulceration, bleeding and necrosis of the gastrointestinal tract usually accompanied by shock and circulatory collapse. Renal failure occurs within 24 hours. Chronic mercury poisoning mainly affects the central nervous system. Characteristic symptoms include increased excitability, tremors, gingivitis, and increased salivation. There have been some instances of proteinuria and renal damage in persons chronically exposed to mercury vapors (Goyer, 1986). The chronic oral RfD for mercury is 3E-04 mg/kg/day (EPA, 1991a), in order to prevent the critical effect of renal damage. An uncertainty factor of 1,000 was applied in order to determine the RfD.

The EPA weight of evidence classification for the carcinogenicity of this compound is "D" - not classifiable as to human carcinogenicity (EPA, 1991).

Polycyclic (Polynuclear) Aromatic Hydrocarbons

In animal studies, symptoms of polycyclic aromatic hydrocarbon (PAH) toxicity can consist of decreased body weight, decreased testes size, decreased organ weights, hematological effects, neuropathy, increased salivation and increased liver enzymes (EPA, 1991). These symptoms are not associated with every PAH. Several of the polycyclic aromatic hydrocarbons detected in Tank Farm Five have been classified by the EPA as probable human carcinogens including benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene and benzo(a)pyrene. The oral slope factor for benzo(a)pyrene is 11.1 $(mg/kg/day)^{-1}$ and has sufficient animal evidence to show liver, lung and/or skin cancer in animal models (EPA, 1991).

4,4'-DDE

No RfDs for 4,4'-DDE were found in either IRIS or HEAST.

The EPA weight of evidence classification for the carcinogenicity of this

compound is "B2" - a probable human carcinogen (sufficient animal evidence, inadequate/no human evidence). The oral slope factor for 4,4'-DDE is 3.4E-01 $(mg/kg/day)^{-1}$ and it has been shown to produce liver tumors in animal models (EPA, 1991).

4,4'-DDT

The chronic oral RfD for 4,4'-DDT is 5E-04 mg/kg/day (EPA, 1991) and is based on a subchronic feeding study in rats in which the critical effects seen were histopathological effects to the liver. An uncertainty factor of 100 was applied in developing this RfD.

The EPA weight of evidence classification for the carcinogenicity of this compound is "B2" - a probable human carcinogen (sufficient animal evidence, inadequate/no human evidence). The oral slope factor for 4,4'-DDT is 3.4E-01 $(mg/kg/day)^{-1}$ and has been shown to produce liver tumors in animal models (EPA, 1991).

1.7 Risk Characterization

The potential risks posed by the contaminants of concern (COC) have been characterized in a qualitative sense. In some cases, simple comparisons of surficial contamination at the site to off-site monitored levels (for example, U.S. background levels) provides sufficient consideration of risk in a qualitative assessment. In other instances, more detailed consideration may be warranted. Both children and adults have the potential for exposure to these compounds, primarily through incidental ingestion of soil. Each contaminant of concern is addressed individually below.

1.7.1 Arsenic

Arsenic was chosen as a COC based on the carcinogenic potential of this element. Arsenic has been classified as a group "A" carcinogen following oral exposure by EPA (known human carcinogen).

The concentration of arsenic (6.6 ppm) in the surface soil sample SS-56 (near Tanks 56) does not appear to be elevated when compared to the national average and range of arsenic in soil. Specifically, the concentration of arsenic detected in SS-56 is lower than the national average (6.6 ppm as compared to a national average of 7.2 ppm). Furthermore, the background location for this site had an arsenic level of 7 ppm. These results suggest that arsenic in soil at this site would not be responsible for elevating cancer risks above that experienced elsewhere.

1.7.2 Lead

Lead was chosen as a COC based on concentration in surface soil sample 56 (SS-56) and on toxicity. Lead was detected in SS-56 at a concentration of 56.6 ppm, which exceeds the national average (19 ppm) but is well within the national range (<10-700 ppm). However, this on-site lead level is slightly higher than the concentrations found at the background sample location (6.2 ppm). Lead has been shown to produce neurotoxicity (particularly in children) and has been classified as a group "B2" carcinogen following oral exposure by EPA. In recent Superfund decisions, EPA has required cleanup of lead in soil to 200-500 ppm, depending upon the nature of the site.

The relatively low level of lead in surface soil does not appear to present a health risk to children or employees of the FTC, although future studies of lead effects may indicate that even low soil levels are of concern.

1.7.3 Mercury

Mercury concentrations at surface soil sample SS-56 (54 ppm) exceed both the national average (0.09 ppm) and range (<0.01-4.6 ppm) for mercury in soil. Mercury was not detected at the reported detection limit (0.11 ppm) in the background sample. Recommended drinking water standards (1-2 ug/l) and the acceptable daily intake (ADI) for mercury of 20 ug/day (EPA, 1984) suggest that there is a potential for adverse health effects following ingestion exposure to soils in the area of Tanks 53 and 56. However, it would require a soil ingestion rate of approximately 400 mg per day for the level of mercury ingestion from this source to reach the ADI. This level of soil ingestion is four times and two times the currently accepted values for soil ingestion for adults (100 mg/day) and children (200 mg/day), respectively (EPA, 1989). Therefore, it is highly unlikely that this exposure pathway, on its own, could be responsible for excess mercury consumption. However, since mercury contamination of fish and other food products is also a contributor to human exposure, it is possible that on-site soil exposure might bring the total level of mercury exposure close to the ADI. Although this is theoretically possible, it is improbable that either adults or children would ingest, on a daily basis, on-site soils at a rate of 100-200 mg per day.

1.7.4 Polycyclic Aromatic Hydrocarbons

PAHs were detected on site (surface sample SS-56) at a total concentration of 1,285 ppb. All of the PAHs were detected at concentrations below the range of background for urban soils (ATSDR, 1990). Benzo(a)anthracene, chrysene, benzo(b)- fluoranthene, benzo(k)fluoranthene and benzo(a)pyrene are all group "B2" carcinogens by the oral route; however, based on the low concentration of PAHs in surface soil, adverse health effects beyond that experienced elsewhere are not expected under the proposed exposure scenarios.

1.7.5 Pesticides

4,4'-DDE and 4,4'-DDT were detected at 32 ppb and 74 ppb in surface soil sample SS-56, respectively. Both DDE and DDT are group "B2" carcinogens. EPA's Office of Emergency and Remedial Response has suggested cleanup levels for DDT in soils based on a cancer risk of 10^{-5} (EPA, 1988). These cleanup levels are 3 ppm (3,000 ppb) for a child and 21 ppm (21,000 ppb) for an adult. Comparisons of contamination at SS-56 with these cleanup levels indicates that a significant health threat does not exist.

1.8 Conclusions

This qualitative risk assessment has evaluated the key contaminants on-site in terms of the concentrations found in surface soil, the potential for human exposure, and in terms of the toxic effects that have been observed after exposure to these agents in clinical reports or in animal experiments. While a variety of toxic agents have been found on-site, including arsenic, lead, mercury, polycyclic aromatic hydrocarbons, and the pesticides DDT and DDE, the potential for an adverse effect on human health is low. This is based upon the current use of the site in which trespassers (children) and employees may inadvertantly contact the soil and thus ingest small quantities of contaminants in soil. Additionally, the only contaminants found on-site which exceed typical background levels are DDT, DDE, and mercury. The DDT and DDE levels are low and are not anticipated to create a body burden or adverse health effects from incidental soil ingestion. The mercury level is high and does pose a possible threat to the health of individuals who ingest large quantities of soil (e.g., pica children). However, for typical children entering the site on an occasional basis, this level of mercury in the soil should not produce an elevated risk.

The major uncertainty regarding this qualitative assessment is that the contaminant data were reported from only one sampling location. Therefore, it is not possible to ascertain how representative the collected data are of the entire site. The risk assessment is based upon the data set from one sampling location, and thus cannot be used to generalize for the remainder of the site. Thus, although the data currently available do not suggest a significant health threat, additional sampling data are required to verify that this is actually the case.

2.0 REFERENCES

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TABLES

TABLE 1
SAMPLE ANALYSES SUMMARY
TANK FARM 5
NAVAL EDUCATION TRAINING CENTER
NEWPORT, RHODE ISLAND

TANK CONTENTS (O = Oil, W = Water, June 27, 1990)

SAMPLE NUMBER	TCL VOA	TCL BNA	TCL PCB'S	TAL METALS	CYANIDE
O-53	X	X	X	X	X
O-56	X	X	X	X	X
W-53	X	X		X	X
W-56	X	X		X	X

SURFACE SOIL SAMPLES (May 10, 1990, June 14, 1990)

SAMPLE NUMBER	TCL VOA	TCL BNA	TCL PESTICIDES/PCB'S	TPH	LEAD	TAL METALS
SS-56	X	X	X	X		X
SS-53/SS-61				X	X	
SS-53D				X	X	
SS-56D				X	X	

SOIL BORINGS (September 11-20, 1990)

SAMPLE NUMBER	DEPTH (ft. below grade)	PARAMETERS TCL VOA	TCL BNA	TCL PESTICIDES/PCB'S	TPH	TAL METALS
M7-1	12-14	X				
M8-1	29-31	X	X	X	X	X
M9-1	27-29	X	X	X	X	X
M10-1	26-28	X	X	X	X	X
RW1-1	5-7	X	X	X	X	
RW1-2	33-35	X	X	X	X	X

TABLE 1
SAMPLE ANALYSES SUMMARY
TANK FARM 5
NAVAL EDUCATION TRAINING CENTER
NEWPORT, RHODE ISLAND
(continued)

GROUND WATER (July, 1990)

	PARAMETERS						
SAMPLE NUMBER	TCL VOA	TCL BNA	TCL PESTICIDES/PCB'S	TPH	LEAD	TAL METALS	CYANIDE
MW-53E				X	X		
MW-53W	X	X	X	X		X	X
MW-56E				X	X		
MW-56W	X	X	X	X		X	X
MW-86-1				X	X		
MW-86-2				X			
MW-86-4				X	X		

GROUND WATER (October 25, 1990)

SAMPLE NUMBER	VOA 8240	BNA 8270	PRIORITY POLLUTANT METALS	OIL & GREASE	TOTAL SUSPENDED SOLIDS
MW-7	X	X	X	X	X
MW-9	X	X	X	X	X
MW-10	X	X	X	X	X
RW-1	X	X	X	X	X
MW-53E	X	X			
MW-53W	X *				
MW-56E	X	X	X	X	X
MW-56W	X	X	X	X	X
MW-86-1	X	X	X	X	X
MW-86-2	X	X	X	X	X
MW-86-4	X				X

* = Oil Sample From Well

TABLE 2
SURFACE SOIL SAMPLE DESCRIPTIONS
TANK FARM 5
NAVAL EDUCATION TRAINING CENTER
NEWPORT, RHODE ISLAND

SAMPLE NUMBER	DATE	ANALYSES	SOIL DESCRIPTION
SS-53	6/14/90	TPH, LEAD	SILT, SOME SAND, LITTLE GRAVEL, BROWN *DUPLICATE SAMPLE (SS-61) TAKEN
SS-53D	6/14/90	TPH, LEAD	SILT, LITTLE CLAY, SOME SHALE FRAGMENTS, BROWN
SS-56	5/10/90	VOA, BNA, PEST/PCB, INORG, TPH	SILT, SOME FINE-COARSE SAND, LITTLE GRAVEL, BROWN
SS-56D	6/14/90	TPH, LEAD	SILT, SOME FINE-COARSE SAND, LITTLE GRAVEL, BROWN

NOTES: D - INDICATES A DISCRETE SAMPLE

TABLE 3

BOREHOLE DEPTHS AND WELL CONSTRUCTION DETAILS
TANK FARM 5
NAVAL EDUCATION TRAINING CENTER
NEWPORT, RHODE ISLAND

Well No.: Diameter: Materials:	MW-7 4-inch PVC	MW-8 4-inch PVC	MW-9 4-inch PVC	MW-10 4-inch PVC	RW-1 8-inch Stainless Steel
Land surface elevation (ftmlw)[1]	69.04	66.59	78.94	80.84	68.59
Total boring depth (ftbg)[2]	45.0	46.7	43.0	42.0	45.0
Depth to top of weathered rock (ftbg)[2]	40	21	26	20	33
Depth to top of competent rock (ftbg)[2]	--	33.5	33	--	--
Depth to bottom of well (ftbg)[2]	45.0	45.0	37.4	36.0	45.0
Depth to top of screen (ftbg)[2]	25.0	25.0	17.4	16.0	25.0
Depth to top of sand pack (ftbg)[2]	22.5	22.0	15.4	14.0	22.0
Depth to top of bentonite seal (ftbg)[2]	2.5	20.0	12.4	12.0	20.0
Top of casing elevation (ftmlw)[1]	71.81	69.81	82.26	83.53	72.52

[1] Feet above mean low water
[2] Feet below grade

Depth of well construction measurements are accurate to the nearest 0.5 feet.

TABLE 4

SUMMARY OF WATER LEVEL MEASUREMENTS AND ELEVATIONS IN MONITOR WELLS TANK FARM 5

Well No.	Top of Casing Elevation	Depth to Water on 07/17/90 (ft btoc)[1]	Water Level Elevation on 07/17/90 (ft mlw)[2]	Depth to Water on 10/25/90 (ft btoc)[1]	Water level Elevation on 10/25/90 (ft mlw)[2]
Tank 53					
MW-53E	71.16	35.16*	36.00*	40.70*	30.40*
MW-53W	68.50	32.82*	35.70*	36.60*	31.90*
MW-7	71.85	--	--	38.89	32.96
MW-8	69.49	--	--	>47.90	<21.59
MW-86-2	60.54	25.78	34.76	--	--
MW-86-4	62.66	30.12	32.54	34.88	27.78
MW-86-5	56.06	>28.24	<27.82	>28.24	<27.82
RW-1	72.12	--	--	39.21	32.91
Tank 56					
MW-56E	90.39	30.92	59.47	34.06	56.33
MW-56W	86.97	27.32	59.65	31.89	55.08
MW-9	82.27	--	--	25.93	56.34
MW-10	83.53	--	--	27.93	55.60
MW-86-1	90.45	25.37	65.08	33.10	57.35
Other Tank Farm 5 Wells					
MW-1	33.97	17.10	16.87	--	--
MW-2	42.83	13.43	29.40	--	--
MW-3	50.08	12.30	37.78	--	--
MW-4	52.89	32.03	20.86	--	--
MW-5	77.37	19.16	58.21	--	--
MW-6	75.33	9.20	66.13	--	--

* Approximate due to the presence of free product.

[1] Feet below top of casing.

[2] Feet above mean low water.

TABLE 5
CONSTITUENTS DETECTED IN OIL SAMPLES FROM TANKS
TANK FARM 5
NAVAL EDUCATION TRAINING CENTER
NEWPORT, RHODE ISLAND

SAMPLE IDENTIFICATION:	0-53	0-56
OIL THICKNESS (IN):	2.4	7.2
* VOLATILE ORGANIC COMPOUNDS (PPB) *		
CHLOROMETHANE.....		
METHYLENE CHLORIDE.....	110000 U*	110000 U*
ACETONE.....	57000 U*	
CARBON DISULFIDE.....		
1,2-DICHLOROETHENE (TOTAL).....		
CHLOROFORM.....		
1,1,1-TRICHLOROETHANE.....	15000 J	
TRICHLOROETHENE.....	17000 J	14000 J
BENZENE.....	22000 J	
TETRACHLOROETHENE.....	16000 J	
TOLUENE.....	530000	110000
ETHYLBENZENE.....	220000	99000
XYLENE.....	1100000	690000
TOTAL VOLATILE ORGANICS.....	1920000	903000
* BASE NEUTRAL / ACID EXTRACTABLE COMPOUNDS (PPB) *		
NAPHTHALENE.....@	660000 J	820000 J
2-METHYLNAPHTHALENE.....@	1700000	2300000
FLUORENE.....@	210000 J	
PHENANTHRENE.....@	320000 J	260000 J
BIS(2-ETHYLHEXYL)PHTHALATE.....	430000 J	
TOTAL BNA'S.....	3320000	3380000
TOTAL PAH'S.....	2890000	3380000
TOTAL CARCINOGENIC PAH'S.....	0	0
**** PESTICIDES/PCB'S (PPB) ****		
AROCLOR-1016.....		1600 J
******* INORGANICS (PPM) *******		
ALUMINUM.....	15.4 J*	
ARSENIC.....	0.49 U*	
BARIUM.....	7.8 U*	3.7 B1
CALCIUM.....	46.7 U*	31 J*
COBALT.....		
CHROMIUM.....	0.87 U*	
COPPER.....	5 U*	1.1 U*
IRON.....	95.7 J*	25.3 J*
MAGNESIUM.....	12.5 U*	
MANGANESE.....	0.68 U*	
SODIUM.....	68.3 U*	
NICKEL.....	2.2 U*	2.3 U*
LEAD.....	39.8 J*	5.3
VANADIUM.....	5.6 U*	14.6 U*
ZINC.....	14.8	7.8 U*
CYANIDE.....		

NOTE: J - INDICATES AN ESTIMATED VALUE. THE VALUE IS BELOW THE SAMPLE QUANTITATION LIMIT BUT GREATER THAN ZERO.
U - INDICATES THAT THE COMPOUND IS BELOW DETECTION LIMITS.
B1 - INDICATES THAT THE REPORTED VALUE IS LESS THAN THE CRDL BUT GREATER THAN THE IDL.
* - INDICATES THAT THE QUALIFIER HAS CHANGED ACCORDING TO DATA VALIDATION.
** - INDICATES THAT THE CONTAMINANT VALUE HAS CHANGED ACCORDING TO DATA VALIDATION
@ - INDICATES THAT THE COMPOUND IS A POLYNUCLEAR AROMATIC HYDROCARBON (PAH).
N/A - INDICATES THAT THE COMPOUND WAS NOT ANALYZED FOR.
A BLANK INDICATES THAT THE ANALYTE WAS NOT DETECTED.
COMPLETE ANALYTICAL SUMMARY TABLES ARE PRESENTED IN APPENDIX B.
TABLE INCLUDES ALL COMPOUNDS DETECTED IN AT LEAST 1 SAMPLE OF THIS MEDIA COLLECTED FROM THE SITE.

TABLE 6
CONSTITUENTS DETECTED IN WATER SAMPLES FROM TANKS
TANK FARM 5
NAVAL EDUCATION TRAINING CENTER
NEWPORT, RHODE ISLAND

SAMPLE IDENTIFICATION:	W-53	W-56	FB-062690
WATER THICKNESS (FT):	29.15	18.03	
* VOLATILE ORGANIC COMPOUNDS (PPB) *			
CHLOROMETHANE.....			
VINYL CHLORIDE.....		2 J	
CHLOROETHANE.....	210	10	
METHYLENE CHLORIDE.....	46 U*	6 U*	
ACETONE.....		12 J*	
CARBON DISULFIDE.....		10	35
1,2-DICHLOROETHANE.....	130	14	
1,2-DICHLOROETHENE (TOTAL).....	44	5	
CHLOROFORM.....			
1,1,1-TRICHLOROETHANE.....	19 J	1 J	
CARBON TETRACHLORIDE.....			
TRICHLOROETHENE.....		1 J	
BENZENE.....	480 **	46	
4-METHYL-2-PENTANONE.....	250 J**		
TETRACHLOROETHENE.....			
TOLUENE.....	2200	160	
ETHYLBENZENE.....	140	25	
XYLENE.....	590	120	
TOTAL VOLATILE ORGANICS.....	4063	406	35
* BASE NEUTRAL / ACID EXTRACTABLE COMPOUNDS (PPB) *			
PHENOL.....	56		
2-METHYLPHENOL.....	67	180	
4-METHYLPHENOL.....	30	27	
ISOPHORONE.....	26		
2,4-DIMETHYLPHENOL.....	140	150	
NAPHTHALENE.....@	75	110	
2-METHYLNAPHTHALENE.....@	70	98	
ACENAPHTHENE.....@			
DIBENZOFURAN.....			
FLUORENE.....@	2 J		
PHENANTHRENE.....@	2 J	3 J	
DI-N-BUTYLPHTHALATE.....			
PYRENE.....@			
BIS(2-ETHYLHEXYL)PHTHALATE.....	6 J		
TOTAL BNA'S.....	474	568	0
TOTAL PAH'S.....	149	211	0
TOTAL CARCINOGENIC PAH'S.....	0	0	0

NOTE: J - INDICATES AN ESTIMATED VALUE. THE VALUE IS BELOW THE SAMPLE QUANTITATION LIMIT BUT GREATER THAN ZERO.
U - INDICATES THAT THE COMPOUND IS BELOW DETECTION LIMITS.
* - INDICATES THAT THE QUALIFIER HAS CHANGED ACCORDING TO DATA VALIDATION.
** - INDICATES THAT THE CONTAMINANT VALUE HAS CHANGED ACCORDING TO DATA VALIDATION.
@ - INDICATES THAT THE COMPOUND IS A POLYNUCLEAR AROMATIC HYDROCARBON (PAH).
A BLANK INDICATES THAT THE ANALYTE WAS NOT DETECTED.
COMPLETE ANALYTICAL SUMMARY TABLES ARE PRESENTED IN APPENDIX B.
TABLE INCLUDES ALL COMPOUNDS DETECTED IN AT LEAST 1 SAMPLE OF THIS MEDIA COLLECTED FROM THE SITE.

TABLE 6
CONSTITUENTS DETECTED IN WATER SAMPLES FROM TANKS
TANK FARM 5
NAVAL EDUCATION TRAINING CENTER
NEWPORT, RHODE ISLAND

SAMPLE IDENTIFICATION:	W-53	W-56	FB-062690
WATER THICKNESS (FT):	29.15	18.03	
**** PESTICIDES/PCB'S (PPB) ****			
	NONE DETECTED		
******* INORGANICS (PPB) *******			
SILVER.....			
ALUMINUM.....			
ARSENIC.....	2.6 U*		2.2 J*
BARIUM.....	188 J*	120 B1	
BERYLLIUM.....			
CALCIUM.....	88000 J*	76500	180 J*
CADMIUM.....			
COBALT.....			
CHROMIUM.....	13 U*	5.7 B1	
COPPER.....			
IRON.....	667 J*	324	
MERCURY.....			
POTASSIUM.....	41400 J*	44700	
MAGNESIUM.....	108000 J*	121000	
MANGANESE.....	1150 J*	410	
SODIUM.....	827000 J*	973000 J*	425 J*
NICKEL.....		13.3 U*	
LEAD.....	10.9 J*		
ANTIMONY.....	36.1 J*		
SELENIUM.....			
VANADIUM.....	19.7 U*	61.3 U*	
ZINC.....	35.1 J*	19 U*	11.7 J*
CYANIDE.....			

NOTE: J - INDICATES AN ESTIMATED VALUE. THE VALUE IS BELOW THE SAMPLE QUANTITATION LIMIT BUT GREATER THAN ZERO.
U - INDICATES THAT THE COMPOUND IS BELOW DETECTION LIMITS.
B - COMPOUND ALSO DETECTED IN THE BLANK.
B1 - INDICATES THAT THE REPORTED VALUE IS LESS THAN THE CRDL BUT GREATER THAN THE I
* - INDICATES THAT THE QUALIFIER HAS CHANGED ACCORDING TO DATA VALIDATION.
A BLANK INDICATES THAT THE ANALYTE WAS NOT DETECTED.
COMPLETE ANALYTICAL SUMMARY TABLES ARE PRESENTED IN APPENDIX B.
TABLE INCLUDES ALL COMPOUNDS DETECTED IN AT LEAST 1 SAMPLE OF THIS MEDIA COLLECTED FROM THE SITE.

TABLE 7

CONSTITUENTS DETECTED IN DISCRETE SURFACE SOIL SAMPLE FROM TANK 56

TANK FARM 5

NAVAL EDUCATION TRAINING CENTER

NEWPORT, RHODE ISLAND

SAMPLE IDENTIFICATION:	SS-56
* VOLATILE ORGANIC COMPOUNDS (PPB) *	
METHYLENE CHLORIDE.....	13 U*
ACETONE.....	10 U**
BENZENE.....	
4-METHYL-2-PENTANONE.....	
TETRACHLOROETHENE.....	2 J
TOLUENE.....	
XYLENE.....	
TOTAL VOLATILE ORGANICS.....	2
* BASE NEUTRAL / ACID EXTRACTABLE COMPOUNDS (PPB) *	
BENZOIC ACID.....	
PHENANTHRENE.....●	240 J
ANTHRACENE.....●	45 J
DI-N-BUTYLPHTHALATE.....	46 J
FLUORANTHENE.....●	370 J
PYRENE.....●	440 U**
BUTYLBENZYLPHTHALATE.....	
BENZO(a)ANTHRACENE.....●●	160 J
CHRYSENE.....●●	190 J
BIS(2-ETHYLHEXYL)PHTHALATE.....	560 U*
BENZO(b)FLUORANTHENE.....●●	140 J
BENZO(k)FLUORANTHENE.....●●	
BENZO(a)PYRENE.....●●	140 J
TOTAL BNA'S.....	1331
TOTAL PAH'S.....	1285
TOTAL CARCINOGENIC PAH'S.....	630

NOTE: J - INDICATES AN ESTIMATED VALUE. THE VALUE IS BELOW THE SAMPLE QUANTITATION LIMIT BUT GREATER THAN ZERO.

U - INDICATES THAT THE COMPOUND IS BELOW DETECTION LIMITS.

* - INDICATES THAT THE QUALIFIER HAS CHANGED ACCORDING TO DATA VALIDATION.

** - INDICATES THAT THE CONTAMINANT VALUE HAS CHANGED ACCORDING TO DATA VALIDATION

● - INDICATES THAT THE COMPOUND IS A POLYNUCLEAR AROMATIC HYDROCARBON (PAH).

●● - INDICATES THAT THE COMPOUND IS A CARCINOGENIC POLYNUCLEAR AROMATIC HYDROCARBON.

A BLANK INDICATES THAT THE ANALYTE WAS NOT DETECTED.

COMPLETE ANALYTICAL SUMMARY TABLES ARE PRESENTED IN APPENDIX B.

TABLE INCLUDES ALL COMPOUNDS DETECTED IN AT LEAST 1 SAMPLE OF THIS MEDIA COLLECTED FROM THE SITE.

TABLE 7

CONSTITUENTS DETECTED IN DISCRETE SURFACE SOIL SAMPLE FROM TANK 56

TANK FARM 5

NAVAL EDUCATION TRAINING CENTER

NEWPORT, RHODE ISLAND

SAMPLE IDENTIFICATION:	SS-56
**** PESTICIDES/PCB'S (PPB) ****	
4,4'-DDE.....	32 J
4,4'-DDT.....	74
AROCLOR-1254.....	
******* INORGANICS (PPM) *******	
SILVER.....	
ALUMINUM.....	9060
ARSENIC.....	6.6 J*
BARIUM.....	19.9 J*
CALCIUM.....	B54 B1
COBALT.....	15.1 J*
CHROMIUM.....	14 J*
COPPER.....	24.3 J*
IRON.....	25500
MERCURY.....	54 J**
POTASSIUM.....	182 B1
MAGNESIUM.....	2960
MANGANESE.....	445 J*
NICKEL.....	21 J*
LEAD.....	56.6
SELENIUM.....	
VANADIUM.....	21 J*
ZINC.....	B3
PETROLEUM HYDROCARBONS (PPM)....	24

NOTE: J - INDICATES AN ESTIMATED VALUE. THE VALUE IS BELOW THE SAMPLE QUANTITATION LIMIT BUT GREATER THAN ZERO.

U - INDICATES THAT THE COMPOUND IS BELOW DETECTION LIMITS.

B1 - INDICATES THAT THE REPORTED VALUE IS LESS THAN THE CRDL BUT GREATER THAN THE IDL.

* - INDICATES THAT THE QUALIFIER HAS CHANGED ACCORDING TO DATA VALIDATION.

** - INDICATES THAT THE CONTAMINANT VALUE HAS CHANGED ACCORDING TO DATA VALIDATION

COMPLETE ANALYTICAL SUMMARY TABLES ARE PRESENTED IN APPENDIX B.

TABLE INCLUDES ALL COMPOUNDS DETECTED IN AT LEAST 1 SAMPLE OF THIS MEDIA COLLECTED FROM THE SITE.

TABLE 8
CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES FROM TANKS 53 AND 56
TANK FARM 5
NAVAL EDUCATION TRAINING CENTER
NEWPORT, RHODE ISLAND

SAMPLE IDENTIFICATION:	SS-53	SS-61 DUP SS-53	SS-53D	SS-56D
PETROLEUM HYDROCARBONS..(PPM)...	16	31		9.5
LEAD (PPM).....	16.2 J*	17.9 J*	9 J*	8.6 J*

NOTE: J - INDICATES AN ESTIMATED VALUE. THE VALUE IS BELOW THE SAMPLE QUANTITATION LIMIT BUT GREATER THAN ZERO.
* - INDICATES THAT THE QUALIFIER HAS CHANGED ACCORDING TO DATA VALIDATION.
D - DISCRETE SOIL SAMPLE LOCATION; OTHERS ARE COMPOSITES.
A BLANK INDICATES THAT THE ANALYTE WAS NOT DETECTED.
COMPLETE ANALYTICAL SUMMARY TABLES ARE PRESENTED IN APPENDIX B.

TABLE 9

BACKGROUND SOIL SAMPLE RESULTS

SAMPLE IDENTIFICATION:	TF5-M6-1
SAMPLE DEPTH (FT):	0-2
**** VOLATILE ORGANICS (PPB) ***	
METHYLENE CHLORIDE.....	19 U*
ACETONE.....	2 U*
TOTAL VOLATILE ORGANICS.....	0
** BASE NEUTRAL / ACIDS (PPB) **	
DI-N-BUTYLPHTHALATE.....	120 J
TOTAL BNA'S.....	120
TOTAL PAH'S.....	0
TOTAL CARCINOGENIC PAH'S.....	0
**** PESTICIDES/PCB'S (PPB) ****	
AROCLOR-1254.....	230 U*
******* INORGANICS (PPM) *******	
SILVER.....	0.74 U
ALUMINUM.....	6090 J*
ARSENIC.....	7
BARIUM.....	14.5 B1
BERYLLIUM.....	0.24 U
CALCIUM.....	969 B1
CADMIUM.....	0.75 U
COBALT.....	7.7 B1
CHROMIUM.....	7.1
COPPER.....	12.8
IRON.....	16000 J*
MERCURY.....	0.11 U
POTASSIUM.....	178 U
MAGNESIUM.....	1300
MANGANESE.....	306
SODIUM.....	22.4 U
NICKEL.....	16.1
LEAD.....	6.2
ANTIMONY.....	5.4 U
SELENIUM.....	0.5 U
VANADIUM.....	15
ZINC.....	42.3
CYANIDE.....	0.64 U

NOTE: J - INDICATES AN ESTIMATED VALUE. THE VALUE IS BELOW THE SAMPLE QUANTITATION LIMIT BUT GREATER THAN ZERO.
U - INDICATES THAT THE COMPOUND IS BELOW DETECTION LIMITS.
B1 - INDICATES THAT THE REPORTED VALUE IS LESS THAN THE CRDL BUT GREATER THAN THE IDL.
* - INDICATES THAT THE CONTAMINANT VALUE HAS CHANGED ACCORDING TO DATA VALIDATION.

SAMPLE TF5-MD6-1 WAS COLLECTED AT MONITORING WELL 6 AT TANK FARM 5 LOCATED UPGRADIENT OF THE SITE.
TABLE INCLUDES ALL COMPOUNDS DETECTED IN AT LEAST 1 SAMPLE OF THIS MEDIA COLLECTED FROM THE SITE.

TABLE 10
CONSTITUENTS DETECTED IN SOIL SAMPLES
FROM WELL BORINGS
TANK FARM 5
NAVAL EDUCATION TRAINING CENTER
NEWPORT, RHODE ISLAND

SAMPLE IDENTIFICATION:	M7-1	M8-1	M9-1	M10-1	RW1-1	RW1-2	FB-091890	TB-091190	TB-091490	TB-091890	TB-092090
DEPTH (feet below grade):	12-14	29-31	27-29	26-28	5-7	33-35	*** QA/QC SAMPLES ***				
* VOLATILE ORGANIC COMPOUNDS (PPB) *											
METHYLENE CHLORIDE.....	58 B	46 B	41 B	47 B	4100 B	160 B	12 B	13 B	35 B	120 B	21 B
ACETONE.....	47 B	21 B	39 B	18 B	3700 B	42 JB	7 JB		96 B		25
1,1-DICHLOROETHANE.....					530 J						
1,2-DICHLOROETHENE (TOTAL).....					300 J						
CHLOROFORM.....										1 J	
1,1,1-TRICHLOROETHANE.....					190 J						
TRICHLOROETHENE.....		2 J									
TETRACHLOROETHENE.....				1 J	150 J						
TOLUENE.....					8400						
ETHYLBENZENE.....					8500						
XYLENE.....					34000						
TOTAL VOLATILE ORGANICS.....	105	69	80	66	59870	202	19	13	131	121	46
* BASE NEUTRAL / ACID EXTRACTABLE COMPOUNDS (PPB) *											
NAPHTHALENE.....@	NA				5800	370 J					
2-METHYLNAPHTHALENE.....@	|				15000	1400					
ACENAPHTHENE.....@	|				1200 J						
FLUORENE.....@	|				2700 J						
PHENANTHRENE.....@	|				4200	440					
ANTHRACENE.....@	|				510 J						
DI-N-BUTYLPHTHALATE.....	|		130 J	63 J							
FLUORANTHENE.....@	|				700 J						
PYRENE.....@	|				1100 J						
BUTYLBENZYLPHTHALATE.....	|				630 J						
BENZO(a)ANTHRACENE.....@@	|				570 J						
CHRYSENE.....@@	|				760 J						
BIS(2-ETHYLHEXYL)PHTHALATE.....	|	1000 B	140 JB	90 JB	5300	1100					
BENZO(b)FLUORANTHENE.....@@	|										
BENZO(k)FLUORANTHENE.....@@	|										
BENZO(a)PYRENE.....@@	NA										
TOTAL BNA'S.....		1000	270	153	38470	3310	0				
TOTAL PAH'S.....		0	0	0	32540	2210	0				
TOTAL CARCINOGENIC PAH'S.....		0	0	0	1330	0	0				
****** INORGANICS (PPM) *******											
SILVER.....	NA	2.1 U	3.8	3.9	NA	3.6					
ALUMINUM.....	|	2760	7060	8860	|	10300					
ARSENIC.....	|	51.3	54.7	41.8	|	15.7					
CALCIUM.....	|	1360	3470	1800	|	12700					
COBALT.....	|	10.5 U	23.1	20.1	|	14.2					
CHROMIUM.....	|	3.3	10.3	16.3	|	13.8					
COPPER.....	|	24.2	28.2	38.5	|	21.1					
IRON.....	|	22000	40000	34400	|	33900	0.406				
MAGNESIUM.....	|	1050 U	4250	3240	|	4260					
MANGANESE.....	|	87.3	816	530	|	327					
NICKEL.....	|	10.7	44.7	32.2	|	29.5					
LEAD.....	|	33.4	850	8	|	3.5					
SELENIUM.....	|	1.1 U	2.8	1.1 U	|	1.2 U					
ZINC.....	NA	32.4	77.9	61.2	NA	69.2	0.0284				
PETROLEUM HYDROCARBONS (PPM)....	NA	4.5	8.7	15	22000	2000					

NOTE: J - INDICATES AN ESTIMATED VALUE. THE VALUE IS BELOW THE SAMPLE QUANTITATION LIMIT BUT GREATER THAN ZERO.
U - INDICATES THAT THE COMPOUND IS BELOW DETECTION LIMITS.
B - COMPOUND ALSO DETECTED IN THE BLANK.
@ - INDICATES THAT THE COMPOUND IS A POLYNUCLEAR AROMATIC HYDROCARBON (PAH).
@@ - INDICATES THAT THE COMPOUND IS A CARCINOGENIC PAH.
N/A - INDICATES THAT THE COMPOUND WAS NOT ANALYZED FOR IN SAMPLE.
A BLANK INDICATES THAT THE ANALYTE WAS NOT DETECTED.
COMPLETE ANALYTICAL SUMMARY TABLES ARE PRESENTED IN APPENDIX B.
TABLE INCLUDES ALL COMPOUNDS DETECTED IN AT LEAST 1 SAMPLE OF THIS MEDIA COLLECTED FROM THE SITE.

TABLE 11
CONSTITUENTS DETECTED IN GROUND WATER SAMPLES
TANK FARM 5
COLLECTED ON JULY 20, 1990
NAVAL EDUCATION TRAINING CENTER
NEWPORT, RHODE ISLAND

SAMPLE IDENTIFICATION:	MW-53W	MW-53E	MW-56W	MW-56E	MW-86-1	MW-86-2	MW-86-4
* VOLATILE ORGANIC COMPOUNDS (PPB) *							
CHLOROMETHANE.....		N/A		N/A	N/A	N/A	N/A
VINYL CHLORIDE.....							
CHLOROETHANE.....							
METHYLENE CHLORIDE.....	47 U*		6 U*				
ACETONE.....	10 U**						
CARBON DISULFIDE.....							
1,2-DICHLOROETHANE.....	23 J						
1,2-DICHLOROETHENE (TOTAL).....	630						
CHLOROFORM.....							
1,1,1-TRICHLOROETHANE.....	190 J*						
CARBON TETRACHLORIDE.....	25 U**						
TRICHLOROETHENE.....	38						
BENZENE.....							
4-METHYL-2-PENTANONE.....							
TETRACHLOROETHENE.....	7 J						
TOLUENE.....	38						
ETHYLBENZENE.....	47						
XYLENE.....	100	N/A		N/A	N/A	N/A	N/A
TOTAL VOLATILE ORGANICS.....	1073		0				
* BASE NEUTRAL / ACID EXTRACTABLE COMPOUNDS (PPB) *							
PHENOL.....		N/A		N/A	N/A	N/A	N/A
2-METHYLPHENOL.....							
4-METHYLPHENOL.....							
ISOPHORONE.....							
2,4-DIMETHYLPHENOL.....							
NAPHTHALENE.....●	27 J						
2-METHYLNAPHTHALENE.....●	71 J						
ACENAPHTHENE.....●							
DIBENZOFURAN.....							
FLUORENE.....●	45 J						
PHENANTHRENE.....●	42 J						
DI-N-BUTYLPHTHALATE.....							
PYRENE.....●	21 J						
BIS(2-ETHYLHEXYL)PHTHALATE.....	100 U**	N/A		N/A	N/A	N/A	N/A
TOTAL BNA'S.....	206		0				
TOTAL PAH'S.....	206		0				
TOTAL CARCINOGENIC PAH'S.....	0		0				

NOTE: J - INDICATES AN ESTIMATED VALUE. THE VALUE IS BELOW THE SAMPLE QUANTITATION LIMIT BUT GREATER THAN ZERO.
U - INDICATES THAT THE COMPOUND IS BELOW DETECTION LIMITS.
* - INDICATES THAT THE QUALIFIER HAS CHANGED ACCORDING TO DATA VALIDATION.
** - INDICATES THAT THE CONTAMINANT VALUE HAS CHANGED ACCORDING TO DATA VALIDATION
● - INDICATES THAT THE COMPOUND IS A POLYNUCLEAR AROMATIC HYDROCARBON (PAH).
N/A - INDICATES THAT THE COMPOUND WAS NOT ANALYZED FOR IN SAMPLE.
A BLANK INDICATES THAT THE ANALYTE WAS NOT DETECTED.
COMPLETE ANALYTICAL SUMMARY TABLES ARE PRESENTED IN APPENDIX B.
TABLE INCLUDES ALL COMPOUNDS DETECTED IN AT LEAST 1 SAMPLE OF THIS MEDIA COLLECTED FROM THE SITE.

TABLE 11
CONSTITUENTS DETECTED IN GROUND WATER SAMPLES
TANK FARM 5
COLLECTED ON JULY 20, 1990
NAVAL EDUCATION TRAINING CENTER
NEWPORT, RHODE ISLAND

SAMPLE IDENTIFICATION:	MW-53W	MW-53E	MW-56W	MW-56E	MW-86-1	MW-86-2	MW-86-4
**** PESTICIDES/PCB'S (PPB) ****							
		N/A		N/A	N/A	N/A	N/A
******* INORGANICS (PPB) *******							
SILVER.....		N/A		N/A	N/A	N/A	N/A
ALUMINUM.....	3900						
ARSENIC.....	21.4 J*						
BARIUM.....	24 J*						
BERYLLIUM.....							
CALCIUM.....	44200						
CADMIUM.....							
COBALT.....	22.8 B1						
CHROMIUM.....	2.4 B1						
COPPER.....	14.4 U*						
IRON.....	34700						
MERCURY.....							
POTASSIUM.....	1790 B1						
MAGNESIUM.....	29900						
MANGANESE.....	4720						
SODIUM.....	15700						
NICKEL.....	46 U*						
LEAD.....	13.4 J*	115 J*	44.5 J*	80.5 J*	21.6 J*		20.2 J*
ANTIMONY.....							
SELENIUM.....							
VANADIUM.....	10.7 U*						
ZINC.....	69.8						
CYANIDE.....		N/A		N/A	N/A	N/A	N/A
PETROLEUM HYDROCARBONS (PPM)....	230	4600					

NOTE: J - INDICATES AN ESTIMATED VALUE. THE VALUE IS BELOW THE SAMPLE QUANTITATION LIMIT BUT GREATER THAN ZERO.
U - INDICATES THAT THE COMPOUND IS BELOW DETECTION LIMITS.
B1 - INDICATES THAT THE REPORTED VALUE IS LESS THAN THE CRDL BUT GREATER THAN THE IDL.
* - INDICATES THAT THE QUALIFIER HAS CHANGED ACCORDING TO DATA VALIDATION.
** - INDICATES THAT THE CONTAMINANT VALUE HAS CHANGED ACCORDING TO DATA VALIDATION
N/A - INDICATES THAT THE COMPOUND WAS NOT ANALYZED FOR IN SAMPLE.
A BLANK INDICATES THAT THE ANALYTE WAS NOT DETECTED.
COMPLETE ANALYTICAL SUMMARY TABLES ARE PRESENTED IN APPENDIX B.
TABLE INCLUDES ALL COMPOUNDS DETECTED IN AT LEAST 1 SAMPLE OF THIS MEDIA COLLECTED FROM THE SITE.

TABLE 12
CONSTITUENTS DETECTED IN GROUND WATER SAMPLES
TANK FARM 5
COLLECTED ON OCTOBER 25, 1990
NAVAL EDUCATION TRAINING CENTER
NEWPORT, RHODE ISLAND

SAMPLE IDENTIFICATION:	MW-7	MW-11 DUP MW-7	MW-9	MW-10	MW-53E	MW-53W OIL	MW-56E	MW-56W
* VOLATILE ORGANIC COMPOUNDS (PPB) *								
CHLOROMETHANE.....								
VINYL CHLORIDE.....					2 J			
METHYLENE CHLORIDE.....	1 JB	2 JB	3 JB	3 JB	12 B	7900 B	19 B	12 B
ACETONE.....				3 JB	12 B		13 B	10 B
1,1-DICHLOROETHENE.....					4 J			
1,1-DICHLOROETHANE.....	51	52			58	3600		
1,2-DICHLOROETHENE (TOTAL).....	140	140			1400	7000		
CHLOROFORM.....			1 J	1 J	3 J			
2-BUTANONE.....					10			
1,1,1-TRICHLOROETHANE.....	25	24			690	27000		
TRICHLOROETHENE.....	6	6			460	2200 J		
BENZENE.....	16	15			200			
TETRACHLOROETHENE.....	2 J				33	5100		
TOLUENE.....	4 J	4 J			100	2800		
ETHYLBENZENE.....	6	5			150	22000		
XYLENE.....	8	8			430	38000		
TOTAL VOLATILE ORGANICS.....	259	256	4	7	3564	115600	32	22
* BASE NEUTRAL / ACID EXTRACTABLE COMPOUNDS (PPB) *								
NAPHTHALENE.....@	5 J	7 J			4700	N/A		
2-METHYLNAPHTHALENE.....@	2 J	3 J			12000	|		
ACENAPHTHENE.....@						|		
FLUORENE.....@	1 J	2 J				|		
PHENANTHRENE.....@					2000 J	|		
PYRENE.....@					330 J	|		
BIS(2-ETHYLHEXYL)PHTHALATE.....	2 J	2 J			3400	N/A	1 J	
TOTAL BNA'S.....	10	14	0	0	22430		1	0
TOTAL PAH'S.....	8	12	0	0	19030		0	0
TOTAL CARCINOGENIC PAH'S.....	0	0	0	0	0		0	0
******* INORGANICS (PPB) *******								
ARSENIC.....	31.3	38.8		34.6	N/A	N/A	26.3	62.5
CHROMIUM.....					|	|	15.8	
COPPER.....	31.4	77.3			|	|	60.6	51.2
NICKEL.....	52.8	95		92	|	|	90.4	138
LEAD.....	31.6	32	5.8	11.4	|	|	35.6	25.2
ZINC.....	130	202	42.2	95.5	N/A	N/A	138	199
OIL AND GREASE (PPM).....	18.6	12.8			N/A	N/A		
TOTAL SUSPENDED SOLIDS (PPM)....	3060	3530	412	908	N/A	N/A	6280	740

NOTE: J - INDICATES AN ESTIMATED VALUE. THE VALUE IS BELOW THE SAMPLE QUANTITATION LIMIT BUT GREATER THAN ZERO.
B - COMPOUND ALSO DETECTED IN THE BLANK.
@ - INDICATES THAT THE COMPOUND IS A POLYNUCLEAR AROMATIC HYDROCARBON (PAH).
N/A - INSUFFICIENT SAMPLE VOLUME FOR ANALYSIS.
A BLANK INDICATES THAT THE ANALYTE WAS NOT DETECTED
COMPLETE ANALYTICAL SUMMARY TABLES ARE PRESENTED IN APPENDIX B.
TABLE INCLUDES ALL COMPOUNDS DETECTED IN AT LEAST 1 SAMPLE OF THIS MEDIA COLLECTED FROM THE SITE.

TABLE 12
CONSTITUENTS DETECTED IN GROUND WATER SAMPLES
TANK FARM 5
COLLECTED ON OCTOBER 25, 1990
NAVAL EDUCATION TRAINING CENTER
NEWPORT, RHODE ISLAND

SAMPLE IDENTIFICATION:	RW-1	MWB6-1	MWB6-2	MWB6-4	FB-1025	TB1-1025	TB2-1025	TB3-1025
* VOLATILE ORGANIC COMPOUNDS (PPB) *								
CHLOROMETHANE.....		2 J						
VINYL CHLORIDE.....	27							
METHYLENE CHLORIDE.....	16 B	11 B	11 B	8 B	13 B	2 JB	7 B	16 B
ACETONE.....	14 B	4 JB	3 JB		6 JB		9 JB	5 JB
1,1-DICHLOROETHENE.....								
1,1-DICHLOROETHANE.....	100		1 J					
1,2-DICHLOROETHENE (TOTAL).....	190		12					
CHLOROFORM.....			5		2 J			
2-BUTANONE.....								
1,1,1-TRICHLOROETHANE.....	29		7					
TRICHLOROETHENE.....	5		8					
BENZENE.....	18							
TETRACHLOROETHENE.....						1 J		
TOLUENE.....	5				1 J			
ETHYLBENZENE.....	11							
XYLENE.....	18							
TOTAL VOLATILE ORGANICS.....	433	17	47	8	22	3	16	21
* BASE NEUTRAL / ACID EXTRACTABLE COMPOUNDS (PPB) *								
NAPHTHALENE.....●	16			N/A		N/A	N/A	N/A
2-METHYLNAPHTHALENE.....●	27			|		|	|	|
ACENAPHTHENE.....●	1 J			|		|	|	|
FLUORENE.....●	2 J			|		|	|	|
PHENANTHRENE.....●	3 J			|		|	|	|
PYRENE.....●				|		|	|	|
BIS(2-ETHYLHEXYL)PHTHALATE.....	3 J			N/A	1 J	N/A	N/A	N/A
TOTAL BNA'S.....	52	0	0		1			
TOTAL PAH'S.....	49	0	0		0			
TOTAL CARCINOGENIC PAH'S.....	0	0	0		0			
******* INORGANICS (PPB) *******								
ARSENIC.....	19.1	159	51.6	N/A		N/A	N/A	N/A
CHROMIUM.....			12.4	|		|	|	|
COPPER.....		160	91.2	|	28.8	|	|	|
NICKEL.....		250	134	|		|	|	|
LEAD.....	7	48.6	36.2	|		|	|	|
ZINC.....	73	334	331	|	27	|	|	|
CYANIDE.....				N/A		N/A	N/A	N/A
OIL AND GREASE (PPM).....	35.1			N/A		N/A	N/A	N/A
TOTAL SUSPENDED SOLIDS (PPM)....	2450	N/A	2000	20100		N/A	N/A	N/A

NOTE: J - INDICATES AN ESTIMATED VALUE. THE VALUE IS BELOW THE SAMPLE QUANTITATION LIMIT BUT GREATER THAN ZERO.
B - COMPOUND ALSO DETECTED IN THE BLANK.
● - INDICATES THAT THE COMPOUND IS A POLYNUCLEAR AROMATIC HYDROCARBON (PAH).
N/A - NOT ANALYZED FOR IN SAMPLE.
A BLANK INDICATES THAT THE ANALYTE WAS NOT DETECTED.
COMPLETE ANALYTICAL SUMMARY TABLES ARE PRESENTED IN APPENDIX B.
TABLE INCLUDES ALL COMPOUNDS DETECTED IN AT LEAST 1 SAMPLE OF THIS MEDIA COLLECTED FROM THE SITE.

TABLE 13
SUMMARY OF GROUND WATER SAMPLE RESULTS
EXCEEDING DEVELOPED ACTION LEVELS
TANK FARM 5
NAVAL EDUCATION TRAINING CENTER
NEWPORT, RHODE ISLAND

COMPOUND	WELL NUMBER	CONCENTRATION (ppb)	ACTION LEVEL[1] (ppb)
VOAs			
Vinyl Chloride	MW-53E	2	2[2] (F)
	RW-1	27	
1,2 Dichloroethene (total)	MW-7	140/140[5]	70[2*] (F)
1,1,1-Trichloroethane	MW-53E	690	200[2] (F)
Trichloroethene	MW-7	6/6[5]	5[2] (F)
	MW-53E	460	
	RW-1	5	
	MW-86-2	8	
Tetrachloroethene	MW-53E	33	5[2] (F)
Benzene	MW-7	16/15[5]	5[2] (F)
	MW-53E	200	
	RW-1	18	
Toluene	MW-53E	100	40[3] (F)
Ethylbenzene	MW-53E	150	30[3] (F)
Xylene	MW-53E	430	20[3] (F)
INORGANICS			
Arsenic	MW-56W	62.5	50[4] (F)
	MW-86-1	159	
	MW-86-2	51.6	
Nickel	MW-56W	138	100[2] (T)
	MW-86-1	250	
	MW-86-2	134	

TABLE 13
SUMMARY OF GROUNDWATER SAMPLE RESULTS
EXCEEDING DEVELOPED ACTION LEVELS
TANK FARM 5
NAVAL EDUCATION TRAINING CENTER
NEWPORT, RHODE ISLAND

COMPOUND	WELL NUMBER	CONCENTRATION (ppb)	ACTION LEVEL[1] (ppb)
INORGANICS			
Lead	MW-7	31.6/32[5]	5[2] (P)
	MW-9	5.8	
	MW-10	11.4	
	MW-56E	35.6	
	MW-56W	25.2	
	RW-1	7	
	MW-86-1	48.6	
	MW-86-2	36.2	

(1) The most stringent Federal standard or criteria is listed as the action level.

(2) The Federal Maximum Contaminant Level (MCL).

(3) A secondary Federal Drinking Water Standard based on organoleptic data (i.e., taste and odor).

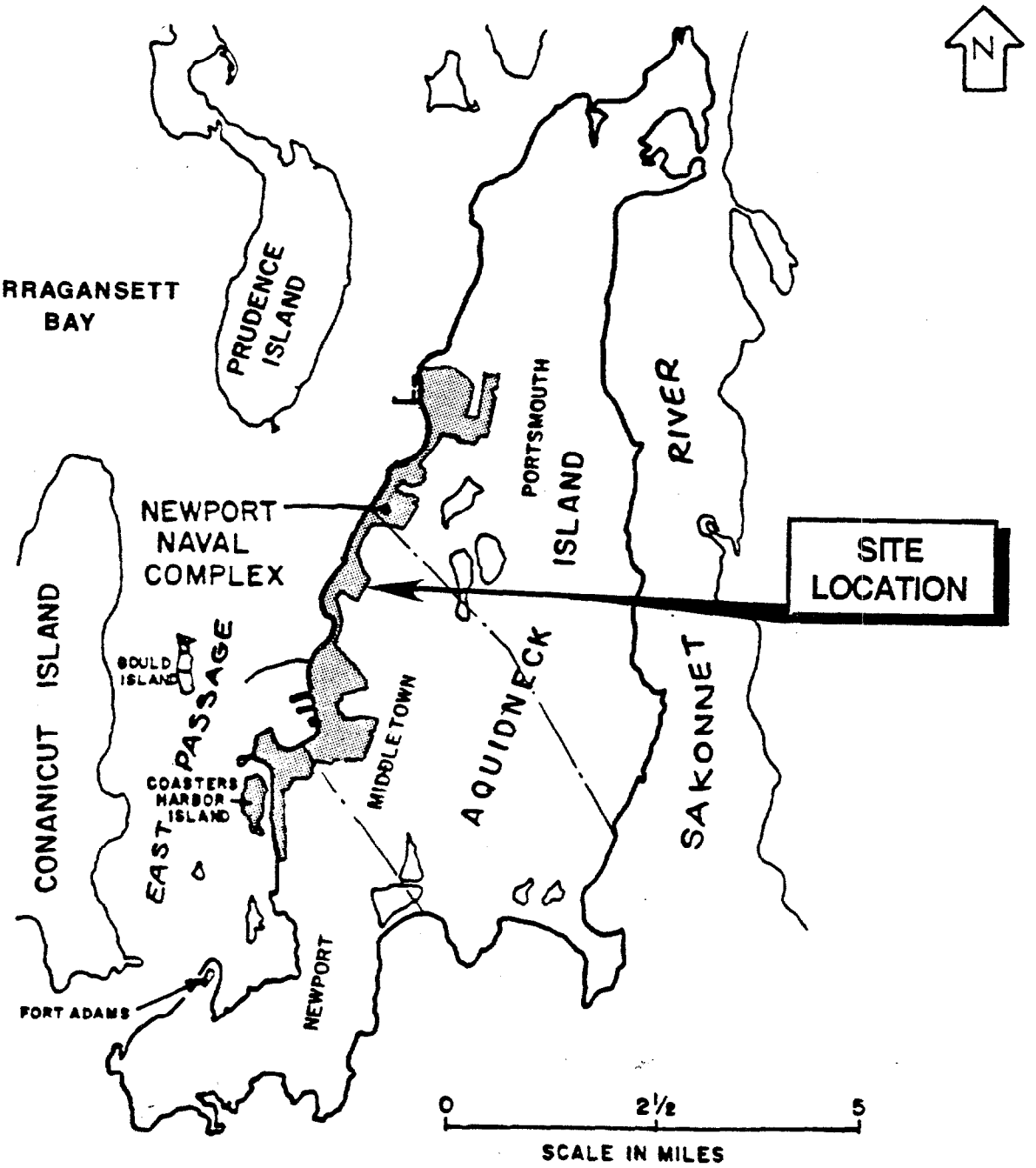
(4) The National Interim Primary Drinking Water Regulation (NIPDWR).

(5) Duplicate samples collected at this location.

(F) - Final
(P) - Proposed
(T) - Tentative

* - The action level for 1,2-Dichloroethene is based on cis-1,2-Dichloroethene and not 1,2-Dichloroethene (total).

FIGURES



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NAVAL EDUCATION TRAINING CENTER NEWPORT, RI

FIGURE 1.

NAVAL EDUCATION AND TRAINING CENTER VICINITY MAP

SOURCE: INITIAL ASSESSMENT STUDY (ENVIRODYNE, 1983)

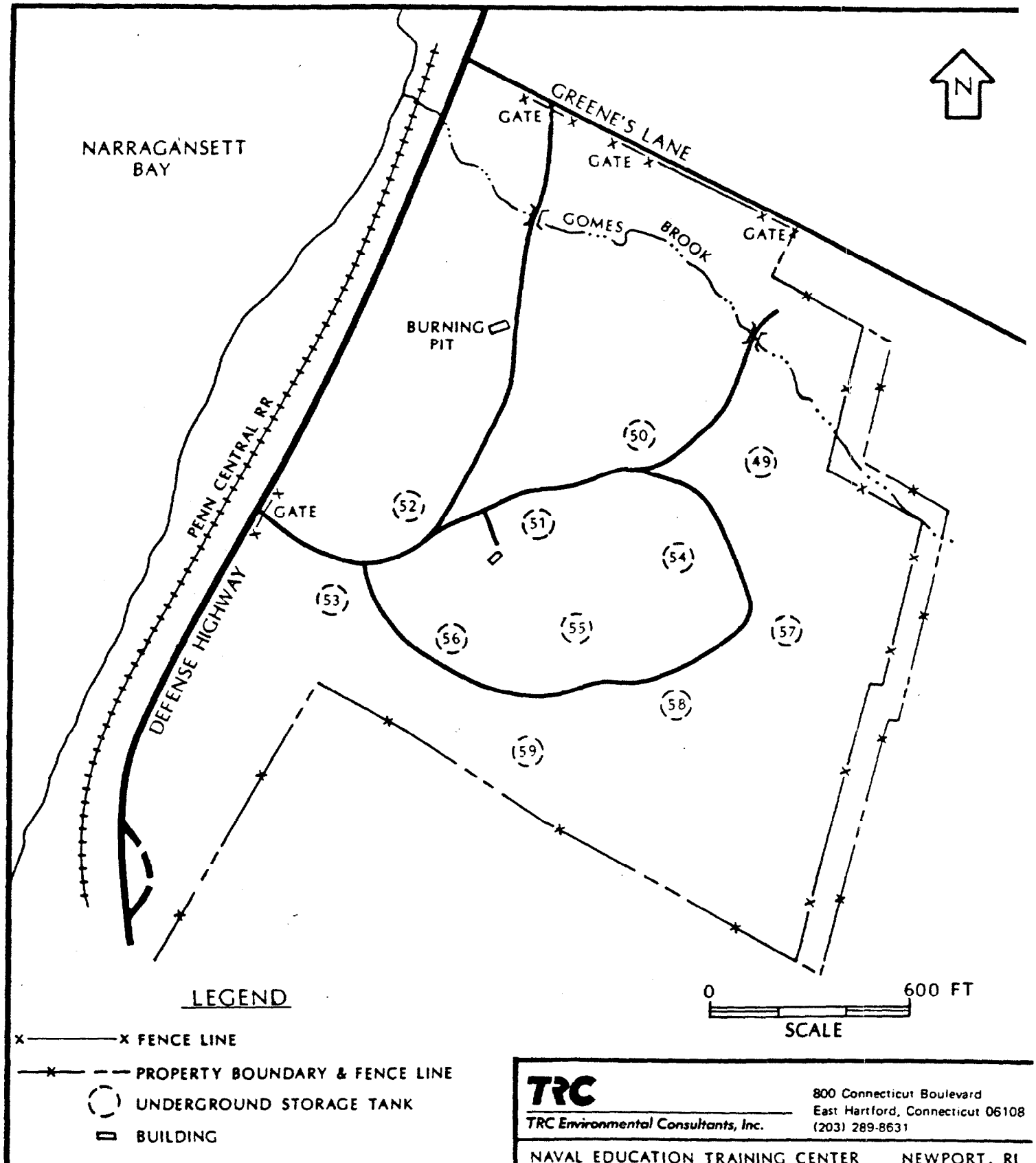

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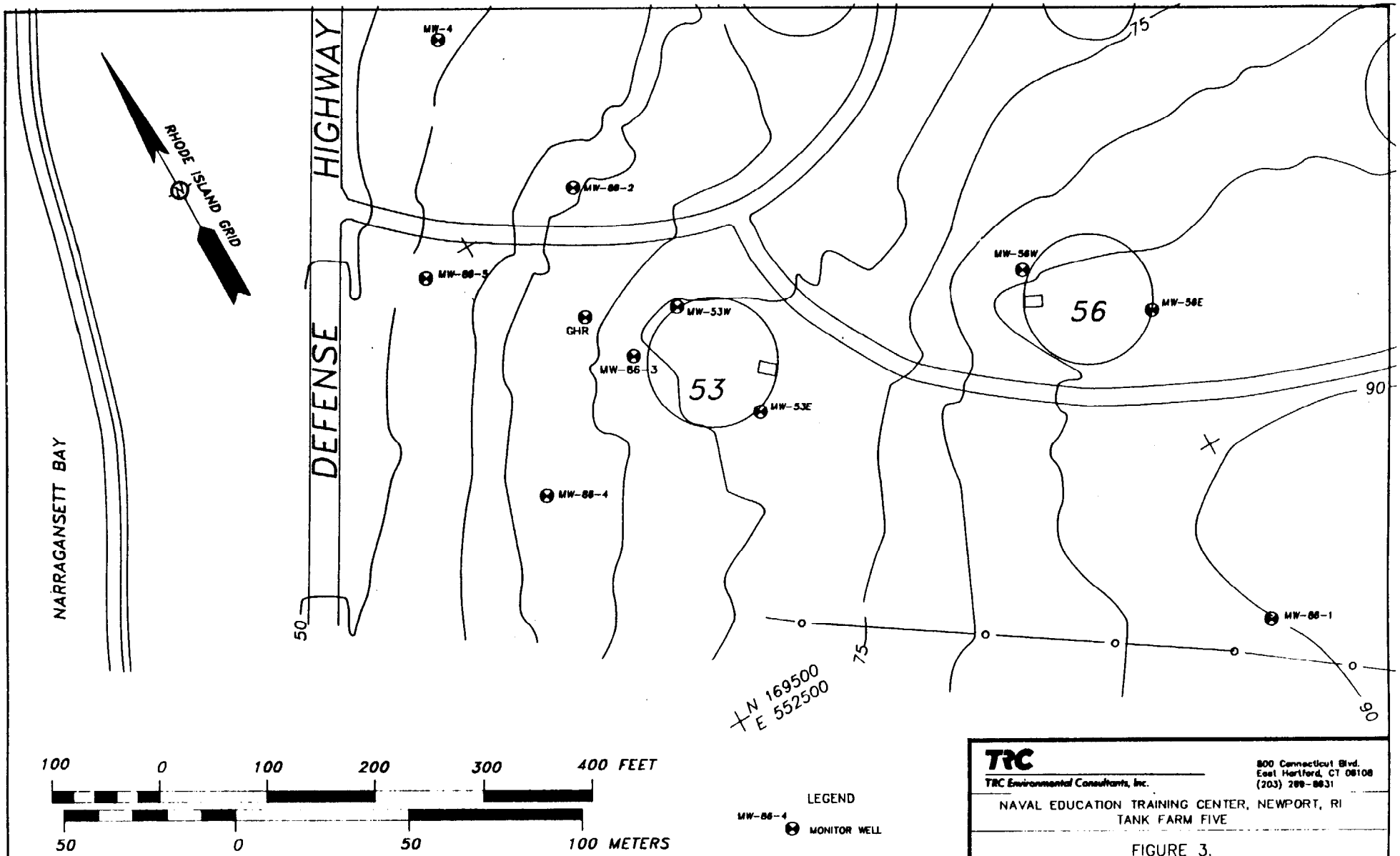
FIGURE 2.

TANK FARM FIVE SITE MAP



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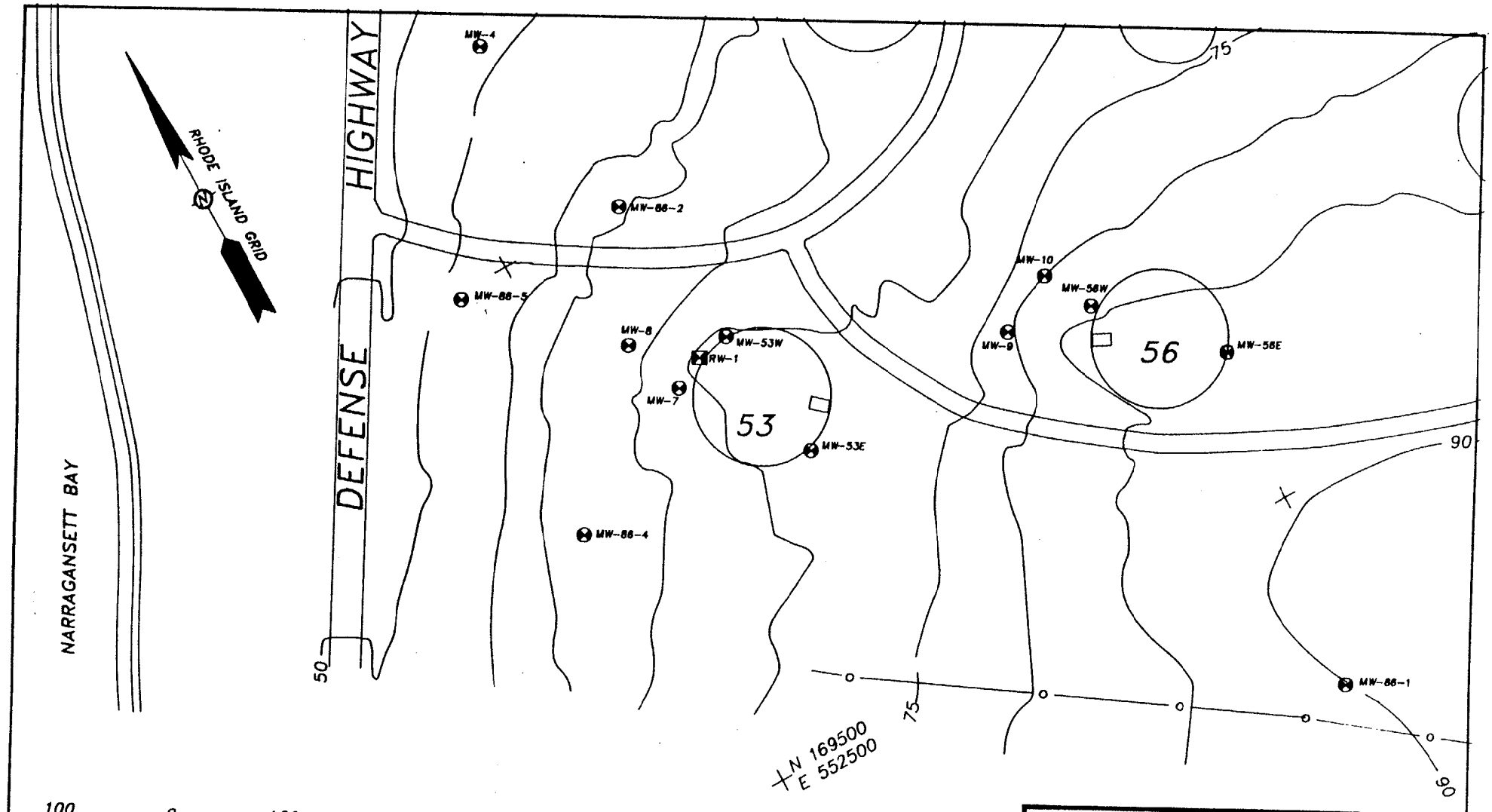
NAVAL EDUCATION TRAINING CENTER, NEWPORT, RI
TANK FARM FIVE

FIGURE 3.
SITE MAP -- TANKS 53 AND 56
(SHOWING MONITOR WELLS INSTALLED
DURING PREVIOUS INVESTIGATIONS)



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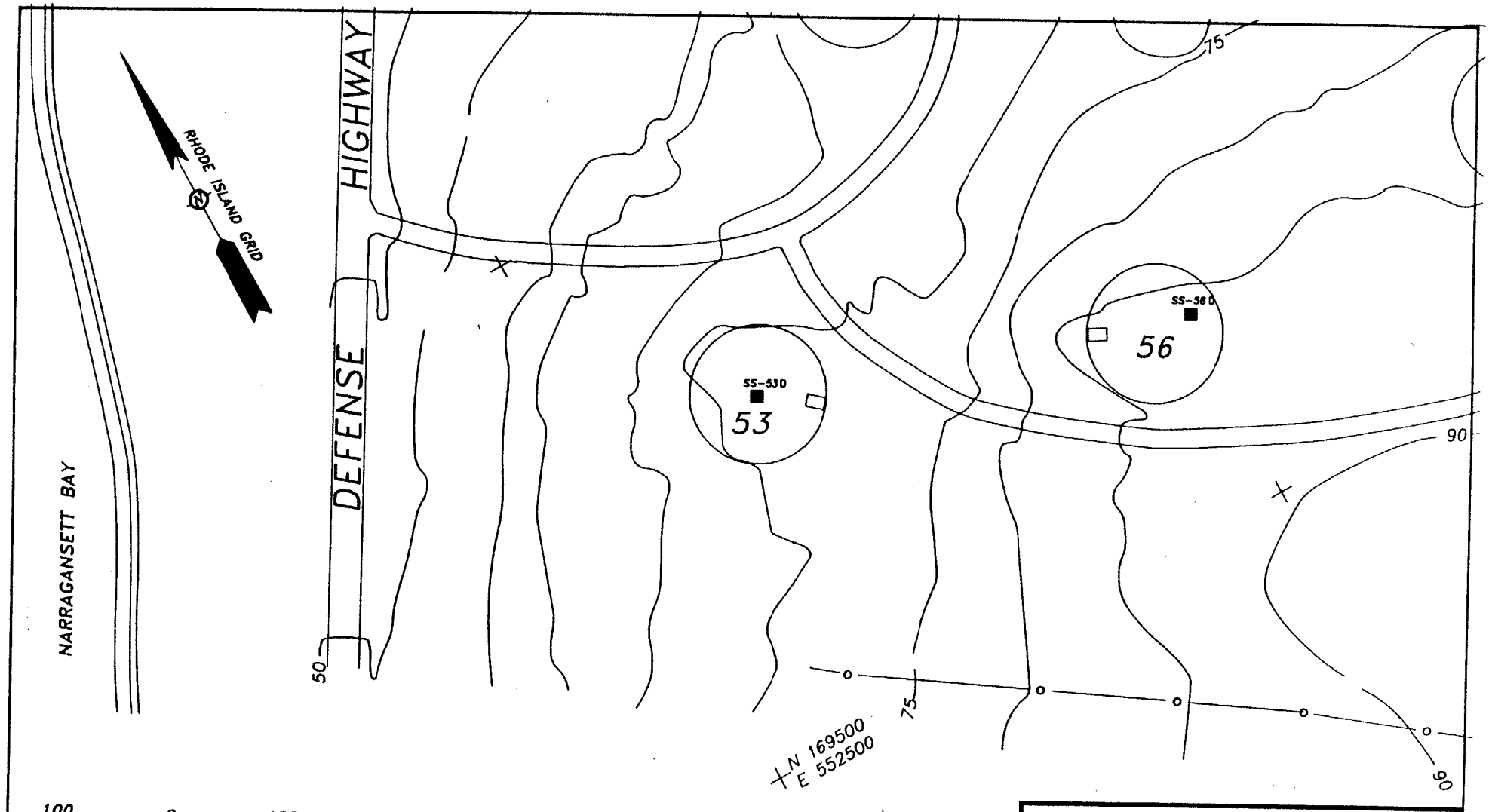
TANK FARM FIVE

FIGURE 4.
MONITOR WELL LOCATION MAP



NOTE: One composite surface soil sample was also collected from each tank area.

LEGEND

SS-530 ■ DISCRETE SOIL SAMPLE LOCATION

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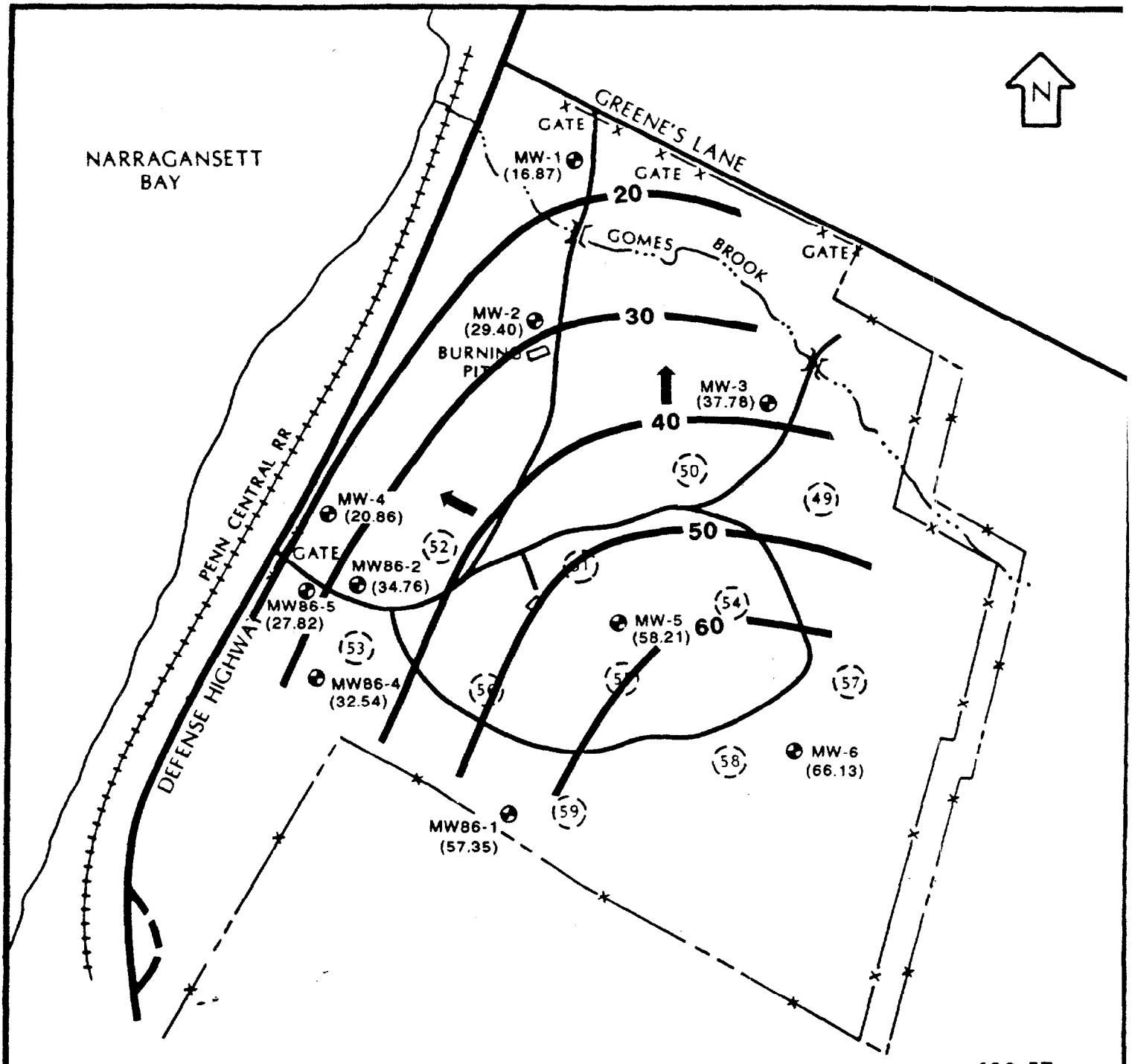
NAVAL EDUCATION TRAINING CENTER, NEWPORT, RI
TANK FARM FIVE

FIGURE 5.
SURFACE SOIL SAMPLE LOCATION MAP



LEGEND

x——x FENCE LINE

PROPERTY BOUNDARY & FENCE LINE

UNDERGROUND STORAGE TANK

BUILDING

MW-6 (66.13) MONITOR WELL LOCATION AND WATER LEVEL ELEVATION ON 7/17/90 IN FEET ABOVE MEAN LOW WATER

—20— GROUND WATER ELEVATION CONTOUR IN FEET ABOVE MEAN LOW WATER

DIRECTION OF GROUND WATER GRADIENT

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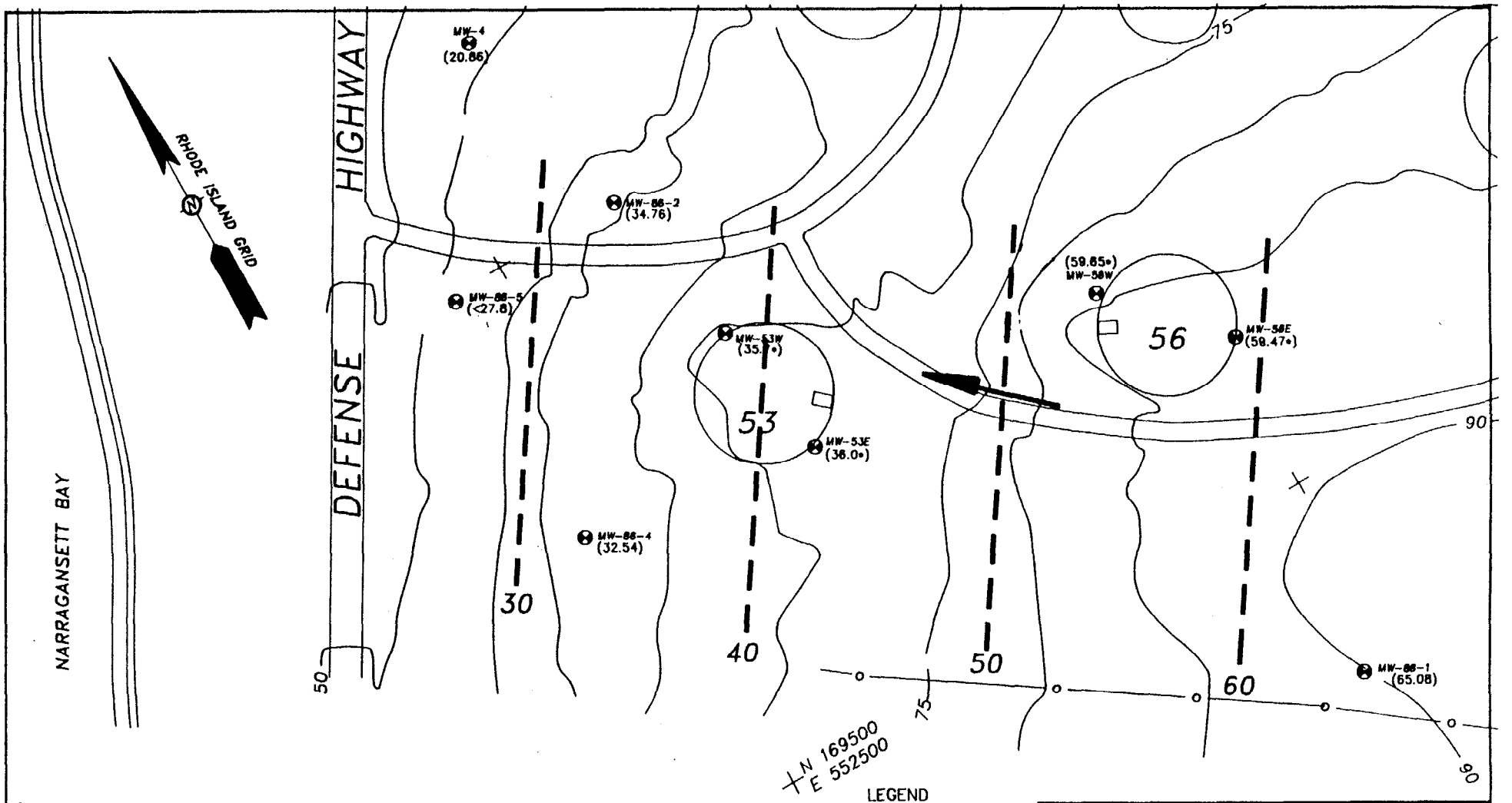
NAVAL EDUCATION TRAINING CENTER NEWPORT, RI

FIGURE 6.

GROUND WATER LEVEL CONTOUR MAP - TANK FARM FIVE JULY 17, 1990



LEGEND

100 0 100 200 300 400 FEET

50 0 50 100 METERS

MW-86-4 (32.54) MONITOR WELL LOCATION AND WATER LEVEL ELEVATION ON 7/17/90 IN FEET ABOVE MEAN LOW WATER (* DENOTES WATER LEVEL NOT UTILIZED IN CONTOURING)

30 GENERALIZED GROUND WATER ELEVATION CONTOUR IN FEET ABOVE MEAN LOW WATER

GENERALIZED DIRECTION OF GROUND WATER GRADIENT

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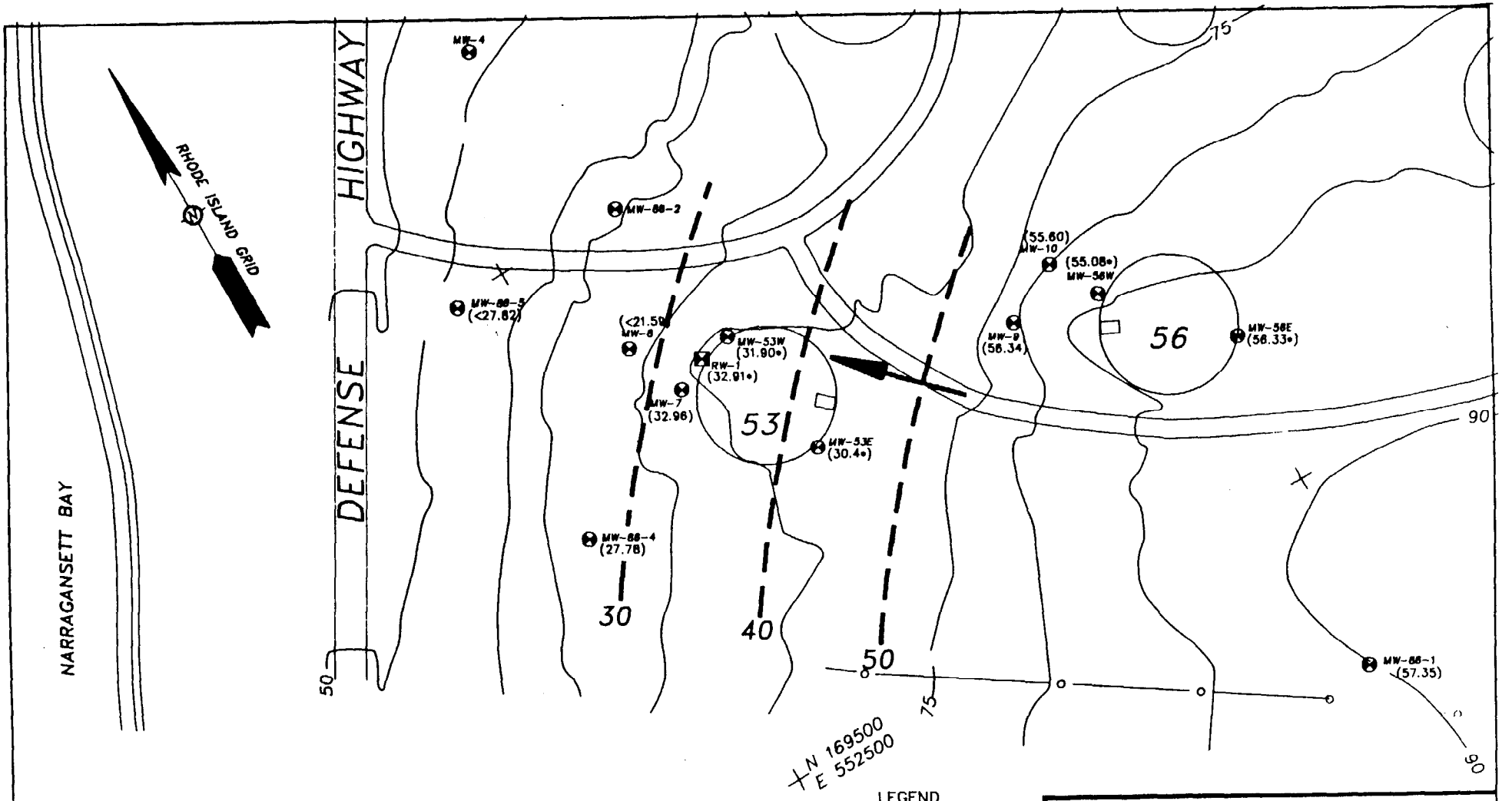
FIGURE 7.

GROUND WATER LEVEL ELEVATION CONTOUR MAP – JULY 17, 1990



LEGEND

MW-88-4 (27.78) MONITOR WELL LOCATION AND WATER LEVEL ELEVATION ON 7/17/90 IN FEET ABOVE MEAN LOW WATER (• DENOTES WATER LEVEL NOT UTILIZED IN CONTOURING)

30 GENERALIZED GROUND WATER ELEVATION CONTOUR IN FEET ABOVE MEAN LOW WATER

GENERALIZED DIRECTION OF GROUND WATER GRADIENT

100 0 100 200 300 400 FEET

50 0 50 100 METERS

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FIGURE 8.

GROUND WATER LEVEL ELEVATION CONTOUR MAP – OCTOBER 25, 1990