November 9, 2005

Mr. Todd Daniels
USACE Kansas City District
CENWK-PM-ES
Federal Building
601 East 12th St
Kansas City, MO 64106-2896

Re: Submittal of Final Work Plan for the Installation of Additional Monitoring Wells-Phases 1 & 2
Claremont Polychemical Superfund Site

Dear Mr. Daniels:

Science Applications International Corporation (SAIC) is submitting the attached final version of the Work Plan for the Installation of Additional Monitoring Wells-Phases 1 & 2 for the Claremont Polychemical Superfund Site, located in Old Bethpage, NY. Five hard copies of the Work Plan are attached for your use.

Comments from CENWK on the draft version of the Work Plan were incorporated into the final version of this document. Following is a summary of changes incorporated.

COMMENTS RECEIVED ON THE WORK PLAN

Comment 1. General Comment: The reader is assuming that all work is in accordance with an existing site Quality Control/Management Plan. If so, please state this in section 1.2 (Scope of Work Plan).

Response 1: Section 5.0 has been added to address quality control management. Quality control checklists to be used during the well installations are included in Appendix C.

Comment 2: Section 1.1 - Second to last Paragraph, Page 2 - Please add a figure depicting the location of new well EW-14D and reference.

Response 2: A figure 1a has been added depicting the location of EW-14D.

Comment 3: Figure 1 - Reader assumes this figure will be enlarged for legibility in the final document.

Response 3: The commentor is correct. Figure 1 will be printed on 24 x 36 inch paper.

Comment 4: Figure 2 - (editorial) Delete extra space in SAIC Project Safety Office block.

Response 4: Completed.

Comment 5: Section 3.2 - (editorial) Delete extra space in third paragraph, fist sentence between "Addendum (USACE:2005)".

Response 5: Completed.

Comment 6: Section 3.5/3.6, page 13 - Are the number designations on the Morie Silica Sand really zero (0 or 000)? If so, ok. If not, please revise four references on this page accordingly.

Response 6: Triple 0 sand between the well sand pack and the bentonite seal is required by NYSDEC.

Comment 7: Section 3.6, page 14 - (editorial) space out second to last paragraph.

Response 7: Completed.

Please contact me with any questions or comments.

Sincerely,

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

Richard C. Cronce

Richard C. Cronce, Ph.D.
Program Manager

Attachment

WORK PLAN
FOR THE INSTALLATION OF ADDITIONAL MONITORING WELLS – PHASES 1 & 2 AT THE CLAREMONT POLYCHEMICAL SUPERFUND SITE

OLD BETHPAGE, NEW YORK

November 2005

prepared for:
United States Army Corps of Engineers, Kansas City District

prepared by:
Science Applications International Corporation
Under Contract No. DACW41-02-D-005, Task Order No. 0002

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Acronyms and Abbreviations

μg/L	micrograms per liter
μmhos/c	micro-mhos per centimeter
AMSL	above mean sea level
bgs	below ground surface
C	Celsius
CPR	cardiopulmonary resuscitation
DO	dissolved oxygen
EDD	electronic data deliverable
EPA	United States Environmental Protection Agency
gpm	gallons per minute
GWTF	groundwater treatment facility
HTRW	hazardous, toxic and radioactive waste
IDW	investigation derived waste
LTRA	Long Term Response Action
mg/L	milligrams per liter
mS/cm	milli-siemens per centimeter
mV	millivolts
NTU	nephelometric turbidity units
NYSDEC	New York State Department of Environmental Conservation
O&M	operation and maintenance
ORP	oxidation reduction potential
OU1	Operable Unit 1
PCE	tetrachloroethene
PID	photoionization detector
PM	Project Manager
PPE	personal protective equipment
psi	pounds per square inch
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
QCP	quality control plan
ROD	record of decision
SAIC	Science Applications International Corporation
SAP	sampling and analysis plan
SOW	scope of work
SSHP	site safety and health plan
S.U.	standard units
SUNY	State University of New York
TCE	trichloroethene
USACE	United States Army Corps of Engineers
VOC	volatile organic compound

1.0 INTRODUCTION

This work plan describes activities related to the installation of seven additional monitoring wells to be installed at the Claremont Polychemical Superfund Site in Old Bethpage, New York in two phases. Four wells will be installed in Phase 1 during fall 2005; and in Phase 2, three wells will be installed during the spring of 2006. Science Applications International Corporation (SAIC) prepared this work plan in accordance with the U.S. Army Corps of Engineers Kansas City District (USACE CENWK) *LTRA Scope of Work Addendum* (USACE, 2005) and SAIC's proposal to USACE (SAIC, 2005a).

1.1 Background

Operation of the Groundwater Treatment Facility (GWTF) at the Claremont Polychemical Facility began in February 2000 as part of the remedy for Operable Unit 1 (OU1) for groundwater as identified in the Record of Decision (ROD) dated 1990. The plant pumps and treats contaminated groundwater stemming from the release of hazardous chemicals, primarily volatile organic compounds (VOCs), from a former chemical manufacturing plant. Groundwater is extracted at a rate of approximately 400 gallons per minute (gpm) from three extraction wells. Groundwater is treated to meet discharge requirements in accordance with a New York State Department of Environmental Conservation (NYSDEC) state discharge equivalency permit. Treated groundwater is discharged to groundwater via four groundwater injection wells. Historical site monitoring conducted in support of the Claremont Polychemical treatment program has included quarterly sampling and analysis of approximately 15 to 33 groundwater monitoring wells and extraction wells. Additional groundwater data collected includes groundwater elevations and stabilized water quality data.

There are two other groundwater extraction and monitoring programs ongoing in the area of the Claremont Site. These include a groundwater remediation program being performed by Nassau County in relation to a groundwater plume thought to be originating from the Fireman's Training Center, and a groundwater remediation program being performed by the Town of Oyster Bay in relation to a groundwater plume thought to be originating from the Old Bethpage Landfill.

Interpretations of the data collected under the Claremont Polychemical and Nassau County programs indicate that there may be hydrogeologic interrelationships between the three ongoing groundwater extraction and plume monitoring programs. Groundwater monitoring at additional locations and depths, as described in this work plan, are required to further define regional groundwater plume conditions. Further definition of regional plume characteristics will allow a reevaluation of the adequacy and efficiency of the three groundwater extraction systems. This approach to groundwater management may suggest opportunities for operating the three systems in consideration of the regional picture so that the total effectiveness and efficiency of the three programs are optimized.

Data obtained by Nassau County during investigations conducted for the Fireman's Training Center indicate that contamination is present at depths not currently monitored at the Claremont site. Site-specific data at Claremont also suggests the occurrence of groundwater contamination below the maximum depth of site monitoring at monitoring well clusters EW-2 and EW-4.

Installation of monitoring wells EW-7C, EW-7D, EW-8D, and EW-9D (see Figure 1) completed in November and December 2004, indicated the possible presence of a contaminant plume originating from a source hydraulically upgradient of the Claremont site. This plume, if confirmed, is likely commingling with the contaminant plume originating from Claremont.

Four additional monitoring wells (MW-10D, MW-11D, MW-12D, and MW-13D) are proposed to define the eastern side of the plume and determine the effects of the extraction and injection well fields on plume capture. These wells will be installed in Level 5 (equivalent with Level B in the Nassau County well field). The Levels are defined in Table 1.

Table 1. Claremont Aquifer Screening Levels

Level	**Screened Interval (ft amsl)**
1	75.10 to 44.86
2	42.35 to 22.32
3	20.62 to 2.99
4	-13.99 to -40.99
5	-91.00 to -118.10
6	-149.20 to -176.00

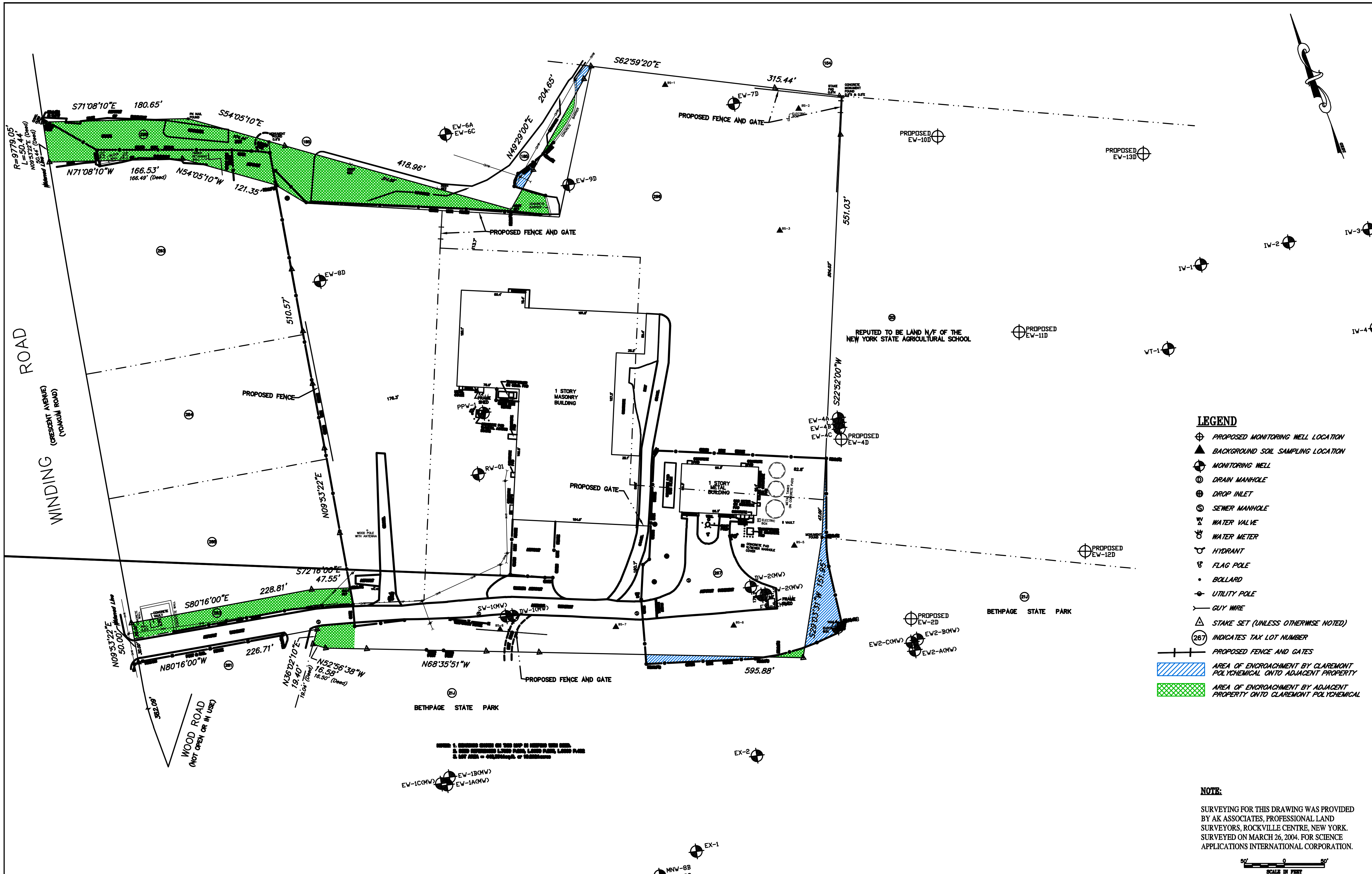
Source: USACE 2003.
ft amsl – feet above mean sea level

One additional well will be installed at each of the existing well clusters EW-2 and EW-4 to assist in the vertical delineation of the contaminant plume. Monitoring well EW-14D will be installed on the State University of New York (SUNY) Farmingdale property, approximately 1,000 feet east-southeast of Nassau County's extraction well RW-4. EW-14D will be placed outside of the extraction well's radius of influence to determine if contamination from Claremont and/or the upgradient off-site source is bypassing the County's extraction system. The approximate locations of the proposed monitoring wells are indicated on Figures 1 and 1a.

Phase 1 will include installation of monitoring wells EW-2D, EW-10D, EW-12D, and EW-14D. Phase 2 will include installation of monitoring wells EW-4D, EW-11D, and EW-13D.

1.2 Scope of Work Plan

SAIC will provide oversight for the installation of seven additional monitoring wells using rotary sonic drilling methods. During drilling, groundwater samples will be collected at discrete intervals for screening level purposes. The samples will be analyzed by a local analytical laboratory with rapid turn around times. Screening level results will be available in less than two hours to support decision making. These results will be used to determine that rotary sonic drilling has advanced to or below the maximum depth of contamination, and to assure that the screened interval depth is within the zone of contamination for the level being evaluated. After construction, wells will be developed and dedicated bladder pumps will be installed in each monitoring well. The new monitoring wells will be formally sampled and analyzed using standard site monitoring protocols during the quarterly groundwater sampling events. Well locations and elevations will be determined by engineering survey. All work will be done in accordance with the USACE approved *Site Safety and Health Plan* (SSHP) (SAIC, 2004), and the *Sampling and Analysis* (SAP) (SAIC, 2005b).



NOTE:

SURVEYING FOR THIS DRAWING WAS PROVIDED BY AK ASSOCIATES, PROFESSIONAL LAND SURVEYORS, ROCKVILLE CENTRE, NEW YORK. SURVEYED ON MARCH 26, 2004. FOR SCIENCE APPLICATIONS INTERNATIONAL CORPORATION.

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SCALE IN FEET

Verify Scale
bar is one inch on original drawing
0 1"
if not one inch on this sheet, adjust scales accordingly

CLAREMONT POLYCHEMICAL SITE

OLD BETHPAGE, NASSAU, NEW YORK

SITE FEATURES AND PROPOSED MONITORING WELL LOCATIONS

drawn DAK	checked	approved	figure no.
date 07/22/05	date	date	1
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Science Applications International Corporation
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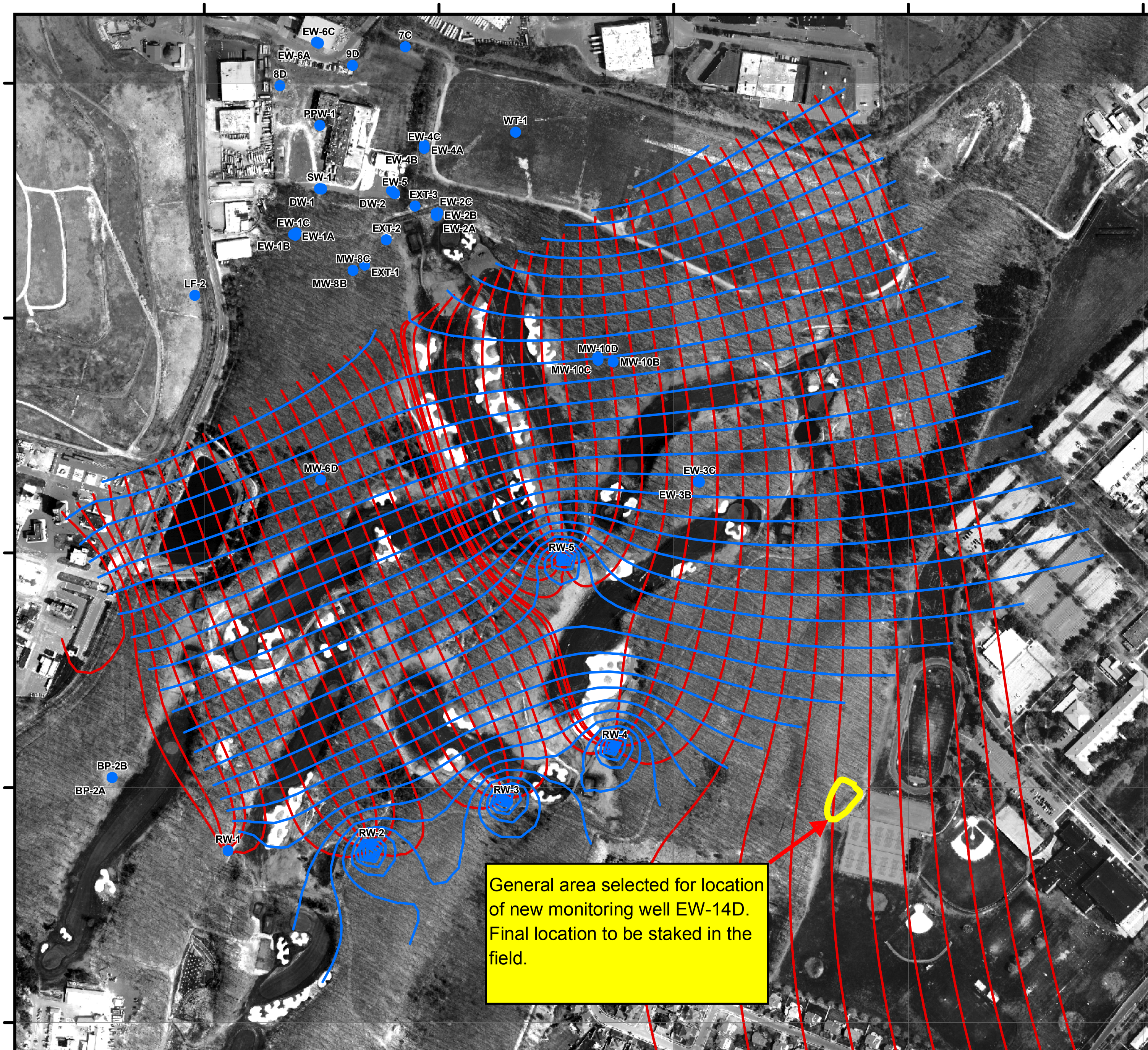
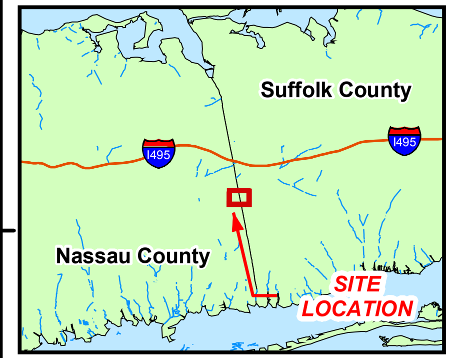


Legend

- Monitoring Wells
- Groundwater Contours (0.2 Foot)
- Groundwater Flow Lines

NAD1983 StatePlane New York Long Island FIPS 3104
Projection: Lambert Conformal Conic
False Easting: 984251.968504
False Northing: 0.000000
Central Meridian: -74.000000
Standard Parallel 1: 40.666667
Standard Parallel 2: 41.033333
Latitude Of Origin: 40.166667



KEY MAP
NOT TO SCALE

N

500 250 0 500 Feet

US Army Corps of Engineers

SAIC From Science to Solutions

Claremont Polychemical
Proposed EW-14D Location

Claremnont Polychemical
Nassau County, New York

PROJECT: \GIS_DATA\CLRMNT\Projects\
Claremont Capture Zone Analysis.mxd

FIGURE 1a	DATE: 07-13-2005

1.3 Site Geology

Historical site boring records indicate the generalized site geologic conditions to be as follows:

- The Cretaceous Magothy Formation, a sole-source aquifer for central Long Island, underlies the site.
- The Cretaceous Magothy Formation extends approximately 300 feet below ground surface (bgs) and consists of well-stratified unconsolidated sand, silt, and clay.
- The silt and clay content dominates the northwestern portion of the site, and the proportion of sand increases toward the southern boundary of the site.
- Depth to water is typically 65 to 70 feet bgs and flows to the south-southeast, toward the golf course and Bethpage State Park.
- Organic solvents from historical spills and discharge incidents have contaminated on-site soil and groundwater.

1.4 Groundwater Contaminants of Concern

The primary contaminants of concern affecting groundwater are VOCs including tetrachloroethene (PCE), trichloroethene (TCE), TCE degradation products, and other organics. Table 1 lists the maximum contaminant concentrations detected in the groundwater, as taken from the Remedial Investigation report (Ebasco, 1990).

Table 2. Historical Maximum Concentrations of Volatile Organic Compounds in Groundwater

Volatile Organic Compounds	Groundwater Concentration (Micrograms/L)
Acetone	132
Benzene	150
1,2 Dichloroethylene	3,158
Methyl Ethyl Ketone (2-Butanone)	21
Tetrachloroethylene	6,197
Trichloroethylene	620
1,1,1 Trichloroethane	1,557
Toluene	160
Vinyl Chloride	12
Xylenes (Total)	Not Detected

Source: Ebasco 1990.

During the installation of the four upgradient monitoring wells in November and December 2004, TCE was found in EW-7C, EW-7D, and EW-9D. The highest concentration of TCE was found in the EW-7 cluster at approximately -49.9 to -45.9 feet above mean sea level (ft amsl) or 197.3 to 201.3 ft bgs. The screened interval of EW-7C was selected to intercept the most concentrated part of the plume. Additional information on the sampling results during well installation can be found in the Well Completion Report (SAIC, 2005c). EW-7C has been sampled three times as part of the Claremont quarterly groundwater sampling with TCE concentrations varying from 900 to 1,800 micrograms/liter (µg/L).

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

SAIC, on behalf of USACE, has overall responsibility for the installation of the additional monitoring wells at the site. USACE will provide project direction and oversight and will be responsible for reviewing sampling results and field observations, and for making final decisions on the depth and screened intervals of the monitoring wells. The USACE and the U.S. Environmental Protection Agency (EPA) will provide periodic field oversight. Additional information concerning responsibilities for the site is included in Section 2.0 of the SAP (SAIC, 2005b).

In addition to the positions identified in Section 2.1.2 of the SAP, SAIC has assigned staff personnel to the following key positions for the well installation project:

- **Field Manager, Project Safety Officer and Geologist**: Mr. Todd Eaby, P.G., will function as the Field Manager, Project Safety Officer and Project Geologist. He will provide direct oversight of the drilling subcontractor, coordinate daily work activities, catalog subsurface materials, conduct field screening for health and safety and analytical purposes, conduct daily tailgate safety meetings, and supervise collection of samples.

- **Field Sample Manager**: Ms. Cathy Huss will function as the Field Sample Manager and be the on-site point of contact with the laboratory. She will collect samples, deliver samples to the laboratory, and manage and distribute/communicate sample results to the appropriate personnel.

- **Task QA/QC Manager**: Mr. Ross Hibler will function as the Task Quality Assurance/Quality Control (QA/QC) Manager. He will be responsible for conducting QC inspections at the drill site and of related activities and will conduct QA/QC reviews of field documentation completed by the Field Manager, Project Safety Officer, Geologist and Field Sample Manager.

The well installation project organization is shown in Figure 2.

2.1 Subcontractors

SAIC has identified the following subcontractors for drilling, laboratory analytical, and surveying services:

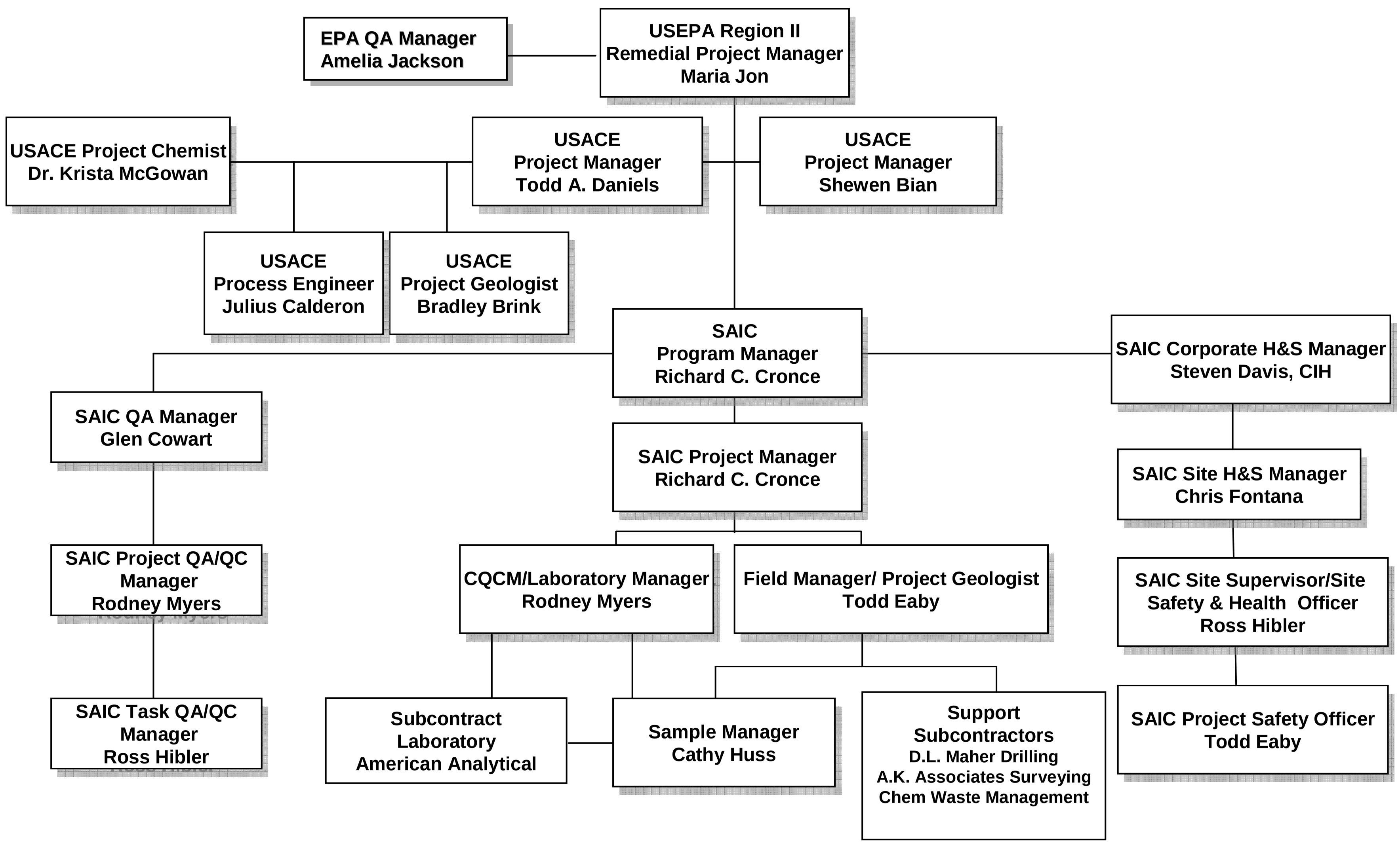
- D.L. Maher Drilling & Pump Services, a Division of Boart Longyear Company
  71 Concord Street
  North Reading, MA 01864

- American Analytical Laboratories
  56 Toledo Street
  Farmingdale, NY 11735

- AK Associates Professional Land Surveyors
  143 North Long Beach Road
  Rockville Centre, NY 11570

Figure 2 Well Installation Project Organizational Chart

Claremont Polychemical Superfund Site



2.2 Points of Contact

The points of contact for key individuals for the well installation project are shown on Table 3.

Table 3. Points of Contact - Well Installation Project

Name	Address	Telephone/Facimile/e-mail
Richard C. Cronce, Ph.D (SAIC Program/Project Manager)	Science Applications International Corporation 6310 Allentown Blvd. Harrisburg, PA 17112	Ph – 717-901-8852 Fax – 717-901-8105 Richard.C.Cronce@saic.com
Ross Hibler (SAIC Site Supervisor and Site Safety and Health Officer)	Science Applications International Corporation 505 Winding Road Old Bethpage, NY 11804	Ph – 516-777-7242 Fax – 516-777-7243 Ross.G.Hibler.Jr@saic.com
Todd Eaby, P.G. (SAIC Field Manager and Project Geologist)	Science Applications International Corporation 6310 Allentown Blvd. Harrisburg, PA 17112	Ph – 717-901-8823 Fax – 717-901-8102 Todd.D.Eaby@saic.com
Rodney Myers (SAIC CQCM/Laboratory Manager)	Science Applications International Corporation 6310 Allentown Blvd. Harrisburg, PA 17112	Ph – 717-901-8836 Fax – 717-901-8102 Rodney.G.Myers@saic.com
Cathy Huss (SAIC Field Sample Manager)	Science Applications International Corporation 6310 Allentown Blvd. Harrisburg, PA 17112	Ph – 717-901-8806 Fax – 717-901-8102 hussca@saic.com
Steve Davis, CIH (SAIC Health and Safety Manager)	Science Applications International Corporation 151 LaFayette Drive Oak Ridge, TN 37831	Ph – 865-481-4755 Fax – 865-481-8797 Stephen.L.Davis@saic.com
Todd A. Daniels (USACE Project Manager)	USACE, Kansas City District 601 East 12th Street Kansas City, MO 64106	Ph – 816-983-3584 Fax – 816-426-5550 todd.a.daniels@usace.army.mil
Krista McGowan, Ph.D. (USACE Project Chemist)	USACE, Kansas City District 601 East 12th Street Kansas City, MO 64106	Ph – 816-983-3884 Fax – 816-426-5550 Krista.I.McGowan@usace.army.mil
Julius Calderon (USACE Project Engineer)	USACE, Kansas City District 601 East 12th Street Kansas City, MO 64106	Ph – 816-983-3550 Fax –816-426-5550 Julius.C.Calderon@usace.army.mil
Bradley Brink (USACE Project Geologist)	USACE, Kansas City District 601 East 12th Street Kansas City, MO 64106	Ph – 816-983-3883 Fax – 816-426-5550 Bradley.J.Brink@usace.army.mil
Maria Jon (EPA Project Manager)	USEPA Region II 290 Broadway, 20th Floor New York, NY 10007	Ph – 212-637-3967 Fax – 212-637-4282 Jon.Maria@epamail.epa.gov
Rob Alvey (EPA Geologist)	USEPA Region II 290 Broadway, 18th Floor New York, NY 10007-1866	Ph – 212-637-3258 Fax – 212-637-4360 alvey.robert@epamail.epa.gov
Kevin P. Mayer (D.L. Maher Project Manager)	D.L. Maher Drilling & Pump Services 71 Concord Street North Reading, MA 01864	Ph – 781-933-3210 Fax – 978-664-3299 kmaher@dlmaher.com
Remo Gigante (American Analytical Project Manager)	American Analytical Laboratories, Inc. 56 Toledo Street Farmingdale, NY 11735	Ph – 631-454-6100 Fax – 516-644-6703 rgigante@american-analytical.com

3.0 FIELD ACTIVITIES

Seven additional monitoring wells will be installed in two phases: Phase 1 will be completed in the fall of 2005 and Phase 2 will be completed in the spring of 2006.

3.1 Well Locations and Proposed Depths

One of the objectives of the work will be to construct groundwater monitoring wells in such a manner to evaluate groundwater conditions at target elevations at each location. The proposed new monitoring well locations are shown in Figure 1 and a summary of the proposed depths of the screened intervals is included in Table 4.

Table 4. Rotary Sonic Additional Well Installation Summary

Proposed Well ID	Location	Target Monitoring Well Screening Level	Proposed Depth of Screened Interval (feet bgs)*	Proposed Elevation of Screened Interval (feet amsl)*
Phase 1				
EW-2D	EW-2 Cluster (Golf Course)	6	315 to 325	-160 to -170
EW-10D	Injection Well Field	5	270 to 280	-108 to -118
EW-12D	Injection Well Field	5	270 to 280	-108 to -118
EW-14D	SUNY property ESE of Nassau County RW-4	5	252 to 262	-108 to -118
Phase 2				
EW-4D	EW-4 Cluster	6	315 to 325	-160 to -170
EW-11D	Injection Well Field	5	270 to 280	-108 to -118
EW-13D	Injection Well Field	5	270 to 280	-108 to -118

*Well screened interval can be adjusted based on analytical contamination screening results
bgs – below ground surface
amsl – above mean sea level
SUNY – State University of New York

As noted in Table 4, the depth and screened intervals of the wells may be adjusted based on field observations and analytical contamination screening results. Analytical results will be reviewed by the USACE and SAIC and a conference call will be convened. USACE will make final decisions as to the depth of the screened interval and email the decision to SAIC.

Before starting field activities, SAIC will stake the proposed well locations in the field, and the drilling subcontractor will complete a New York City & Long Island One Call to identify underground utilities. SAIC will use an auto level and known surveyed elevations to determine the surface elevation at each drilling location for use during drilling and sampling activities.

3.2 Rotary Sonic Drilling

Rotary sonic drilling is a multi-cased system that simultaneously uses high-frequency vibration and low-speed rotational motion coupled with downward pressure to advance the cutting edge of the circular drill string. This action produces a uniform borehole while providing relatively continuous, undisturbed core samples of both overburden and most bedrock formation.

For this project, rotary sonic drilling will use a 6-inch core barrel cased with an 8-inch override to drill through the dry overburden. This will reduce the surface friction on the outside of the drill pipe to ensure that the desired total depth can be reached. Following advancement of the 6 x 8-inch drill string to the water table, a 4-inch diameter core barrel with 6-inch diameter override casing will be used to advance the borehole to depth. Continuous core samples from the ground surface to the bottom of the deepest borehole at each monitoring location will be collected for logging purposes.

Monitoring wells will be installed in accordance with the Long Term Response Action (LTRA) scope of work (SOW) Addendum (USACE, 2005) and the NYSDEC State Requirements for Drilling and Well Construction (6 NYCRR 360-2.11) included in Appendix A. The senior driller on the rig will be certified and licensed to operate in the State of New York.

SAIC will be on-site during all drilling and well installation activities to provide well installation oversight, catalog subsurface materials, conduct field screening for health and safety and analytical purposes, and manage sampling and delivery of samples to the analytical laboratory.

The drilling subcontractor will provide all equipment in first-class working order, clean, and free from oil, hydraulic, or other leaks. The drill rig and all down-hole equipment will be free of any contamination (radiological, organic or inorganic) from previous work. All drilling equipment will be inspected for contamination prior to beginning down-hole work.

Upon mobilization to the site, SAIC will verify that equipment is acceptable and operable, and will require the drilling subcontractor to demonstrate that all drill rig safety devices and equipment are operable. At a minimum, three operable kill switches must be on each rig. The SAIC Field Manager will complete a Drill Rig Operational Checklist at the beginning of each 10-day shift. The Daily Drill Rig Inspection Checklist will be completed each day. Copies of these forms are available in Appendix B of the SSHP (SAIC, 2004).

3.3 Core Sampling

Continuous core samples from the ground surface to the bottom of the deepest borehole at each monitoring location will be collected as follows:

1. The core barrel is advanced to the desired depth. The depth inside the core barrel is measured to determine recovery.
2. The override casing is advanced to the same depth as the core barrel. The top of the core barrel and rods are sealed before driving the casing to prevent flushing of the core barrel if water is required.
3. The core barrel is retrieved to the surface. A second measurement is taken inside the core barrel and the recovery is compared to the first measurement to determine if any of the core was lost during retrieval.
4. The core barrel is raised and the sample vibrated out into plastic sleeves and labeled. The first material out of the core barrel is the bottom of the core.
5. Retrieved soils will be screened immediately with a photoionization detector (PID) and logged in the field by SAIC’s field geologist using USACE Forms MRK55 and MRK55-2 in accordance with the USACE borehole logging guidance (Appendix B).
6. If appropriate, a water sample is collected (see Section 3.4). Otherwise, the core barrel is put back in the casing and the process repeated.

The use of water and drilling fluid to assist in drilling will be avoided or minimized if possible unless determined to be necessary due to encountered subsurface conditions. Below the water table, heaving sand conditions can occur during retrieval of the core barrel. If these conditions are encountered, actions will be taken to minimize heaving by adding potable water to the inside of the drill string in an attempt to maintain positive hydrostatic pressure within the drill string. If heaving sands are identified, a minimal quantity of water will be used to remove the sand from the drill string. Drill cuttings and fluids will be containerized and processed as discussed in Section 3.9.

3.4 Discrete Interval Groundwater Sampling

Groundwater samples will be collected during advancement of the boreholes using discrete interval groundwater sampling protocols. These screening level samples will be analyzed with rapid turn around times by American Analytical Laboratories, a local analytical laboratory. The results will be used to determine that rotary sonic drilling has advanced to or below the maximum depth of contamination, and to assure that the screened interval depth is within the desired zone of contamination for the level being evaluated.

All sampling, equipment, containers and preservatives, sample handling, and documentation will be in accordance with the SAP (SAIC, 2005b). Groundwater samples will be analyzed for VOCs by Method 8260B by American Analytical Laboratories with analytical results provided within two hours of receipt of samples, or within a timeframe as otherwise necessary to not slow the progress of the work.

3.4.1 Groundwater Sampling Depths

At well locations EW-10D, EW-11D, EW-12D, EW-13D, and EW-14D, groundwater samples will be collected at 20-foot intervals beginning at the apparent water table surface, and continuing to the bottom depth of the borehole. At well locations EW-2D, groundwater samples will be collected at 20-foot intervals beginning at a depth of 150 ft bgs (the deepest existing screened interval at the EW-2 cluster) and continue to the bottom of the borehole. Groundwater sampling at EW-4D will begin at a depth of 155 ft bgs and be collected at 20-foot intervals to the bottom depth of the borehole. A groundwater sampling summary is included in Table 5.

Table 5. Rotary Sonic Additional Well Sampling Summary

Proposed Well ID	Start Sampling at	Level	Proposed Elevation of Screened Interval (feet amsl)*	Anticipated No. of Groundwater Samples
Phase 1				
EW-2D	150 ft bgs	6	-160 to -170	9
EW-10D	Water table surface	5	-108 to -118	10
EW-12D	Water table surface	5	-108 to -118	10
EW-14D	Water table surface	5	-108 to -118	10
Phase 2				
EW-4D	155 ft bgs	6	-160 to -170	9
EW-11D	Water table surface	5	-108 to -118	10
EW-13D	Water table surface	5	-108 to -118	10

*Well screened interval can be adjusted based on analytical contamination screening results
bgs – below ground surface

3.4.2 Discrete Interval Groundwater Sampling Procedure

The following discrete interval sampling procedure for rotary sonic drilling was adapted from D.L. Maher (Maher, 2002). Water samples will be collected using an electric submersible pump in combination with a packer system to collect water from the bottom of the casing. Stabilized water quality parameters will be used to determine when purging is complete.

The following materials and equipment are required for discrete interval groundwater sampling:

- Means to measure amount of water injected.
- Source of potable water.
- Pump and packer equipment.
- Hose line and reel for pump discharge.
- Generator to run pump.
- Screen and K-packer (a K-packer is a rubber seal attached to the top of the lead rod to prevent heaving sands from entering the bottom of the drill casing during purging of water).
- Means to measure amount of water purged.

Prior to sampling, the following pre-measurements will be taken:

- Measure the length of the screen section, the position of the K-packer, and the length of the lead rod. The purpose of this is to know where the screen is and where the pump will rest on top of the lead rod.
- Measure the pump and packer set up. The length from the bottom of the pump to the pump intake, and the distance from the bottom of the packer to the bottom of the pump will be measured and recorded. The information will be used to calculate the amount of water to be purged and to determine the position of the pump relative to the water table.
- Measure the length and diameter of hose to calculate volume.
- Both inside and outside casing diameters will be measured and recorded.

Once the outer casing is at the sampling depth and the core sample has been retrieved (see Section 3.3), the following steps will be followed:

1. Measure the depth to the bottom of the casing to ensure there is no heave. If heave exists, additional water will be used to force the solids from the casing. (One to two feet of heave may remain in the casing after addition of water.)
2. Attach the quick connect to the wireline and lower the screen and lead rod with K-packer assembly.
3. Retract the casing a predetermined length to expose the screen.
4. Re-measure to the top of screen assembly to determine depth of screen. The screen may have moved when the casing was retracted. If the screen remains inside the casing, the purge rate may be lowered.
5. Attach pump and packer assembly to wireline wench and lower to depth.
6. Inflate packer. Nitrogen gas or compressed air is generally used to inflate packer to proper pressure, or pounds per square inch (psi) (psi = 0.433 x height of column of water). It is not necessary to inflate packer if the first zone is at the water table.
7. Turn pump on to begin purging. The initial purge rate will be as low as possible given the limitations of the pump, the amount of head, and the aquifer conditions. Water will flow from the pumping zone unless: (1) the screen is in a no-yield zone; (2) the screen is obstructed; or (3) the pump is not working properly. The purge water will be discharged into a drum or tank for subsequent transfer to and treatment at the GWTF.

8. Calculate purge rate.
9. The pH, conductivity, temperature, dissolved oxygen (DO), oxidation reduction potential (ORP) and turbidity will be monitored during purging. The purge rate will be adjusted, as necessary, until a stabilized flow rate is achieved. Ideally, a steady flow rate should be maintained that results in a stabilized water level. After the water level has stabilized and all air removed from the tubing, field water quality parameters will be measured and recorded a minimum of once every three to five minutes on the Groundwater Sampling Log included in Appendix B or entered into a field pocket computer. Purging will be considered complete when the field parameters stabilize after a minimum of three readings at five minute intervals according to the following criteria (SAIC, 2005b):

   - DO: ± 0.1 milligrams/liter (mg/L) for DO values less than 1 mg/L, or ± 10 percent for DO values greater than 1 mg/L
   - Eh (ORP): ± 10 milli-volts (mV)
   - conductivity: ± 20 micro-mhos/centimeter (µmhos/cm), or ± 20 mS/cm (milli siemens/centimeter), or ± 1 percent of full-scale reading (instrument repeatability)
   - temperature: ± 0.5 degrees Celsius (°C)
   - pH: ± 0.1 Standard units (S.U.)
   - turbidity: < 50 nephelometric turbidity units (NTU). If fine sands and silt are present, a developed sand pack around the temporary well point may not be possible. In such cases, a turbidity less than 50 NTUs may not always be feasible. Since the groundwater sampling results are being used for screening purposes only, samples may be collected with higher turbidity readings if all other water quality parameters are stable.

10. The collection of groundwater samples will begin immediately after determination of stabilized readings. The pump tubing will be disconnected from the flow through cell and checked to make sure that no air is entrapped in the lines prior to sample collection. Samples will be transferred directly into pre-preserved laboratory sample containers from the pump tubing.
11. Once the sample has been collected, the pump can be turned off, packer deflated, and pump assembly reeled in.
12. Lower the quick connect on the wireline and retrieve the screen assembly.
13. Decontaminate the pump and hose line (usually done by pumping a minimum of 50 gallons of Alconox solution followed by 50 gallons of potable water through the pump and hose line).
14. Advance casing to next interval.
15. Repeat process.

If geologic conditions cause slow recharge through the screened interval during the purging process, the purge volumes may be altered to allow sample collection and boring advancement to continue at an efficient rate.

3.4.3 Sample Collection and Analysis

As shown in Table 5, approximately 39 groundwater samples will be collected for analysis during Phase 1 and 29 samples will be collected during Phase 2. In addition, one sample of drilling water, one duplicate groundwater sample, and one purge water (casing water) sample will be collected for QA/QC purposes during each phase in accordance with the SAP (SAIC, 2005b). A maximum of four groundwater samples is anticipated per day (excluding QC samples). Samples will be analyzed for VOCs in accordance with EPA Method 8260B with reporting levels in accordance with the SAP.

Samples will be immediately transported by SAIC to American Analytical Laboratories. The laboratory will contact the field sample manager via telephone with screening level results within two hours of sample collection, or within a time period short enough to not impede the progress of the work. Electronic data deliverables (EDD) will be prepared in accordance with the SAP and emailed daily to personnel identified by SAIC. The VOC results are being used for screening level data only to support immediate decision making, and no data validation is required. Final hard copy deliverables as specified in the SAP (SAIC, 2005b) will be submitted within two weeks of completion of analysis.

3.5 Borehole Abandonment Procedure

If it is determined that the desired screened interval is shallower than the bottom depth of the borehole, bentonite chips will be used to backfill the borehole. One foot of Morie No. 000 will be placed above the bentonite chips.

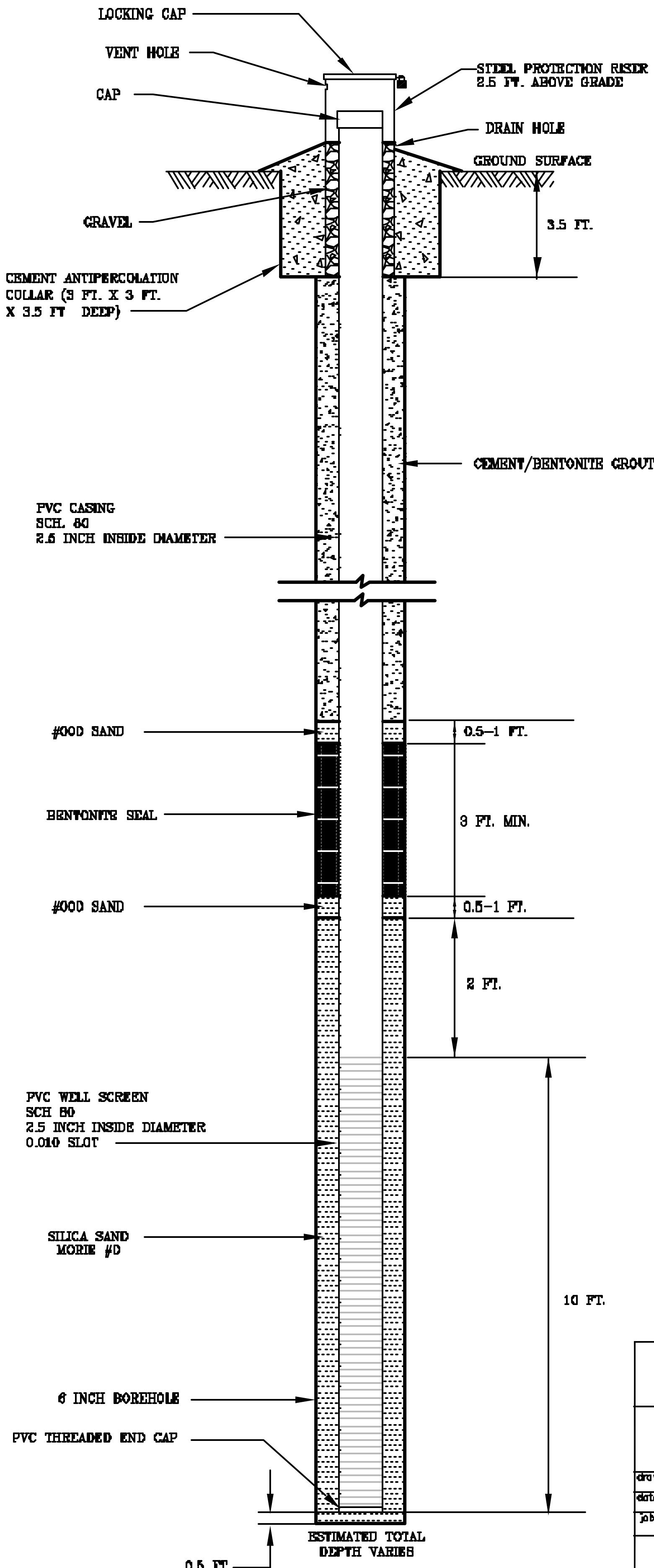
3.6 Well Construction

Well construction will be in accordance with the New York State requirements (6 NYCRR 360-2.11) included in Appendix A. A typical monitoring well construction diagram is included in Figure 3. Monitoring wells screens will be nominal 2.25-inch inside diameter, Schedule 80 polyvinyl chloride (PVC) and 10 feet in length. Slots will be 0.010-inches (or sized in accordance with the formation materials encountered). Monitoring well riser pipe will be 2.25-inch inside diameter schedule 80 PVC. Stainless steel centralizers will be installed at the top and bottom of the screen.

Selection of the filter pack will be made in the field based on the observed grain size distribution of subsurface materials. It is anticipated that a sand pack consisting of Morie No. 0 silica sand will be selected. The sand pack will be installed to a minimum of 2 feet above the top of the well screen and 6 inches below the bottom of the screen. The sand pack will be installed at a uniform rate and will be closely monitored to ensure even placement and prevent bridging. The sonic casing will be vibrated in order to settle and set the filter pack. The sand pack will than be sounded again and additional sand will be added as needed to maintain the minimum of 2 feet above the top of the well screen. Six inches of a finer grained sand pack material (100 percent passing the No. 30 sieve and less than 2 percent passing the No. 200 sieve [Morie No. 000]) will be placed at the top of the sand pack between the sand and the bentonite seal [6 NYCRR 360-2.11(ii)(c)].

Following the placement of the filter pack, a bentonite pellet seal of at least 3 feet will be placed above the sand pack in a manner that will prevent bridging. If pellets or chips are used, sufficient time should be allotted to allow for full hydration of the bentonite prior to emplacement of overlying materials [6 NYCRR 360-2.11(ii)(d)]. If a bentonite slurry is used the slurry will be allowed to hydrate per manufacturer's recommendation. The top of the bentonite seal will be verified using a weighted tape. A 6 to 12 inch fine grained sand pack (Morie No. 000) must be placed above the bentonite seal to minimize grout infiltration.

An annular seal consisting of a cement-bentonite grout will placed above the sand overlying the bentonite seal using a side discharge tremie pipe. The annular seal will be installed in one continuous operation from the top of the sand overlying the bentonite seal to the ground surface. The tremie pipe will be closed ended with side discharging openings along the bottom portion of the pipe. The side discharge application of the annular seal will allow the grout to be placed into the annular space without disturbing the bentonite seal.



NOT TO SCALE

CLAREMONT POLYCHEMICAL SUPERFUND SITE
OLD BETHPAGE, NASSAU COUNTY, NEW YORK

TYPICAL MONITORING WELL CONSTRUCTION

drawn RAM	checked	approved	figure no. 3
date 11/02/04	date	date	
job no. 01-1633-00-5386-350		file no. 5386-DD6.dwg	

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For all wells except EW-2D, a locking above ground protective steel casing will be placed over the well casing and secured with a concrete anti-percolation collar. A drain hole will be drilled at the base of the protective casing and a vent hole near the top. The annulus of the protective casing will be filled with gravel. A flush mount will be used for EW-2D.

The concrete surface seal will extend to 3.5 feet, the normal maximum frost depth, to prevent potential well damage. The anti-percolation collar will be constructed by pouring concrete into a pre-built form with a minimum of 3-foot long sides. The anti-percolation collar is designed to prevent surface runoff from ponding and entering the well casing [6 NYCRR 360-2.11(ii)(f-g)]. Well construction specifications for each monitoring well will be documented on the Well Construction Log found in Appendix B.

The need for, the number of protective posts (bollards) required, and the schedule for bollard installation will be determined based on the final well location and projected risk of accidental damage to the wells. Some bollards may be installed quickly, while others may be installed at a later date.

3.7 Decontamination

A temporary decontamination pad will be constructed adjacent to the treatment plant building, and the drilling equipment will be decontaminated upon mobilization to the site, between wells, and upon demobilization in accordance with the site SAP. Decontamination fluids generated will be handled in accordance with the procedures detailed in the Section 3.10 and in accordance with the SAP (SAIC, 2005b).

3.8 Well Development

The wells will be developed by pumping until pH, conductivity, DO, and ORP are stable (see Section 3.4.2) and turbidity is less than 50 NTUs. If the pump rate required for proper development is greater than the capacity of the flow through cell and prevents its use, stabilization of DO may be impractical. In addition, a minimum of three well volumes and three times the volume of water lost during drilling within the screened interval will be removed. Well development will continue for a maximum of three hours, at which time USACE will be contacted to determine additional development requirements. Development activities will be documented on the Well Development Log included in Appendix B. Development water will be transported to the treatment plant as discussed in Section 3.10.

3.9 Pump Installation

Dedicated stainless steel bladder pumps will be installed in each of the new monitoring wells. Poly tubing will be used for the bladder pump airline, and Teflon® tubing will be used for the discharge line. Pump intakes will be set 5 feet from the bottom of the well. Stainless steel cable will be used to tether each pump.

3.10 Waste Management

3.10.1 Soil

Drill cuttings generated at each boring location will be placed into 55-gallon drums, labeled, and stored in a central location for off-site disposal. Drill cuttings will be transported from the soil boring locations to the central staging area upon completion of each borehole or on a daily basis, if requested. It is assumed that a total of 38 drums of cuttings for Phase 1 and 29 drums for Phase 2 will be disposed of off-site at the Chemical Waste Management hazardous waste facility in Model City, New York, as non-hazardous waste.

3.10.2 Water

Drilling water, purge water, development water and decontamination water will be transported to the outside subsurface sump of the GWTF for subsequent treatment by the plant. Sediment will be removed from the drilling water prior to transfer to the GWTF.

3.11 Surveying

Prior to drilling, SAIC will use an auto level and known elevations (monuments or surveyed wells) to determine the elevation at each of the boring locations. These elevations will be used during drilling to convert depths to feet amsl.

Following the completion of field activities, a State certified surveyor will determine the elevations and positions of the newly installed monitoring wells. All monitoring well locations will be surveyed horizontally to the nearest 0.1 foot and tied into the State Plane System (NAD27). The ground surface elevation of the locations will be measured to the nearest 0.1 foot relative to mean sea level (NGDV29). For all monitoring wells, a notch cut in the top of the riser pipe and the brass tab located on the well pad will be surveyed to the nearest 0.01 foot relative to mean sea level.

3.12 Sampling of New Monitoring Wells

The new monitoring wells will be sampled during the next quarterly groundwater sampling event and will be included in subsequent quarterly sampling events. The new wells will be sampled and analyzed in accordance with SAP in the same manner as all other site monitoring wells (SAIC, 2005b).

4.0 HEALTH AND SAFETY

All work will be completed in accordance with the SSHP (SAIC, 2004). Daily health and safety tailgate meetings will be required during the performance of the work. All fieldwork is expected to be conducted in Level D personal protective equipment (PPE). Clothing and equipment required to comply with this level of worker protection shall include the following:

- leather overgloves
- steel-toed boots
- chemical resistant overboots covers [as required by the Health & Safety Officer]
- hard hats
- safety eyewear
- hearing protection

Due to the potential for encountering materials with elevated concentrations of VOCs, provision for upgrading health and safety protection to Level C will be available for this project. The decision to upgrade to Level C will be in accordance with criteria provided in the SSHP, and as agreed by the Project Health and Safety Officer.

5.0 QUALITY CONTROL

5.1 Background and Purpose

SAIC will provide drilling, well installation, groundwater sampling and contaminant plume vertical profiling services during this task. This quality control section/plan was developed as a basis for ensuring the quality control of site drilling and sampling activities. Quality Control (QC), as designated in this plan, means conformance to requirements as defined in various site project documents including work plans, the SAP, the SSHP and the Quality Assurance Project Plan (QAPP).

Implementation of this quality plan will be performed in a manner that produces work that meets or exceeds expectations of USACE and SAIC. This plan has been developed to provide a systematic and accountable method of guiding and checking the quality of work performed both in the field and in the office. Through the proper execution of this QC plan, a high level of confidence can be placed in work products delivered. This includes all aspects of fieldwork, office work related to field activities, and report documents produced for projects. Proper execution of this plan will also assure USACE that deficiencies identified during the project have been resolved.

This plan is designed:

1--to document the activities performed by the Project Team as a matter of routine,
2--as a mechanism to improve the quality of the field work, and
3--in the end, improve overall performance.

5.2 Quality Control Organization and Responsibilities

5.2.1 Organization

The Organization chart for the entire Project Team is shown in Figure 2, Well Installation Project Organizational Chart.

5.2.2 Responsibilities

The responsibilities of the key SAIC personnel responsible for ensuring quality, monitoring field activities, conducting quality inspections, documenting the results of the quality plan and conducting quality related field tasks are detailed in the following sub-sections.

5.2.2.1 Project Quality Analysis/Quality Control (QA/QC) Manager (Rodney Myers):

As the SAIC QA/QC Manager, Rodney Myers is responsible for the Project QA/QC Program, including the following tasks:

- Development, implementation, and supervision of the QA/QC Program;
- Meets with Task QA/QC Manager, field manager, sample manager and project manager to define project requirements and schedule;
- Consults with Task QA/QC manager, field manager, sample manager, and project manager

regarding progress of the project and quality of the work; and
- Reviews the performance of all QC activities.

The QA/QC manager shall also be responsible for directing, overseeing and/or conducting QC inspections at the site. The QA/QC manager will direct and review QC inspections conducted by the Task QA/QC manager. Mr. Myers will be supported by other SAIC project team members, as well as Todd Daniels of the USACE as necessary to provide field confirmation of project quality control documentation. The QA/QC manager and/or designee shall observe or otherwise document all work being performed at the site. During QC inspections, QC checklists shall be filled out as work is being performed (real time) and reviewed by the QA/QC manager and/or Task QA/QC manager. Any deficiencies, non-conformance issues not corrected by the fieldwork team shall be addressed and corrected immediately by the QA/QC manager or Task QA/QC manager and documented in a field logbook and the appropriate QC Checklist. Following fieldwork activities the QA/QC manager shall prepare a detailed activity report that discusses each deficiency, etc. and the resulting correction and the overall effectiveness of the QC process.

5.2.2.2 The Task QA/QC Manager (Ross Hibler)

The task QA/QC manager for drilling operations is responsible for conducting QC inspections at the drill site and related activities and the following:

- Occasional site supervisions of drill and sampling crews
- Safety of Drill Crews
- Review of boring logs and field logbooks provided by the Field Geologist;
- Review of well installation and sampling progress.

5.2.2.3 Field Manager/Project Geologist/Project Safety Officer (Todd Eaby)

The Field Manager/Project Geologist/Project Safety Officer is responsible for all aspects of Crew Safety, logging and monitoring, project coordination, coordination with the Driller to insure the efficient, complete, and accurate execution of the assignment and drilling operation including the following tasks:

- Full-time on-site supervision of drill crews;
- Borehole Location (if applicable);
- Borehole Logging;
- Technical advisor for drilling operations;
- Instrument Calibration;
- Environmental monitoring;
- Daily activity reports;
- Daily tailgate safety meetings;
- Marking drums and maintaining a drum inventory;
- Documentation of field operations, field conditions, and monitoring wells;
- Determine and/or confirm the sampling needs and advise the Project Manager (PM) on the best drilling and/or sampling methods to obtain the best possible results;
- Ensure the completeness of the assignment preparation, and ensure that materials required are on hand or ordered, and to coordinate for utility clearances;
- Resolution of problems concerning drilling methods that are beyond the drillers capability;
- Safety of drill crews; and
- Training of drill crews.

5.2.2.4 Drilling Subcontractor Quality Manager (senior driller, to be determined)

As the Drilling Subcontractor Quality Manager the senior driller is responsible for the overall crew safety and the efficient, accurate and complete execution of the assignment, to include the following responsibilities and tasks:

- Crew safety;
- Communication with Field Manager/Project Geologist;
- Sample retrieval;
- Equipment decontamination (when applicable);
- Well installation;
- Backfilling of borehole (if applicable);
- Containerization of spoils and investigation derived waste (IDW) (when applicable);
- Problem resolution as it applies to drilling methods; and
- Equipment maintenance.

5.2.2.5 Sample Manager (Cathy Huss):

The Sample Manager is responsible for close coordination with the contracted laboratory, field manager/Project Geologist and the drill crew to insure the efficient, complete, and accurate execution of the assignment, to include the following tasks:

- Sample collection;
- Sample preservation;
- Shipment of samples;
- Instrument calibration; and
- Documentation of sample collection, sample chain-of-custody.

5.3 Implementation

5.3.1 The Project Team

The Project Team consists of all those persons that have responsibility for the project whether it is supervisory, planning, or actual work. Every member of the project team is responsible for producing a quality product through Team Work.

5.3.2 Safety

Safety is the primary consideration in all aspects of operations. Safety is the responsibility of the entire project team and begins with planning and does not end until demobilization is complete. The keys to safety are to follow established safety procedures, be aware of what you are doing, and be aware of what others around you are doing.

5.3.3 Quality Planning

Quality planning for the quality control plan (QCP) implementation will be the responsibility of the QA/QC manager. Planning is a continuous process throughout the life of the project and adjusts to the needs and requirements of a project as the project progresses.

The quality of a work product is a function of the level of planning. The overall quality plan for a project should be well thought out at the beginning of a project, but should also be continually adjusted and improved throughout the project life to address all aspects and needs of the project which develop. The QA/QC manager should incorporate the following items into their planning for their respective project tasks and objectives:

- Identify specific technical needs;
- Select the appropriate work crew;
- Provide all applicable project plans; and
- Identify method for tracking project schedule and funding.

5.3.4 Quality Work

The work crew will normally consist of a driller, field manager/field geologist, sample manager and one to two drill rig helpers. Additional persons will be added as dictated by project requirements. Crew members assigned to specific tasks will be technically qualified and competent, and will have shown high quality of work on previous projects. Crew members that have demonstrated a high level of experience will be assigned to lead tasks for field work and will serve as trainers for mentoring, training, and developing the technical skills of less experienced crew members.

5.3.5 Training

5.3.5.1 Project Team

The project team members working on hazardous, toxic and radioactive waste (HTRW) sites assigned to field operations will have, at a minimum, completed the following training:

- A Hazardous Waste Operations 40-hour training course; and
- Appropriate refresher courses

5.3.5.2 Crew Members

At a minimum two crew members per crew will be required to have the following current training, but all crew members are encouraged to have:

- Completed courses in first aid; and
- Completed courses in cardiopulmonary resuscitation (CPR).

5.3.6 Project Meetings

Routine Meetings for a project should be scheduled as appropriate but need to include as a minimum the following:

- Project coordination/review;
- Review of daily tailgate safety meetings.

5.3.7 Correcting Deficiencies

Corrective actions will be taken as necessary to correct deficiencies. Corrective action will be determined based on the specific deficiency and the impact on the technical quality of the project.

Deficiencies detected during project execution and resolutions will be thoroughly documented in field logbooks, on daily exploration reports, and on boring logs, as appropriate.

5.3.8 Checklists

The quality control checklists in Appendix C as well as the field forms in Appendix B of this work plan are provided as a means to insure that certain tasks are performed correctly and thoroughly. The quality control checklists are intended to be generic but in general should be used as a reminder to perform a task or as a minimum to consider whether or not a task needs to be performed. Checklists act as reminders. The field forms will be completed in the field by the field manager, Task QA/QC Manager, or Field Sample Manager during completion of the specific activity or inspection and are more task-specific. The field forms reinforce that specific procedures be followed during specific tasks. The quality control checklists are listed below and included in Appendix C of this work plan:

- Borehole and Core Logging Checklist (one for each boring log)
- Well Development Checklist (one for each monitoring well)
- Drilling Methods Checklist (daily for each monitoring well)
- Field Documentation Checklist (one for each field shift, anticipate one per 10-day shift)
- Health and Safety Checklist (one for each field shift, anticipate one per 10-day shift)
- Investigation Derived Waste Management Checklist (one for each field shift, anticipate one per 10-day shift)
- Instrument Calibration Checklist (one for each field shift, anticipate one per 10-day shift)
- Mobilization/Demobilization Checklist (one time for mobilization and one time following demobilization)
- Well Construction Checklist (one for each monitoring well)
- Decontamination Checklist (one for each well inspected)
- Sample Collection Checklist (one for each monitoring well location inspected)

5.4. Recommendations

Recommendations for changes/improvements should be directed to the QA/QC Manager or Field Manager.

6.0 DELIVERABLES

A monitoring well installation report will be prepared to document the details of the monitoring well installation. The report will include: detailed description of all field activities and protocols; copies of daily activity logs; well boring and construction logs; well development forms; quality control checklists and supporting photographs. Copies of these forms and checklists are included in Appendix B and C. The drilling subcontractor will submit a Long Island Well Completion Report to the NYSDEC Regional Headquarters office in Stony Brook, New York.

7.0 SCHEDULE

The drilling program will be completed in 10-day cycles (10 days on and 4 days off). The first 10-day shift for Phase 1 will begin on or around November 20, 2005, and a total of 29 field days are planned. A total of 22 field days are planned for Phase 2. Phase 2 is projected to begin in April-May 2006 with the actual start date to be determined. The estimated number of days per well is as follows:

Phase 1
- EW-2D – 8 days
- EW-10D – 7 days
- EW-12D – 7 days
- EW-14D – 7 days

Phase 2
- EW-4D – 8 days
- EW-11D – 7 days
- EW-13D – 7 days

Anti-percolation collars will be installed soon after the installation of each monitoring well. Development of the monitoring wells will be performed as time permits during drilling activities.

8.0 REFERENCES

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APPENDIX A

TECHNICAL SPECIFICATIONS
DRILLING AND WELL CONSTRUCTION
New York State Requirements 6 NYCRR 360-2.11

(8) Monitoring wells and piezometers.

<u>(i) Construction in general</u>.

(a) Monitoring wells and piezometers must define the three-dimensional flow system within the critical stratigraphic section to justify the interpretations and conclusions of the hydrogeologic report.

(b) Construction techniques must be appropriate to ensure that groundwater samples and head level measurements characterize discrete stratigraphic intervals; and to prevent leakage of groundwater or contaminants along the well annulus. If leakage is detected, it must be corrected or the well abandoned.

(c) Monitoring wells and piezometers may be placed individually or as well clusters. Well clusters consist of individual wells at varying depths in close proximity, each installed in its own boring. Multiple wells placed into one large borehole are prohibited unless prior department approval in writing is obtained.

(d) Soil borings, soil samples, and rock cores must characterize each stratigraphic unit within the critical stratigraphic section to justify the interpretations and conclusions of the hydrogeologic report.

(e) Every precaution must be taken during drilling and construction of monitoring wells to avoid introducing contaminants into a borehole. Only potable water of known chemistry may be used in drilling monitoring wells or piezometers unless otherwise approved by the department.

(f) All equipment placed into the boring must be properly decontaminated before use at the site and between boreholes. The initial cleaning at the site must ensure that no contaminants from the last site drilled will be introduced into the borings. All equipment must be steam cleaned between holes. Where possible, upgradient wells should be drilled first.

(g) Use of drilling muds is to be avoided unless prior department approval in writing is granted. If drilling muds are used, the material used must avoid the introduction of stray contaminants. Drilling muds must not be used within 10 feet of the screened interval.

(h) Air systems and drilling lubricants must not introduce contaminants into the borehole.

(i) Well borings must have an inside diameter at least two inches larger than the outside diameter of the casing and screen to ensure that a tremie may be properly used.

(j) Wells and borings must not be placed through or into waste unless prior department approval has been granted and sufficient safety precautions are employed. If waste is encountered unexpectedly during drilling, drilling of that boring must cease, the hole properly abandoned with cuttings properly disposed of and the department notified.

<u>(ii) Construction of monitoring wells and piezometers.</u>

(a) Well screens and risers must be constructed of materials selected to last for the required monitoring period of the facility without contributing contaminants to, or removing contaminants from, the groundwater. All materials used are subject to department approval. Joints, caps, and end plugs are to be secured by welds, threads with teflon tape, or force fittings. Solvents and glues or other adhesives are prohibited. Caps must be vented to allow for proper pressure equalization. The inside diameter of each well screen or riser pipe must be nominally two inches in diameter and must allow for proper development, survey and sampling equipment to be used within the screen and casing. A permanent mark should be made at the top of the riser pipe to provide a datum

for subsequent water level measurements.
(b) Unless otherwise approved by the department, well screens are required for all wells and piezometers. All screens used must be factory constructed non-solvent welded/bonded continuous slot wire wrap screens of a material appropriate for long-term monitoring without contributing contaminants to or removing contaminants from the groundwater. The slot size of the screen must be compatible with the sand pack. Water table variations, site stratigraphy, expected contaminant behavior, and groundwater flow must be considered in determining the screen length, materials, and position. Where existing contamination is suspected or known, down-hole geophysical techniques may be required by the department to aid in selecting well screen elevations.
(c) The sand pack surrounding the well screen must consist of clean, inert, siliceous material. Grain size must be based upon a representative sieve analysis of the zone to be screened. The sand pack must minimize the amount of fine materials entering the well and must not inhibit water inflow to the well. The sand pack must be placed in the annular space around the well screen and extend two feet or 20 percent of the screen length (whichever is greater) above the top, and six inches below the bottom, of the screen. The sand pack material must be placed using the tremie method or another method approved by the department and must avoid bridging. The sand pack must be checked for proper placement. A finer grained sand pack material (100 percent passing the No. 30 sieve and less than two percent passing the No. 200 sieve) six inches thick must be placed at the top of the sand pack between the sand and the bentonite seal.
(d) Bentonite must be placed above the sand pack using the tremie or other approved method to form a seal at least three feet thick. A 6 to 12 inch fine grained sand pack must be placed above the bentonite seal to minimize grout infiltration. If pellets or chips are used, sufficient time should be allotted to allow for full hydration of the bentonite prior to emplacement of overlying materials.
(e) Grout of cement/bentonite, bentonite alone, or other suitable, low permeability material, if approved by the department, must completely fill the remaining annular space to the surface seal. The grout mixture must set up without being diluted by formation water, and must displace water in the annular space to ensure a continuous seal. The grout mixture must be placed under pressure using a tremie or other method approved by the department. Auger flights or casing must be left in the hole before grouting to prevent caving. The cement used must be appropriate for the groundwater chemistry of the site.
(f) A protective steel casing, at least two inches larger in diameter than the well casing, must be placed over the well casing or riser pipe and secured in a surface well seal to adequately protect the well casing. A distinctive, readily visible marker must be permanently affixed to the protective casing or near the well to identify the well number and ensure visibility even in periods of high snow cover. A drain hole must be drilled at the base of the protective casing. A vent hole must be located near the top of the protective casing to prevent explosive gas build up and to allow water levels to respond naturally to barometric pressure changes. The annulus of the protective casing should be filled with gravel. A locking cap must be installed with one to two inches clearance between the top of the well cap and the bottom of the locking cap when in the locked position and a weather resistant padlock must be placed on the protective casing and duplicate keys provided to the department.
(g) A concrete surface seal designed to last throughout the planned life of the monitoring well must be constructed. The surface seal must extend below the frost depth to prevent potential well damage. The top of the seal must be constructed by pouring the concrete into a pre-built form with a minimum of three foot long sides. The seal must be designed to prevent surface runoff from ponding and entering the well casing. In areas where traffic may cause damage to the well, bumperguards or other suitable protection for the

well is required. Any damaged or deteriorated surface seals must be reported to the department and repaired or replaced in an appropriate manner. The department may allow alternate designs when documentation is presented which demonstrates the intent of the regulations.

(h) Where under the circumstances of a particular situation the department believes that the methods identified in this section are inadequate, it may require that additional measures be taken to prevent migration of contaminants along the annulus of the well or to protect the well.

(i) Alternative construction methods for piezometers and wells which are not to be part of the environmental monitoring plan may be approved by the department if those methods meet the requirements set forth in clause (i)(b) of this paragraph.

<u>(iii) Well and piezometer development</u>.

All wells and piezometers must be developed as soon as possible after installation, but not before the well seal and grout have set. Water must not be introduced into the well for development, except with approval of the department. Any contaminated water withdrawn during development must be properly managed. Development must not disturb the strata above the water-bearing zone or damage the well. The entire saturated screened interval must be developed. The department may require multiple attempts at well development to increase the likelihood that sediment free water can be obtained. Development methods should be appropriate for conditions/stratigraphy encountered. Placement of screens in a fine grained strata may require gentle development techniques to avoid pulling sediment into the well. The selected method must minimize to the greatest extent possible the amount of turbidity in the well.

<u>(iv) Survey</u>.

The locations and elevations of all existing and abandoned test pits, soil borings, monitoring wells, and piezometers must be surveyed to obtain their precise location and plotted on a map in the hydrogeologic report. The vertical location of the ground surface and the mark made on the top of the monitoring well and piezometer risers must be accurately measured to the nearest 100th foot.

<u>(v) Replacement of wells</u>.

All wells must be properly protected to ensure their integrity throughout the active and post-closure period of the facility. If, in the opinion of the department, water quality or other data show that the integrity of a well is lost, the well must be replaced and sampled within a time period acceptable to the department (but not to exceed 120 days) after written notification by the department. The initial sample for the replacement well must be analyzed for baseline parameters in the Water Quality Analysis Tables in this section.

<u>(vi) Abandonment of wells</u>.

All soil borings or rock cores which are not completed as monitoring wells or piezometers and other abandoned wells must be fully sealed in a manner appropriate for the geologic conditions to prevent contaminant migration through the borehole. Generally, such sealing must include:

(a) Overboring or removal of the casing to the greatest extent possible, followed by perforation of any casing left in place. All casing and well installations in the upper five feet of the boring, or within five feet of the proposed level of excavation, must be removed.

(b) Sealing by pressure injection with cement bentonite grout, using a tremie pipe or other method acceptable to the department, must extend the entire length of the boring to five feet below the ground surface or the proposed excavation level. The screened interval of the borehole must be sealed separately and tested to ensure its adequacy before sealing the remainder of the borehole. Where the surrounding geologic deposits are highly permeable, alternate methods of sealing may be required to prevent the migration of the grout into the surrounding geologic formation. The upper five feet must be backfilled with appropriate native materials compacted to avoid settlement.

(c) The sealed site must be restored to a safe condition. The site must be inspected periodically after sealing for settlement or other conditions which require remediation.

(9) Geologic sampling.

(i) All borings and rock cores must be sampled continuously to the base of the critical stratigraphic section. For well clusters, continuous samples must be collected from the surface to the base of the deepest well. Other wells in the cluster must be sampled at all stratigraphic changes, and at the screened interval. At sites where the geology is not of a complex nature the department may allow a reduction in the number of wells requiring continuous sampling. Soil borings must be sampled using the split spoon method and bedrock or boulders must be sampled by coring with standard size NX or larger diameter core bits. Samples must be retained in labeled glass jars or wooden core boxes. All samples must be securely stored and accessible throughout the life of the facility. The location of the storage area must be designated in the operation and maintenance plan for the facility.

(ii) A representative number of undisturbed samples must be collected from test pits and soil borings using appropriate methods to identify the soil characteristics of all cohesive soil units. Such samples must be analyzed in the laboratory for: Atterberg limits; gradation curves by sieve or hydrometer analysis or both, as appropriate; undisturbed permeabilities; and visual descriptions of undisturbed soil structures and lithologies.

(10) Logs.

(i) Complete and accurate drilling logs must be provided to the department for all soil borings. These logs must provide detailed soil classification according to the Unified Soil Classification System (USCS). The USCS visual method must be used on all samples supplemented by the USCS laboratory tests on a representative number of samples from each stratigraphic unit and each screened interval. Logs also must contain a description of matrix and clasts, mineralogy, roundness, color, appearance, odor, and behavior of materials using an appropriate descriptive system. A clear description of the system used must be included with the logs. When undisturbed samples have been taken, the interval tested and the test results must be clearly shown on the logs. All well logs must contain drilling information as observed in the field including: moisture content, location of the water table during drilling, water loss during drilling; depth to significant changes in material and rock; sample recovery measured in tenths of a foot; hammer blow counts, and other pertinent comments; the method of drilling, anomalous features such as gas in the well, and the use and description of drilling fluids or additives, including the source, and calculated and actual amounts of materials used.

(ii) Rock core logs must describe the lithology, mineralogy, degree of cementation, color, grain size, and any other physical characteristics of the rock; percent recovery and the rock quality designation (RQD); other primary and secondary features, and contain all drilling observations and appropriate details required for soil boring logs. A clear photograph of all labeled cores must also be taken and submitted with the logs.

(iii) Well completion logs must contain a diagram of the completed well, all pertinent details on well construction, a description of the materials used, and elevations of all well features.

(iv) Copies of original field logs must be submitted to the department upon request.

APPENDIX B

FIELD FORMS

Daily Activity Report

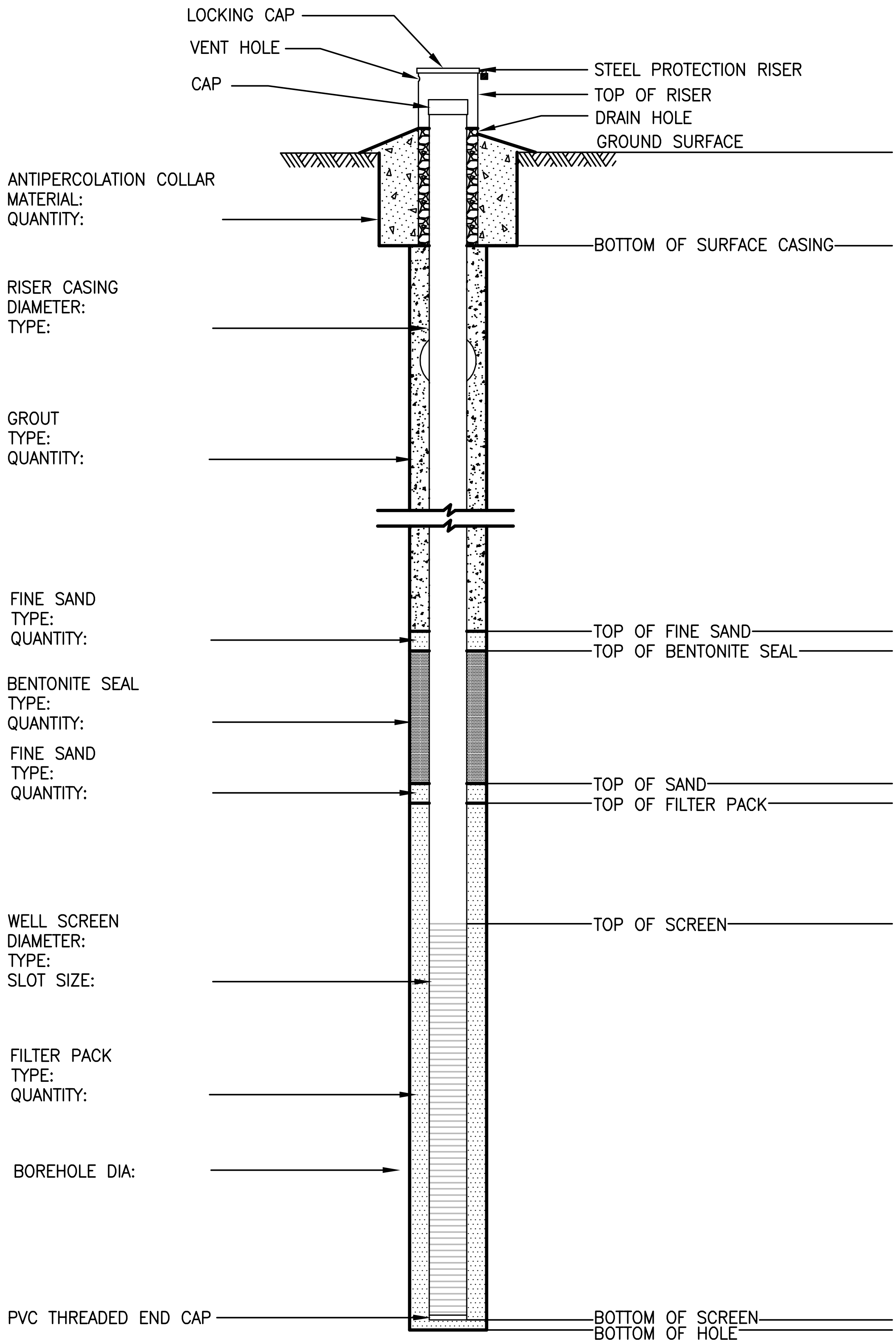
Claremont Polychemical Well Installation

Date:	**Weather/Site Conditions:**
On-site Personnel:	**Visitors:**
Summary of Days Activities:	
Problems Encountered:	
Significant Communications/Conversations:	
Compliance/Deviations from the Work Plan:	
Health and Safety Issues:	
Signature of Field Manager:	

5386-TWC.dwg

MONITORING WELL CONSTRUCTION LOG FORM
POLYCHEMICAL SUPERFUND SITE

WELL NUMBER:	COORDINATES:	ELEVATION:	REFERENCE POINT:
		DEPTH	ELEVATION
		0	



Science Applications International Corporation
An Employee-Owned Company

GROUNDWATER SAMPLE LOG

Project Name: ______________________________
Project Number: ______________________________
Purged by: ______________&______________
Sampled by: ______________&______________

Well Identification: ______________________________
Project Location: ______________________________
Date: ______________________________
Date: ______________________________

GROUNDWATER PURGE INFORMATION:

Time	Temp. Celsius	pH	Cond. mS/cm	Turb. NTU	D.O. mg/l	Eh mv	Sal	Purged Quantity	D.T.W.	Comments

PURGE INFORMATION:

Time/Date Started: ______________ | ______________
Time Purge End: ______________________________
Purge Rate(s): ________________________ (gpm)
Purged Volume: ________________________(gal.)
Water Quality Instrument: ______________________
Pump Type and ID: __________________________
Depth(s) to Intake: __________________________
Water Containerized/Amount? ________________
Did the well cavitate? YES_________ NO_________

SAMPLING INFORMATION:

Time/Date Started: ______________ | ______________
Sampled by: ______________ & ______________
Sample Method: ______________________________
Parameters to be Analyzed: ____________________
Number of Bottles Collected: __________________
Bottle Preservatives: ________________________
Other: ______________________________

ADDITIONAL INFORMATION: (i.e. weather conditions, problems encountered, maintenance required, unusual color/odor, etc.) ____

____

____

____

Science Applications International Corporation
An Employee-Owned Company

WELL DEVELOPMENT LOG

Project Name: ______________________________ Well Identification: ___________________________

Project Number: ____________________________ Project Location: ____________________________

Developed by: ______________&______________ Date: ______________________________________

DEVELOPMENT INFORMATION:

Time	Temp. Celsius	pH	Cond. mS/cm	Turb. NTU	D.O. mg/l	Eh mv	Sal	Purged Quantity	D.T.W.	Comments

DEVELOPMENT INFORMATION:

Time/Date Started: _____________| ____________ Development Method: ________________________

Time Ended: _________________________________

Purge Rate(s): _________________________ (gpm)

Purged Volume: ________________________(gal.)

Water Quality Instrument: ____________________

Water Containerized/Amount? __________________

ADDITIONAL INFORMATION: (i.e. weather conditions, problems encountered, maintenance required, unusual color/odor, etc.) ____

APPENDIX C

QUALITY CONTROL FORMS

BOREHOLE AND CORE LOGGING CHECKLIST

Project Name/Number: ______________________________

Site: ______________________________

Boring/Monitoring Well Number: ______________________________

Starting Date: ______________________ **Completion Date:** ______________________

Complete for each boring log. Answer each question by checking the appropriate column (yes, no, not observed (N/O) or N/A). If a No *is checked, provide an explanation on the Noncompliance and Corrective Actions form.*

<u>Borehole Logging</u>

	Yes	**No**	**N/O**	**N/A**
1. Was boring logged by a geologist or geological engineer?	☐	☐	☐	☐
2. Was log completed and entries printed legibly on USACE Form MRK-55 or MRK-55-2?	☐	☐	☐	☐
3. Was the log scale 1 inch = 1 foot?	☐	☐	☐	☐
4. Were logs completed in the field (originals)?	☐	☐	☐	☐
5. Does log contain the following •routine entries•?	☐	☐	☐	☐
• Unique well number (as per Work Plan)?	☐	☐	☐	☐
• Depositional type (alluvium, till, loess, etc.)	☐	☐	☐	☐
• Depths/Heights recorded in tenths of feet?	☐	☐	☐	☐
• Other descriptive features (bedding, organic material, soil structures; e.g., root-holes)	☐	☐	☐	☐
• Soils classified as per USCS and fully described with numerical percents of constituents?	☐	☐	☐	☐
• Soil moisture content and texture or cohesiveness?	☐	☐	☐	☐
• Soil color described using the Munsell System?	☐	☐	☐	☐
6. Was general information (top of form MRK-55) completed?	☐	☐	☐	☐
7. Was the log signed by person preparing the log?	☐	☐	☐	☐
8. Were special conditions (i.e., intervals of hole instability) and their resolution recorded?	☐	☐	☐	☐
9. Were start and completion dates and time included for boring and well installation activities?	☐	☐	☐	☐
10. Were boundaries between soils noted (solid line at appropriate depth or dashed line if transitional or if observed in cuttings)?	☐	☐	☐	☐

11. Were depths at which free water was encountered and stabilized water levels recorded?	☐	☐	☐	☐
12. Were soil sample depths recorded?	☐	☐	☐	☐
13. Were changes in drilling or sampling methods or equipment and changes in sample or borehole diameter recorded?	☐	☐	☐	☐
14. Were soil sampling methods and recovery recorded?	☐	☐	☐	☐
15. Were instrument (e.g., LEL, OVM) and detector tube measurements recorded?	☐	☐	☐	☐
16. Was observed evidence of contamination in samples, cuttings, or drilling fluids recorded?	☐	☐	☐	☐
17. Were abbreviations used on log defined?	☐	☐	☐	☐
18. Were drilling fluid losses including depth, rate, and volume in the subsurface recorded?	☐	☐	☐	☐
19. Were drilling fluids described (water source, additive brand, product name, and mixture, and type and brand of compressed air filter)?	☐	☐	☐	☐
20. Were drilling pressures and driller's comments recorded?	☐	☐	☐	☐
21. Was total depth recorded and marked with a double line?	☐	☐	☐	☐
22. Was monitoring well diagram completed and attached to log?	☐	☐	☐	☐

Core Logging

In addition to the items above, the following also apply to core-logging:

23. Was rock described using standard geologic nomenclature; e.g., rock type, relative hardness, density, texture, color, weathering, bedding, fossils, crystals, and open or closed fractures, joints, bedding planes, or cavities and filling materials?	☐	☐	☐	☐
24. Was start and stop time of each core run recorded?	☐	☐	☐	☐
25. Were depths to top and bottom of each core run recorded?	☐	☐	☐	☐
26. Was length of core recovered in each core run recorded?	☐	☐	☐	☐
27. Were the size and type of coring bit and barrel recorded?	☐	☐	☐	☐
28. Was the depth to the bottom of the hole measured after the core was removed for each core run?	☐	☐	☐	☐

The QC Inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: ____

Date: ______________________________________

WELL DEVELOPMENT CHECKLIST

Project Name/Number: ____

Site: ____

Monitoring Well Number: ____

Starting Date: ___________________________ **Completion Date:** ________________________

Complete for each monitoring well. Answer each question by checking the appropriate column (yes, no, not observed (N/O) or N/A). If a No *is checked, provide an explanation on the Noncompliance and Corrective Actions form.*

General	**Yes**	**No**	**N/O**	**N/A**
1. Was the grout allowed to set at least 48 hours after placement before starting development?	☐	☐	☐	☐
2. Were methods of development in accordance with the Work Plan?	☐	☐	☐	☐
3. Was final development water free of sand and drilling fluids?	☐	☐	☐	☐
4. Was development sufficiently complete to allow collection of ground water samples at 50 NTUs or less?	☐	☐	☐	☐
5. Was a minimum of 3 times the volume of liquid lost during drilling and filter pack placement removed during development?	☐	☐	☐	☐
6. Was well development information accurately recorded on the well development form?	☐	☐	☐	☐
7. Were color photographs taken of the water after completion of development?	☐	☐	☐	☐

The QC Inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: ____

Date: ____

DRILLING METHODS CHECKLIST

Project Name/Number: ____

Site: ____

Boring/Monitoring Well Number(s): ____

Sampling Date: ______________________________

Complete daily for each monitoring well. Answer each question by checking the appropriate column (yes, no, not observed (N/O) or N/A). If a No *is checked, provide an explanation on the Noncompliance and Corrective Actions form.*

General	**Yes**	**No**	**N/O**	**N/A**
1. Are chemically inert hoses (i.e. nylon, PVC, polyethylene) used on all water equipment (i.e. steam cleaner, submersible pumps, Pad water tanks)?	☐	☐	☐	☐
2. Are there any fluid leaks on drilling rig and associated equipment?	☐	☐	☐	☐
3. If so, have oil absorbent pads been used to contain leaks?	☐	☐	☐	☐
4. Was sampling equipment transported or stored away from fuel sources or fuel spill areas?	☐	☐	☐	☐
5. Was clean equipment wrapped in visqueen?	☐	☐	☐	☐
6. If monitoring wells were developed using a utility winch on the rig, did the winch cable come in contact with the well casing or ground water?	☐	☐	☐	☐
7. Were clean and dirty equipment stored or transported separately?	☐	☐	☐	☐
8. Did sampling equipment such as auger flights, drill rods, and split spoon samplers come in contact with lubricants?	☐	☐	☐	☐
Air Rotary				
9. Was the type of air compressor noted?	☐	☐	☐	☐
10. Was the type of lubricating oil recorded?	☐	☐	☐	☐
11. Was an airline oil filter used?	☐	☐	☐	☐
12. Was the filter changed per manufacturers recommendation?	☐	☐	☐	☐
13. Were PID checks of the quality of the compressed air recorded in the logbook?	☐	☐	☐	☐
14. Was the air checked for dust during air rotary drilling, and if present, was water added to the compressed air?	☐	☐	☐	☐
15. Was the amount of water added to the compressed air recorded on the boring log?	☐	☐	☐	☐

16. Were air rotary drilling techniques halted when ground water was encountered?	☐	☐	☐	☐

Rotary Wash

17. Was a sample of the proposed drilling water analyzed?	☐	☐	☐	☐
18. Was the source of drilling water approved by the USACE in writing before mobilization to the Site?	☐	☐	☐	☐
19. Was the water circulated in portable tanks?	☐	☐	☐	☐
20. Was bentonite used?	☐	☐	☐	☐
21. Were any additives used besides bentonite?	☐	☐	☐	☐
22. If bentonite or other additives were added to the water, was the situation requiring their use documented on the boring log?	☐	☐	☐	☐
23. Was the bentonite supplier, brand and type recorded on the Materials Summary Form?	☐	☐	☐	☐

Depth Measurements Precision and Accuracy

24. Was the well installed to the depth defined in the Work Plan?	☐	☐	☐	☐
25. Was the depth of each boring verified by measuring with a fiberglass or steel tape?	☐	☐	☐	☐
26. Was depth to ground water measurements collected with an electronic tape?	☐	☐	☐	☐
27. Were depth measurements verified by estimating the amount of drill rods or by taking multiple measurements?	☐	☐	☐	☐
28. Was the Kelly Bar marked to verify depth during drilling?	☐	☐	☐	☐
29. Was the boring open to the bottom?	☐	☐	☐	☐

Cable-Tool Methods

30. Were all drilling tools and cables inspected daily prior to their use?	☐	☐	☐	☐
31. Was the proper speed of drilling utilized to allow a smooth operation and a clean hard tool drop?	☐	☐	☐	☐
32. Did the driller check the drill tools with a level on two sides at right angles to ensure a straight boring prior to drilling?	☐	☐	☐	☐
33. Was the drill cable marked to identify depths during drilling?	☐	☐	☐	☐
34. Were the chain tongs or other hand tools laid on the ground at anytime?	☐	☐	☐	☐
35. Was the length of the drilling stroke recorded in the field notebook?	☐	☐	☐	☐

36. Were all drive shoes and the depth of any changes recorded on the drilling log?	☐	☐	☐	☐
37. Were the number of blows per drive interval recorded on the drilling log?	☐	☐	☐	☐
38. If the boring required casing were the individual sections measured and recorded on the drilling log?	☐	☐	☐	☐

The QC Inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: ____

Date: ____

FIELD DOCUMENTATION CHECKLIST

Project Name/Number: ____

Site: ____

Complete following each field shift (Anticipated to be completed following each ten day shift). Answer each question by checking the appropriate column (yes, no, or N/A). If a No *is checked, provide an explanation on the Noncompliance and Corrective Actions form.*

Field Documentation	**Yes**	**No**	**N/A**
1. Was all original field data, except boring logs, recorded in black indelible ink?	☐	☐	☐
2. Were logbooks filled out properly; accurately recounting the day's events?	☐	☐	☐
3. Were all field forms completed and information accurately recorded:	☐	☐	☐
• DQCR's?	☐	☐	☐
• Borehole Logs?	☐	☐	☐
• Well Construction Diagrams?	☐	☐	☐
• Well Development Forms?	☐	☐	☐
• Sampling Forms?	☐	☐	☐
• Water Level Forms?	☐	☐	☐
• Chain of Custody Forms?	☐	☐	☐
• Field Log Books?	☐	☐	☐
• Project Photograph Log (in Log Book)?	☐	☐	☐
• Daily Air Monitoring Record?	☐	☐	☐

List additional field forms completed: ____

____

____

4. Was field documentation forwarded to office for peer review and QC?	☐	☐	☐
5. Were deficiencies reported to QC Manager/Project Team Manager?	☐	☐	☐

The QC Inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: ____

Date: ______________________________

HEALTH AND SAFETY CHECKLIST

Date: ______________________________

Project Name/Number: ______________________________

Site: ______________________________

Personnel Observed and Locations: ______________________________

____

Complete following each field shift (Anticipated to be completed following each ten day shift). Answer each question by checking the appropriate column (yes, no, or N/A). If a No *is checked, provide an explanation on the Noncompliance and Corrective Actions form.*

Documentation	**Yes**	**No**	**N/A**
1. Is the Site Health and Safety Plan (SSHP) on the Site?	☐	☐	☐
2. Has the SSHP been reviewed, dated, and signed within the last year?	☐	☐	☐
3. Are the tasks being completed reflected in the hazard task analysis?	☐	☐	☐
4. Is there a written acknowledgement that all employees, including subcontractors have been briefed and read the SSHP?	☐	☐	☐
5. Are the following training records current and available:			
• 40-Hour HAZWOPER/8-hour refresher for ALL employees and subcontractors?	☐	☐	☐
• 24 Hours Supervised Field Experience?	☐	☐	☐
• 8-Hour HAZWOPER Annual Refresher?	☐	☐	☐
• CPR/First Aid?	☐	☐	☐
• 8-Hour Hazardous Waste Site Supervisor, and refresher?	☐	☐	☐
• Initial Site Health and Safety Briefing?	☐	☐	☐
• Site Health and Safety Briefing for each location or site?	☐	☐	☐
6. Are emergency maps posted at the site and maintained in vehicles?	☐	☐	☐
7. Were daily safety checklists completed and fire extinguishers checked?	☐	☐	☐
8. Were applicable Material Safety Data Sheets at the Site?	☐	☐	☐
9. Are documents current and available that indicate employees and subcontractors are medically fit to work and wear the required personal protective equipment?	☐	☐	☐
10. Were daily air monitoring equipment calibrations recorded?	☐	☐	☐

11. Are respirator fit test records available and current?	☐	☐	☐
Observations			
12. Are exclusion zones and contaminant reduction zone adequately marked?	☐	☐	☐
13. Is required personal protective equipment available and correctly used, maintained, and stored?	☐	☐	☐
14. Is the following emergency equipment located at each site:	☐	☐	☐
• Fire extinguisher?	☐	☐	☐
• Eyewash (15 minutes fresh water)?	☐	☐	☐
• Communications (walkie-talkie or phone)?	☐	☐	☐
• First aid kit?	☐	☐	☐
15. Is the buddy system in use?	☐	☐	☐
16. Are personnel refraining from drinking, chewing, smoking, taking medications, or other hand-to-mouth contact while working in the exclusion zone?	☐	☐	☐
17. Is air monitoring equipment being used appropriately?	☐	☐	☐
18. Is the site organized to allow the use of lifting equipment, and avoid tripping hazards and spreading contamination?	☐	☐	☐
19. Was a random employee asked if he/she know site hazard and emergency procedures?	☐	☐	☐
20. Is the drill rig kill switch clearly marked and easily accessible?	☐	☐	☐

The QC Inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: ____

Date: ________________________________

INVESTIGATION-DERIVED WASTE MANAGEMENT CHECKLIST

Project Name/Number: ____

Site: ____

Boring/Monitoring Well Number(s): ____

Date: ______________________________

Complete following each field shift (Anticipated to be completed following each ten day shift). Answer each question by checking the appropriate column (yes, no, or N/A). If a No *is checked, provide an explanation on the Noncompliance and Corrective Actions form.*

	Investigation-Derived Waste Management	**Yes**	**No**	**N/A**
1.	Was all IDW managed according to the WMP?	☐	☐	☐
2.	Were soil cuttings, drilling fluids, decon water, development water, and PPE containerized in 55-gallon drums?	☐	☐	☐
3.	Were all containers properly labeled and placed on pallets?	☐	☐	☐
4.	Was the Drum Inventory Worksheet completed?	☐	☐	☐
5.	Were all containers in satisfactory condition?	☐	☐	☐

The QC Inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: ____

Date: ______________________________

INSTRUMENT CALIBRATION CHECKLIST

Project Name/Number: ______________________________

Site: ______________________________

____

Date: ______________________

Complete following each field shift (Anticipated to be completed following each ten day shift). Answer each question by checking the appropriate column (yes, no, or N/A). If a No *is checked, provide an explanation on the Noncompliance and Corrective Actions form.*

	Instrument Calibration	**Yes**	**No**	**N/A**
1.	Were all field instruments calibrated properly?	☐	☐	☐
2.	Were all field instruments calibrated on the schedule in the Work Plan/SSHP?	☐	☐	☐
3.	Did the Field Calibration Forms list all calibration events?	☐	☐	☐

List instruments used at the Site: ______________________________

____

____

____

The QC Inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: ______________________________

Date: ______________________

MOBILIZATION/DEMOBILIZATION CHECKLIST

Project Name/Number: ______________________________

Site: ______________________________

Mobilization complete one time at the beginning of the project. Demobilization complete one time at the end of the project. Answer each question by checking the appropriate column (yes, no, or N/A). If a No *is checked, provide explanation on the Noncompliance and Corrective Actions form.*

	Site Access and Security	**Yes**	**No**	**N/A**
	Complete 4 weeks prior to start of field activities.			
1.	Has a copy of the Right of Entry Permit(s) been received?	☐	☐	☐
2.	Are the time frames on the Right of Entry Permits adequate for the entire job including IDW disposal?	☐	☐	☐
	Permits and Licenses			
	Complete 4 weeks prior to start of fieldwork.			
3.	Are all subcontractors licensed to operate in the state?	☐	☐	☐
4.	Are license numbers of subcontractors recorded in the project files?	☐	☐	☐
5.	Have subcontractors provided proof of insurance?	☐	☐	☐
6.	Have variances been obtained from the state?	☐	☐	☐

If yes, provide a list of variances obtained: ______________________________

____

	Coordination with Property Owners and Tenants			
	Complete 4 weeks before start of field activities.			
7.	Has the property owner been contacted?	☐	☐	☐
8.	Did the property owner designate a contractor staging area?	☐	☐	☐
9.	Did the property owner designate an IDW staging area?	☐	☐	☐
10.	Did the property owner approve a source for water?	☐	☐	☐
	Coordination with Environmental Authorities			
	Complete within 4 weeks of notice to proceed.			
11.	Has the State approved the Work Plan?	☐	☐	☐
12.	Has the State been informed of the planned sampling events?	☐	☐	☐
13.	Has USEPA approved the Work Plan?	☐	☐	☐

14. Has USEPA been informed of the planned sampling events?	☐	☐	☐
<u>Safety Planning and Equipment</u>			
Complete 1 week before start of field activities.			
15. Has the SSHP been submitted to subcontractors for review?	☐	☐	☐
16. Have all personnel read and signed the SSHP?	☐	☐	☐
17. Was the local hospital contacted to verify the phone number and address?	☐	☐	☐
18. Can the hospital treat anticipated potential chemical exposures?	☐	☐	☐
19. Have all field personnel been fit-tested for respirator use?	☐	☐	☐
20. Were all training certificates, including subcontractors, in a file to take to the field?	☐	☐	☐
21. Are all training certificates current?	☐	☐	☐
22. Are all MSDS's in a file to take to the field?	☐	☐	☐
23. Are all required instruments reserved and complete with calibration standards and manuals?	☐	☐	☐
24. Do the instruments meet manufacturer maintenance and calibration standards?	☐	☐	☐
25. Does the PID have the correct lamp?	☐	☐	☐
26. Does the LEL meter have the correct sensors?	☐	☐	☐
27. Are the detector tubes current and stored properly?	☐	☐	☐
<u>Logistical Planning</u>			
Complete within 1 week of notice to proceed.	**<u>Yes</u>**	**<u>No</u>**	**<u>N/A</u>**
28. Have the Work plan documents been approved by USACE?			
29. Has the SSHP been approved by Health and Safety Services?	☐	☐	☐
30. Has notice to proceed from the USACE been received?	☐	☐	☐
31. Are the project personnel available and scheduled?	☐	☐	☐
32. Are subcontractors available?	☐	☐	☐
33. Do subcontractors SOWs correspond to the approved Work Plan?	☐	☐	☐
34. Has the laboratory agreed to the planned sample volume load?	☐	☐	☐
35. Has the bottle order been placed?			

		Yes	No	N/A
		☐	☐	☐
36.	Have correct sample containers been received?	☐	☐	☐
37.	Has USACE been notified of schedule?	☐	☐	☐

Utility Clearances

Complete not less than 1 week before fieldwork is scheduled to begin.

		Yes	No	N/A
38.	Has the State or Local utility clearance agency been contacted and a meeting scheduled?	☐	☐	☐
39.	Has a representative from each notified utility called to confirm the utility meeting?	☐	☐	☐
40.	Was a utility work authorization number recorded?	☐	☐	☐
41.	Was the property owner asked about the existence of any underground utilities or tanks?	☐	☐	☐
42.	Has a UXO survey been conducted at the site?	☐	☐	☐
43.	If yes to the above question, is a report available?	☐	☐	☐

Environmental Site Protection

44.	Are drilling and sampling locations accessible without property damage?	☐	☐	☐
45.	Is work area limited to prevent property damage?	☐	☐	☐
46.	Is IDW area greater than 100 feet away from a major stream, tributary, or drinking water well?	☐	☐	☐
47.	If field activities damage property, will measures be taken to restore the Site (explain below)?	☐	☐	☐

Demobilization

		Yes	No	N/A
48.	Was the site returned, as much as possible, to its original condition?	☐	☐	☐
49.	Was each work area policed for trash?	☐	☐	☐
50.	Did the site point of contact inspect the site?	☐	☐	☐
51.	Was the integrity of each drum of IDW inspected?	☐	☐	☐

The QC Inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: ____

Date: ____

WELL CONSTRUCTION CHECKLIST

Project Name/Number: ______________________________

Site: ______________________________

Injection/Monitoring/Vapor Extraction Well Number: ______________________________

Starting Date: ____________________ **Completion Date:** ____________________

Complete for each monitoring well. Answer each question by checking the appropriate column (yes, no, not observed (N/O) or N/A). If a No *is checked, provide an explanation on the Noncompliance and Corrective Actions form.*

	General	**Yes**	**No**	**N/O**	**N/A**
1.	Was a geologist or geotechnical engineer present during installation of the monitoring well?	☐	☐	☐	☐
2.	Were all depths verified during installation by measurement with a weighted tape?	☐	☐	☐	☐
	Selection and Placement of Screen				
3.	Was the screen length specified in the Work Plan used in construction of the well?	☐	☐	☐	☐
4.	Was the approved screen slot size and filter pack used?	☐	☐	☐	☐
5.	Was the screen placed at the depth specified in the Work Plan?	☐	☐	☐	☐
6.	Did the rig geologist document the stable water level before installing the well?	☐	☐	☐	☐
7.	Was the boring bailed dry during drilling to check for recharge?	☐	☐	☐	☐
	Construction Materials and Techniques				
8.	Was the well constructed using flush threaded screen and riser conforming to ASTM D1785?	☐	☐	☐	☐
9.	Were the well materials transported to the Site in the manufacturer's original plastic sleeves and shipping containers?	☐	☐	☐	☐
10.	Was the shipping container labeled to identify the materials?	☐	☐	☐	☐
11.	Was the location of the markings, the brand and the supplier of the well materials recorded on the Materials Summary Form?	☐	☐	☐	☐
12.	Did the filter pack material conform to the specifications of the Work Plan?	☐	☐	☐	☐
13.	Was the location of the markings, the brand and the supplier of the filter pack recorded on the Materials Summary Form?	☐	☐	☐	☐
14.	Was the filter pack tremied into the well?	☐	☐	☐	☐

15. Was the elevation of the filter pack accurately monitored during installation?	☐	☐	☐	☐
16. Was the filter pack installed to 2-5 feet above the screen?	☐	☐	☐	☐
17. Was the bentonite seal a minimum of 2 feet thick?	☐	☐	☐	☐
18. Were the brand, supplier, size and location of markings of the bentonite recorded on the Materials Summary Form?	☐	☐	☐	☐
19. Was the bentonite seal allowed to hydrate for a minimum of 24 hours before grouting when using bentonite pellets and as per manufacturer's specifications when using high solids bentonite slurries?	☐	☐	☐	☐
20. Was the remainder of the annular space tremie grouted with a 2% to 5% bentonite/cement grout?	☐	☐	☐	☐
21. Was the grout allowed to set a minimum of 48 hours before any additional work was resumed on the well?	☐	☐	☐	☐
22. Was Monitoring Well Construction Diagram completed?	☐	☐	☐	☐
23. Was Materials Summary Form completed?	☐	☐	☐	☐
Surface Completion and Well Security				
24. Was the well completed with 2-3 feet of stick-up?	☐	☐	☐	☐
25. Was a locking steel protective casing placed over the riser?	☐	☐	☐	☐
26. Was a weep hole drilled in the protective cover approximately one inch above its base?	☐	☐	☐	☐
27. Was a minimum 3-foot square, 4-inch thick concrete pad sloping away from the well constructed around the steel protective casing?	☐	☐	☐	☐
28. Was a 3.5-inch diameter survey marker permanently placed in the well pad?	☐	☐	☐	☐
29. Does the survey marker contain the well identification number, survey marker and well riser elevations, and well coordinates?	☐	☐	☐	☐
30. Were three protective steel posts installed around the well?	☐	☐	☐	☐
31. Was water-level survey mark/notch placed on well casing?	☐	☐	☐	☐
32. Was the well locked when not attended by a Site worker?	☐	☐	☐	☐
Monitoring Well Construction Diagrams				
33. Was the construction diagram prepared by the geologist or geotechnical engineer present during the well installation?	☐	☐	☐	☐
34. Does the construction diagram accurately depict each and every	☐	☐	☐	☐

component and their respective vertical positions?

35. Does the construction diagram list the types and quantities of materials used? ☐ ☐ ☐ ☐

The QC Inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: ____

Date: ____

DECONTAMINATION CHECKLIST

Project Name/Number:____

Injection/Monitoring/Vapor Extraction Well Number(s): _____________________________

Starting Date: _____________ **Completion Date: _____________**

Complete once for each well inspected. Answer each question by checking the appropriate column (yes, no, not observed (N/O) or N/A). If "no" is checked, provide an explanation on the form.

Equipment	**Yes**	**No**	**N/O**	**N/A**
1. Was all sampling equipment decontaminated properly prior to use and between sample intervals?				
2. Was each decontamination event recorded in the logbook?				
3. Was IDW (decontamination water) handled in accordance with the approved work plan?				

Corrective Actions:

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The QC Inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature: ____

Date: ______________________

SAMPLE COLLECTION CHECKLIST

Project Name/Number: ____

Injection/Monitoring/Vapor Extraction Well Number: ____

Sampling Date: ________________

Complete for each monitoring well sampling location inspected. Answer each question by checking the appropriate column (yes, no, not observed (N/O) or N/A). If "no" is checked, provide an explanation on the form.

General	**Yes**	**No**	**N/O**	**N/A**
1. Were new protective gloves worn between sampling locations and/or intervals?				
2. Were samples collected using methods described in the FSP?				
3. Were sample containers filled in the correct order?				
4. Was sampling equipment appropriate for the purpose and site conditions?				
5. Was sampling equipment decontaminated or disposable/dedicated equipment used between each sample?				
6. Were procedures for collecting QA/QC samples followed as per the FSP?				
7. Were sampling locations properly identified by land survey?				
8. Were bottles adequately protected from contamination prior to sample collection?				
Groundwater for Chemical Analysis				
9. Were ground water parameters stable before sample collection (as per FSP)?				
10. Were turbidity readings below 50 NTU (or if all other field parameters are stable and turbidity can not be lowered below 50 NTU, were turbidity readings within + or – 10% over three, five-minute readings)? Note: approval must be obtained from the project geologist and project manager prior to sampling in turbid conditions.				
11. Was a field sampling form completed?				
13. Was low-flow sampling conducted in accordance with the approved SAP?				

14. Was headspace in sample containers for volatiles eliminated?

Corrective Actions: ____
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QC Inspectors Signature: ___________________________________

Date: __________________