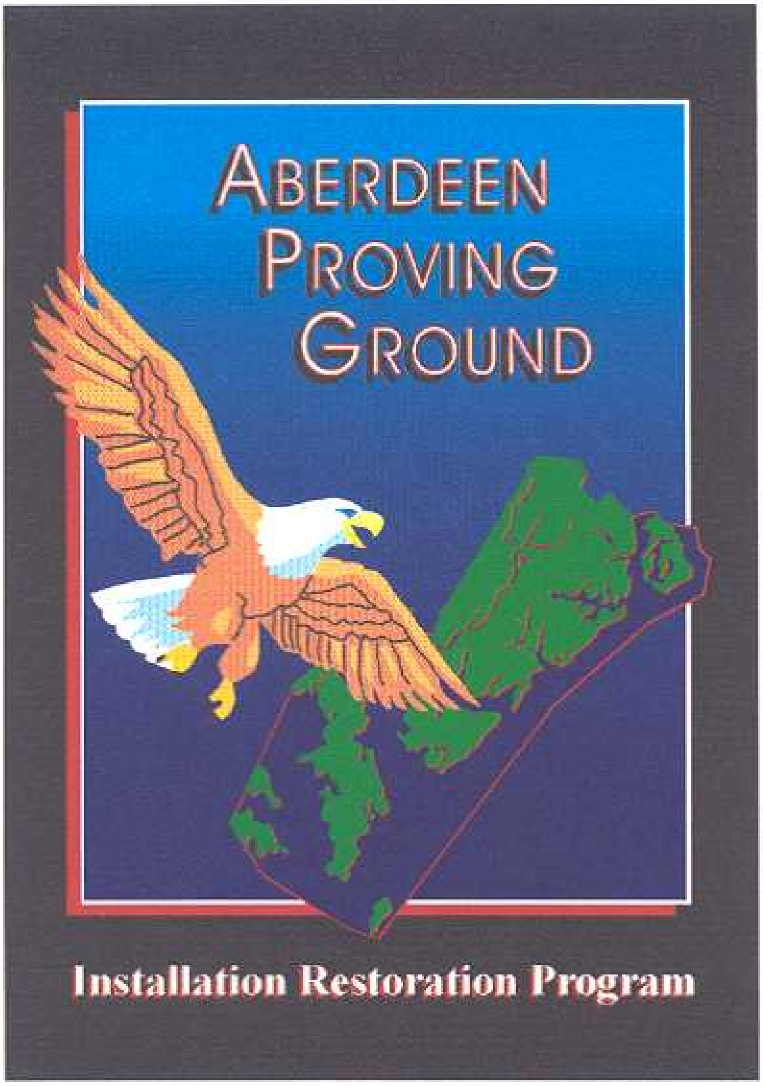

QUALITY ASSURANCE WORK PLAN FOR THE J-FIELD PHYTOREMEDIATION STUDY AND THE POOLES ISLAND GEOPHYSICAL AND ECOLOGICAL ASSESSMENTS

ABERDEEN PROVING GROUND, MARYLAND

FEBRUARY 1996

Final 2nd version

QUALITY ASSURANCE WORK PLAN
J-FIELD PHYTOREMEDIATION STUDY
POOLES ISLAND GEOPHYSICAL AND ECOLOGICAL ASSESSMENT
ABERDEEN PROVING GROUND, MARYLAND

Prepared by
Roy F. Weston, Inc.(WESTON)

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OPSEC # 1464-A-3

1.0 OBJECTIVE

The Response Engineering and Analytical Contract (REAC) under the U.S. Environmental Protection Agency's Environmental Response Team (U.S. EPA/ERT) will provide technical support for the remediation of soil and groundwater contamination at the J-Field Toxic Pits site and in performing an ecological and geophysical assessment at Pooles Island located off the tip of Robins Point, Aberdeen Proving Ground (APG), Maryland.

The objectives of this project are:

(1) to perform a pilot-scale phytoremediation study which utilizes trees (TreeMediation ®) to

- test this new and innovative technology.
- remediate groundwater at the J-Field Toxic Pits site.

(2) to perform an ecological assessment of Pooles Island to

- determine if any chemical contaminants are present on the island.
- determine if these chemicals are having any adverse affects on the wildlife of the island.

and (3) to perform a geophysical assessment of Pooles Island to

- determine the location of any subsurface anomalies.
- determine if any burried chemicals or dumps are present on the island.

2.0 PROJECT SCOPE

J-Field is located at the tip of Gunpowder Neck, Edgewood Area of APG in Harford County, Maryland. The Toxic Pits area of J-Field was once the disposal site for chemical warfare agents, munitions, and industrial chemicals. The Toxic Pits area consists of two parallel disposal pits that are approximately 10-feet-deep by 15-feet-wide by 200 feet long (Figure 1). Remnants of other pits extend into the marsh area to the southeast. The pits were used for open-pit burning and detonation from 1940 through 1980.

During open burning, wood was first placed in the pit and the agents, munitions, and chemicals were placed on top. The pit was then flooded with fuel oil and ignited. After the first burn, a reburn of the material was performed in the adjacent pit. Any remaining debris was pushed into the marsh. The pits and surrounding land have been disturbed by the activities that took place on J-Field. The area to the northeast of the pits appears to be the main pushout area for the pits.

The types of materials handled at these pits included:

High explosives
Nerve agents
Mustard agents
Smoke materials
Solvents

The contaminants of concern are:

1,1,2,2-tetrachloroethane (PCA)
1,1,2-trichloroethane (TCA)
trans-1,2-dichloroethene (DCE)
trichloroethene (TCE)
tetrachloroethene (PCE)
lead (Pb)

The volume of contaminated groundwater and soil to be addressed are unknown at this time. The ecosystem of concern is the Chesapeake Bay and surrounding waterways. Additional information/data may be found in: *Hydrology and Soil Gas at J-Field, Aberdeen Proving Ground, Maryland, U.S. Geological Survey, Water-Resources Investigations Report 92-4087, 1993.*

Pooles Island is located off the point of Gunpowder Neck in the Chesapeake Bay. This island was utilized as a line of sight for lines-of-fire that were either over or to the left or right of the island ana as an impact area during the 1950s and later for amphibious fording operations, and as an observation point for water impacts.

A firing records search has revealed limited information regarding test activities at the island. In 1923, colored smoke and flare signals were dropped over Pooles Island. In 1955, trinitrotoluene (TNT) and inert loaded 280 millimeter (mm) shells were fired at the island. It is also suspected that Agent Orange may have been sprayed on the island from a boat during the Vietnam War. Also, hellicopters had fired 2.75 inch rockets at the beach near the lighthouse. The last firing conducted below Pooles Island was in November 1985. Due to the close proximity of Pooles Island to other targets, other UXOs may exist.

The northwest tip of the island houses the lighthouse. The island is approximately 1.5 miles by 0.5 miles in size and encompasses approximately 275 acres. The last firing conducted below Pooles Island was in November 1985. There are several pools/ponds of water located on the island. The island is currently heavily overgrown.

2.1 J-Field Phytoremediation

Phytoremediation is being studied as an interim measure to prevent the migration of contaminants into the marsh area located to the east of the toxic pits. The feasibility and implementability of this type of process will be studied and evaluated for future full-scale use in remediating the site. Contaminant migration will be reduced either by depletion of the concentration of contaminants in the groundwater by means of transpiration and microbial degradation, by intercepting the flow of groundwater by means of water uptake, or by reduction the concentration of contaminants in the soil by means of microbial degradation and natural soil flushing.

<u>REAC</u>

REAC will provide the following services which are required for the successful completion of the study:

- technical oversight of the pilot study
- review of pertinent data to determine if additional piezometers are necessary
- a Health & Safety Plan (HASP) for the pilot study

- sampling and analysis to determine the effect of the study on the groundwater
- unexploded ordinance (UXO) sweeps
- protective gear
- sampling equipment
- sample containers
- sampling personnel
- field analysis
- analysis
- subcontract analysis
- sample collection
- sample disposal
- treatment system oversight

Applied Natural Sciences, Inc. (ANS)

ANS will provide the following services which are required for the successful completion of the study:

- an evaluation of pertinent data (well logs, contaminant plume maps, etc.)
- TreeMediation study design
- an evaluation report 15 business days following the planting of trees
- tree installation services
- health & safety equipment/personnel protective equipment

2.2 Pooles Island Ecological Assessment

The ecological assessment of Pooles Island will be implemented in several distinct operations, each designed to address an individual area of concern based on the information currently available about the past uses of the island.

2.2.1 Habitat utilization by waterfowl.

A survey will be conducted to evaluate the utilization of pond and wetland habitat by waterfowl. The main focus will be to determine the species, numbers, and percentage of use (e.g. migratory or year round) of the ponds by waterfowl.

2.2.2 Chemical analysis of water column and sediments from ponds.

Chemical analysis of pond sediments and water will be used to evaluate potential for exposure to site contaminants. If elevated levels of munitions related contaminants (e.g. TNT) are found, the ponds will be sampled for toxicity testing.

2.2.3 Impact craters.

A map will be created showing the size, shape, and location of impact craters on the island. Depressions formed by other causes may be distinguished by their shape or size. A subset of the total number of craters will be selected for sampling. If standing water is present, ten craters will be selected as a subset of the total number of craters, their general water quality parameters will be determined, and the surface water and sediments will be sampled for chemical analysis. If elevated levels of munitions related contaminants are found, the craters will be sampled for toxicity testing.

2.2.4 Agent Orange and related compounds.

A literature search will be conducted to determine past testing methods for Agent Orange and related compounds to develop a sampling strategy to test for residual contamination. Overflight photos (both visual and IR wavelength) will be taken during late spring and late fall, and compared with historical overflight photos (if available) to determine potential irregularities in plant distribution.

2.2.5 Battery disposal areas.

Areas which may have been used for disposal of batteries from navigational aids will be examined for evidence of metals contamination. Where evidence of battery disposal is present soil and sediment samples will be screened for metals by Field Portable X-ray Fluorometry (FPXRF) with laboratory confirmation of at least 10% of the screened samples.

2.3 Pooles Island Geophysical Investigation

An integrated geophysical investigation will be conducted at Pooles Island to detect subsurface anomalies (e.g. disposal sites), and to delineate the spatial extent of these anomalies. This investigation will require a two-phased approach. Phase I will involve a literature search, a review of historic aerial photographs and infrared images, a site walkover, a surficial UXO sweep, brush clearing, and geophysical grid establishment. During this phase, an explosive ordnance disposal (EOD) expert from APG will be present to identify any exposed UXO prior to the establishment of the geophysical survey grid. All necessary brush clearing will be completed following the UXO sweep to ensure that data acquisition can be finished without obstruction. The geophysical grid will be located using a global positioning system (GPS) or radio positioning system due to the remote site location and difficulty using conventional optical survey techniques. The location of the geophysical measurements will be in accordance with WGS84 geodetic datum and the universal transverse mercator (U.T.M.) zone 18 coordinate system.

Phase II will involve the collection of geophysical data on the survey grid, and the reduction, processing, analyses, and interpretation of the results. Electromagnetic conductivity (EM), magnetic, fathometer, and marine magnetic methods will be used to meet the objectives of this project. The EM technique is sensitive to the presence of buried trenches, waste disposal areas, and buried metallic objects. The magnetic methods detect anomalous perturbations in earth's magnetic field that are due to the presence of ferrous metals in the vicinity of the measuring station. The fathometer data will be collected in the ponds to determine the depth and configuration of the bottom prior to a marine magnetometer survey. Geophysical data will be acquired over Pooles Island and within the ponds.

3.0 TECHNICAL APPROACH

3.1 J-Field Phytoremediation Pilot Study

The following approach will be adhered to during the pilot-scale study:

- Determine the specific area to be planted.
- Obtain approvals to plant the trees.
- Subcontract Applied Natural Sciences, Inc. (ANS) to provide the TreeMediation design.

- Determine the number of trees to be planted.
- Determine ways to monitor the effectiveness trees have on the groundwater flow and contaminant concentrations.
- Obtain an approved HASP.
- Subcontract an Explosive Ordnance Disposal (EOD) vendor to clear planting areas.
- Plant trees.
- Collect soil samples for chemical analysis.
- Install additional piezometers, if necessary, for the monitoring of the system.

Any soil sampling or boring will require a mag sweep for UXO avoidance. An EOD contractor to REAC will provide this service. This will ensure that no unexploded ordinance or munitions are present where sampling and/or boring is being performed. Soil samples may be collected from the boreholes during the installation of the trees for chemical analysis. Any samples to be taken off base will be cleared of chemical agents through the CTF lab and Scitech Services of APG.

A report on the installation of the pilot-scale system will be written which will include baseline data from any relevant wells, piezometers, and soil samples that were recorded previously. This data will allow the comparison of any new data collected after the trees are installed.

ANS has performed an Agronomic Assessment of the J-Field site under work assignment No. 0-007. This assessment has determined that there is no indication of any chemical and physical contaminants and problems that would prohibit the implementation of a TreeMediation study. The timing of the planting of the trees is subject to the ability of the nursery to provide the trees and the frost-line at the site. ANS will design the TreeMediation program to be utilized at the site. Overall oversight will be provided by REAC personnel.

3.1.1 Treatability Study Design

Based on data and recommendations supplied in the *Ground-Water Flow and the Possible Effects of Remedial Actions at the J-Field, Aberdeen Proving Ground, Maryland, Hughes, B. W., U.S. Geological Survey, Water-Resources Investigations Report 95-4075, 1995.*, the TreeMediation system will be designed to both intercept and capture the groundwater. Unlike a barrier which restricts groundwater flow, the TreeMediation system would slow down the discharge of groundwater into the wetlands areas. Like a pump and treat system, the trees will extract and treat the volatile organics and bind metals through various mechanisms. The effect of the TreeMediation system on the groundwater would be seasonal and is not meant as a permanent solution but rather as a measure to slow down the rate of transport of contaminants into the marsh areas.

ANS will design the TreeMediation study to be utilized at J-Field upon the approval of this work plan. Approximately 150 to 200 trees per acre will be planted in the area to the east and south of the toxic pits. All measures will be taken to avoid areas of extremely high contamination, e.g. inside the toxic pits.

3.1.2 Installation

Installation will be performed in the areas to the south and east of the toxic pits (Figure 1). The area to be planted is approximately 1 acre in size. The design will be based on interception of groundwater flow and contamination (Figure 2). Areas of extreme contamination, roads, wells, and other features will be avoided. Installation will be performed by ANS personnel. An auger will be utilized to bore holes to a maximum depth of 8 feet below ground surface (bgs). The diameter of the hole will be approximately 12 inches. All bore holes will be cleared by EOD personnel subcontracted to REAC. A hybrid poplar tree (HP 510) will be utilized for the study. This poplar was bred regionally for use in strip mine reclamation, primarily in Pennsylvania. Soil excavated from the hole along with other additives will be utilized to backfill the same hole. All efforts will be made to limit the amount of excess soil. Excess soil can be drummed or placed in a roll-off container for disposal. A composite soil sample will be collected for chemical analysis.

WESTON home office personnel will provide video documentation and photo documentation of the tree installation for future reference. This video footage will be edited and graphics will be added so that a tape displaying this new and innovative remediation technology can be produced.

3.1.3 Maintenance

After the initial planting, any trees which have died during the first season will be removed and replanted with new trees. It is estimated that 5 to 10 percent of all trees will require replanting. Replanting of the trees should be easier than initial planting.

Once established, the trees should not require any maintenance. Poplar trees are able to tolerate saturated conditions for long periods, it is estimated that this period may be as long as 3 months.

3.1.4 Monitoring

Monitoring will include obtaining quarterly groundwater contaminant concentration and water table level data from other agencies working at the site. If additional piezometers are installed along with the trees, REAC will be responsible for the monitoring of this data. Monthly and possibly weekly water elevations will be collected to determine groundwater levels throughout the year. Daily readings can be made with dedicated transducers in each well. This data will be compared to weather parameters to determine the effect on fluctuations in the groundwater. Growth rates of the trees will be monitored along with plant stress. This data will be compared to groundwater contaminant modeling data to determine the impact of more highly contaminated groundwater on the trees.

Methods will be developed to determine the mechanism(s) behind the remediation of the groundwater. These methods will include harvesting parts of the trees (leaves, woody stems, and/or roots) and performing chemical analysis. Samples will be collected during the growth and dormant periods for comparison.

3.1.5 Evaluation

Evaluation of the pilot-scale study will be performed by REAC personnel and/or ANS personnel. Monitoring well data, piezometer data, soil data, tree data, and any other relevant data will be utilized to determine if the TreeMediation program retards and/or remediates the groundwater at the site. This evaluation will include the suspected mechanisms behind the remediation of the groundwater.

3.2 Pooles Island Ecological Assessment

3.2.1 Habitat Utilization by Waterfowl

Previous surveys have been conducted by biologists from Aberdeen and U.S. Fish and Wildlife Service. Additional survey information will be gathered, using the same survey methods as previous surveys, by REAC personnel in conjunction with other site activities. Dominant species, sex (if possible), habitat usage (feeding, nesting), and general health factors will be recorded. Dead or distressed birds will be collected as needed for possible chemical analysis of tissues.

3.2.2 Chemical Analysis of Water Column and Sediments from Ponds

Thick vegetation reportedly restricts access to the ponds, therefore a path will be cleared to launch a johnboat onto the pond to conduct sampling activities. Water samples will be collected at four locations as close to the sediment-water interface as practical without inducing sediment suspension. Water samples will be preserved and shipped to a laboratory for nitroaromatics/nitramines, TAL metals, and total dissolved solids analysis.

The water column will be tested at half-meter depth intervals for temperature, pH, dissolved oxygen, conductivity, oxidation-reduction potential, and salinity using a Hydrolab Surveyor II™. Time and tide data will be recorded along with the water quality measurements due to the proximity of tidal water bodies.

Pond sediments will be collected at four locations using a stainless-steel petite Ponar dredge and placed into a 5-gallon plastic bucket. Prior to sampling, all intrusive sampling locations will be swept for avoidance of UXO. After a sufficient quantity for the required analyses is collected, the sample will be homogenized and divided into appropriate sample containers for preservation and shipping to the sub-contract laboratory. The sample locations will be recorded using a Differential Global Positioning System (DGPS) receiver. Sediment samples will be analyzed for nitroaromatics/nitramines, TAL metals, total organic carbon, grain size, and macro nutrients.

If elevated levels of munitions related contaminants are found, additional samples will be collected for toxicity testing. An appropriate test organism will be selected based on water hardness and sediment grain size.

3.2.3 Impact Craters

A map will be created showing the size, shape, and location of impact craters on the island. The locations will be determined by DGPS and the shape and size will be recorded. Provided that a sufficient number of craters meet the sampling criteria (i.e. sufficient depth of standing water to sample without inducing sediment suspension), ten craters will be tested for general water quality parameters using a Hydrolab Surveyor II ™, and samples will be collected for laboratory analysis. Surface water and sediment sampling will follow the same procedures used in the ponds. Prior to sampling, all intrusive sampling locations will be swept for avoidance of UXO. Impact crater sediment and water samples will be analyzed for the same analytes as samples collected from the ponds.

If elevated levels of munitions related contaminants are found, additional samples will be collected for toxicity testing. An appropriate test organism will be selected based on water hardness and sediment grain size.

3.2.4 Agent Orange and Related Compounds

A literature search will be conducted to determine possible past testing methods for Agent Orange and related compounds. Any available information from overflight photographs will be examined to attempt to locate possible test areas. If possible test areas are located, a series of eight surface soil samples will be collected from the test area using a stainless-steel trowel. Prior to sampling, all intrusive sampling locations will be swept for avoidance of UXO. The sample will be collected into a stainless-steel bucket until a sufficient quantity for the required test is obtained. After homogenization the sample will be placed into appropriate sample containers, preserved, and shipped to the sub-contracted laboratory for analysis. These samples will be analyzed for Agent Orange and related compounds listed in the Target Compound List for chlorinated acid herbicides and the Target Compound List for pesticides/PCBs.

3.2.5 Battery Disposal Areas

Based on historical information, discarded batteries may be present near navigational aids. Areas which may have been used for disposal of batteries will be examined for evidence of metals contamination or battery fragments. In areas where evidence is found, soil and sediment samples will be collected for screening analysis. Prior to sampling, all intrusive sampling locations will be swept for avoidance of UXO. After homogenization, a 10-gram aliquot will be placed in a labelled aluminum weigh dish dried at 100° C and screened by FPXRF using standard prepared sample cup methods following ERT/REAC SOP #1713 *Spectrace 9000 Field Portable X-Ray Flourescence Operating Procedure*. Samples will be analyzed for lead, antimony, cadmium, and mercury. At least 10% of screened samples will be analyzed using atomic absorption (AA) spectroscopy for confirmation of FPXRF results.

3.3 Pooles Island Geophysical Investigation

3.3.1 Literature Search, Aerial and Infrared Photograph Review

A literature search and aerial photograph review will be conducted to determine the history, nature, and practices involved at the site that are related to potential waste disposal locations. This information may be helpful in determining the location, size, makeup, and number of anomalies. The yearly construction activities may also be important in locating disposal locations existing and past disposal locations and anomalies. A potential source for subsurface anomalies is an impact crater, which may be observed on aerial or low-altitude color IR photos. All data that is pertinent to the location and detection of these anomalies will be correlated with the geophysical results to better define their spatial extent.

3.3.2 Site Walkover

A site walkover is tentatively scheduled for the week of 12 February 1996. This visit will provide first-hand knowledge of the site conditions, and potential sources of electrical interference such as, metal fencing, metal debris, discarded vehicles, buildings, tanks, pipelines, and other miscellaneous metal objects. This information will prevent the misinterpretation of potential anomalies. In addition, this data will be integrated into the geophysical survey design.

3.3.3 Anomaly Survey

This event involves the assessment of surface soils for the presence of subsurface anomalies. Due to the possibility of UXOs, all geophysical survey lines will be swept by experienced Aberdeen Test Center (ATC) personnel prior to brush clearing and geophysical grid establishment tasks. Magnetometer hits will be flagged and mapped. Brush, in areas of high vegetation, may be cleared to permit the unimpeded collection of geophysical data and to protect workers safety.

3.3.4 Geophysical Survey Grid

A geophysical survey grid will be established over Pooles Island. This grid will cover approximately 275 acres (1.5 miles long by 0.5 miles wide, 12,000,000 square feet). The anticipated line spacing is 25 feet and the station spacing will be 5 feet. Based upon this survey configuration, approximately 172,000 data points will be collected. It is important to note that depending on the size of the anomaly, a 25-foot line spacing will not enable full coverage of potential anomaly locations. Magnetic model studies have indicated that smaller metal objects (the size of 55mm UXOs) can be detected only if lines are separated by less than 10 feet. Based on information provided by the U.S. Army, that only 280mm shells were fired at the island. It is believed that a 25-foot spacing will be able to pick up this size shell. If a 10-foot line spacing were implemented, the number of station points would increase to approximately 430,000. Unfortunately, due to time and economic constraints, a 10-foot spacing would not be practical.

A GPS Pathfinder Pro XL differential global positioning system (DGPS) by Trimble, Inc. will be used to survey the line and station points for the survey. This system is accurate to less than 1.0 meter, and data can be recorded in a matter of seconds at each station. This portion of the investigation will follow the anomaly survey and brush clearing activities.

3.3.5 Terrain Conductivity Method

The terrain conductivity method is an electromagnetic surveying technique that measures the bulk electrical conductivity of the earth at established station points. Terrain conductivity is commonly used to detect lateral variations in subsurface characteristics. These variations can be due to conductive contaminant plumes in the groundwater, shallow, discontinuous clay and silt horizons, disturbed waste burial areas, or buried metal objects such as drums, tanks, or utility lines. At the Pooles Island site, terrain conductivity measurements will be used to detect buried objects.

An EM-31, manufactured by Geonics, Ltd. will be used to conduct the survey. The EM-31 is a portable, one-man system, that induces a sinusoidal, 9.8 KiloHertz (Khz)

EM signal into the ground. The transmitted signal induces eddy currents in the subsurface materials, which then generate a secondary magnetic field that is measured by the receiver coil. Two measurements are recorded at each station. (1) The quadrature response measured in milli-Siemens per meter (mS/m), that is out of phase with the transmitted signal, and (2) the in-phase signal measured in parts per thousand (ppt), which is in-phase with the transmitted signal. For the interpretation of high conductivity targets (steel drums or metallic containers), the in-phase component is the most discriminatory. Lower contrast targets such as clay layers, contaminant plumes, and waste disposal areas are better indicated in the quadrature data set. The detectability of a metal object with either mode may be dependant upon specific site characteristics.

Anomalies expected from a confined metal object, such as a burried drum, are U-shaped for a loop-loop vertical dipole electromagnetic system such as the Geonics EM-31. The distance between inflection points on the inside of this U-shape is equal to the coil separation of the instrument, and has little to do with the target geometry.

The EM data will not be processed (filtered or modeled, etc.) in the office. The direct readout measurements will be sufficient to meet the objectives of this investigation. The conductivity and in-phase data will be contoured to observe anomalous features in plan view, and the profiles from each line will be analyzed to determine the nature and configuration of the anomalies.

3.3.6 Magnetic Method (Land and Marine)

The magnetic method involves the measurement of the earth's magnetic field at discrete station points, and the processing and interpretation of the data. The object of a magnetic survey is to detect anomalous fluctuations in the magnetic field, due to magnetic or magnetically susceptible objects buried beneath the grid or on the bottom of a body of water. A buried ferrous object distorts the earth's magnetic field and results in a magnetic anomaly. Based upon the shape or pattern of the anomaly, the location of the buried object can be determined and marked for later excavation.

The magnetometer to be used at the Poole's Island site is the GSM-19BG Overhauser Memory Magnetometer/ Gradiometer, manufactured by GEM Systems, Inc. The instrument has a precision of 0.1 nanoteslas (nT) and a broad dynamic range. The total magnetic field and magnetic gradient will be measured at each station and stored into memory in the magnetometer.

The total magnetic field and magnetic gradient will be measured at each station point. The total field is more representative of deeper geologic features (except in the vicinity of ferrous metal objects) and the gradient measurement represents a shallower depth of investigation. In addition, the gradient measurement removes the effects of diurnal variations in the earth's magnetic field, and it is not necessary to apply these corrections to the data from repeated base station readings throughout the day. However, the total field data, must be corrected for diurnal variations.

The raw magnetic gradient and total field data will be contoured, and maps will be generated for each measurement. Because the value of each magnetic response near a metal object is at least two orders of magnitude greater than the observed diurnal responses, the total field data will not be corrected for these diurnal variations. In addition, the magnetic gradient data will be more sensitive to the presence of magnetic ferrous objects in the near subsurface, and will be weighted more heavily in the final interpretation.

3.3.7 Fathometer Survey

The fathometer survey will be conducted in the ponds to determine the depth and configuration of the bottom surface. This data will be used to assist the placement of the marine magnetometer along each survey line. The closer the magnetometer is located to the bottom, the better the ability to distinguish a potentially important anomaly.

A model 448 Single Frequency Depth Sounder from Innerspace Technology, Inc. will be used to collect the fathometer data. A 200 Kilohertz (Khz), 8 degree beam transducer will provide excellent shallow (1 foot to 600 feet) bottom information.

3.4 Boating operations

Pooles Island and many of the sampling locations are only accessible by boat. The main work vessel will be the U.S. EPA/ERT 26-foot Boston Whaler which is capable of carrying an operator and 6 person crew or an operator and 1,000 pounds of equipment. Since a considerable quantity of equipment will be transported to the site, the most convenient staging dock will be used provided it complies with the area restriction regulations.

3.5 Standard Operating Procedures

UXO avoidance will be performed according to procedures set forth in the Site Health and Safety Plan before any intrusive activities are performed at either J-Field or Pooles Island.

3.5.1 Sample Documentation

Sample documentation will be completed as per the following Standard Operating Procedures (SOPs):

- ERT/REAC SOP #2002, Sample Documentation
- ERT/REAC SOP #4005, Chain of Custody Procedures

3.5.2 Sample Packaging and Shipment

Sample packaging and shipment will be conducted in accordance with the following SOP:

- ERT/REAC SOP #2004, Sample Packaging and Shipment

3.5.3 Sampling Techniques

- ERT/REAC SOP #2007, Groundwater Well Sampling
- ERT/REAC SOP #2012, Soil Sampling
- ERT/REAC SOP #2001, General Field Sampling Guidelines
- ERT/REAC SOP #2003, Sample Storage, Preservation, and Handling
- ERT/REAC SOP #2013, Surface Water Sampling
- ERT/REAC SOP #2041, Operation of the Hydrolab Surveyor II Water Quality Management System

- ERT/REAC SOP #2016, Sediment Sampling
- ERT/REAC SOP #2043, Water Level Measurement

Other ERT/REAC SOPs will be followed where appropriate for the various phases of the project.

3.6 Equipment Decontamination

The following equipment decontamination procedure will be employed prior and subsequent to boring holes for tree planting:

- physical removal
- high pressure nonphosphate detergent wash
- potable water rinse

The following sample equipment decontamination procedure will be employed prior to collection environmental samples with nondedicated sampling equipment:

- physical removal
- nonphosphate detergent wash
- deionized water rinse
- 10% nitric acid wash
- deionized water rinse

- acetone wash
- deionized water rinse
- air dry

3.7 Waste/Sample Disposal

3.7.1 Investigation-Derived Waste (IDW) Disposal

RCRA hazardous IDW:

- Any waste generated from the analytical procedures will be disposed through the appropriate hazardous waste disposal contractors in accordance with applicable regulations.

Other IDW:

- Waste generated on site will remain on site and be disposed through the appropriate hazardous waste disposal contractors in accordance with applicable regulations.

3.7.2 Sample Residuals Disposal

All of the treated and untreated samples will be maintained for 60 days after the issuance of the final report. If no additional testing is requested at the end of the 60 days, arrangements will be made for disposal.

4.0 PROJECT MANAGEMENT AND REPORTING

The REAC Task Leader will maintain contact with the U.S. EPA/ERT Work Assignment Manager to provide information on the technical and financial progress of this project. This communication will commence with the issuance of the work assignment and project scoping meeting. Activities under this project will be reported in status or trip reports and other deliverables (e.g., analytical reports, final reports) identified in Section 8.0. Activities will also be summarized in appropriate format for inclusion in REAC Monthly and Annual Reports.

WESTON and C.C. Johnson & Malhotra, P.C. (CCJM) personnel performing work under this work assignment have received the REAC Conflict of Interest Plan and been informed of their obligation to report personal conflicts of interest. Each employee has agreed to this policy by signing a statement related to conflict of interest responsibilities. In addition, WESTON and CCJM will conduct searches of corporate conflict of interest data bases in reference to this work assignment. Any actual or potential conflict of interest associated with this work assignment will be brought to the attention of the Contract and Project Officers. Lastly, WESTON recognizes the continuing obligation to identify and report any actual or potential conflicts of interest arising at any time during performance of this work assignment.

5.0 PROJECT SCHEDULE

The assignment for this project was received on 01/26/96. The QAWP was initiated at that time, developed, completed, and submitted on 02/15/96. The overall project is expected to close out with the issuance of a final report on 05/30/96. Refer to Section 8.0 for additional deliverables and tasks.

6.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The REAC Task Leader/Quality Control (QC) Coordinator (Richard Tobia) is the primary REAC point of contact with the U.S. EPA Work Assignment Manager. The Task Leader is responsible for the development and completion of the QAWP, project team organization, and supervision of all project tasks, including reporting and deliverables. In addition, the QC Coordinator is responsible for ensuring field adherence to the QAWP and recording any deviations from the QAWP.

The following REAC personnel will participate in this project:

Personnel	Responsibility
Richard Tobia	Task Leader/Phytoremediation
Gary Newhart	Hydrogeologic modeling
Brian Holderness	Phytoremediation Technician
Larry Kaelin	Field Chemist
Mike Van Cleff	Phytoremediation Monitoring/ecological assessment
Mark Finley	Task Leader/Ecological Assessment
Peter Miller	Task Leader/Geophysicist
Sherry Butters	Geophysics Technician

The following WESTON personnel will participate in this project:

Noel Rogers	Geophysicist
Stewart Sandberg	Geophysicist
Steve Yurick	Video/Photo Documentation
Ron Addleburg	Video/Photo Documentation

The following laboratories are expected to provide sample analyses:

Lab Name	Location	Parameters
REAC	Edison, NJ	VOA, metals, pesticide/PCB
EEU	Edison, NJ	physical parameters, sample preparation
To be determined	To be determined	all others

The REAC QA Officer is Ed McGovern, the Health and Safety Officer is Tom Mignone, the Operations Section Leader is Edward Gilardi, and the Analytical Section Leader is Vinod Kansal. These individuals are responsible for auditing and guiding the project team, reviewing/auditing the deliverables and proposing corrective action, if necessary, for nonconformity to the QAWP or HASP.

While not specifically identified, activities such as video documentation, photo documentation, computer graphics and support, statistics, word processing, report preparation and purchasing support will be required in order to accomplish the objectives of this project.

7.0 MANPOWER AND COST PROJECTIONS

7.1 Cost Summary

The estimated costs (including labor, travel, materials and equipment, subcontractor, and analytical services) to complete this project are depicted in the attached cost summary sheet.

7.2 Travel Summary

It is anticipated that the following trips will be made in support of the phytoremediation studies:

		Planning	Planting	Monitoring
-	Number of Trips, APG, Maryland	2	1	2
-	Number of Days/Trip	1	10	2
-	Number of Personnel	2	3	2
-	Per Diem ($116/day)	$464	$3480	$928
-	Other Relevant Costs (tolls, car rental, gas)	$400	$1000	$400

It is anticipated that the following trips will be made in support of the ecological assessment phase of this project:

		Site Visit	Trip 1	Trip 2
-	Number of Trips, APG, Maryland	1	1	1
-	Number of Days/Trip	2	5	4
-	Number of Personnel	2	4	4
-	Per Diem	$464	$2320	$1856
-	Other Relevant Costs (tolls, car/truck rental, gas)	$200	$1400	$1400

It is anticipated that the following trips will be made in support of the geophysical assessment phase of this project:

		Site Visit	Phase 1	Phase 2
-	Number of Trips, APG, Maryland	1	1	1
-	Number of Days/Trip	2	5	5
-	Number of Personnel	2	4	4
-	Per Diem	$1392	$2320	$2320
-	Other Relevant Costs (tolls, car/truck rental, gas)	$500	$3500	$3500

8.0 DELIVERABLES AND TASKS

The following deliverables will be provided under this project:

	Item	Date
X	QAWP	02/14/96
X	TreeMediation Design Report	02/27/96
X	Trip Report (Phase I activities)	03/29/96
X	Trip Report (Phase II activities)	04/30/96
X	Geophysical Status Report	05/30/96
X	Phytoremediation Installation Report	05/30/96
X	Ecological Status Report	05/30/96

The following tasks will be performed for this project:

	ITEM	DATE
X	Pooles Island Walkover	02/14/96
X	Phytoremediation Planting	03/04 - 03/15/96
X	Geophysical Investigation Field Work (Phase I)	03/18 - 03/22/96
X	Ecological Investigation Field Work (Trip I)	03/18 - 03/22/96
X	Geophysical Investigation Field Work (Phase II)	04/15 - 04/19/96
X	Ecological Investigation Field Work (Trip II)	04/15 - 04/19/96

All project deliverable and task dates are estimates based on the information available at the time of QAWP completion. New information, additional tasks, changes in scope, and events outside the control of REAC may result in revisions to these dates.

9.0 QUALITY ASSURANCE

The following QA objectives and protocols apply, as per Tables 9.1 and 9.2:

The following QA Protocols for QA1 data are applicable to all sample matrices and include:

1. Sample documentation in the form of field logbooks, the appropriate field data sheets, and chain of custody forms will be provided.
2. All instrument calibration and/or performance check procedures/methods will be summarized and documented in the field/personal or instrument log notebook.
3. Detection limit(s) will be determined and recorded, along with the data, where appropriate.

The following QA Protocols for QA2 data are applicable to all sample matrices and include:

1. Sample documentation in the form of field logbooks, the appropriate field data sheets, and chain of custody forms will be provided. Chain of custody sheets are optional for field screening locations.
2. All instrument calibration and/or performance check procedures/methods will be summarized and documented in the field/personal or instrument log notebook.
3. Detection limit(s) will be determined and recorded, along with the data, where appropriate.
4. Sample holding times will be documented; this includes documentation of sample collection and analysis dates.
5. Initial and continuing instrument calibration data, will be provided.
6. For **soil, sediment and water samples**, rinsate blanks, field blanks, and trip blanks will be included at the rate specified in Table 9.1, footnotes 2 and 3, respectively.
7. **Definitive Identification** - the identification on 10% of the screened (field or lab) or 100% of the unscreened samples will be confirmed via an EPA-approved method; documentation such as chromatograms, mass spectra, etc will be provided.
8. **Quantitation** - documentation for quantitative results from screening and an EPA-approved verification methods (for screened samples) or just quantitative results (in the case of unscreened samples) will be provided.

Numbers of samples to be collected for this project/event are entered onto Table 9.1, Field Sampling Summary, and Table 9.2, QA/QC Analysis and Objectives Summary, to facilitate ready identification of analytical parameters desired, type, volume and number of containers needed, preservation requirements, number of samples required and associated number, and type of QA/QC samples required based on the QA level.

All project deliverables will receive an internal peer review prior to release, per guidelines established in the REAC Administrative Procedures.

Table 9.1. J-Field Phytoremediation Study Sampling Summary - Soil/Water

							QC Extra's				
Analytical Parameter	Action Level[1]	Matrix *	Container Type and Volume (# Containers rq'd)	Preservative	Holding Times	Subtotal Samples	Rinsate Blanks[2]	Field/ Trip Blanks[3]	PE Samples[4]	Total Matrix Spikes[5]	**Total Field Samples[6]**
VOA	10 ppb	S	40 ml vial (2)	4°C	7 day	20	NA	2/2	NA	2	24
VOA	10 ppb	W	40 ml vial (3)	4°C**	7 day	5	NA	1/1	NA	1	7
TAL Metals	1 ppm	S	8 oz glass (1)	4°C	6 mon	20	2	NA/NA	NA	2	22
TAL Metals	1 ppm	W	1 liter glass or polyethylene (1)	HNO_3 to pH<2 4°C	6 mon	5	1	1/1	NA	1	8
Grain Size	NA	S	4 oz glass	None	None	5	NA	NA	NA	NA	5
Moisture	NA	S	4 oz glass	None	None	5	NA	NA	NA	NA	5

* Matrix: S-Soil, W-Water, O-Oil, DS-Drum Solid, DL-Drum Liquid, SD-Sediment, PW-Potable Water, GW-Groundwater, SW-Surface Water, SL-Sludge, X-Other

** If residual chlorine is present, preserve with 0.008% $Na_2S_2O_3$.

1. The concentration level, specific or generic, that is needed in order to make an evaluation. This level will provide a basis for determining the analytical method to be used.
2. If dedicated sampling tools are not used, rinsate blanks are required for the aqueous matrix. They are optional for the soil matrix. For QA2 and QA3, a minimum of one blank required per type of sampling device per day. For QA1, enter "N/A".
3. Field blanks are required for aqueous and non-aqueous matrices. Aqueous field blanks are prepared with distilled/deionized water and non-aqueous field blanks are prepared with clean sand or soil. For QA2 and QA3, one blank required per day. For QA1, enter "N/A". For QA2 and QA3, one trip blank required per cooler used to transport VOA samples. For QA1, enter "N/A". Each aqueous trip blank consists of two 40ml vials filled with distilled/deionized water. Each non-aqueous trip blank consists of two 40 ml vials filled with clean sand or soil.
4. Performance evaluation samples are optional for QA2 and mandatory for QA3 at one per parameter per matrix. For QA1, enter "N/A".
5. Ensure that sufficient volume of environmental sample is collected for lab spiking. All analyses conducted at the REAC laboratories require matrix spike samples at a frequency of ≥10% total samples, regardless of QA Objective. In addition, for QA2 (optional) and for QA3 (mandatory): Determine bias (% recovery) using a minimum of 2 matrix spikes. Determine precision using a minimum of 8 matrix spikes.
6. Add the numbers of rinsate blanks, field blanks, trip blanks, and PE samples to the subtotal number of samples to determine this.

Table 9.2. QA/QC Analysis and Objectives Summary · Soil/Water

			Matrix Spikes		QA/QC	
Analytical Parameter	Matrix *	Analytical Method Ref.	Lab[1]	Additional[2]	Detection Limits[3]	QA Objective[4]
VOA	S	8240/SW-846	2	NA	5 ppb	QA2
VOA	W	P200 screening	1	NA	5 ppb	QA2
TAL Metals	S	SW-846	2	NA	0.5 ppm	QA2
TAL Metals	W	EPA-600/CFR 40	1	NA	0.5 ppm	QA2
Grain Size	S	ASTM D422	0	NA	NA	QA1
Moisture	S	EPA 160.3	0	NA	0.5%	QA1

* Matrix: S-Soil, W-Water, O-Oil, DS-Drum Solid, DL-Drum Liquid, SD-Sediment, PW-Potable Water, GW-Groundwater, SW-Surface Water, SL-Sludge, X-Other

1. Ensure that sufficient volume of environmental sample is collected for lab spiking. All analyses conducted at the REAC laboratories require matrix spike samples at a frequency of $\geq$10% total samples, regardless of QA Objective.
2. For QA2 (optional) and for QA3 (mandatory): Determine bias (% recovery) using a minimum of 2 matrix spikes. Determine precision using a minimum of 8 matrix spikes. Laboratory matrix spikes may be utilized to fulfill these additional QA requirements.
3. To be determined by the person arranging the analysis. Should be equal to or less than the action level.
4. Enter QA Objective desired: QA1, QA2, or QA3.

TABLE 9.1 Pooles Island Field Sampling Summary - Tissue

							QC Extra's				
Analytical Parameter	Action Level[1]	Matrix *	Container Type and Volume (# Containers rq'd)	Preservative	Holding Times	Subtotal Samples	Rinsate Blanks[2]	Field/ Trip Blanks[3]	PE Samples[4]	Total Matrix Spikes[5]	Total Field Samples[6]
Chlorinated Herbicides	To be determined	X	8 oz glass (1)	4°C	7/40d	8	0	0/NA	0	1	8
PEST/PCB	To be determined	X	8 oz glass (1)	4°C	7/40d	8	0	0/NA	0	1	8
Nitroaromatics /Nitramines	To be determined	X	8 oz glass (1)	4°C	7/40d	8	0	0/NA	0	1	8
Lipids	To be determined	X	4 oz glass (1)	4°C	7/40d	8	0	0/NA	0	0	8
Percent Moisture	To be determined	X	8 oz glass (1)	4°C	7/40d	8	0	0/NA	0	0	8
Histopathology	To be determined	X	4 oz glass (2)	4°C 10% buffered formalin	7/40d	8	0	0/NA	0	0	8

* Matrix: S-Soil, W-Water, SD-Sediment, X-Tissue , SW-Surface Water

1. The concentration level, specific or generic, that is needed in order to make an evaluation. This level will provide a basis for determining the analytical method to be used.
2. If dedicated sampling tools are not used, rinsate blanks are required for the aqueous matrix. They are optional for the soil matrix. For QA2 and QA3, a minimum of one blank required per type of sampling device per day. For QA1, enter "N/A".
3. Field blanks are required for aqueous and non-aqueous matrices. Aqueous field blanks are prepared with distilled/deionized water and non-aqueous field blanks are prepared with clean sand or soil. For QA2 and QA3, one blank required per day. For QA1, enter "N/A". For QA2 and QA3, one trip blank required per cooler used to transport VOA samples. For QA1, enter "N/A". Each aqueous trip blank consists of two 40ml vials filled with distilled/deionized water. Each non-aqueous trip blank consists of two 40 ml vials filled with clean sand or soil.
4. Performance evaluation samples are optional for QA2 and mandatory for QA3 at one per parameter per matrix. For QA1, enter "N/A".
5. Ensure that sufficient volume of environmental sample is collected for lab spiking. All analyses conducted at the REAC laboratories require matrix spike samples at a frequency of ≥10% total samples, regardless of QA Objective. In addition, for QA2 (optional) and for QA3 (mandatory): Determine bias (% recovery) using a minimum of 2 matrix spikes. Determine precision using a minimum of 8 matrix spikes.
6. Add the numbers of rinsate blanks, field blanks, trip blanks, and PE samples to the subtotal number of samples to determine this.

TABLE 9.1 Pooles Island Fielo .pling Summary - Soil, Sediment, Water

							QC Extra's				
Analytical Parameter	Action Level[1]	Matrix *	Container Type and Volume (#Containers rq'd)	Preservative	Holding Times	Subtotal Samples	Rinsate Blanks[2]	Field/ Trip Blanks[3]	PE Samples[4]	Total Matrix Spikes[5]	Total Field Samples[6]
Nitroaromatics /Nitramines	To be determined	SD	32 oz glass (1)	4°C	7/40d	14	NA	5/NA	0	2	21
Nitroaromatics /Nitramines	To be determined	W	32 oz amber glass (2)	4°C	7/40d	14	2	5/NA	0	2	19
TAL METALS	To be determined	S	8 oz glass (1)	4°C	6 mon	4	NA	5/NA	0	1	9
TAL METALS	To be determined	SD	8 oz glass (1)	4°C	6 mon	14	NA	5/NA	0	2	19
TAL METALS	To be determined	W	1 liter glass or polyethylene (1)	HNO_3 to pH<2 4°C	6 mon	14	2	2/NA	0	2	18
Total Organic Carbon (Loss on Ignition)	To be determined	SD	4 oz glass (1)	4°C	28 days	14	NA	NA	0	0	14
Grain Size	To be determined	SD	32 oz glass (1)	N/A	28 days	14	NA	NA	0	NA	14
Total Dissolved Solids	To be determined	W	32 oz glass (1)	N/A	28 days	14	0	NA	0	0	14

* Matrix: S-Soil, W-Water, SD-Sediment, X-Tissue , SW-Surface Water

** If residual chlorine is present, preserve with 0.008% $Na_2S_2O_3$.

1. The concentration level, specific or generic, that is needed in order to make an evaluation. This level will provide a basis for determining the analytical method to be used.
2. If dedicated sampling tools are not used, rinsate blanks are required for the aqueous matrix. They are optional for the soil matrix. For QA2 and QA3, a minimum of one blank required per type of sampling device per day. For QA1, enter "N/A".
3. Field blanks are required for aqueous and non-aqueous matrices. Aqueous field blanks are prepared with distilled/deionized water and non-aqueous field blanks are prepared with clean sand or soil. For QA2 and QA3, one blank required per day. For QA1, enter "N/A". For QA2 and QA3, one trip blank required per cooler used to transport VOA samples. For QA1, enter "N/A". Each aqueous trip blank consists of two 40ml vials filled with distilled/deionized water. Each non-aqueous trip blank consists of two 40 ml vials filled with clean sand or soil.
4. Performance evaluation samples are optional for QA2 and mandatory for QA3 at one per parameter per matrix. For QA1, enter "N/A".
5. Ensure that sufficient volume of environmental sample is collected for lab spiking. All analyses conducted at the REAC laboratories require matrix spike samples at a frequency of $\geq$10% total samples, regardless of QA Objective. In addition, for QA2 (optional) and for QA3 (mandatory): Determine bias (% recovery) using a minimum of 2 matrix spikes. Determine precision using a minimum of 8 matrix spikes.
6. Add the numbers of rinsate blanks, field blanks, trip blanks, and PE samples to the subtotal number of samples to determine this.

TABLE 9.1 Pooles Island Field Sampling Summary - Soil, Sediment

							QC Extra's				
Analytical Parameter	Action Level[1]	Matrix *	Container Type and Volume (# Containers rq'd)	Preservative	Holding Times	Subtotal Samples	Rinsate Blanks[2]	Field/ Trip Blanks[3]	PE Samples[4]	Total Matrix Spikes[5]	Total Field Samples[6]
Chlorinated Herbicides	To be determined	S	8 oz glass (1)	4°C	7/40d	8	0	1/NA	0	1	9
PEST/PCB	To be determined	S	8 oz glass (1)	4°C	7/40d	8	0	1/NA	0	1	9
Macro Nutrients[7]	To be determined	SD	8 oz glass (1)	4°C	28 day	14	0	2/NA	0	2	16
Dioxin	To be determined	S	8 oz glass (1)	4°C	7/40d	8	0	1/NA	0	1	9

* Matrix: S-Soil, W-Water, SD-Sediment, X-Tissue , SW-Surface Water

** If residual chlorine is present, preserve with 0.008% $Na_2S_2O_3$.

1. The concentration level, specific or generic, that is needed in order to make an evaluation. This level will provide a basis for determining the analytical method to be used.
2. If dedicated sampling tools are not used, rinsate blanks are required for the aqueous matrix. They are optional for the soil matrix. For QA2 and QA3, a minimum of one blank required per type of sampling device per day. For QA1, enter "N/A".
3. Field blanks are required for aqueous and non-aqueous matrices. Aqueous field blanks are prepared with distilled/deionized water and non-aqueous field blanks are prepared with clean sand or soil. For QA2 and QA3, one blank required per day. For QA1, enter "N/A". For QA2 and QA3, one trip blank required per cooler used to transport VOA samples. For QA1, enter "N/A". Each aqueous trip blank consists of two 40ml vials filled with distilled/deionized water. Each non-aqueous trip blank consists of two 40 ml vials filled with clean sand or soil.
4. Performance evaluation samples are optional for QA2 and mandatory for QA3 at one per parameter per matrix. For QA1, enter "N/A".
5. Ensure that sufficient volume of environmental sample is collected for lab spiking. All analyses conducted at the REAC laboratories require matrix spike samples at a frequency of $\geq$10% total samples, regardless of QA Objective. In addition, for QA2 (optional) and for QA3 (mandatory): Determine bias (% recovery) using a minimum of 2 matrix spikes. Determine precision using a minimum of 8 matrix spikes.
6. Add the numbers of rinsate blanks, field blanks, trip blanks, and PE samples to the subtotal number of samples to determine this.
7. Analyses of macronutrients in soils include total organic nitrogen, ammonium, nitrate, phosphorus, potassium, calcium, magnesium, and sulphur.

TABLE 9.1 Pooles Island Field Sampling Summary - Sediment/Water

							QC Extras **			
Analytical Parameter	Action Level	Matrix *	Container Type and Volume (# Containers rq'd)	Preservative	Holding Times	Subtotal Samples	Controls (100% Diluent Water or Clean Sediment)	Reference Toxicants	Replicates	Total Samples
48-HOUR _Daphnia magna_ TOXICITY TEST	Mortality	W	1 liter polyethylene (1)	4°C	4 days	5	1	1	3	5
96-HOUR _Pimephales promelas_ TOXICITY TEST	Mortality	W	1 liter polyethylene (3)	4°C	4 days	5	1	1	3	5
10-DAY _Hyallela Azteca_ TOXICITY TEST	Mortality & Growth	SD	32 oz glass (1)	4°C	4 days	5	1	0	3	5

* Matrix: S-Soil, W-Water, O-Oil, DS-Drum Solid, DL-Drum Liquid, SD-Sediment, PW-Potable Water, GW-Groundwater, SW-Surface Water, SL-Sludge, X-Other
** 3 replicates per sample location and for each control

TABLE 9.2 QA/QC Analysis and Objectives Summary - Soil, Sediment, Water, and Tissue

			Matrix Spikes		QA/QC	
Analytical Parameter	Matrix *	Analytical Method Ref.	Lab[1]	Additional[2]	Detection Limits[3]	QA Objective[4]
CHLORINATED HERBICIDES	S	SW-8150/SW-8151	1	0	10 ppb	QA2
CHLORINATED HERBICIDES	X	SW-8150/SW-8151	1	0	10 ppb	QA2
PEST/PCB	S	8080/SW-846	1	0	10 ppb	QA2
PEST/PCB	X	8080/SW-846	1	0	10 ppb	QA2
DIOXIN	S	8280/8290	1	0	10 ppb	QA2
NITROAROMATICS & NITRAMINES	SD	8330	2	0	10 ppb	QA2
NITROAROMATICS & NITRAMINES	W	8330	2	0	10 ppb	QA2
NITROAROMATICS & NITRAMINES	X	8330	1	0	10 ppb	QA2
TAL METALS	S/SD	SW-846	3	0	10 ppb	QA2
TAL METALS	W	EPA-600/CFR 40	2	0	10 ppb	QA2
TOTAL ORGANIC CARBON	S/SD	AASHTO T267-86	0	0	1 ppm	QA2
GRAIN SIZE	S/SD	ASTM D422-63	NA	0	NA	QA1
TOTAL DISSOLVED SOLIDS	W	To be determined	0	0	100 ppm	QA2
PERCENT LIPIDS	X	To be determined	0	0	0.5%	QA2
PERCENT MOISTURE	X	EPA 160.3	0	0	0.5%	QA2

* Matrix: S-Soil, W-Water, O-Oil, DS-Drum Solid, DL-Drum Liquid, SD-Sediment, PW-Potable Water, GW-Groundwater, SW-Surface Water, SL-Sludge, X-Other

1. Ensure that sufficient volume of environmental sample is collected for lab spiking. All analyses conducted at the REAC laboratories require matrix spike samples at a frequency of ≥10% total samples, regardless of QA Objective.
2. For QA2 (optional) and for QA3 (mandatory): Determine bias (% recovery) using a minimum of 2 matrix spikes. Determine precision using a minimum of 8 matrix spikes. Laboratory matrix spikes may be utilized to fulfill these additional QA requirements.
3. To be determined by the person arranging the analysis. Should be equal to or less than the action level.
4. Enter QA Objective desired: QA1, QA2, or QA3.

TABLE 9.2 QA/QC Analysis and Objectives Summary - Soil Macro Nutrients

			Matrix Spikes		QA/QC	
Analytical Parameter	Matrix *	Analytical Method Ref.	Lab[1]	Additional[2]	Detection Limits[3]	QA Objective[4]
TOTAL ORGANIC NITROGEN	S	EPA 600/4, 351.2-4, potentiometric	2		30 µg TKN/l	QA2
AMMONIUM (NH_4^+)	S	KCL Extraction[5] Colorimetric	2		Not Specified	QA2
NITRATE (NO_3^-)	S	KCL Extraction[5] Colorimetric	2		Not Specified	QA2
AVAILABLE PHOSPHORUS	S	Ammonium Fluoride Colorimetric	2		1 µg/L	QA2
AVAILABLE POTASSIUM	S	Ammonium Acetate Extraction[5] or ICP/AA	2		Varies or 10 µg/L, respectively	QA2
AVAILABLE CALCIUM	S	Ammonium Acetate Extraction[5] or ICP/AA	2		10 µg/L	QA2
MAGNESIUM	S	DTPA Extraction[7] or ICP/AA	2		30 µg/L or 1µg/L, respectively	QA2
SULPHUR	S	ASTM D12964	2		Not Specified	QA2

* Matrix: S-Soil, W-Water, O-Oil, DS-Drum Solid, DL-Drum Liquid, SD-Sediment, PW-Potable Water, GW-Groundwater, SW-Surface Water, SL-Sludge, X-Other

1. Ensure that sufficient volume of environmental sample is collected for lab spiking. All analyses conducted at the REAC laboratories require matrix spike samples at a frequency of ≥10% total samples, regardless of QA Objective.
2. For QA2 (optional) and for QA3 (mandatory): Determine bias (% recovery) using a minimum of 2 matrix spikes. Determine precision using a minimum of 8 matrix spikes. Laboratory matrix spikes may be utilized to fulfill these additional QA requirements.
3. To be determined by the person arranging the analysis. Should be equal to or less than the action level.
4. Enter QA Objective desired: QA1, QA2, or QA3.

TARGET COMPOUND LIST (TCL) AND QUANTITATION LIMITS (QL)[1]

Pesticides/PCBs	CAS Number	Quantitation Limits[2] Water µg/L	Soil/Sediment[3] µg/kg
alpha-BHC	319-84-6	0.02	3.3
beta-BHC	319-85-7	0.02	3.3
delta-BHC	319-86-8	0.02	3.3
gamma-BHC (Lindane)	68-89-9	0.02	3.3
Heptaclor	46-44-8	0.02	3.3
Aldrin	309-00-2	0.02	3.3
Heptachlor epoxide	1024-57-3	0.02	3.3
Endosulfan I	659-98-8	0.02	3.3
Dieldrin	60-57-1	0.02	3.3
4,4'-DDE	72-55-9	0.02	3.3
Endrin	72-20-8	0.02	3.3
Endrin aldehyde	7421-93-4	0.02	3.3
Endosulfan II	33213-65-9	0.02	3.3
4,4'-DDD	72-54-8	0.02	3.3
Endosulfan sulfate	1031-07-8	0.02	3.3
4,4'-DDT	50-29-3	0.02	3.3
Methoxychlor	72-43-5	0.02	3.3
Endrin ketone	53494-70-5	0.02	3.3
alpha-Chlordane	5103-71-9	0.02	3.3
gamma-Chlordane	5103-74-2	0.02	3.3
Toxaphene	8001-35-2	0.50	83
Aroclor-1016	12674-11-2	0.25	42
Aroclor-1221	11104-28-2	0.50	83
Aroclor-1232	11141-16-5	0.25	42
Aroclor-1242	53469-29-6	0.25	42
Aroclor-1248	12672-29-6	0.25	42
Aroclor-1254	11097-69-1	0.25	42
Aroclor-1260	11096-82-5	0.25	42

(1) Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

(2) Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment on a dry weight basis will be higher.

(3) Medium Soil/Sediment QLs for Pesticides/PCB TCL compounds are 15 times the individual Low Soil/Sediment QL.

INORGANIC TARGET ANALYTE LIST (TAL)

Metals	Analyte	Range of Detection Limits Water µg/L	 Soil mg/kg
	Aluminum	100	20
	Antimony	10	6
	Arsenic	5	1
	Barium	5	5
	Beryllium	2	0.5
	Cadmium	5	1
	Calcium	500	50
	Chromium	5	1
	Cobalt	10	1.5
	Copper	10	1
	Iron	50	10
	Lead	5	5
	Magnesium	500	50
	Manganese	5	2
	Mercury	0.2	0.04
	Nickel	10	2
	Potassium	2000	200
	Selenium	5	1
	Silver	5	1
	Sodium	500	50
	Thallium	5	1
	Vanadium	10	2
	Zinc	5	2

TARGET COMPOUND LIST (TCL) AND QUANTITATION LIMITS (QL)[(1)]
SW 846 Method 8151

Chlorinated Acid Herbicides	CAS Number	Quantitation Limits[(2)] Water µg/L	Low Soil/Sediment[(3)] µg/kg
Acidfluorfen	50594-66-6	0.096	
Bentazon	25057-89-0	0.20	
Chloramben	133-90-4	0.093	4.0
2,4-D	94-75-7	0.20	0.11
Dalapon	75-99-0	1.3	0.12
2,4-DB	94-82-6	0.8	
DCPA Diacid(b)	2136-79-0	0.02	
Dicamba	1918-00-9	0.081	
3,5-Dichlorobenzoic Acid	51-36-5	0.061	0.38
Dichlorprop	120-36-5	0.26	
Dinoseb	88-85-7	0.19	
5-Hydroxydicamba	7600-50-2	0.04	
MPCA	94-74-6	0.056	43
MCPP	93-65-2	0.090	66
4-Nitrophenol	100-02-1	0.13	0.34
Pentachlorophenol	87-86-5	0.076	0.16
Picloram	1918-02-01	0.14	
2,4,5-TP	93-72-1	0.075	0.28
Silvex	93-72-1	0.075	
2,4,5-T	93-72-5	0.080	

(1) Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

(2) Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment on a dry weight basis will be higher.

(3) Medium Soil/Sediment QLs for Pesticides/PCB TCL compounds are 15 times the individual Low Soil/Sediment QL.

TARGET COMPOUND LIST (TCL) AND
QUANTITATION LIMITS (QL)[1]
SW 846 Method 8151

Nitroaromatics and Nitramines	CAS Number	Quantitation Limits[2] Water µg/L	Low Soil/Sediment[3] µg/kg
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	13.0	2.2
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	14.0	1.0
1,3,5-Trinitrobenzene (TNB)	99-35-4	7.3	0.25
1,3-Dinitrobenzene (DNB)	99-65-0	4.0	0.25
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	44.0	0.65
Nitrobenzene (NB)	98-95-3	NA	0.26
2,4,6-Trinitrotoluene (TNT)	118-96-7	6.9	0.25
2,4-Dinitrotoluene (24DNT)	121-14-2	5.7	0.25
2,6-Dinitrotoluene (26DNT)	606-20-2	9.4	0.26
o-Nitrotoluene (2NT)	88-72-2	12.0	0.25
m-Nitrotoluene (3NT)	99-08-1	7.9	0.25
p-Nitrotoluene (4NT)	99-99-0	8.5	0.25

(1) Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

(2) Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment on a dry weight basis will be higher.

(3) Medium Soil/Sediment QLs for Pesticides/PCB TCL compounds are 15 times the individual Low Soil/Sediment QL.

TARGET COMPOUND LIST (TCL) AND QUANTITATION LIMITS (QLs)[1]

Volatiles	CAS Number	Quantitation Limits[2] Water µg/L	Low Soil/Sediment[3] µg/kg
Chloromethane	74-87-3	10	10
Bromomethane	74-83-9	10	10
Vinyl Chloride	75-01-4	10	10
Chloroethane	75-00-3	10	10
Methylene Chloride	75-09-2	5	5
Acetone	67-64-1	10	10
Carbon Disulfide	75-15-0	5	5
1,1-Dichloroethane	75-35-4	5	5
1,1-Dichloroethene (DCE)	75-34-3	5	5
1,2-Dichloroethane	540-59-0	5	5
Chloroform	67-66-3	5	5
1,2-Dichloroethane	107-06-2	5	5
2-Butanone	78-93-3	10	10
1,1,1-Trichloroethane	71-55-6	5	5
Carbon Tetrachloride	56-23-5	5	5
Bromodichloromethane	75-27-4	5	5
cis-1,3-Dichloropropene	10061-01-5	5	5
Trichloroethene (TCE)	79-01-6	5	5
Dibromochloromethane	124-48-1	5	5
1,1,2-Trichloroethane	79-00-5	5	5
Benzene	71-43-2	5	5
trans-1,3-Dichloropropene	10061-02-6	5	5
Bromoform	75-25-2	5	5
4-Methyl-2-pentanone	108-10-1	10	10
2-Hexanone	591-78-6	10	10
Tetrachloroethene (PCE)	127-18-4	5	5
Toluene	108-88-3	5	5
1,1,2,2-Tetrachloroethane	79-34-5	5	5
Chlorobenzene	108-90-7	5	5
Ethyl Benzene	100-41-4	5	5
Styrene	100-42-5	5	5
Xylenes (total)	1330-20-7	5	5

TARGET COMPOUND LIST (TCL) AND QUANTITATION LIMITS (QLs)[(1)]

Volatiles (Cont'd)	CAS Number	Quantitation Limits[(2)] Water µg/L	Low Soil/Sediment[(3)] µg/kg
Dichlorofluoromethane	75-43-4	10	10
Trichlorofluoromethane	75-69-4	5	5
trans-1,2-Dichloroethene	156-60-5	5	5
2,2-Dichloropropane	594-20-7	5	5
cis-1,2-Dichloroethene	156-59-2	5	5
1,1-Dichloropropene	563-58-6	5	5
1,2-Dichloropropane	78-87-5	5	5
Dibromomethane	74-95-3	10	10
1,3-Dichloropropane	142-28-9	5	5
1,2-Dibromomethane	106-93-4	5	5
1,1,1,2-Tetrachloroethane	630-20-6	5	5
p-Xylene	106-42-3	5	5
m-Xylene	108-38-3	5	5
o-Xylene	95-47-6	5	5
Isopropylbenzene	98-82-8	5	5
1,2,3-Trichloropropane	96-18-4	5	5
Bromobenzene	108-86-1	5	5
n-Propylbenzene	103-65-1	5	5
2-Chlorotoluene	95-49-8	5	5
4-Chlorotoluene	106-43-4	5	5
1,3,5-Trimethylbenzene	25551-13-7	5	5
tert-Butylbenzene	98-06-6	5	5
1,2,4-Trimethylbenzene	25551-13-7	5	5
sec-Butylbenzene	135-98-8	5	5
1,3-Dichlorobenzene	541-73-1	5	5
p-Isopropyltoluene	99-87-6	5	5
1,4-Dichlorobenzene	106-46-7	5	5
1,2-Dichlorobenzene	95-50-1	5	5
n-Butylbenzene	104-51-8	5	5
1,2-Dibromo-3-Chloropropane	96-12-8	5	5
1,2,4-Trichlorobenzene	120-82-1	5	5
Naphthalene	91-20-3	5	5
Hexachlorobutadiene	87-68-3	10	10
1,2,3-Trichlorobenzene	12002-48-1	10	10

(1) Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

(2) Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, on a dry weight basis will be higher.

(3) Medium Soil/Sediment QLs for Volatile TCL Compounds are 125 times the individual Low Soil/Sediment QL.

TARGET COMPOUND LIST (TCL) AND QUANTITATION LIMITS (QL)(1)

Semivolatile	CAS Number	Quantitation Limits(2) Water µg/L	Low Soil/Sediment(3) µg/kg
Phenol	108-95-2	10	330
bis (2-Chloroethyl) ether	111-44-4	10	330
2-Chlorophenol	95-57-8	10	330
1,3-Dichlorobenzene	541-73-1	10	330
1,4-Dichlorobenzene	106-46-7	10	330
Benzyl alcohol	100-51-6	10	330
1,2-Dichlorobenzene	95-50-1	10	330
2-Methylphenol	95-48-7	10	330
bis (2-Chloroisopropyl) ether	108-60-1	10	330
4-Methylphenol	106-44-5	10	330
N-Nitroso-di-n-propylamine	621-64-7	10	330
Hexachloroethane	67-72-1	10	330
Nitrobenzene	98-95-3	10	330
Isophorone	78-59-1	10	330
2-Nitrophenol	88-75-5	10	330
2,4-Dimethylphenol	105-67-9	10	330
bis (2-Chloroethoxy) methane	111-91-1	10	330
2,4-Dichlorophenol	120-83-2	10	330
1,2,4-Trichlorobenzene	120-82-1	10	330
Naphthalene	91-20-3	10	330
4-Chloroaniline	106-47-8	10	330
Hexachlorobutadiene	87-68-3	10	330
4-Chloro-3-methylphenol	59-50-7	10	330
2-Methylnaphthalene	91-57-6	10	330
Hexachlorocyclopentadiene	77-47-4	10	330
2,4,6-Trichlorophenol	88-06-2	10	330
2,4,5-Trichlorophenol	95-95-4	50	1700
2-Chloronaphthalene	91-58-7	10	330
2-Nitroaniline	88-74-4	50	1700
Dimethylphthalate	131-11-3	10	330
Acenaphthylene	208-96-8	10	330
2,6-Dinitrotoluene	606-20-2	10	330
3-Nitroaniline	99-09-2	50	1700
Acenaphthene	83-32-9	10	330
2,4-Dinitrophenol	51-28-5	50	1700
4-Nitrophenol	100-02-7	10	1700
Dibenzofuran	132-64-9	10	330
2,4-Dinitrotoluene	121-14-2	10	330
Diethylphthalate	84-66-2	10	330
4-Chlorophenyl-phenyl ether	7005-72-3	10	330
Fluorene	86-73-7	10	330
4-Nitroaniline	100-01-6	50	1700

TARGET COMPOUND LIST (TCL) AND QUANTITATION LIMITS (QL)[1]

Semivolatile (Cont'd)	CAS Number	Quantitation Limits[2] Water µg/L	Low Soil/Sediment[3] µg/kg
4,6-Dinitro-2-methylphenol	534-52-1	50	1700
N-nitrosodiphenylamine	86-30-6	10	330
4-Bromophenyl-phenyl ether	101-55-3	10	330
Hexachlorobenzene	118-74-1	10	330
Pentachlorophenol	87-86-5	50	1700
Phenanthrene	85-01-8	10	330
Anthracene	120-12-7	10	330
Carbazole	86-74-8	10	330
Di-n-butylphthalate	84-74-2	10	330
Fluoranthene	206-44-0	10	330
Pyrene	129-00-0	10	330
Butylbenzylphthalate	85-68-7	10	330
3,3-Dichlorobenzidine	91-94-1	20	6700
Benzo (a) anthracene	56-55-3	10	330
Chrysene	218-01-9	10	330
bis (2-Ethylhexyl) phthalate	117-81-7	10	330
Di-n-octylphthalate	117-84-0	10	330
Benzo (b) fluoranthene	205-99-2	10	330
Benzo (k) fluoranthene	207-08-9	10	330
Benzo (a) pyrene	50-32-8	10	330
Indeno (1,2,3-cd) pyrene	193-39-5	10	330
Dibenz (a,h) anthracene	53-70-3	10	330
Benzo (g,h,i) perylene	191-24-2	10	330

(1) Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

(2) Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment on a dry weight basis will be higher.

(3) Medium Soil/Sediment QLs for Semivolatile TCL Compounds are 60 times the individual Low Soil/Sediment QL.

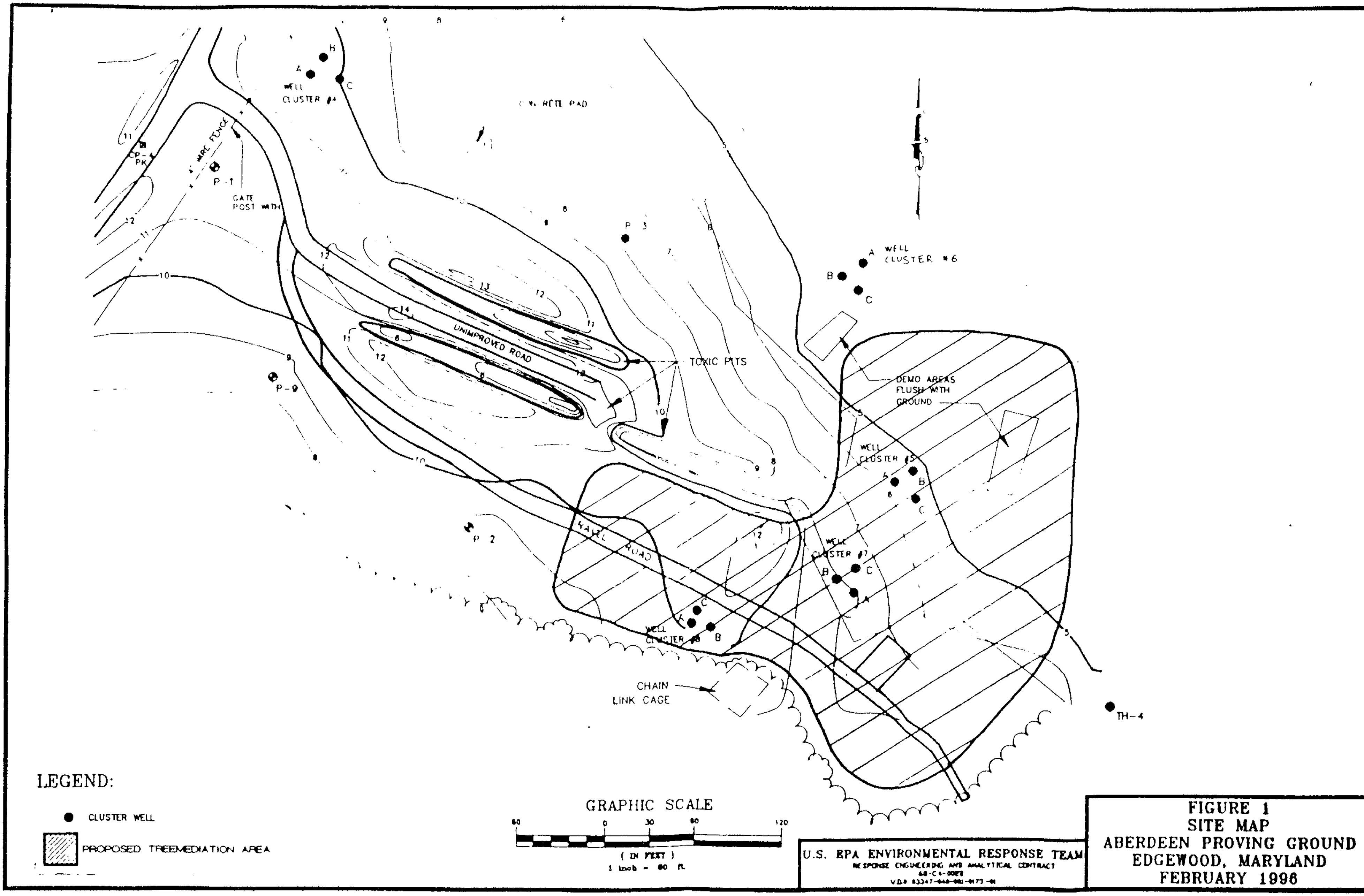
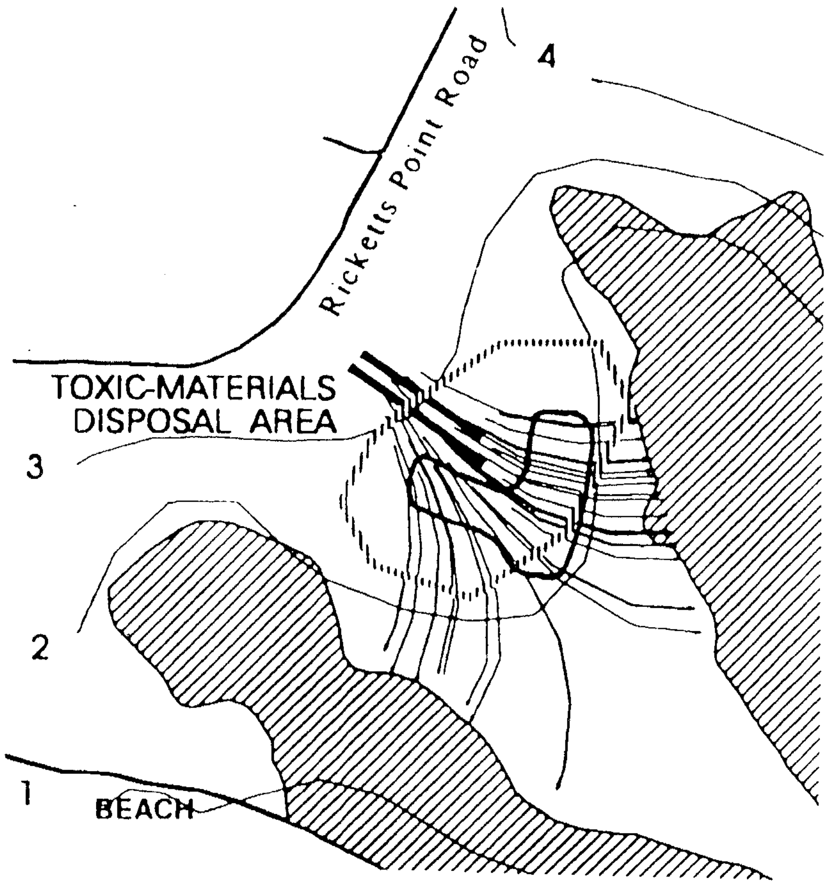
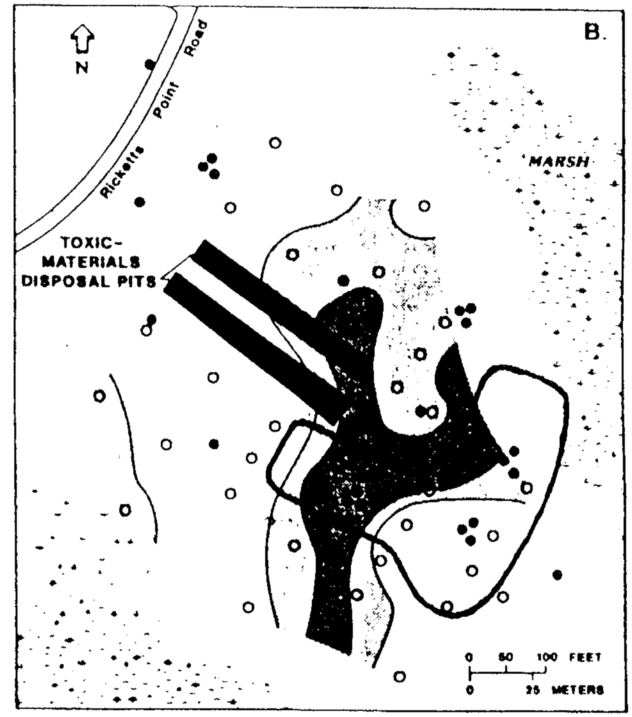


FIGURE 1
SITE MAP
ABERDEEN PROVING GROUND
EDGEWOOD, MARYLAND
FEBRUARY 1996





B. TETRACHLOROETHYLENE RELATIVE-FLUX VALUES
(Ion counts)

- Greater than 100,000
- 10,000 - 100,000
- Less than 10,000

- DISPOSAL PIT AND GROUND-WATER PATHLINES
- WETLANDS
- APPROXIMATE AREA OF KNOWN GROUND-WATER CONTAMINATION
- PROPOSED TREEMEDIATION AREA

SOURCE: U.S. GEOLOGICAL SURVEY

U.S. EPA ENVIRONMENTAL RESPONSE TEAM
RESPONSE ENGINEERING AND ANALYTICAL CONTRACT
68-C4-0022
W.O.# 03347-040-001-0173-01

FIGURE 2
TREEMEDIATION AREA
J-FIELD AREA
ABERDEEN PROVING GROUND
FEBRUARY, 1996

DEPARTMENT OF THE ARMY
U.S. Army Garrison, Aberdeen Proving Ground
Directorate of Safety, Health and Environment
Building E4430
Aberdeen Proving Ground, Maryland 21010

OFFICE : (410) 671-3320
FAX : (410) 671-3010

LETTER OF TRANSMITTAL

DATE : February 27, 1996

PROJECT :

CONTRACT NO. :

TO: U.S. Environmental Protection Agency
841 Chestnut Building
Philadelphia, Pennsylvania 19107

ATTN: Steve Hirsh

( ) We are transmitting
( ) We are returning ( ) herewith ( ) Under separate cover
( ) Request for ( ) Information ( ) Response
( ) For your approval ( ) For your action ( ) For your information
(X) For your review and comment ( ) Clarification

The following documents:

COPIES **DESCRIPTION**

(1) Quality Assurance Work Plan, J-Field Phytoremediation Study, Pooles Island Geophysical and Ecological Assessment, Aberdeen Proving Ground, Maryland.

* If enclosures are not as stated, kindly notify us at once.

REMARKS:

Gerald Gardis 2/27/96
SIGNED DATE

Steven Hirsh 3/7/96
MDE ~~RECEIPT~~ DATE
EPA

DEPARTMENT OF THE ARMY
U.S. Army Garrison, Aberdeen Proving Ground
Directorate of Safety, Health and Environment
Building E4430
Aberdeen Proving Ground, Maryland 21010

OFFICE : (410) 671-3320
FAX : (410) 671-3010

LETTER OF TRANSMITTAL

DATE : March 8, 1996

PROJECT :

CONTRACT NO. :

TO: U.S. Environmental Protection Agency
841 Chestnut Building
Philadelphia, Pennsylvania 19107

ATTN: Steve Hirsh

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COPIES	DESCRIPTION
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REMARKS:

[signature] 3/8/96
SIGNED DATE

[signature] 3/13/96
RECEIPT DATE