FINAL
REMEDIAL INVESTIGATION/ FOCUSED FEASIBILITY STUDY WORK PLAN

Prepared for:

Performing Parties Group
(Beazer East, Inc., Cooper Industries, LLC, Tierra Solutions, Inc. on behalf of Occidental Chemical Corporation, and Apogent Transition Corporation)

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ABBREVIATIONS/ACRONYMS

ACO	Administrative Consent Order
Agreement	Administrative Settlement Agreement and Order on Consent
ATSDR	Agency for Toxic Substances and Disease Registry
BCF	Bioconcentration Factor
BERA	Baseline Ecological Risk Assessment
BHHRA	Baseline Human Health Risk Assessment
BHHRAR	Baseline Human Health Risk Assessment Report
Beazer	Beazer East, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
COI	Constituents of Interest
COPR	Chromite Ore Processing Residue
CRSWP	Cultural Resources Survey Work Plan
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
Dioxin	2,3,7,8-Tetrachlorodibenzo-p-dioxin
DNAPL	Dense Non-Aqueous Phase Liquid
DPS	Distinct Population Segment
DQO	Data Quality Objective
EE/CA	Engineering Evaluation/Cost Analysis
EFH	Essential Fish Habitat
ERM	Environmental Resources Management, Inc.
ESD	Environmental Sciences Division
FFS	Focused Feasibility Study
FSP	Field Sampling Plan
GIS	Geographic Information System
GRA	General Response Action
Group	Performing Parties Group
HASP	Health and Safety Plan
HCTS	Hydraulic Control Treatment System
HDPE	High Density Polyethylene
HMD	Hackensack Meadowlands District
IDW	Investigation-Derived Waste
IRA	Interim Response Action
IRAW	Interim Response Action Workplan
IRM	Interim Remedial Measure
KEY	Key Environmental, Inc.
LIF	Laser-Induced Fluorescence
MESA	Memorandum on Exposure Scenarios and Assumptions

mg/Kg	Milligram per Kilogram
mg/L	Milligrams per Liter
N.J.A.C.	New Jersey Administrative Code
NHPA	National Historic Preservation Act
NJDEP	New Jersey Department of Environmental Protection
NPL	National Priorities List
NOAA	National Oceanic and Atmospheric Administration
OCC	Occidental Chemical Corporation
OM&M	Operations, Monitoring, and Maintenance
PAH	Polynuclear Aromatic Hydrocarbon
PAR	Pathway Analysis Report
PCB	Polychlorinated Biphenyl
PCDD	Polychlorinated Dibenzo-p-dioxin
PCDF	Polychlorinated Dibenzo-p-furan
PID	Photoionization Detector
PRG	Peninsula Restoration Group
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RA	Removal Action
RAO	Remedial Action Objective
RfC	Reference Concentration
RfD	Reference Dose
RI	Remedial Investigation
ROST	Remote Optical Sensing Tool
SAS	Special Analytical Services
SCCC	Standard Chlorine Chemical Co., Inc.
SCSR	Site Characterization Summary Report
SDG	Sample Delivery Group
Seaboard	Former Koppers Seaboard Site
SOP	Standard Operating Procedure
SOW	Statement of Work
SLERA	Screening Level Ecological Risk Assessment
SVOCs	Semi-Volatile Organic Compounds
TAL	Target Analyte List
TAT	Technical Assistance Team
TCDD	Tetrachlorodibenzo-p-dioxin
TCL	Target Compound List
TEQ	Toxicity Equivalents
Tierra	Tierra Solutions, Inc.
UCL	Upper 95% Confidence Limit on the Mean
URF	Unit Risk Factor

USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
Weston	Roy F. Weston, Inc.

1.0 INTRODUCTION

This Remedial Investigation/Focused Feasibility Study (RI/FFS) Work Plan for the Standard Chlorine Chemical Co. Inc. (SCCC) Site (Site) located in Kearny, New Jersey has been prepared by Key Environmental, Inc., (KEY) on behalf of the Performing Parties Group ("Group"). The Group consists of Beazer East, Inc. (Beazer), Cooper Industries, LLC (Cooper), Tierra Solutions, Inc. on behalf of Occidental Chemical Corporation (Tierra), and Apogent Transition Corporation (Apogent).

The SCCC Site is located at 1025-1035 Belleville Turnpike in Kearny, New Jersey. Figure 1-1 is a Site location map which shows the existing Site boundaries on a base map which consists of combined portions of two United States Geologic Survey 7.5 minute quadrangles (Jersey City and Weehawken, New Jersey). The Site is situated adjacent to the Hackensack River in Hudson County, New Jersey, and is located approximately 4,000 feet east of the intersection of I-95 and I-280. The Site is bounded to east by the Hackensack River, to the south by the adjacent Seaboard Site, to the north by the adjacent Diamond Site, and to the west by the Belleville Turnpike.

This RI/FFS Work Plan has been prepared pursuant to an Administrative Settlement Agreement and Order on Consent for Remedial Investigation/Focused Feasibility Study (the Agreement) dated May 3, 2013, for the SCCC Site. Specifically, this plan has been prepared to address the requirements listed in Section III: TASK 2 – RI/FFS Work Plan of the RI/FFS Statement of Work, which is Appendix A of the Agreement.

1.1 PURPOSE

This RI/FFS Work Plan has been prepared to address Task 2 of the SOW as previously discussed. It is intended to be a project planning document that: 1) summarizes the data evaluation activities used to develop the RI/FFS scope of work; 2) identifies additional data requirements necessary to more thoroughly define site conditions; 3) ensures that data suitable for completion of human health and ecological risk assessments are obtained; and 4) identifies

any additional activities or studies necessary to support completion of a focused feasibility study of potential remedial alternatives for the Site.

Pursuant to the SOW, this Work Plan is accompanied by several supporting project planning documents. The supporting documents consist of a Health and Safety Plan (HASP) and a Sampling and Analysis Plan (which comprises a Field Sampling Plan [FSP] and a Quality Assurance Project Plan [QAPP]). All field activities (and laboratory analyses, as applicable) described in this Work Plan will be performed in accordance with the HASP, FSP and QAPP that were developed for the Site as part of project planning activities for implementation of an Interim Response Action (IRA) for the Site. These documents have been revised and updated as necessary to ensure that they adequately address the scope of work as outlined herein.

The HASP (Appendix A) specifies necessary procedures to ensure safety of Site workers during the investigation activities. The FSP (Appendix B) provides requirements for all field work by defining in detail the investigation and sampling procedures to be employed. The QAPP (Appendix C) describes quality assurance and quality control protocols necessary to achieve the Data Quality Objectives (DQOs) dictated by the intended use of the data. In addition, an Operations, Maintenance, and Monitoring (OM&M) Plan (Appendix D) is provided as part of this submittal. The submittal of the OM&M Plan is not specified as a requirement of the SOW, but the preparation and submittal of an OM&M Plan as part of the RI/FFS Work Plan was discussed at a January 8, 2013 meeting between representatives of USEPA and the Group. Furthermore, a Cultural Resources Survey Work Plan (CRSWP) to address the requirements of the National Historic Preservation Act is required by the SOW and is provided as Appendix E.

1.2 DOCUMENT ORGANIZATION

This RI/FFS Work Plan is organized into eight sections and is supported by multiple figures, tables, and appendices. The eight sections of the report are as follows:

Section 1.0 – Introduction – Provides a brief introduction regarding the Site, the basis for preparation of this document, and the purpose of the document.

Section 2.0 – Site Information – Provides a cross reference to the USEPA-approved Site Characterization Summary Report (SCSR). Historical Site information has been considered in the preparation of this Work Plan, but, given the extensive nature of the historical information, it has been incorporated by reference rather than reiterated herein. Further, as specified in the SOW, the USEPA-approved SCSR will be incorporated into the RI Report. Relevant Site information requested by the USEPA that was not provided in the SCSR is provided in Section 2.0. Specifically, a summary of OM&M activities for the Interim Response Action, which was completed in 2011, is provided.

Section 3.0 – Conceptual Site Model – The Conceptual Site Model (CSM) summarizes information regarding the nature and extent of the constituents of interest, fate and transport information, potential migration pathways, and potential receptors and associated potential exposure routes, and a summary of the model. The CSM provided in the SCSR is reproduced in Section 3.0 given that it is particularly relevant to the scoping of the RI/FFS. In addition, supplemental information provided by the USEPA pursuant to review of the SCSR has been added to the CSM section.

Section 4.0 – Work Plan Rationale – Identifies the basis and reasoning for collection of additional data (primarily the DNAPL delineation and varved clay sampling) with reference to the existing conditions.

Section 5.0 – RI/FFS Tasks – Provides a brief Project Planning outline and a description of various tasks to be conducted as part of the RI/FFS including: Field Activities; Data Evaluation and Validation; SCSR Addendum; Identification of Candidate Technologies; need for additional Treatability Studies; Baseline Risk Assessment activities; Reporting of the Remedial Investigation activities conducted as per this Work Plan; need for Development and Screening of Alternatives and completion of a Focused Feasibility Study Report.

Section 6.0 – Schedule – Provides a Schedule for the activities at the Site in accordance with the SOW.

Section 7.0 – Project Management – Identifies specific relationships and responsibilities for selected tasks and project management items.

Section 8.0 – References – Provides a list of all relevant historical documents referenced in this RI/FFS Work Plan.

2.0 SITE INFORMATION

Multiple historical investigations and studies have been completed at the Site and surrounding properties dating back to the 1980s. In addition, the Site has undergone substantial remedial efforts in the form of Interim Remedial Measures and an Interim Response Action which were completed pursuant to one or more Administrative Consent Orders with the NJDEP.

Currently, the Site is fully enclosed by a barrier wall system and groundwater recovery and treatment and Dense Non Aqueous Phase Liquid (DNAPL) recovery and offsite disposal (DNAPL) are underway. In addition, various material consolidation efforts, engineering control measures, stormwater management system upgrades, management unit closure, and near-shore river sediment remediation efforts have been completed. The general configuration of the Site under current conditions is depicted on Figure 2-1. An aerial photograph displaying the Site under current conditions is provided as Figure 2-2.

Various remedial efforts completed to date were a comprehensive response for both the SCCC Site and the Diamond Site to the north and hence Figure 2-1 depicts the condition of both of these Sites. Furthermore, as a result of the detection of DNAPL on the Seaboard Site to the south, remedial measures have also been implemented on that Site as depicted on Figure 2-1. The Diamond Site and the Seaboard Site are each undergoing independent remediation oversight pursuant to New Jersey law and are not part of the ongoing CERCLA activities at SCCC except to the extent such properties might be relevant to investigation of Site-related impacts.

Detailed information regarding the Site is provided in the aforementioned SCSR. In accordance with the SOW for the RI/FFS, the SCSR is hereby incorporated by reference as the basis of the RI/FFS Work Plan.

To provide a summary of information contained in the SCSR, the Executive Summary is provided in its entirety in Section 2.1. The reader is referred to the SCSR for more detailed Site information. In addition, the USEPA expressed interest in OM&M. This information is provided in Section 2.2 to supplement the information provided in the SCSR. Finally,

subsequent to the submittal of the SCSR, the USEPA also provided an aerial photographic analysis report for the Site and that document has been reviewed and is discussed in Section 2.3.

2.1 SCSR EXECUTIVE SUMMARY

The following subsections (2.1.1 through 2.1.3) comprise selected sections of SCSR Executive Summary and are presented herein to provide for a general understanding of Site history, physical conditions, and available Site characterization data.

2.1.1 Site History

The Site consists of seven (7) different parcels of land located at 1025-1035 Belleville Turnpike, Kearny, Hudson County, New Jersey adjacent to the Hackensack River. Various forms of chemical manufacturing and/or processing have occurred on the different parcels of the Site since 1916. These activities included naphthalene refining and product formulation, dye-carrier production, dichlorobenzene refining and product formulation, and lead-acid battery manufacture. These activities were performed by multiple different corporate entities on different parcels of the Site.

In October 1989, the New Jersey Department of Environmental Protection (NJDEP) and SCCC entered into an Administrative Consent Order (ACO). This ACO required SCCC to plan and implement the following:

- Interim Remedial Measures to prevent potential contact with materials in the lagoon area and to secure damaged tanks and containers
- A Remedial Investigation and Feasibility Study
- Selected remedial alternative(s)

In December 2001, NJDEP referred the SCCC Site to the USEPA for proposed addition to the National Priorities List (NPL). On April 30, 2003, the USEPA proposed to add the Site to the NPL and the Site was subsequently listed on September 19, 2007. Work under the SCCC ACO continued through the period of Site Listing, and included the development of an NJDEP-

approved Interim Response Action Workplan (IRAW). Upon Site listing, an Engineering Evaluation/Cost Analysis (EE/CA) corresponding to the response proposed in the NJDEP-approved IRAW was submitted to (and approved by) the USEPA. The USEPA designated NJDEP as the lead agency for implementation of the Interim Response Action (IRA) as described in the IRAW and EE/CA.

Over the last twenty-five to thirty years numerous investigative and response activities have been undertaken at the Site. Most of these activities were funded by SCCC, by the Peninsula Restoration Group (PRG), a group that consisted of Beazer, Tierra on behalf of Occidental Chemical Corporation (OCC), and SCCC, and by the Cooperating Parties Group (CPG), a group that consisted of Beazer, Tierra on behalf of OCC, and Cooper. Going forward, site investigation activities will be funded by the Performing Parties Group, which consists of the CPG members plus Apogent. While the PRG and NJDEP were in the process of negotiating a scope of work for an Interim Response Action (IRA), activities such as multiple work plan submittals, an asbestos and lead paint survey, wetlands delineation, an aerial topographic survey, waste classification requests, offsite disposal of demolition debris, numerical groundwater model development, vault content sampling and analysis, and a request to use the Area of Contamination Policy were completed proactively by the PRG. Environmental investigations, dating back to the early 1980s, have also been completed for the Site, as follows:

1983-1984	Hydrogeologic Investigation	Roy F. Weston, Inc.
1985	Phase II Dioxin Investigation	E.C. Jordan, Inc.
1987	Stage 1 Dioxin Investigation	Roy F. Weston, Inc.
1988	Stage 2 and 3 Dioxin Investigations	Roy F. Weston, Inc.
1991	Chromium Delineation	French & Parrello Associates
1990-1993	Remedial Investigation/Supplemental RI	Roy F. Weston, Inc.
1996-1997	Focused Remedial Investigation	ERM, Inc.
1997-1999	Supplemental Remedial Investigation	Key Environmental, Inc.
2000	Soil/Sediment Sampling and Analysis	Enviro-Sciences, Inc.
2000	Characterization of Containerized Materials	Enviro-Sciences, Inc.
2002	Surface Water and Sediment Sampling	USEPA TAT
2008-2009	IRA Pre-Design Investigation	Key Environmental, Inc.
2008-2009	Phase II Supplemental RI	Key Environmental, Inc.

Multiple response actions have also been undertaken at the Site, consisting of Interim Remedial Measures, an Interim Response Action, a Removal Action, and other miscellaneous responses. Brief descriptions of these responses are as follows:

Interim Remedial Measures – Various Interim Remedial Measures (IRMs) have been implemented at the Site dating back to the early 1990s. These IRMs have been completed to preclude potential risks associated with exposure to chromium-impacted soils, to preclude access to impacted soils and the lagoon in the former process area, to control fugitive dust emissions, to provide protection of the lagoon area from flooding, and to control potential constituent migration via existing storm sewers. IRM activities were as follows:

- Installation of security fencing surrounding a former production area and lagoons to prevent unauthorized access (early 1990s);
- Addition of soil to the lagoon berm to increase its height and freeboard to prevent potential overflows (early 1990s);
- Placement of stabilizing geotextile and rip rap along the Hackensack River shoreline in the vicinity of the lagoon (early 1990s);
- Removal of the contents of five above-ground storage tanks and repackaging of asbestos-containing material removed from the former distillation building (early 1990s);
- Installation of an asphalt pavement overlay on traffic areas where existing asphalt pavement was present (1991);
- Installation of geotextile fabric/aggregate/asphalt cover in all remaining traffic areas with total chromium concentrations exceeding the NJDEP standard at the time, 75 mg/kg (1991);
- Geotextile/geomembrane liner/aggregate cover construction in non-traffic areas west of a railroad right-of-way (1991);
- Installation of a dust fence barrier along the railroad right-of-way and north fence line of the former northeast process area (1991);
- Improvements to existing stormwater sewer located between the SCCC Site and the adjacent Diamond Site to the north (2008).

Interim Response Action – An Interim Response Action (IRA) was completed in 2010 and 2011 and included significant construction components which have resulted in containment, control, and treatment of impacted media at the Site. The IRA was designed to address environmental conditions at both the Site and at the adjacent Diamond Site. The IRA was completed to eliminate the potential for subsurface discharge of constituents to the Hackensack River from the Site, to eliminate the potential for overland runoff of constituents to the Hackensack River from the Site, to remove DNAPL to the extent practicable as a source control measure, and to eliminate the potential for direct contact with constituents of interest at the Site. The IRA consisted of the following major components:

- Site Preparation Activities
- Physical Barrier Wall System
- Hydraulic Control System (consisting of groundwater extraction wells and treatment system)
- DNAPL Recovery System
- Lagoon Dewatering, Backfilling, and Surface Cover
- Near Shore Sediment Management
- South Ditch Sediment Management and Stormwater Management System Construction
- Consolidation Area Construction
- Wetland and Shoreline Mitigation
- Septic Tank Closure
- Transformer Pad Removal and Remediation
- Site Restoration
- Air Monitoring Activities

Implementation of the IRA was such that the Site is now fully enclosed by a slurry wall, is further protected along the Hackensack River by a steel sheet pile wall, is capped to prevent direct contact and overland runoff, has an upgraded infiltration-resistant stormwater management system, and has had multiple potential sources and impacted media removed or managed (i.e., Polychlorinated Biphenyl [PCB]-impacted soil, lagoons, septic tanks, ditch sediments, and near shore river sediments). Reduction of toxicity, mobility, and volume has been achieved to date and is ongoing via the operation of groundwater and DNAPL recovery wells and a robust,

permitted groundwater treatment plant with unit operations consisting of chromium reduction, metals precipitation, carbon adsorption, oil separation, and solids management.

Removal Action – A Removal Action (RA) was completed at the Site in 2010 which consisted of sealing existing structures that were perceived to be potential sources of wind-borne contamination. The RA was completed pursuant to an Administrative Settlement Agreement and Order on Consent for Removal Action entered into between the USEPA, SCCC, and Beazer dated June 7, 2010. An Administrative Order Notice of Completion was issued by the USEPA on January 20, 2011.

Additional Response Actions – Several additional responses have been completed at the Site and consisted of demolition of the majority of the Site structures and disposal of historical containerized materials associated with abatement operations and Site investigations. Demolition of all structures except historical structures associated with former activities of Thomas A. Edison Inc. at the Site (Buildings 1, 2, 3 and 4) has been completed. The demolition of the structures was completed in three separate phases designated as Track 1, Track 2, and Track 3. Track 1 demolition was completed prior to IRA implementation to facilitate construction and Track 2 and Track 3 demolition were conducted as the IRA neared completion. NJDEP-approved work plans which were also provided to USEPA for review, were prepared for each phase of the demolition. Upon completion, each phase of demolition was summarized in a Demolition Remedial Action Report that was submitted to the NJDEP. Various asbestos-abatement materials and investigation-derived waste had been previously containerized and stored at the SCCC Site in six SeaLand containers. These materials were appropriately characterized and managed. A total of seven material shipments were made to an off-site disposal facility.

2.1.2 Physical Setting

The SCCC Site occupies an area of approximately 25 acres, consisting of six (6) upland land parcels referred to on the Tax Map of the Town of Kearny as Block 287, Lots 48, 49, 50, 51, 52, and 32.01, as well as one (1) riparian parcel located adjacent to Lot 52 that is referred to on the Tax Map as Block 287 Lot 52R. The Site is bounded by the Hackensack River to the northeast,

Belleville Turnpike to the southwest, the Diamond Site to the north and northwest, and the Seaboard Site to the southeast. The SCCC Site is located along the tidal portion of the Hackensack River. Land use in the general vicinity is industrial, commercial, and/or used as transportation corridors. There are no nearby residential areas.

The Site is located in a former meadow that was filled in at the beginning of the 20th century. The tidal Hackensack River forms the eastern property boundary. The entire property lies within the 100-year floodplain of the Hackensack River. The Hackensack River adjacent to the SCCC Site is classified as SE2 (Saline Estuarine waters with specific uses as codified at N.J.A.C. 7:9B-1.12(e)). Various drainage ditches to the Hackensack River historically existed at the Site, including the South Ditch.

Hudson County lies within the Piedmont Province of New Jersey. It is mainly underlain by slightly folded and faulted sedimentary rocks of Triassic and Jurassic age (240 to 140 million years old) and igneous rocks of Jurassic age. Geology at the Site consists of upper fill materials ranging in thickness from 2 to 10 feet, an underlying peat layer locally referred to as the Meadow Mat, a deeper sand unit approximately 10 feet thick, and below these units, a massive low permeability varved clay unit. The varved clay is continuous beneath the areal extent of the Site, is at least 40 feet thick if not more, and is underlain by glacial till and bedrock.

Historically, surface water runoff at the Site was channeled into surface ditches that originated on the Site and flowed to the south into what was referred to as the South Ditch. In addition, an underground storm sewer with catchment basins was located along the northern Site boundary between Lots 48 and 49 and the Diamond Site. Under current conditions, all surface flows at the Site are directed to one of the two enclosed culvert stormwater management systems.

Two separate shallow groundwater-bearing units have been the focus of the groundwater investigation activities performed at the Site: 1) the shallow fill unit; and 2) the deeper sand unit that underlies the Meadow Mat and overlies the varved clay. The water table at the Site occurs in the shallow fill material overlying the Meadow Mat. The Meadow Mat acts as a basal semi-confining unit that limits, but does not completely eliminate the hydraulic connection between the shallow fill materials and the underlying deeper sand unit.

Prior to construction of the Site barrier walls and stabilization/backfilling/covering of the lagoons and development of the consolidation area, groundwater flow in the shallow fill unit at the Site appeared to be influenced by recharge and discharge phenomena. The installation of the IRA slurry wall and subsequent operation of the hydraulic control groundwater collection network was intended to depress the water table to ensure inward hydraulic gradients and progress toward this objective is being accomplished.

The Site was inundated during a recent storm (Hurricane Sandy). Given that the Site is currently largely paved or covered with other impervious surfaces, the majority of the stormwater associated with the hurricane ran off via the new storm sewer system. As a consequence of the storm, an increase in inward hydraulic gradients has recently been observed across the slurry wall because water levels rose more on the outward side of the slurry wall than on the inside. Piezometers located on either side of the subsurface barrier walls are being used to monitor the groundwater flow elevations and gradients at the Site.

Additionally, areas of minor erosion attributable to storm surge flooding and the receding of the flood waters were noted. Such erosional effects are being addressed pursuant to an existing Operation and Maintenance Plan. No deposition of sediments was observed on the Site in the aftermath of the storm other than the accumulation of some fine sediment in above ground pumping well vault control boxes, which could not drain from the Site. The fine sediment in the control boxes has since been removed. Larger debris was deposited on the Site by the Storm and has been removed from the Site. A report summarizing the Post-Hurricane Sandy Storm Damage Response for the Site was submitted to the USEPA (FTS, April 26, 2013).

2.1.3 Summary of Site Characterization Data

As a result of extensive prior investigations of the Site, the nature and extent of contamination is well defined although final resolution of some issues remains. In general the findings of the investigations have been as follows:

Chromium-impacted soils exist in many areas of the Site. These areas have been capped with various types of cover materials as part of the NJDEP-approved IRMs and the IRA. The

Meadow Mat at the Site serves to reduce hexavalent chromium to the insoluble trivalent form and consequently groundwater impacts associated with the chromium are essentially limited to the surficial fill materials.

Elevated concentrations of 2,3,7,8-TCDD toxicity equivalents (TCDD TEQ) were detected at the Site (primarily in the lagoon solids but also in DNAPL) and polychlorinated-dibenzofurans are the primary contributors to the TCDD TEQ.

Subsurface DNAPL at the Site has migrated to offsite properties (the adjacent Diamond Site to the north and the Seaboard Site to the south). The DNAPL has been observed to contain chlorinated benzenes, naphthalene, polychlorinated biphenyls, and polychlorinated-dibenzodioxins/furans.

2.2 SITE OPERATION, MAINTENANCE, AND MONITORING

OM&M activities at the Site entail a number of recurring activities, performed as needed and/or at specifically scheduled intervals, necessary to maintain the engineering controls established as part of the IRMs and IRA. The current Site OM&M activities consist of the following tasks:

- Visual inspection of the freshwater wetland mitigation areas
- Visual inspection of the various surface covers
- Visual inspection of the stormwater system
- Visual inspection of the barrier wall system
- Visual inspection of the consolidation area surface cover
- Visual inspection of drainage channels
- Visual inspection of Site security (fences)
- Dense Non-Aqueous Phase Liquid recovery
- Operation of the hydraulic control groundwater collection and treatment systems
- Waste management (i.e., DNAPL and filter cake characterization and off-site disposal)
- Measurement of potentiometric surface elevations and apparent DNAPL thicknesses
- Maintenance of the vegetative surface cover

- Periodic maintenance of IRA and IRM components
- Record keeping and reporting of the monitoring and maintenance activities

Operation and maintenance of the Hydraulic Control Treatment System (HCTS), as well as discharge and air monitoring is a primary component of OM&M activities for the Site. A detailed description of the HCTS is provided in the SCSR. Additional detailed information regarding the HCTS is provided in a three volume Operation and Maintenance Manual which is maintained on Site. Certified personnel operate the HCTS in accordance with the requirements of an NJDEP New Jersey Pollutant Discharge Elimination System (NJPDES)/Discharge to Surface Water permit (Permit Number NJG0175102). The permit authorizes the offsite discharge of treated groundwater and lists the associated requirements such as effluent limits, influent and effluent monitoring, monthly and annual reporting, and recordkeeping.

The Site's shallow zone groundwater table within the barrier wall system is regulated by the hydraulic control and recovery wells connected to the HCTS. Monthly gauging of piezometers located inboard and outboard of the slurry wall barrier wall system is conducted to evaluate the effectiveness of the hydraulic control system. In addition, routine inspection and maintenance of various Site improvements, IRM and IRA features is completed as listed above. Operation and maintenance associated with these features is accomplished via the use of checklists and corrective action is initiated when and if necessary.

An OM&M plan documenting the scope of the various ongoing activities and associated reporting requirements is provided in Appendix D. Additional information from the HCTS OM&M Manual appendices, including thousands of pages of equipment cut sheets and brochures, is available upon USEPA's request.

2.3 AERIAL PHOTOGRAPHIC INTERPRETATION

The USEPA Office of Research and Development Environmental Sciences Division (ESD) located in Las Vegas, Nevada completed a photographic analysis of the SCCC Site and surroundings as documented in a report dated May 2002 (USEPA, May 2002). This information was recently provided to the Group by the USEPA and has been reviewed as part of the RI/FFS

scoping process. Additional aerial photographs representing different dates of operation are also maintained by KEY in its project files. These photographs were included in the SCSR and were also reviewed as part of the RI/FFS scoping process.

The Group makes the following observations regarding the subject aerial photographic analysis report:

- The report abstract (paragraph 1) specifies an area of approximately 15 hectares (37 acres) for the SCCC Site. The Site is actually comprised of various lots with an approximate acreage of 25 acres. It appears that the reported photographic interpretation was based on consideration of data for both the SCCC Site and the Diamond Site.
- The report abstract (paragraph 1) identifies the SCCC Site as a pesticide manufacturing site. Various chemical processing, formulation, and packaging activities were completed at the SCCC Site (including preparation and packaging of disinfectants) but none of the industrial operations consisted of pesticide manufacture.
- Figure 2 of the report identifies the study area for the photographic analysis and it is clear from Figure 2 that the photographic analysis comprised an area covering both the SCCC Site, and, inadvertently the Diamond Site. Analysis of activities unrelated to SCCC in other surrounding areas (i.e., the Seaboard Site and properties on the west side of Belleville Turnpike) was also completed and reported.

The remainder of this section focuses only on those aspects of the photographic interpretation document that relate specifically to the SCCC Site. Any observations regarding activities or impacts on the adjacent Diamond Site or other properties are not considered applicable for the purposes of the RI scoping unless they are considered clear indications of potential impacts associated with SCCC Site operations.

Review of the various aerial photographs and the associated interpretations confirms the understanding of the Site history and operations. The various structures, equipment, and tankage known to have existed at the Site are clearly identified in the various photographs analyzed by ESD. The most significant piece of new information gleaned via review of the historical aerial

photography is the confirmation of the presence of a rail spur on the south side of Building 2 (referred to as Building B-15 in the subject report) which was encountered during installation of conveyance lines for the groundwater recovery network. This spur is noted in multiple annotated photographs spanning the time period between 1940 and 1973 and tank cars are evident on the spur in several photographs. Consequently, it is apparent that bulk transfer of liquids may have occurred via this spur and the possibility exists that this may have contributed to the presence of DNAPL in this area as evidenced by historical boring and monitoring well information.

3.0 CONCEPTUAL SITE MODEL

A preliminary Conceptual Site Model (CSM) was developed for the SCCC Site under current (2012) Site conditions and was presented in the Site Characterization Summary Report (SCSR). This model was based on consideration of the Site modifications resulting from the implementation of the IRA, including but not necessarily limited to, the existence of the fully-enclosing perimeter subsurface barrier wall system, the operation of the groundwater and DNAPL collection and treatment system (i.e., the HCTS), the presence of historical and new cover materials, the existence of a replacement storm water control system (i.e., butt-fused high density polyethylene [HDPE] storm water conveyance piping and associated appurtenances), and onsite consolidation, stabilization and capping of impacted materials including the former lagoon contents, South Ditch soft soils/sediments and near shore Hackensack River sediments. Under current Site conditions, the potential for Site-related exposures is considered minimal as is the potential for migration of any constituents to offsite locations. Figure 3-1 is a graphical representation of the CSM. Nature and extent of Constituents of Interest (COI), fate and transport evaluation, potential migration pathways, potential receptors and exposure routes, and a summary of the CSM are discussed in the remainder of this section.

3.1 CONSTITUENTS OF INTEREST

Based on chemical-analytical data generated as a result of sampling and analysis over approximately 30 years, multiple constituents of interest have been identified for the Site. In broad terms, these constituents, or classes of constituents, are as follows:

- Chlorinated benzenes
- PAHs (primarily naphthalene)
- Polychlorinated Biphenyls (PCBs)
- Dioxins/Furans (PCDDs/PCDFs)
- Hexavalent chromium

While other specific analytes have been detected in various Site media, these constituents constitute the COI based on their historical use (or placement at the Site), their prevalence in environmental media, and the measured concentrations.

3.2 FATE AND TRANSPORT EVALUATION

This section presents a brief summary of general fate and transport information for the major chemicals or classes of chemicals observed in various environmental media at the Site as well as general information indicative to transport at the Site. Major classes of chemicals detected include chlorinated aromatic compounds such as chlorobenzene, dichlorobenzene isomers (1,4-dichlorobenzene being the most prominent) and 1,2,4-trichlorobenzene; PCBs (Aroclor 1260 being the most prominent); PCDDs/PCDFs (1,2,3,6,7,8-heptachlorodibenzofuran [or HCDF] being a representative congener); and PAHs (naphthalene being the most prominent by far). In addition, various metals have been detected in Site media, with chromium being the metal most frequently detected.

A general indication of the fate and potential environmental mobility of the various organic chemicals, or classes of organic chemicals is provided by typical chemical-physical property information. A summary of relevant chemical-physical information for selected organic constituents, including molecular weight (MW), water solubility (S), vapor pressure (P_v), organic carbon partition coefficient (K_{oc}), dimensionless Henry's Law Constant (H'), and bioconcentration factor (BCF) for aquatic organisms is provided in the following table.

Representative Constituents of Interest	**MW (g/mol)**	**S (mg/L)**	**P_v (mm Hg)**	**K_{oc} (L/kg)**	**H' (none)**	**BCF (L/kg)**
Chlorobenzene	1.13E+02	4.98E+02	1.20E+01	2.34E+02	1.27E-01	1.78E+01
1,4-Dichlorobenzene	1.47E+02	8.13E+01	1.74E+00	3.75E+02	9.85E-02	4.20E+02
1,2,4-Trichlorobenzene	1.81E+02	4.90E+01	4.60E-01	1.36E+03	5.81E-02	2.08E+03
Aroclor 1260	3.95E+02	1.44E-02	1.30E-07	3.50E+05	1.37E-02	-
HCDF	4.09E+02	1.35E-06	3.53E-11	6.50E+05	5.76E-04	-
Naphthalene	1.28E+02	3.10E+01	8.50E-02	1.54E+03	1.80E-02	8.45E+01

Physical property information obtained from the Oak Ridge National Laboratory Risk Assessment Information System. Available online at http://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chem_spef.

As is shown in the preceding table, the various chlorinated aromatic hydrocarbons and naphthalene are sparingly soluble in water and exhibit some volatility in comparison to the representative dioxin/furan and representative PCB. The distribution of these constituents at the Site is consistent with their physical properties; these compounds have been identified in groundwater samples obtained at the Site. PCBs and PCDDs/PCDFs have been identified in DNAPL samples obtained at the Site given that they are expected to be soluble in organic solvents such as the chlorinated aromatics that constituent a large fraction of the DNAPL.

All of the chemicals exhibit some affinity for sorption to soils as evidenced by their organic carbon partition coefficients, although the representative dioxin/furan and representative PCB have a much greater propensity for sorption to the solid phase which renders these COI essentially immobile in the aqueous phase. The detection of relatively high concentrations of all of these compounds in solid media such as the lagoon solids, soil, and sediment, particularly in comparison to the concentrations detected in ground water and surface water, is consistent with their sorptive nature. Although the referenced source does not report BCFs for the representative dioxin/furan and the representative PCB, these compounds are considered highly lipophilic in general and are expected to bioaccumulate. The more heavily chlorinated aromatics can also be expected to bioaccumulate.

All of the representative chemicals are considered relatively persistent in the environment, particularly the representative dioxin/furan and PCB. Chlorinated aromatics are more resistant to biodegradation than many commonly encountered classes of chemicals. While naphthalene is generally recognized to be somewhat biodegradable, such biodegradation is more likely to occur in locations where concentrations are relatively low (i.e., downgradient ground waters and sediments). Biodegradation of naphthalene in potential source areas at the Site is expected to be limited given the very high concentrations encountered in source materials such as the lagoon solids (e.g., percent levels).

Of the various metals detected in Site media, chromium is considered to be of the greatest potential concern from an environmental fate and transport perspective given the fact that high concentrations of hexavalent chromium, the water soluble species, are present at the Site.

However, Site conditions are somewhat favorable in that an organic rich carbon layer (i.e., the Meadow Mat) exists directly below the fill. Hexavalent chromium has not penetrated this organic layer to any appreciable extent given the ability of organic compounds to act as reducing agents for chromium. Chromium fate appears to be largely controlled by reductive processes; it is reduced to the relatively insoluble trivalent species by either the Meadow Mat or by sediments high in organic carbon content. Lead has been encountered primarily in solid media sampled at the Site, and appears to be bound to soils and sediments. Migration of lead at the Site is expected to be primarily controlled by erosional processes (particulate transport).

In general, Site conditions appear to be somewhat favorable with respect to the fate and transport of the constituents of interest. Although some limited migration of the constituents of interest is evidenced by the river sediment samples, as previously discussed, and by offsite migration of DNAPL in the sand unit to the south onto the Seaboard Site and to the north onto the Diamond Site (possibly as a result of movement along the top of the varved clay), the constituents appear to have migrated to a much lesser extent than might be expected given the high concentrations encountered. This is particularly true for the constituents present in the former lagoons. For example, although percent levels of naphthalene were encountered in the lagoon solids, groundwater concentrations were substantially lower, and concentrations in sediment samples obtained near the lagoons were many orders of magnitude lower.

The migration of dioxins/furans also appears to have been similarly limited. In spite of the detection of high concentrations on the Site, concentrations in sediment in the potential receiving surface water body are relatively low and the constituent make up with respect to PCDD/PCDF in the river is markedly different than that in on-site soil or sediment. Similarly, hexavalent chromium has not been detected to any significant extent in the adjacent river.

3.3 POTENTIAL MIGRATION PATHWAYS

Historically, the analytical data for various Site media provided direct indications of the potential for migration of constituents via multiple pathways. Evidence of prior potential subsurface migration and discharge of constituents to the Hackensack River is apparent based on the

concentrations of chlorinated aromatic hydrocarbons in deep sediment samples although such compounds appear to have been attenuated prior to reaching the biotic zone. Evidence of potential gravimetric migration of DNAPL was apparent via consideration of the presence of DNAPL at offsite locations to the south of the Site. Although overland runoff was considered to be of particular concern given the detection of high concentrations of constituents in ditch sediments/soft soils and in the lagoon solids, this potential migration pathway appears to have been limited based on the measurements obtained for samples from the end of the South Ditch and from the Hackensack River. Atmospheric erosion and transport of wind-blown dust was also considered a potentially significant migration pathway and, in part, precipitated the installation of IRM cover materials and dust fences and the process area Removal Action required by the USEPA.

Under existing conditions, all potential migration pathways have been substantially addressed. Installation of the slurry wall and steel sheet pile wall has effectively addressed the potential for discharge of constituents to adjacent properties (beyond the barrier wall) and the Hackensack River via subsurface routes. In addition, the slurry wall was designed to encompass the DNAPL that extended onto the Seaboard Site to the south of the SCCC Site and this objective was also accomplished. The groundwater collection and treatment system is operational and is effectively reducing the mobility and the volume of constituents of interest at the Site and will continue through long term operation and maintenance of the system. The removal of sediments/soft soils from the South Ditch and from the Hackensack River, in concert with construction of a water tight stormwater management system, has also served to address potential overland transport pathways. Finally, the construction of the SCCC Consolidation Area, and the consolidation therein of various impacted materials under a cover, coupled with the construction of the IRMs has served to address the potential for atmospheric transport of Site-related constituents. The IRMs and the Consolidation Area will require ongoing maintenance and monitoring.

3.4 POTENTIAL RECEPTORS AND EXPOSURE ROUTES

Surrounding land use was reviewed with a primary emphasis on the location of sensitive environmental areas and human receptors. Land use within the 1,000-foot radius of the Site is

industrial in nature and no residential areas or sensitive human receptors are known to exist within this radius.

The following is a list of the closest known schools, medical facilities, day care centers, and recreational areas, including the type, name, address, approximate ordinal direction relative to the Site, and approximate distance from the Site:

Type	Name	Address	Direction	Distance	
				Feet	Miles
School	Elementary School 23	143 Romaine Ave. Jersey City, NJ	SE	9,350	1.77
School	Dr. Charles P DeFuccio School	214 Plainfield Ave. Jersey City, NJ	SE	8,450	1.60
Recreation Area	Laurel Hill Park	New County Road Secaucus, NJ	NNE	2,750	0.52
Recreation Area	Lincoln Park	State Route 440 Jersey City, NJ	SSE	5,700	1.08
Daycare	St. Elizabeth Child Care Center	129 Garrison Ave. Jersey City, NJ	SE	9,650	1.83
Hospital	West Hudson Hospital	206 Bergen Ave. Kearny, NJ	WNW	13,350	2.53
Hospital	Jersey City Medical Center	50 Baldwin Ave. Jersey City, NJ	SW	12,720	2.41

As shown in the preceding table, no sensitive human receptors are located proximate to the Site. A Public Health Assessment was completed for the Site in 2005 (ATSDR, April 5, 2005). At that time, no completed human exposure pathways were identified because the Site had restricted entry from the land-side, and no Site-related constituents of interest had been measured in marine life. However, ATSDR considered recreational users of the river to be potential intermittent receptors, as well as Site trespassers and Site visitors, but these exposures were considered to be minimal and infrequent.

Fisherman at Laurel Hill Park (located approximately 0.5 miles upstream of the Site) and at the confluence of Penhorn Creek and the Hackensack River (located approximately 0.5 miles downstream of the Site) were identified by the ATSDR as potential receptors in spite of the fish consumption advisories in place, although a complete exposure pathway had not been confirmed.

Fish consumption advisories have been issued for the River as part of the Newark Bay complex advisory, and there are no commercial fisheries. As a result of the completion of the IRA and other responses at the Site, this is no longer considered a viable exposure pathway from the Site. The ATSDR concluded that the Site posed an *indeterminate public health hazard* via fish/shellfish consumption and air pathways. The ATSDR also concluded that the Site posed *no apparent public health hazard* as a result of potential exposure associated with trespassing and/or recreational use of the river. Given the completion of the IRA and the various other responses, including the Removal Action, these pathways are also considered incomplete under current Site conditions.

The Site is located adjacent to the Hackensack River at the southern end of the Hackensack Meadowlands District (HMD). The HMD is an important ecological resource and is an Atlantic flyway stopover and nesting point for migratory birds. No federally-listed threatened or endangered species have been observed onsite to date. According to the ATSDR Public Health Assessment, state-listed species such as northern harrier hawks (*Circus cyaneus* – state endangered list), black-crowned night herons (*Nycticorax nycticorax* – state threatened list), and yellow-crowned night herons (*Nyctanassa violacea* – state threatened list) were alleged to roost at the Site, but no actual observation of these species has occurred at the Site. Additionally, according to the United States Fish and Wildlife Service and the National Oceanographic and Atmospheric Administration, state- and federally-listed threatened or endangered species have historically been observed in the Hackensack River watershed, and include the following: bald eagle (*Haliaeetus leucocephalus* – state endangered list); shortnose sturgeon (*Acipenser brevirostrum* – federal endangered list); New York Bight Distinct Population Segment (DPS) of Atlantic sturgeon (*Acipenser oxyrinchus* – federal endangered list); dwarf wedgemussel (*Alasmidonta heterodon* – federal endangered list); bog turtle (*Clemmys muhlenbergii* – federal threatened list); and Indiana bat (*Myotis sodalist* – federal endangered list) but no actual observation of these species has occurred at the Site.

Prior to implementation of the IRA, the lagoons represented a potential source of constituent releases at the Site. The South Ditch, which historically received surface runoff from production areas, was also a potential source of constituent releases at the Site prior to implementation of the

IRA. However, at the current time, both of these potential sources have been eliminated as a result of the IRA remedial actions, including stabilization, backfilling, and covering of the lagoons; removal of the South Ditch sediments; and concurrent stormwater management system improvements and expansion of cover material.

DNAPLs are considered to be on-going potential sources of dissolved-phase constituents in groundwater in both the fill material and the deeper sand unit. However, pathways associated with the DNAPL are also currently incomplete as the Site is now fully enclosed by a slurry wall and sheet pile barrier wall, with collection and treatment of onsite groundwater in the HCTS. There are no known wells for private or public drinking water supply within one mile of the Site (KEY, May 2011). No drinking water intakes are located in the Hackensack River in this tidal reach and the Town of Kearny is supplied by the Wanaque Reservoir in Bergen County.

At this time, the following potential exposure pathways have been identified:

- Potential inhalation of volatile organic compounds associated with former industrial releases – This pathway is not considered to be significant, even with no administrative or engineering controls in place because volatile organics are not significant component in surface matrices.

- Potential inhalation of fugitive dust emissions – This pathway is considered to be potentially significant in the future, although minimal at present. If the existing cover materials were disturbed by future construction or utility work, workers potentially could be exposed to multiple constituents of interest present in the fill material. Fugitive dust emissions from disturbed areas could pose a risk to on-Site employees or occasional Site visitors/trespassers barring the use of administrative controls at the Site. In addition, offsite industrial employees could experience minor exposures from disturbed soils if they were to be disturbed during construction.

- Potential contact with surface or subsurface soils – This pathway is currently incomplete as a result of the extensive interim measures and interim response actions

undertaken to date as part of the IRA and the IRMs. However, if the existing covers were to be disturbed, onsite workers or visitors potentially could experience a risk associated with such exposure.

- Potential contact with groundwater, surface water or sediments impacted by DNAPL or leaching from fill materials – At the current time, these pathways are also incomplete. The barrier walls contain all DNAPL. Recoverable DNAPL is currently collected in multiple DNAPL recovery wells and is containerized for offsite disposal. While DNAPL may have migrated in the past, this pathway is currently under control because the barrier walls were aligned to encompass all DNAPL locations. Likewise, groundwater is contained within the limits of the barrier walls, and no potable wells currently exist in the vicinity of or near to the Site.

In conclusion, under current Site conditions, there are no known complete exposure pathways. The IRMs and IRA completed as of 2012 have covered and/or capped all surficial materials, removed significant structures with the exception of four historical structures (and a guard house) associated with the historic operations of Thomas A. Edison, Inc., encircled the Site and all or parts of adjacent properties with a subsurface barrier wall, stabilized soft surficial materials in the former lagoons, and removed sediments and impacted soils and placed them in an engineered consolidation area within the Site.

However, the absence of complete exposure pathways relies on the maintenance of these engineered controls and a continued prohibition against disturbance of the cover materials. Although development of groundwater as a drinking water source is considered a virtual impossibility in this area, an institutional control (e.g., groundwater use prohibition) is considered an appropriate and necessary response. Access to the Site is restricted by a chain-link fence along Belleville Turnpike, a high railroad bed elevation north of the Diamond Site, and major roadways and access ramps as well as railroad tracks along the Seaboard Site south of the SCCC Site.

These difficult access conditions greatly reduce the potential for trespassers to access the Site. Under foreseeable circumstances, the primary potential exposure route is associated with disturbance of the soil by construction or utility workers and potential exposure of these workers via inhalation of fugitive dust or dermal contact with and incidental ingestion of the soils located beneath the covers. However, these potential exposures can be effectively managed via administrative controls (i.e., the establishment of appropriate institutional control and procedures to be followed during any future construction that involves disturbance of the IRM/IRA covers).

3.5 ADDITIONAL RELEVANT OBSERVATIONS (USEPA)

The USEPA offered several observations regarding potential ecological receptors and surrounding land and water use in their SCSR comment letter dated February 7, 2013 and in their RI/FFS Work Plan comment letter dated June 25, 2013. These observations are considered relevant for the RI and are reiterated herein. The USEPA contacted various other government agencies in this respect. The USEPA reported the following:

- Essential Fish Habitat (EFH) information on the website of the Northeast Regional Office of the National Oceanic and Atmospheric Administration (NOAA) Office of Habitat Conservation indicates that the area of Hackensack River adjacent to the Site is designated EFH for one or more life stages of red hake (*Urophycis chuss*), winter flounder (*Pleuronectes americanus*), windowpane (*Scopthalmus aquosus*), Atlantic herring (*Clupea harengus*), bluefish (*Pomatomus saltatrix*), Atlantic butterfish (*Peprilus triacanthus*), summer flounder (*Paralicthys dentatus*), and black sea bass (*Centropristus striata*). As the RI/FFS Work Plan does not call for any in-river work, no effect on the EFH for these species is expected.

- According to the United State Fish and Wildlife Service New Jersey Field Office website and the National Marine Fisheries Service, no other federally listed or proposed endangered or threatened species or critical habitats other than those listed in Section 3.4 above and this section are located in Hudson County, New Jersey. In

consideration of the above, the project is not likely to adversely affect federally-listed or proposed threatened or endangered species or critical habitat.

- There are no wild and scenic rivers, coastal barriers, wilderness areas, or significant agricultural lands on or in the vicinity of the Site. The Site is not located within the State of New Jersey's designated coastal zone. Therefore, the Wild and Scenic Rivers Act, the Coastal Barriers Resources Act, the Wilderness Act, the Farmland Protection Policy Act, and the Coastal Zone Management Act are not considered ARARs/TBC for this Site.

Furthermore, the USEPA's February 7, 2013 comments on the SCSR and June 25, 2013 comments on the RI/FFS Work Plan indicated that the USEPA is aware of wetland mitigation completed to date and that any future impacts to wetlands as a result of implementation of remedial action will similarly require mitigation.

Additionally, the USEPA's February 7, 2013 comments on the SCSR and June 25, 2013 comments on the RI/FFS Work Plan indicated that, according to available GIS layers, much of the Site is located within the 100-year floodplain as determined by the Federal Emergency Management Agency. Accordingly, if any future remedial action will be conducted on-Site, a floodplains assessment will be needed. The USEPA's June 25, 2013 letter also identified location-specific ARARs/TBCs for future Site remedial actions consisting of the following:

- Executive Order 11988 (Floodplain Management);
- Executive Order 11990 (Protection of Wetlands);
- Statement of Policy on Floodplains/Wetlands Assessment for CERCLA actions;
- Magnuson-Stevens Fishery Conservation and Management Act; and,
- National Historic Preservation Act (NHPA).

As part of the permitting process and coordination of an Engineering Evaluation/Cost Analysis with USEPA for the implementation of the 2008 IRAW, pertinent location-specific ARARs were reviewed relative to the IRA activities. Three of the preceding items were identified as potential

ARARs/TBCs (the Executive Orders and NHPA) as well as Federal Coastal Zone Management requirements, the Endangered Species Act of 1973, and the Fish and Wildlife Coordination Act. A review summary letter (KEY, September 14, 2009) was provided to the USEPA and subsequently, an approval letter (USEPA, June 11, 2010) was issued by USEPA. The Statement of Policy on Floodplains/Wetlands Assessment and the Magnuson-Stevens Fishery Conservation and Management Act are additional potential ARARs/TBCs for the Site that will be considered for any future remedial activities.

3.6 CONCEPTUAL SITE MODEL SUMMARY

Under existing Site conditions (i.e., as a result of the multiple, varied, robust response actions previously implemented), potential exposures to Site-related constituents have been mitigated. Migration of constituents from the Site under historical conditions appears to be limited to migration of DNAPL to the adjacent Diamond Site and Seaboard Site properties. Implementation of the IRA and the IRMs has resulted in effective containment at the Site and is believed to have entirely eliminated the potential for exposures under existing Site conditions. Potential exposures are possible under certain hypothetical future land and water use scenarios. Such exposures could occur if Site disturbance associated with construction or utility work occurs or if groundwater is developed as a potable source (unlikely given the Site location and potential salinity issues). However, institutional and administrative controls are considered effective means to mitigate such hypothetical future exposures.

4.0 WORK PLAN RATIONALE

The scope of work for the SCCC Remedial Investigation has been developed based on consideration of historical analytical data and current Site conditions as summarized in a Site Characterization Summary Report (SCSR) dated December 2012 (KEY, December 2012) [as amended in response to comment via a March 27, 2013 submittal – (KEY, March 27, 2013)]. Major portions of the SCSR have been reiterated in this project planning document for ease of reference as presented in the foregoing sections. A previous Supplemental Remedial Investigation work plan was prepared for the SCCC Site in 2008 when the Site was still being investigated pursuant to oversight by the NJDEP (KEY, December 2008). The scope of work outlined in the 2008 work plan was based on discussions with the NJDEP and was designed to address all perceived data deficiencies that existed at that time. The majority of the data required to address the scope of work outlined in the 2008 work plan were acquired concurrently with collection of data to support design activities for the implementation of multiple remedial components constituting an Interim Response Action (IRA) for the Site. The IRA was completed in 2011 as is documented in an IRA Report dated December 2011 (KEY, December 2011).

The SCSR included a comprehensive compilation of historical Site information and analytical data. Additional data requirements were identified based on evaluation of this information and through consideration of current Site conditions as represented by a Conceptual Site Model (discussed in Section 3.0). The identified data requirements focus primarily on the definition of Site impacts associated with the presence of DNAPL in the subsurface. Specifically, Section 6.5 of the SCSR stated the following:

"The following have been identified as additional data needs for the Site:

- *Sampling and analysis of the varved clay to verify the vertical extent of impacts;*
- *DNAPL delineation on the western portion of the SCCC property; and,*
- *DNAPL delineation in the vicinity of boring D-4 on the Seaboard property.*

This section provides additional information regarding these data needs. The decisions to be made based on these data and associated Data Quality Objectives are discussed in Section 4.1 (Data Quality Objectives). The approach to be employed to satisfy the data needs in consideration of available information is discussed in Section 4.2 (Work Plan Approach).

4.1 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) specify the appropriate quantity and type of data required to make informed environmental and risk management decisions, including tolerable levels of uncertainty. USEPA has developed a systematic process for developing DQOs that includes consideration of several critical elements. The process requires definition of the problem and statement of the decisions that will be made based on the study results. Information needed to support the decision-making process can then be defined, and includes identification of the constituents or parameters of interest, delineation of the physical boundaries of the study area, definition of the quantity of data that will be needed, identification of the means to collect the required data, and the level of uncertainty that will be acceptable. Program design can then be optimized to collect defensible data in the most efficient manner. For the purposes of this RI/FFS Work Plan, the following specific decisions have been identified:

Are additional response actions necessary to control the potential for vertical movement of DNAPL into the varved clay beneath the site to ensure that migration of DNAPL beyond the barrier walls (which are keyed into the varved clay to a minimum depth of 3 feet) does not occur?

Based on the assumption that institutional controls will preclude residential land use as does the most recent Redevelopment Plan adopted for the Site and its vicinity, are additional response actions (including institutional, engineering, or administrative controls) necessary to prevent potential organic and inorganic chemical exposure of relevant receptors (commercial/industrial workers or construction/utility workers) in a portion of Lot 50 which has heretofore been subjected to relatively more limited characterization?

Is modification of the DNAPL recovery operations appropriate to control potential lateral DNAPL movement given the potential presence of DNAPL at depth in the portion of Lot 50 which has been subjected to limited historical investigation primarily via indirect measurement of potential DNAPL presence (i.e., via use of a Remote Optical Sensing Tool and Laser-Induced Fluorescence)?

Is an additional response necessary to remediate or control potential DNAPL migration (laterally and vertically) beyond the limits of the slurry wall in a discrete portion of the Seaboard Site where soil sampling indicated the potential presence of DNAPL at the western property line along the barrier wall alignment, specifically near DNAPL delineation boring D-4)?

This RI/FFS Work Plan and related project planning documents (i.e., the Field Sampling Plan and the Quality Assurance Project Plan) serve as controlling mechanisms for the RI and specify a scope of work and procedures which will ensure that all decisions based on laboratory and field data generated during this investigation are technically sound, statistically valid, and properly documented. Specific procedures for sampling, laboratory analyses, data reporting, and data validation will be presented in the aforementioned supporting project planning documents. Standard Operating Procedures will be provided in the Field Sampling Plan for all investigative methods, field sampling procedures, field measurement procedures, sample handling and shipping, and documentation including chain-of-custody procedures. Key project team members, including quality assurance personnel will be identified in the Quality Assurance Project Plan. The QAPP will also provide detailed discussions of metrics to be used to assess the suitability of the data for its intended purposes in the form of requirements for the following:

Precision	Comparability
Accuracy	Completeness
Representativeness	Sensitivity

As a result of the varying nature of the data required, there are several applicable levels of data quality for the RI. A primary component of data quality is selection of the appropriate analytical

level for the intended data use. Analytical levels, as described in "Data Quality Objectives for Remedial Response Activities" (USEPA, March 1987), are as follows:

- Level I - Field screening or analysis using portable instruments. Results are often not compound-specific and not quantitative, but are available in real-time. Level I data are appropriate for initial field screening and for health and safety monitoring. They are frequently used to determine sample collection locations for laboratory analyses.

- Level II - Field analysis using more sophisticated portable analytical instruments; in some cases, the instruments may be set up in a mobile laboratory on location. There is a wide range in the quality of data that can be generated that is dependent on the use of suitable calibration standards, reference materials and sample preparation equipment. Results are available in real-time or within several hours.

- Level III - All analyses are performed in an off-site analytical laboratory. Level III provides quantitative data. Documented sampling and analysis procedures must be used. Level III analyses may or may not use Contract Laboratory Program (CLP) procedures, but at a minimum, abbreviated CLP-type deliverables are required. Level III may require data validation and QA/QC procedures conducted in accordance with USEPA guidelines. The laboratory may or may not be a CLP laboratory.

- Level IV – CLP-equivalent routine analytical services. All analyses are performed in an off-site analytical laboratory following CLP protocols. Level IV is characterized by rigorous QA/QC protocols and documentation with full validation of all data.

- Level V - Analysis by nonstandard methods. All analyses are performed in an off-site laboratory that may or may not be a CLP laboratory. Method development or method modification may be required for specific constituents or detection limits. CLP Special Analytical Services (SAS) are Level V.

For the purposes of the Remedial Investigation, the Analytical Levels to be employed consist of Levels I, IV, and V. The Analytical Levels to be employed consist of the following:

- Level I – Field Instrumentation Measurements
- Level IV – Contract Laboratory Program Equivalent Data
- Level V – Analysis via Nonstandard Analytical Methods

Level I **-** Level I analytical data will consist of information generated using portable field instrumentation, specifically, a Photoionization Detector (PID). The PID will be used as a screening tool to support selection of appropriate samples to be submitted for laboratory analysis. Sonic borings will be completed, and given the semi-volatile and volatile nature of the constituents of interest (i.e., chlorinated aromatic hydrocarbons) the PID is an appropriate screening tool for selection of such samples. The PID is also an appropriate tool to assess the potential presence of constituents of interest on a semi-quantitative basis.

Level IV – Level IV analytical data will consist of information generated via analysis of solid phase samples by off-site fixed-base laboratories. SW-846 analytical methods (e.g., SW-846 8260B, SW-846 8270C, SW-846 8082A, SW-846 8290A, and SW-846 6000 and 7000 series methods) will be employed for all offsite sample analyses with the exception of hexavalent chromium. Contract Laboratory Program level deliverables will be required such that validation of analytical data in accordance with the National Function Guidelines for organic and inorganic data review can be completed if necessary, as subsequently discussed in Section 5.3.

Level V – Level V analytical data will consist of information generated via analysis of solid phase samples by off-site fixed-based laboratories. Level V data will consist of data developed via nonstandard procedures used for hexavalent chromium analysis. The NJDEP has developed specific procedures to be followed for solid phase hexavalent chromium analysis. While the methods are based on the corresponding SW-846 method for digestion and analysis of solid samples (i.e., SW-846 Methods 3060A and 7199), additional quality assurance and quality control requirements apply such that the potential impacts of reducing conditions can be gauged as a result of the analytical program (i.e., measurement of Eh and pH are required for all samples and additional spiking requirements apply). The NJDEP-modified methods will be employed for hexavalent chromium analysis to satisfy specific state requirements.

4.2 WORK PLAN APPROACH

The scope of work for the RI has been developed based on the DQOs and decisions discussed previously in view of the data requirements identified in the SCSR. The specifics of the investigatory program have been developed via detailed consideration of historical data for specific areas or formations of interest. The scope of the investigatory efforts focuses on surface soil characterization and horizontal and vertical delineation of DNAPL impacts. DNAPL impacts will be assessed/defined via a boring program with associated subsurface soil sampling and analysis.. Vertical migration will be assessed via investigation of areas that have not been fully characterized heretofore. Surface soil characterization will be accomplished via the analysis of surface soil samples collected from DNAPL and varved clay soil boring locations.

Consideration of historical information related to the horizontal and vertical extent of DNAPL has been evaluated in this respect and reference to historical sample locations is made in this context. Figure 4-1 (geologic cross sections) and 4-2 (selected historical boring and well locations) are provided to support the discussions that follow regarding the extent of observed impacts.

4.2.1 Surface Soil Investigation

Historically, surface soil sampling and analysis for the SCCC site has been focused in nature and was geared toward the delineation of surficial chromium/hexavalent chromium and dioxin (as 2,3,7,8-tetrachloro-dibenzo-p-dioxin). Surface soil sampling, with analysis for the full suite of COI, was conducted as a component of the pre-design activities for the Interim Response Action completed in 2011 primarily within the SCCC Site Consolidation Area in support of the “Like versus Like” demonstration for use of the USEPA Area of Contamination Policy. Thus, additional data are considered necessary to define surficial impacts across the site. Consequently additional surface soil sampling is planned for areas that have heretofore been subjected to focused investigation. Surface soil sampling is planned for the western portion of the SCCC site, outside the former process area. Analysis for a full suite of analytical parameters is planned and consists of analysis for volatile and semi-volatile organics, metals, polychlorinated biphenyls,

and dioxins and furans. Details regarding the scope of the planned surface soil characterization effort are provided in Section 5.2.1.

4.2.2 DNAPL Delineation Investigation

Historical DNAPL delineation efforts have focused on several distinct portions of the SCCC Site. Specifically, DNAPL delineation was completed via the completion of soil borings, Rapid Optical Screening Tool (ROST®), and Laser-Induced Fluorescence investigations, and DNAPL measurements for various fill and sand unit monitoring wells. DNAPL was delineated in the vicinity of the former lagoons located in the eastern portion of the Site (which were expected to be potential sources of DNAPL), in the vicinity of monitoring wells MW-2L, MW-3L/17L, MW-5L, and MW-15L located on the western portion of the Site where DNAPL was observed to accumulate in the wells, and to the south on the Seaboard Site in DNAPL delineation borings and barrier wall alignment borings completed as part of the concurrent Phase II Supplemental RI and pre-design investigation to ensure that the planned barrier wall encompassed any DNAPL that may have migrated offsite to the south.

As a result of the historical detection of DNAPL in five wells on the western portion of the Site (i.e., in MW-2L, MW-3L/17L, MW-5L, and MW-15L), four corresponding deep sand DNAPL recovery wells were installed during the IRA in locations generally corresponding to these well locations. Specifically, recovery wells DRWL-3, DRWL-7, DRWL-2, and DRWL-8 were installed near the MW-2L, MW-3L/17L, MW-5L, and MW-15L locations, respectively. During the first DNAPL recovery effort completed in February 2012, 50 gallons of DNAPL was removed from recovery well DRWL-7 located near former monitoring wells MW-3L and MW-17L. No additional DNAPL beyond a trace amount has been identified at this location since that time (through the most recent recovery episode). No DNAPL has been detected in any of the other three wells located on the western portion of the Site. DNAPL recovery has been effective in the eastern portion of the Site and on the Seaboard Site to the south. Additional, DNAPL delineation efforts in the western portion of the site will provide additional data to determine if gradient-enhanced DNAPL recovery may be effective in this area (passive DNAPL recovery has proved successful elsewhere).

Various locations have been identified for investigation in the western portion of the Site based on consideration of available information regarding the topography of the varved clay and via consideration of historical analytical data for potential sources such as septic tanks, a vault, formulation buildings, and a former tank farm.

Boring D-14, located on Lot 48, will be completed to acquire data in the vicinity of a closed septic tank located south of Building 5. During the IRA, the contents of this septic tank were evacuated and the tank was backfilled with flowable fill. Chlorinated aromatic hydrocarbons were detected in samples from this septic tank (obtained as part of the IRA pre-design activities) and evidence of a potential release from the tank was noted via completion of a confirmatory boring/sampling and analysis program in the vicinity of the tank during the IRA. For example, a solid sample from the septic tank yielded a 1,2,4-trichlorbenzene concentration of 2,600 mg/Kg and dichlorobenzene isomer concentrations ranged as high as 9,900 mg/Kg (1,3-dichlorobenzene). Naphthalene was detected in the solid sample at a concentration of 1,100 mg/Kg. As shown on Figure 4-4 of the SCSR, various constituents were detected in a sample from the confirmation boring located on the south side of this closed septic tank (e.g., 1,2,4-trichlorobenzene at a concentration of 12 mg/Kg, 1,4-dichlorobenzene at a concentration of 21 mg/Kg, and naphthalene at a concentration of 620 mg/Kg).

Borings D-15 and D-16, located on Lot 50, are planned for installation in the vicinity of a former above ground storage tank farm located to the west of Building 2. Limited information is available for this area. Weston completed two soil borings in this area as part of the 1992 Phase II Remedial Investigation for the Site. Two samples were obtained from each of these boring, one from the fill material and one from the deep sand just above the varved clay. Chlorinated aromatic compounds were detected in the fill samples from these borings at concentrations ranging as high as 430 mg/Kg (1,4-dichlorobenzene in sample SB-3A). Although chlorinated aromatics were not detected in the deep sand samples for these borings, additional investigation of this area is warranted to investigate potential deeper soil impacts in consideration of the confirmed presence of DNAPL to the south and southwest of this area. In addition, given that chlorinate aromatic compounds have been detected in deep soil samples to the southeast of this location (i.e., on the Seaboard property, as subsequently discussed), an additional boring (D-18)

is planned between the location of the former tank farm and the impacted area on the Seaboard property to determine if the impacts may have originated from the tank farm.

Boring D-17, located on Lot 50, will be completed to acquire data in the vicinity of an additional closed septic tank located near the northeast corner of Building 3. A soil sample from a confirmatory boring located on the south side of the former tank yielded a 1,4-dichlorobenzene concentration of 480 mg/Kg, indicating a potential historic release from this septic tank location. Boring D-19 is sited adjacent to the former central drainage ditch at the Site. This drainage ditch is believed to have conveyed water from various septic tank discharges and historical sampling of soft soils from the drainage ditch demonstrated the presence of multiple Site-related constituents. The closed drainage ditch could constitute an historical source of DNAPL and hence has been targeted for the purposes of this investigation. Boring D-20 is located adjacent to a former vault which was remediated as an Interim Remedial Measure in 2008. Soil samples have not been obtained at this location to date and hence the former vault location has been targeted to determine if it may have acted as a source of DNAPL. Borings D-21 and D-22 have been sited at the southern end of Building 2. DNAPL has historically been observed in the subsurface in the general vicinity of Building 2, primarily at the southeastern corner and these borings are intended to further define the extent of any DNAPL impacts in this area.

Based on the observations regarding DNAPL recovery, it has been concluded that no additional DNAPL delineation efforts are necessary in the eastern portion of the Site. Furthermore, given the absence of any appreciable DNAPL recovery in the vicinity of the various monitoring wells of interest on the western portion of the Site, no additional delineation efforts are considered necessary in most of the discrete areas of interest. Additional delineation efforts on the Seaboard Site are considered necessary in two specific areas. Since its installation as part of the IRAW, a substantial quantity of DNAPL has been recovered from DNAPL recovery well DRWL-11 (approximately 2,000 gallons as of June 30, 2013) and the surface elevations of the varved clay suggests that a potential subsurface low point may exist in the vicinity of this recovery well. Borings D-26 and D-27 have been sited to investigate the presence of DNAPL between the former lagoon area and DRWL-11 (D-26) and in the vicinity of the suspected varved clay subsurface topographic low to the south of DRWL-11 (D-27).

In addition to the preceding, concentrations of semi-volatile constituents (chlorinated aromatic hydrocarbons) suggest that DNAPL may exist in the vicinity of one of the perimeter borings completed on the western side of the Seaboard property. Specifically, chlorinated aromatic hydrocarbons were detected at concentrations ranging to 5,200 mg/Kg in a sample obtained from DNAPL delineation boring D-4 at a depth interval of 14.5 to 15 feet. Review of the boring log for this location indicates that although odors were noted, no visual indication of DNAPL exists. However, the detection of chlorobenzene (51 mg/Kg), 1,2-dichlorobenzene (3,700 mg/Kg), 1,3-dichlorobenzene (4,200 mg/Kg), 1,4-dichlorobenzene (5,200 mg/Kg), and 1,2,4-trichlorobenzene (56 mg/Kg) in the sample obtained from an interval just above the varved clay (which was encountered at a depth of 16 feet at this location) indicates that DNAPL may be present in the area. This DNAPL boring was installed along the barrier wall alignment and hence the potential for the presence of DNAPL beyond the barrier wall exists for this location. Consequently, additional borings are planned for this area to investigate the potential presence of DNAPL in the area. Three borings are currently planned (outside the barrier wall), although the boring program may be expanded in the event that DNAPL is encountered. Visual inspection, PID measurements, incidental olfactory observations, and laboratory analysis will be used to determine the extent of any potential impacts in this location. The planned investigation locations are depicted on Figure 4-3.

Visual inspection, PID measurements, incidental olfactory observations, and laboratory analysis will be used to determine the extent of any potential impacts in the preceding areas. The planned investigation locations are depicted on Figure 4-3. The actual locations of the borings will be determined in the field based on the presence of potential access limitations or other obstructions, buried utilities, etc. Planned sampling intervals and analyses are discussed in Section 5.2.2.

4.2.2 Varved Clay Investigation

Data obtained to date suggest that limited vertical migration of Site-related constituents has occurred. Chromium impacts observed in fill material above the organic rich layer locally referred to as the Meadow Mat do not extend into the deeper sand unit underlying the Meadow Mat. The Meadow Mat acts as a reducing layer which impedes downward movement of the

chromium via reduction of hexavalent chromium to the relatively insoluble and immobile trivalent form. Similarly, although DNAPL consisting of high specific gravity, low viscosity chlorinated aromatic hydrocarbons has been identified at the Site, and is currently being recovered, the DNAPL does not appear to have migrated vertically beyond the interface between the deep sand unit and an underlying massive varved clay unit which acts as an impermeable barrier to vertical movement.

Substantial evidence of the attenuation of hexavalent chromium across the Meadow Mat has been obtained to date as a result of the completion of multiple borings and paired (fill and sand) monitoring wells. However, borings completed at the Site have typically only extended into the deep sand and monitoring wells have not been installed in the varved clay unit given its low yield. Therefore, limited data are available to support assessment of the vertical migration of DNAPL. However, several discrete data points do exist in this respect. Selected borings completed during the concurrent pre-design investigation and Supplemental RI extended into the varved clay and suggest that DNAPL has not penetrated into the varved clay beneath the Site. Specifically, evidence of the absence of vertical penetration is provided by borings and analytical results for the following borings:

- BW-18B (boring on the Seaboard property approximately 180 feet south of SCCC)
- BW-20 (boring on the Seaboard property approximately 180 feet south of SCCC)
- D-4 (boring located in the northwest corner of the Seaboard property)

As a result of the detection of potential free-phase DNAPL in various delineation and barrier wall alignment borings on the Seaboard property, the original alignment of the barrier wall as proposed in the NJDEP-approved Interim Response Action Work Plan dated October 2008 (KEY, October 2008) was revised as documented in an Interim Response Action Work Plan Addendum dated March 2009. Barrier wall borings completed on the Seaboard property provided evidence of lateral migration of DNAPL but no evidence of vertical migration into the underlying varved clay.

For example, barrier wall boring BW-18B was completed south of Building 2 on the Seaboard Site and extended to a depth of 26 feet. The Meadow Mat was encountered at a depth of 6.5 to

12 feet and the varved clay was encountered at a depth of 18 feet. A thin clayey silt layer approximately 3 inches thick was identified at the base of the sand immediately above the varved clay. Product was observed immediately above the silt layer and field measurements using a photoionization detector (PID) yielded a measurement of 303 parts per millions (ppm) for this silt layer. The PID measurement obtained for the split spoon sample obtained from the clay immediately below this sample was 3.3 ppm.

A similar observation was noted for boring BW-20 which was also completed on the Seaboard property. The boring was completed to a depth of 30 feet. The Meadow Mat was encountered at a depth of approximately 6.5 to 10 feet and the varved clay was encountered at a depth of 16 feet. Again, a layer of clayey silt (approximately 8 inches thick) was identified at the base of the sand directly above the clay and product was observed in the split spoon sample from this interval. The PID measurement for this layer was 185 ppm whereas that for the clay immediately below this layer was 15.6 ppm. The slurry wall was ultimately installed to circumscribe both of these boring locations.

Data obtained for the Seaboard property as part of the pre-design investigation for the IRA indicate that, while lateral migration of DNAPL onto the adjacent Seaboard Site has occurred, no vertical migration of DNAPL into the varved clay has taken place. However, limited investigation of vertical migration of DNAPL on the SCCC Site itself has been completed to date and was planned as part of the Phase II Supplemental RI which was scoped in 2008. It is appropriate that the investigation of potential migration of constituents into the varved clay on the SCCC Site be completed and consequently it is planned that five borings be completed to assess this condition on the Site. Varved clay investigation borings will be completed at each of the locations identified on Figure 4-3. Planned sampling intervals and analyses are discussed in Section 5.2.3.

5.0 RI/FFS TASKS

This section provides a brief discussion of the various RI/FFS tasks. Field work activities described in this Work Plan will be performed in accordance with associated project planning documents consisting of a Health and Safety Plan (HASP), Field Sampling Plan (FSP), and Quality Assurance Project Plan (QAPP) provided as Appendices A, B and C of this RI/FFS Work Plan, respectively. At the request of USEPA, a copy of the Operation and Maintenance Plan for the Site Interim Response Action is also provided (Appendix D). A Cultural Resources Survey Work Plan (CRSWP) has also been prepared as part of the project planning documents and is provided as Appendix E of this RI/FFS Work Plan.

As requested by USEPA in the February 7, 2013 comment letter, dates of Thomas Edison's purchase of property at the Site and Edison's construction of the lead-acid battery manufacturing facility will be researched in compliance with the National Historic Preservation Act (NHPA). As acknowledged by USEPA in the SOW and in the June 25, 2013 comment letter, Phase IA Cultural Resources Work Plan (Langan, June 2009), Phase IA Cultural Resource Survey (Langan, August 2009), Geomorphological Assessment (Langan, May 2010), and Phase IB Archaeological Survey for Slurry Wall Construction Work Plan (Langan, July 2010) have been completed for the Site to address the requirements of the NHPA. Several samples were collected from the Slurry Wall installation activities and evaluated to address the requirements of NHPA. The referenced reports have been evaluated to identify the need for additional cultural resource data. Data needs are discussed in the CRSWP (Appendix E).

5.1 PROJECT PLANNING

Project Planning typically includes efforts related to initiating a project after the SOW is issued. The project planning task is deemed as complete when the Work Plan and any supplemental plans are approved (in whole or in part). Under the assumption that a final enforcement document will ultimately be in place for the Site, the following Project Planning elements are included in this task, at this time:

- Submittal of this Draft RI/FFS Work Plan to USEPA
- Submittal of a Revised RI/FFS Work Plan and Appendices (HASP, FSP, QAPP, CRSWP) to USEPA after receipt of USEPA's comments on the Draft Work Plan
- Notification to adjacent Seaboard Site property owner and the SCCC Site property owner regarding site access
- Initiation of utility mark-outs and clearances for existing sub-surface utilities and conveyance lines specifically in the area where drilling activities are proposed
- Notification for approval/concurrence from USEPA for proposed abandonment of monitoring wells, discussed further in Section 5.2.4
- Initiation of subcontractor procurement for field activities, coordination with a New Jersey-licensed driller to obtain permits for proposed abandonment activities and, coordination with analytical laboratories for sample analysis, bottleware provision, and required hard copy and electronic deliverables
- Notify USEPA 14 days prior to initiation of field sampling activities

5.2 FIELD INVESTIGATION ACTIVITIES

Additional soil boring information is to be obtained and combined with existing data to complete the investigations related to surface soil characterization, DNAPL delineation, and the vertical extent of potential impact to the varved clay layer. Sampling will be completed on Lots 48, 50, and 51 of the SCCC Site, as well as on an area to the south-west on the adjacent Seaboard Site as part of the DNAPL delineation efforts. Additional borings will be installed in several portions of the Site as part of the varved clay delineation efforts. Figure 5-1 depicts the proposed boring locations for both the DNAPL and varved clay borings. Surface soil samples will be collected from all borings located on the SCCC site. The planned varved clay investigation locations have been relocated slightly from those planned during preparation of the Supplement Phase II RI scoped in 2008. Site conditions have changed as a result of IRA activities, including construction of the SCCC consolidation area and establishment of upland wetland vegetation and hence two varved clay boring locations have been moved to avoid disturbance of these features.

This section provides a description of the scope of these activities as well as the information regarding the abandonment of select Site monitoring wells/piezometers that are no longer useful

monitoring points given that the IRA is complete. These activities will be conducted by a New Jersey-licensed driller certified to abandon wells in accordance with N.J.A.C. 7:9D. Prior to initiation of drilling work, requisite permits and utility mark-outs (as may be required), will be obtained.

5.2.1 Surface Soil Sampling and Analysis

Surface soil samples collected from the DNAPL and varved clay borings on the SCCC property (D-14 through D-22, VC-1 through VC-5 respectively, discussed in the subsequent section) will be obtained to supplement data collected from previous investigations. The existing ground surface at these locations constitutes an IRM cover, comprised of either asphalt and sub-base or stone and geomembrane lining. The surface soil samples will be collected from the 0 to 6 inch interval directly below the IRM material to target the soil-like fill beneath. Analytical tests for the surface soils at the D-14 through D-22 and VC-1 through VC-5 locations will consist of Target Compound List (TCL) Volatile Organic Compounds (VOCs), including all three trichlorobenzene isomers (1,2,3-, 1,2,4-, and 1,3,5-), TCL Semi-Volatile Organic Compounds (SVOCs), Target Analyte List (TAL) metals, hexavalent chromium, Polychlorinated Biphenyls (PCBs) and Polychlorinated-dibenzo-p-dioxins and furans (PCDD/PCDF). Table 5-1 summarizes the sample locations and parameters for the surface soil sample locations.

5.2.2 DNAPL Delineation

Borings and subsurface soil sampling and analysis will be conducted to supplement existing DNAPL delineation information for the Site. The primary objective of this investigation is to identify the extent of DNAPL impacts in areas heretofore subjected to limited or indirect (i.e., Laser-Induced Fluorescence [LIF]) investigation. The boring program and sampling and analysis activities are discussed in the remainder of this subsection.

Fourteen (14) additional soil borings (D-14 through D-27) are planned to be completed to further delineate the extent of potential DNAPL on the SCCC and Seaboard Sites. Specifically, DNAPL delineation borings will be located around the perimeter of Buildings 2, 3, and 4, and in various other locations of interest as depicted on Figure 5-1 and as discussed in Section 4.2. DNAPL

delineation borings will be focused to investigate both the shallow fill and deep sand units. The proposed boring locations, in conjunction with the numerous previously installed borings are expected to provide all requisite data for completion of the delineation effort. As the investigation progresses, additional borings may be added to the program should it be determined that such borings are necessary to fully evaluate the extent of potential DNAPL.

Borings will be advanced to the top of the varved clay layer (a depth of approximately 20 feet bgs) using either a combination of hollow-stem auger (HSA) and wash rotary techniques, or sonic drilling methods. Temporary steel casing will be keyed into the meadow mat prior to advancement beneath the fill materials to eliminate the potential for impacts to the deep sand aquifer. The casing will be set in a bentonite slurry seal at the meadow mat-fill interface. A second sealed casing will be keyed into the varved clay to eliminate the possibility of downward migration of DNAPL.

Continuous soil samples (split spoon or sonic cores) will be obtained throughout the entire depth of each borehole to accommodate visual determination of the presence/absence of DNAPL. The soil samples will be field screened and logged by the supervising field geologist. Surface soil samples will be obtained for each of the DNAPL borings to be completed on Lots 48, 50, and 51 of the SCCC site as discussed in the preceding section. These data will be used to support risk assessment activities. Additional samples will be obtained at depth based on the identification of the potential presence of DNAPL.

If presence of residual or free-phase DNAPL is noted, then a sample from the DNAPL-impacted zone will be collected for laboratory analysis. The presence of residual or free-phase DNAPL will be determined via visual inspection. A DNAPL ranking system will be employed to characterize the samples and is defined in the associated FSP (Appendix B). Samples assigned a DNAPL rank of 2 (residual DNAPL) or 3 (free-phase DNAPL) will be submitted for analysis subject to the constraint that only one such sample from the fill/meadow mat per boring and only one such sample from the deep sand per boring will be submitted for analysis. Visual evidence of free-phase DNAPL will be a high degree of continuous saturation or free draining conditions in cores of split spoon samples. Residual DNAPL will consist of disconnected, discrete globules that do not drain freely. Determination of Such samples from the fill/meadow mat and/or deep

sand will be discrete grab samples collected from the interval exhibiting the most significant DNAPL impacts. Discrete 6-inch intervals will be sampled subject to the constraint that a larger interval may be sampled if necessary to satisfy analytical volume requirements.

If the presence of residual or free-phase DNAPL is not noted in a given boring, a confirmatory sample will be obtained from the base of the deep sand unit (i.e., the interval immediately above the contact with the varved clay) to confirm that no DNAPL-related constituents are present. Regardless of whether or not the presence of DNAPL is observed in a given borehole, soil sample will be collected for laboratory analysis from the upper portion of the varved clay to confirm the absence or presence of DNAPL-related constituents..

Soil samples obtained for laboratory analysis will be collected in discrete 6-inch intervals (contingent upon volume requirements and recovery).

For all borings where DNAPL is encountered in the sand unit, an additional sample, to be obtained approximately 5 feet below the initial varved clay sample will be collected and kept on hold by the laboratory pending receipt and review of preliminary analytical results for the upper varved clay sample. Should the results indicate impacts to the upper varved clay sample, analysis of the sample on hold at the laboratory will be requested.

If the presence of residual or free-phase DNAPL is not noted in a given boring, the DNAPL delineation samples will be analyzed for TCL VOCs including all three trichlorobenzene isomers (1,2,3-, 1,2,4-, and 1,3,5-), TCL SVOCs, TAL metals and hexavalent chromium.

If the presence of residual or free-phase DNAPL is exhibited anywhere in a given boring, PCB and PCDD/PCDF analyses will be completed for selected discrete DNAPL-impacted zone grab samples given that PCBs and PCDD/PCDF have been noted to be associated with DNAPL at the site.

The total number of samples to be analyzed for PCBs and PCDD/PCDF across all of the DNAPL delineation and varved clay samples from both the fill/meadow mat and the deep sand across

both the SCCC and Seaboard Sites will be ten samples. Table 5-1 lists the analytical parameters and methods for the DNAPL delineation sampling.

All borings will be abandoned with a cement-bentonite mixture using the tremie method. Soil cuttings from drilling activities will be containerized for subsequent management as described in Section 5.2.5. All drilling locations will be staked for subsequent surveying.

5.2.3 Varved Clay Sampling and Analysis

Additional vertical delineation is planned as part of the RI/FFS. This scope consists of the completion of 5 borings into the varved clay unit to supplement data from previous investigations. Borings will be completed in selected areas and are denoted as VC-1 through VC-5 on Figure 5-1. Collection of the soil will be continuous from ground surface to the final boring depth (2 foot split spoon samples or 5-foot sonic cores). Samples for laboratory analysis will be collected in discrete 6 inch intervals (subject to volume requirements and recovery constraints). Drilling methods may include a combination of HSA and wash rotary techniques, or the use of sonic drilling equipment. In either case, temporary, telescopic, steel casings will be set and sealed into both the meadow mat and the varved clay during drilling as previously described in Section 5.2.2. Surface soil samples will be collected at the varved clay boring locations as described in Section 5.2.1.

Visual observations and field screening of the varved clay will be used to determine the intervals to be sampled. Similar to the DNAPL sampling discussed in the previous section, samples may be collected from the fill/meadow mat or deep sand if evidence of the presence of residual or free-phase DNAPL is observed (i.e., a DNAPL ranking of 2 or 3). One such sample will be obtained from each of the upper (i.e., fill/meadow mat) or lower (i.e. deep sand) zones if DNAPL is observed. The samples will be analyzed for the same suite of parameters as the DNAPL delineation samples (i.e., TCL VOCs, including all three trichlorobenzene isomers [1,2,3-, 1,2,4-, and 1,3,5-], TCL SVOCs and possibly PCBs and PCDD/PCDF contingent upon the constraint that a total of 10 DNAPL-impacted zone PCB/PCDD/PCDF samples will be collected and analyzed).

The shallowest varved clay interval where no evidence of impact is observed through visual and incidental olfactory methods, as well as PID readings, will be also be sampled for analysis. At each location, one additional sample will be collected approximately 5 feet below the initial sample and will be kept on hold at the laboratory pending preliminary analysis of the upper sample. Should the results indicate impacts to the upper varved clay sample, the sample on hold at the laboratory will be subjected to analysis (subject to the constraint that sample holding times must not be exceeded).

Laboratory analysis for the varved clay samples will be completed for the following constituents: TCL VOCs (including all three trichlorobenzene isomers [1,2,3-, 1,2,4-, and 1,3,5-], TCL SVOCs, TAL metals and hexavalent chromium. As previously discussed, if DNAPL is identified in a given varved clay investigation sample, analysis for PCBs and PCDD/PCDF may also be completed subject to the constraint that the maximum number of samples subjected for such analysis will not exceed 10 across both the SCCC and Seaboard Sites, across both the DNAPL delineation and varved clay investigation borings, and across the fill/meadow mat and deep sand samples. Table 5-1 lists the analytical parameters and methods for the varved clay sampling.

All borings will be abandoned with a cement-bentonite mixture using the tremie method. Soil cuttings from drilling activities will be containerized for subsequent management as described in Section 5.2.5. All drilling locations will be staked for subsequent surveying.

5.2.4 Surface and Subsurface Soil Sampling and Analysis Summary

Given that the surface and subsurface soil sampling programs are designed to satisfy multiple objectives, and given the diverse nature of site-related impacts, the planned sampling and analysis program as described in the preceding sections is somewhat complex. Consequently, a succinct summary of the sampling and analysis program has been prepared in bulleted form and is as follows:

- ***Surficial Zone*** - Surface soil samples will be obtained from all boring locations on the SCCC Site (borings D-14 through D-22 and VC-1 through VC-5). Surface soil

samples will be analyzed for TCL VOCs, including all three trichlorobenzene isomers, TCL SVOCs, TAL metals, hexavalent chromium, PCBs, PCDD/PCDF, pH, and ORP.

- ***Upper Zone*** - Subsurface soil samples will be obtained from the upper soil horizon (consisting of the fill and meadow mat) at any location where residual or free-phase DNAPL is encountered in this zone in any of the borings (D-14 through D-27 and VC-1 through VC-5). One grab sample will be collected from the most highly impacted interval in each boring where DNAPL is observed. These samples will be analyzed for TCL VOCs, including all three trichlorobenzene isomers, and TCL SVOCs. Up to 19 such samples could be obtained if DNAPL is encountered in the upper zone in each boring. Additionally, such samples may also be analyzed for PCBs and PCDD/PCDF if they are one of the first 10 such samples collected.

- ***Lower Zone*** – One sample will be obtained from the deep sand in each of the borings completed (D-14 through D-27 and VC-1 through VC-5). This sample will be obtained from either: 1) the most highly DNAPL-impacted interval if residual or free-phase DNAPL is observed; or, 2) from the base of the deep sand unit if no DNAPL impacts are noted in the deep sand unit. These samples will be analyzed for TCL VOCs, including all three trichlorobenzene isomers, and TCL SVOCs. Additionally, such samples may also be analyzed for PCBs and PCDD/PCDF if they are one of the first 10 such samples collected.

- ***Varved Clay*** – A varved clay sample will be obtained from the upper portion of the varved clay (i.e., one foot into the clay) at each of the borings (i.e., D-14 through D-27 and VC-1 through VC-5). All of these samples will be analyzed for TCL VOCs, including all three trichlorobenzene isomers, and TCL SVOCs. Additionally, the samples from the varved clay borings (VC-1 through VC-5) will be analyzed for TAL metals, hexavalent chromium, pH, and ORP. Contingency samples of the varved clay will also be obtained approximately 5 feet below the upper varved clay sampling interval. These samples will be retained on hold in the laboratory and will be analyzed as directed only if evidence of impacts is noted in the uppermost varved clay

sample. Contingency samples for organic analysis (TCL VOCs and SVOCs) will be obtained at any location where residual or free-phase DNAPL is noted in the fill/meadow mat or deep sand. Contingency samples for TAL metals, hexavalent chromium, pH, and ORP analysis will be obtained from each of the varved clay (i.e., VC) borings regardless of observations regarding organic impacts in the borings.

Two other issues regarding the planned sampling and analysis program are also noteworthy and are as follows:

- All samples will be collected as discrete grab samples, preferably from a 6-inch sample interval, but possibly from a slightly greater interval based on laboratory sample volume requirements.

- The NJDEP has quality assurance/quality control requirements for hexavalent chromium analysis in soils that are above and beyond those required by the routine SW-846 7199 method. These requirements consist of oxidizing or reducing condition characterization and hexavalent chromium spiking. Hexavalent chromium analysis will be completed subject to these additional requirements.

As previously indicated, the scope of the RI sampling and analysis program is summarized in Table 5-1 which includes relevant and important footnoting.

5.2.5 Monitoring Well/Piezometer Abandonment

The implementation of IRAW activities necessitated the installation of 16 recovery wells, 26 hydraulic controls wells and 28 piezometers throughout the SCCC and neighboring Diamond and Seaboard sites. The inclusion of these wells renders many of the previously installed wells redundant and suitable for decommission. A total of eight (8) monitoring wells and seven (7) piezometers located on the SCCC Site are proposed to be abandoned. Figure 5-2 provides with the locations of these wells. All applicable well records will be provided to the driller before abandonment activities are initiated.

Prior to well abandonment, the total depth of the well will be measured for comparison to the drilled depth reported on well construction forms. This will ensure the correct well is located and that no significant collapse or sediment buildup has occurred which would require the drillers to remove the materials from the well bore or overdrill. Wells will also be checked for removable product before abandonment. If product is encountered the well will be purged immediately prior to sealing. Any purge water generated will be contained and handled as described in Section 5.2.5 of this Work Plan. Abandonment will be completed by tremie grouting cement-bentonite slurry from the base of the well to ground surface. The slurry will be mixed in accordance with N.J.A.C 7:9D. After the cement-bentonite grout has cured for 24 hours and within 72 hours of the grout placement, any settling of the grout will be topped off and the well casing will be capped with concrete. The decommissioning will be performed by a NJ-registered driller certified to abandon wells. The driller shall observe applicable well abandonment regulations as set forth in N.J.A.C 7:9D.

5.2.6 Investigation-Derived Waste Management

Various types of Investigation-Derived Waste (IDW) will be generated during the course of the supplemental field investigation activities. IDW will consist of the following:

- Drill cuttings
- Drilling fluids
- Decontamination fluids
- Personnel protective equipment
- Disposable sampling equipment
- Plastic sheeting

Management of IDW will be conducted according to the applicable procedures provided in KEY SOP No. 122 (Management of Investigation Derived Wastes) that will be included in the updated QAPP (Appendix D).

Soils will be segregated between those above and below the Meadow Mat. Waste profiles for these soil units were previously prepared for disposal purposes during the PDI in 2008, and, as such, the segregated materials will be containerized and labeled accordingly. Likewise, drilling

fluids will be containerized based on depth from above or below the Meadow Mat and handled in the same manner as the soils. Personal protective equipment and sampling equipment will be containerized together and staged for offsite disposal based on previous waste characterization classifications. The surface cover on the Seaboard Site consists of recently placed processed dredge material and will be spread onto the surrounding ground surface prior to advancement of drilling tools into the soils directly beneath.

Decontamination water will be transferred from the decontamination pad into a polyethylene (or similar) storage tank or other suitable container and subsequently transported to and treated at the onsite HCTS. All remaining IDW will be containerized in 55-gallon drums and staged in a secure area on the Site. This staging area will be determined based on accessibility and security at the commencement of the project. A lid and bolt-on collar will be placed on each drum. The exteriors of the drums will be cleaned prior to staging. The drums will be clearly labeled with an identifying number (e.g., drum #1), the generation date, a general description of the contents (e.g., "drill cuttings, above Meadow Mat"), and an annotation indicating the waste classification (which may include "analysis pending"). Labels will be completed with indelible ink. Drum numbers will also be marked on the drum lid. The staged drums will be placed on pallets and covered with plastic sheeting. A log will be retained that indicates the specific contents of each drum (e.g., cuttings D-14, below Meadow Mat). Drums will be staged on-Site for no more than 90 days. Drums will be transported off-Site for disposal at an appropriate facility based upon the waste classification. Transportation and disposal will be completed in accordance with USEPA and Department of Transportation manifesting and record-keeping requirements, including USEPA Region 2 Off-Site Rule requirements.

5.3 DATA MANAGEMENT PROCEDURES

In accordance with the requirements of the SOW, the quality and validity of field and laboratory data compiled during the RI will be documented. Details regarding field and laboratory data management, including record keeping, validation, and reporting are provided in this subsection. The procedures and processes described herein will apply for all data to be collected during the RI but are also applicable for all data generated as a result of KEY investigations that have been completed to date. However, it should be recognized that multiple historical investigations have

been completed for the Site and virtually all of the data generated as a result of the historical investigations and studies is considered relevant for the characterization of the Site. Historical data have been generated by the USEPA, by the NJDEP, by KEY, and other consulting firms previously contracted by SCCC. All data generated to date have been subjected to cursory review for obvious data deficiencies or problems and have been compiled and presented in the NJDEP- and USEPA-approved SCSR. Given that the historical data have been reviewed, and were developed subject to oversight by, or via the direct involvement of regulatory agencies (i.e., USEPA and/or NJDEP), and, in the case of laboratory analysis, have been generated using appropriate methods in effect at the time, it is planned that all historical data will be assumed to be of appropriate quality and validity for the purposes of the RI and other supporting documents such as the Baseline Human Health Risk Assessment, Screening Level Ecological Risk Assessment and if applicable, Baseline Ecological Risk Assessment.

5.3.1 Field Activity Documentation

All field data collection activities will be completed in accordance with existing Standard Operating Procedures which are provided in the associated Sampling and Analysis Plan for the Site which comprises the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP) (see Appendices B and C, respectively).[1] The FSP and the QAPP will be updated as necessary during the RI/FFS to reflect the planned scope of work. Field procedure SOPs which are particularly germane to the upcoming activities include, but are not necessarily limited to, the following:

- Field Log Book
- Field Screening
- Surface Soil Sample Collection
- Subsurface Soil Sample Collection
- Equipment Decontamination

[1] Standard Operating Procedures were provided with the FSP prepared in support of the aforementioned Supplemental Phase II RI conducted with oversight by the NJDEP, in accordance with the requirements of the NJDEP Field Sampling Procedures Manual.

- Sample Packaging, Shipping and Handling
- Chain-of-Custody

The preceding SOPs will be used to ensure that all field data and sample collection activities are completed in accordance with best management practices. Documentation to be generated as a result of the planned field activities will consist of one or more field log books, sample collection forms, boring logs, chain-of-custody forms, and possibly via photographic documentation if appropriate. KEY is certified to collect (regulated) field measurements by the NJDEP Office of Quality Assurance in accordance with the requirements of New Jersey Administrative Code 7:18 (Regulations Governing the Certification of Laboratories and Environmental Measurements).

5.3.2 Laboratory Documentation

Contracted laboratories will be required to provide deliverables (in portable document format - pdf) that comply with the reporting requirements of the USEPA Contract Laboratory Program. As such, laboratory deliverables will include, at a minimum, all of the information required by the SOW, consisting of sample custody documentation (copies of executed chain-of-custody forms), NJDEP certification information, analytical responsibility in the form of a signatory page, analytical results per the relevant method, identification of the analytical method or methods employed, detection limits, qualifier definition, identification of nonconformances (if any), corrective actions (if any), and data deficiencies (if any).

The laboratory reports will also include any requisite quality assurance/quality control information, including holding time and extraction date information, laboratory and field duplicate results, spike sample results, calibration information, surrogate recoveries, etc. necessary to afford data validation. The USEPA will be provided with copies of a Laboratory Quality Assurance Manual for each contracted laboratory. In addition to the preceding, the contracted laboratories will also be required to provide electronic data deliverables which conform to the requirements of an electronic data deliverable SOP included in the QAPP.

5.3.3 Data Validation Documentation

All laboratory data will be subjected to data validation by KEY upon receipt. The scope of data validation is described in the QAPP. Data validation will be completed in conformance with the USEPA's National Functional Guidelines for Organic and Inorganic Data Review. Data validation reports will be generated on a Sample Delivery Group (SDG) basis and a cross reference between each SDG and the associated data validation report shall be maintained. Data validation reports will be maintained by KEY and will be provided to the USEPA upon request. Data provided by the contracted laboratories will be summarized in tabular and graphical format for inclusion in an SCSR Addendum (see Section 5.4) and will include relevant laboratory and data validation qualifiers, including definitions thereof.

5.3.4 Sample Management and Tracking Documentation

In accordance with the SOW, copies of all relevant sampling and analysis documentation will be maintained. Copies of all field reports, trip reports, sample shipping records, chain-of-custody forms, laboratory reports, data validation reports (cross-referenced by the analytical results to be provided in an SCSR Addendum [see Section 5.4]), boring logs, sample log sheets, and any and all other relevant support documentation will be maintained. Such documents will be maintained as 1) hard copies and 2) electronic copies (i.e., pdfs). Electronic copies of pertinent information will reside on KEY's server which is subjected to backup procedures once per week.

5.4 SCSR ADDENDUM

Following USEPA's approval of the RI/FFS Work Plan and implementation of the RI activities, in accordance with the SOW, the validated analytical data set associated with the RI activities will be submitted to the USEPA within the required timeframe after each sampling activity. Within forty-five (45) days after submission to USEPA of the final set of validated data, the Respondents shall submit to USEPA a SCSR Addendum which incorporates the additional data acquired via completion of the RI.

5.5 IDENTIFICATION OF CANDIDATE TECHNOLOGIES

An Identification of Candidate Technologies Memorandum will be prepared and submitted within the required timeframe after submission to USEPA of the last set of final validated analytical data from the RI activities. The candidate technologies identified shall include innovative treatment technologies (as defined in the RI/FS Guidance) where appropriate. The Identification of Candidate Technologies Memorandum will be prepared in view of the fact that an Engineering Evaluation and Cost Analysis (EE/CA) has already been prepared for the Site, and will consider technologies and alternatives if necessary to expand upon, or supplement, the Interim Response Actions and Interim Measures completed to date or currently underway at the Site.

5.6 TREATABILITY STUDIES (AS NECESSARY)

As described in Section 2.1.4 and acknowledged in the SOW, treatability testing consisting of a compatibility study of potential slurry wall mixes, evaluation of groundwater chromium reduction chemistry, estimation of groundwater treatment sludge generation rates, and stabilization of lagoon materials have been completed to support the in-place IRA components.

The treatability studies were completed as part of the IRA pre-design activities as required to implement and design the certain remedial components and verify design and permitting considerations. To develop the treatability testing program for the groundwater and DNAPL, existing boring logs, groundwater sampling data, and DNAPL characteristics and locations were reviewed and evaluated. Additionally, the hydraulic model developed to evaluate the fully encompassing slurry wall containment system was used as basis for determining target well mix ratios used for the HCTS treatability testing. Once the plan for implementation was developed, the treatability studies for groundwater and NAPL related IRA components was generally used to evaluate:

- The potential effect(s) of mixing groundwater from various zones (sand and fill), areas, and with varying chemical make-up;

- The effectiveness and selection of chemicals and dosages necessary to promote hexavalent chromium reduction, where needed;
- The effectiveness of various chemicals and pH requirements for precipitating and removing metals including: pH adjustment and anionic/cationic polymer addition;
- Potential for sludge formation, settling, handling, and sludge generation rates;
- Granular activated carbon treatment performance; and,
- Waste disposal considerations.

The groundwater and DNAPL related treatability testing were completed and used to develop the design and permitting requirements for the temporary construction treatment system previously used for construction dewatering, and the existing hydraulic control and DNAPL recovery system currently in use. The discharge for the systems(s) have been shown to meet the NJPDES permit requirements since operations were initiated and system effectiveness is consistent with the results of the treatability testing.

As part of the slurry wall compatibility assessment, Site DNAPL and groundwater were used in bench scale studies to assess whether the soil-bentonite slurry was compatible with the potential DNAPL and groundwater chemistry. The assessment indicated that the slurry wall backfill would be compatible with Site groundwater COIs and DNAPL.

The lagoon area bench scale and pilot scale studies were conducted to identify a surface improvement technique. Testing was conducted with a variety of reagents combined with the lagoon materials. The test results provided with a suitable mix ratio and solidification of the lagoon materials was completed. To-date no visual surface failures or noticeable settlements have been observed near the surface of the area and therefore indicative of the general functionality of the study.

Should the results of this RI indicate that supplemental remedial actions are necessary to achieve Site-specific risk-based remedial goals, treatability studies will be completed as necessary to support the selection and/or design of the needed additional remedial actions. Treatability studies, if necessary, would be conducted in accordance with a Treatability Study Work Plan submitted to, and reviewed and approved by, the USEPA.

5.7 BASELINE RISK ASSESSMENT

A baseline risk assessment shall be prepared for the Site in accordance with the requirements of the SOW. The baseline risk assessment will consist of two primary components, as follows:

- Baseline Human Health Risk Assessment
- Baseline Ecological Risk Assessment (if necessary)

The Baseline Ecological Risk Assessment will be completed if necessary based on the outcome of an initial Screening Level Ecological Risk Assessment. As specified in the SOW, the baseline risk assessment will be prepared in view of Site conditions at the time that the baseline risk assessment is prepared. Any Interim Remedial Measures or Interim Response Actions completed to date (or underway) shall be reflected in the baseline risk assessment. In accordance with the SOW, the baseline risk assessment shall also consider current and reasonably anticipated future land uses.

The risk assessment activities will be completed in accordance with applicable USEPA guidance for risk assessment. The remainder of this section provides a summary of the major components of the baseline risk assessments for human and ecological receptors with specific emphasis on the site-specific requirements stipulated in the SOW.

5.7.1 Baseline Human Health Risk Assessment

To facilitate the completion of the Baseline Human Health Risk Assessment (BHHRA), an interim deliverable is planned, called the Pathway Analysis Report. As suggested by the USEPA in its June 25, 2013 comments on the April 2013 draft RI/FFS Work Plan, the interim deliverable planned to be submitted prior to the Pathway Analysis Report, called the Memorandum on Exposure Scenarios and Assumptions, is being omitted as a separate submittal. The information will be presented in the Pathway Analysis Report. This will help streamline the BHHRA. The Pathway Analysis Report and the BHHRA Report are discussed in the subsections that follow. Section 5.7.1.1 describes the MESA information to be folded into the Pathway Analysis Report,

Section 5.7.1.2 further describes the Pathway Analysis Report, and Section 5.7.1.3 describes the BHHRA.

5.7.1.1 Memorandum on Exposure Scenarios and Assumptions

Information typically presented in a Memorandum on Exposure Scenarios and Assumptions (MESA) shall be integrated into the Pathways Analysis Report (PAR). Text describing the Conceptual Site Model, exposure scenarios, and assumptions for the Site based on current and reasonably anticipated future land uses will be provided in the PAR. A preliminary Conceptual Site Model (CSM) was prepared as a component of the Site Characterization Summary Report as reproduced in this Work Plan as Section 3.0. This CSM described in Section 3.0 shall provide the basis for the BHHRA CSM, although the CSM may be revised contingent upon the findings of the DNAPL migration investigations previously discussed (e.g., it may be necessary to evaluate potential offsite receptor exposure potential and risks if DNAPL is determined to be present beyond the current barrier wall).

In addition to the aforementioned text, two tables will be prepared to document the pathways/potential exposure scenarios and exposure assumptions. The tables will take the form of Tables 1 and 4 as specified in Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual, Part D (Standardized Planning, Reporting, and Review of Superfund Risk Assessments). These tables are as follows:

Table 1 - Selection of Exposure Pathways - This table shall follow the format specified in Appendix A of the reference document and shall consist of identification of the following:

- Scenario Timeframe
- Medium
- Exposure Medium
- Exposure Point
- Receptor Population
- Receptor Age
- Exposure Route

- Type of Analysis
- Rationale for Selection or Exclusion of Exposure Pathway

The instructions provided in Appendix B of the reference document will be followed to prepare Table 1. As applicable, the menu items (i.e., the pick lists) provided in Appendix B of the Guidance will be employed.

Table 4 - Values Use for Daily Intake Calculations – Reasonable Maximum Exposure – Table 4 will consist of a series of tables identified with sequential designations (i.e., 4.1, 4.2, 4.3 or 4A, 4B, 4C, etc.). These tables shall follow the format in Appendix A of the reference document and shall be scenario timeframe-, medium-, and exposure medium-specific (e.g., Current, Soil, Breathing Zone Air). The tables will consist of identification of the following:

- Scenario Timeframe
- Medium
- Exposure Medium
- Exposure Point
- Receptor Population
- Receptor Age
- Exposure Route
- Parameter Code
- Parameter Definition
- Value
- Units
- Rationale/Reference
- Intake Equation/Model Name

The instructions provided in Appendix B of the reference document will be followed to prepare Table 4. As applicable, the menu items (i.e., the pick lists) provided in Appendix B will be employed. As stated in the SOW, default parameters as identified in the 1991 Standard Default Assumptions or other updated guidance shall be considered the primary source of the parameter

values although other references such as the Exposure Factors Handbook or Site-specific information shall be employed (and documented) as appropriate.

5.7.1.2 Pathway Analysis Report

Upon completion of data collection activities, including laboratory analysis and data validation, a Pathway Analysis Report (PAR) shall be prepared and submitted to the USEPA. As stated previously, information that is typically included in a MESA (Section 5.7.1.1) will be included in the PAR. As required by the SOW, the PAR shall be prepared in accordance with guidance outlined in accordance with the requirements specified in Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual, Part D (Standardized Planning, Reporting, and Review of Superfund Risk Assessments) and other appropriate guidance documents. The PAR will provide the information necessary to ensure that interested parties or stakeholders understand how potential risks associated with the Site will be evaluated. The PAR will form the basis for preparation of the Baseline Human Health Risk Assessment Report (discussed in Section 5.7.1.3). The PAR will consist of brief textual descriptions of major aspects of the BHHRA (e.g., selection of Chemicals of Potential Concern) and will include various tables prepared in accordance with the requirements specified in the aforementioned guidance. Descriptions of the relevant tables to be provided with the PAR are as follows:

Table 2 - Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Table 2 will consist of a series of tables intended to document the identification of Chemicals of Potential Concern (COPCs) for the Site. One table (numbered sequentially as 2.1, 2.2, 2.3 or 2A, 2B, 2C, etc.) will be prepared for each combination of exposure scenario timeframe, medium, and exposure medium (e.g., future, groundwater, indoor air) and shall consist of the following entries:

- Scenario Timeframe
- Medium
- Exposure Medium
- Exposure Point
- CAS Number

- Chemical
- Minimum Concentration
- Maximum Concentration
- Units
- Location of Maximum Concentration
- Detection Frequency
- Range of Detection Limits
- Concentration Used for Screening
- Background Value (as applicable)
- Screening Toxicity Value
- Potential ARAR/TBC Value
- Potential ARAR/TBC Source
- COPC Flag (Y/N)
- Rationale for Selection or Deletion

In the event that multiple exposure units are considered for the Site, the tables may be further subdivided to reflect consideration of the exposure unit (e.g., future, groundwater, indoor air, former lagoon area). In this case, the tables may be numbered as 2.A.1, 2.A.2 or 2.1.A, 2.1.B, or in some similar manner. The COPC screening procedure shall follow the guidance outlined in Section 5.0 (Data Evaluation) of Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A). In accordance with the requirements of the SOW, COPC selection will include, in part, a concentration-toxicity screening step using the Regional Screening Levels (formerly Preliminary Remediation Goals) which have been developed by USEPA and are available online at http://www.epa.gov/region9/superfund/prg. Any concerns regarding the validity of the Regional Screening Levels (RSLs) will be addressed in the uncertainty section of the screening procedure.

Table 3 - Medium-Specific Exposure Point Concentrations - Table 3 will summarize the Exposure Point Concentrations for all COPCs identified in Table 2 on a medium-specific basis. Table numbering for the EPC tables will conform to the format used for Table 2 with respect to numbering to facilitate cross referencing. EPCs shall be determined as Upper 95% Confidence

Limits (UCLs) on the mean and will be determined using the most up-do-date version of the USEPA ProUCL software. A typical Table 3 shall consist of the following entries:

- Scenario Timeframe
- Medium
- Exposure Medium
- Exposure Point
- Chemical of Potential Concern
- Units
- Arithmetic Mean
- 95% UCL
- Maximum Concentration
- EPC Value
- EPC Units
- EPC Statistic
- EPC Rationale

EPCs will consist of either the maximum observed concentration (if the maximum exceed the UCL) or the UCL as determined (and recommended) by the software. The software will provide a recommended UCL based on the data distribution and goodness–of-fit testing and may be based on Student's t, Jackknife, Land's H statistic, maximum likelihood estimators, etc.

Table 5.1 and 5.2 - Non-Cancer Toxicity Information - Oral/Dermal and Inhalation - Table 5 will consist of two tables as required by the Part D guidance document discussed previously. Noncarcinogenic toxicity information will be presented in the form of dose-response parameters (specifically References Doses [RfDs] and Reference Concentrations [RfCs]). One table (5.1) will be prepared for oral (and dermal) toxicity information and a second table (5.2) will be prepared for inhalation toxicity information. Table 5.1 will consist of the following entries:

- Chemical of Potential Concern
- Chronic/Subchronic
- Oral Reference Dose Value

- Oral Reference Dose Units
- Oral Absorption Efficiency for Dermal Exposure
- Adjusted Reference Dose for Dermal Exposure Value
- Adjusted Reference Dose Dermal Exposure Units
- Primary Target Organs/Endpoints
- Combined Uncertainty/Modifying Factors
- Target Organ Source
- Target Organ Source Date

Table 5.2 will be similar in nature to Table 5.1 except that the Oral RfD will be replaced by the Inhalation RfC and the Oral Adsorption Efficiency and Adjusted RfD for dermal exposure will be replaced with one column corresponding to the RfC as extrapolated from oral data. The hierarchy for identification of toxicity information will be as specified in the SOW. The primary source of toxicity information will be IRIS. The second tier shall be Provisional Peer Reviewed Toxicity Values. It has been assumed that USEPA can provide assistance with obtaining this information from the Superfund Health Risk Technical Support Center. Tier 3 sources shall be as identified in the SOW subject to the caveat that CalEPA will be considered the source of last resort given concerns regarding the objectivity of that specific entity and shall be identified via consultation and discussion with the USEPA.

Table 6.1 and 6.2 - Cancer Toxicity Data Oral/Dermal and Inhalation - Table 6 will consist of two tables as required by the Part D guidance document discussed previously. Carcinogenic toxicity information will be presented in the form of dose-response parameters (specifically Cancer Slope Factors [CSFs] and Unit Risk Factors [URFs]). One table (6.1) will be prepared for oral (and dermal) toxicity information and a second table (6.2) will be prepared for inhalation toxicity information. Table 6.1 will consist of the following entries:

- Chemical of Potential Concern
- Oral Cancer Slope Factor Value
- Oral Cancer Slope Factor Units
- Oral Absorption Efficiency for Dermal Exposure
- Absorbed Cancer Slope Factor for Dermal Exposure Value

- Absorbed Cancer Slope Factor for Dermal Exposure Units
- Weight of Evidence for Carcinogenicity
- Oral Cancer Slope Factor Source
- Oral Cancer Slope Factor Source Date

Table 6.2 will summarize the inhalation pathway carcinogenic toxicity information and will consist of the following entries:

- Chemical of Potential Concern
- Unit Risk Factor
- Unit Risk Factor Units
- Inhalation Cancer Slope Factor Value
- Inhalation Cancer Slope Factor Units
- Weight of Evidence for Carcinogenicity
- Unit Risk Factor Source
- Unit Risk Factor Source Date

The hierarchy for the identification of carcinogenic toxicity information shall be as previously discussed for the noncarcinogenic dose-response parameters.

5.7.1.3 Baseline Human Health Risk Assessment Report

Draft and final versions of a Baseline Human Health Risk Assessment Report (BHHRAR) shall be prepared. The tables identified in the previous subsections (i.e., Table 1 through 6) shall be reproduced in the appropriate sections of the BHHRAR (primarily in the Data Evaluation, Exposure Assessment, and Toxicity Assessment sections). Tables corresponding to summary Tables 7 and 10 specified in the Part D guidance referenced previously will be provided in the BHHRAR and will include a summary of carcinogenic and noncarcinogenic risks for all COPCs, receptors, and scenarios on a medium-specific basis (Table 7) and across all pathways (Table 10). The actual contents of these tables are not reiterated herein. While the SOW calls for preparation of Tables 7 through 10, it should be recognized that Table 8 is for radiation risks and Table 9 is a summary of the cumulative chemical and radionuclide risks. Given that

radionuclides and radiation exposure is not of concern for the SCCC Site, it is not planned that these tables (i.e., Table 8 and 9) will be prepared. Consequently, it is planned that the cumulative risk summary table for all pathways (Table 10) be provided as Table 8.

Appropriate text from the MESA/PAR will be incorporated into the BHHRAR in the appropriate sections. Additional information to be provided in the BHHRAR consists of an Executive Summary, a Risk Characterization section which will summarize the results presented in Tables 7 and 8 in textual form, a section summarizing relevant assumptions, an uncertainty section, and an overall summary. Appendices (e.g., UCL calculations, risk assessment calculations, fate and transport calculations, modeling results, IUBEK calculations, etc.) will be provided as appropriate to support the risk assessment. Additional summary tables may also be provided as necessary (e.g., chemical and physical property value information such as organic carbon partition coefficients, Henry's Law Constants, etc.).

5.7.2 Screening Level Ecological Risk Assessment

Upon completion of data collection activities, including laboratory analysis and data validation, a Screening Level Ecological Risk Assessment (SLERA) shall be prepared. The SLERA shall be completed in accordance with Ecological Risk Assessment Guidance for Superfund and will consist of problem formulation, fate and transport assessment, receptor identification, identification of complete exposure pathways, identification of exposure concentrations, identification of appropriate ecological toxicity values and comparison of Site concentrations to the conservative ecological benchmarks. It is planned that the results of the SLERA will be provided in the form of Ecological Hazard Quotients which are simply the ratio of the conservative exposure concentration to the corresponding benchmark. For the purposes of this Work Plan it has been assumed that the SLERA will focus on potential onsite exposures based on 1) how the Site was defined in the SOW and Agreement, and 2) the fact that the sediment adjacent to the Site has been dredged and placed in onsite consolidation areas. In the event that the SLERA indicates that ecological receptors may be at risk, a comprehensive Baseline Ecological Risk Assessment (BERA) may be required. If such is the case, a scope of work for the completion of the BERA will be necessary and will be submitted at a later date.

5.8 REMEDIAL INVESTIGATION REPORT

In accordance with Section IX Task 8 of the draft SOW, a draft Remedial Investigation Report (RIR) will be prepared with summary and details of information collected from the RI activities. The draft RIR will be prepared, following the USEPA RI/FS Guidance and in accordance with the SOW. The RIR will include the following elements:

- Site description
- Site history and previous investigations
- Interim remedial measures, Removal actions and Interim response actions
- Summary of Site Characterization Data (from SCSR, Baseline Human Health Risk Assessment Reporting and Baseline Ecological Risk Assessment, as required and applicable)
- Description of RI Tasks completed
- Summary of field activities and Sampling Results
- Conceptual Site Model
- Findings and Conclusions, and
- Recommendations

Geologic logs, laboratory data, validation reports, and pertinent field data logs will be included as appendices to the draft RIR

5.9 REMEDIAL ALTERNATIVES TECHNICAL MEMORANDUM

As indicated in Section 2.1.1, an EE/CA was completed to evaluate IRA alternatives with emphasis on effectiveness, implementability and cost. Subsequent to the USEPA's approval of the EE/CA, components of the IRA were designed (and implemented) such that the alternative employed demonstrated proven technologies that were effective in attaining their intended objectives. Also, emphasis was made to design and implement the individual IRA components such that they are potentially suitable final remedies or can be easily integrated into a final remedy. As such, the existing IRMs and IRA components will be included as part of each alternative to be evaluated. Nonetheless, as per the SOW, and as indicated in Section 5.5, the

Identification of Candidate Technologies Memorandum will be completed as part of the RI/FFS. Technologies retained after screening may form or may be combined to form (along with the existing remedial components) remedial alternatives for further evaluation. A summary of the assembled alternatives will be prepared for inclusion in the Development and Screening of Remedial Alternatives Technical Memorandum. The reasons for eliminating any technologies or alternatives as well as the basis for inclusion of a specific technology or alternative during the preliminary screening process will be specified in the Memorandum.

5.10 FOCUSED FEASIBILITY STUDY REPORT

A Focused Feasibility Study (FFS) Report will be conducted for the Site based on the results of the RI, Baseline Risk Assessments and, Development and Screening of Remedial Alternatives Technical Memorandum. Upon completion of the detailed evaluation of alternatives, a draft FFS Report will be submitted to the USEPA for review, comments and approval. The report will:

- Describe existing remedial measures or responses
- Summarize Focused Feasibility Study objectives
- Summarize remedial action objectives
- Articulate general response actions
- Identify and screen remedial technologies
- Develop and describe remedial alternatives
- Perform detailed analysis of remedial alternatives
- Present a summary and conclusions

Additional details regarding the content of the FFS Report are provided in the following subsections.

5.10.1 Remediation Requirements and FFS Objectives

The FFS will identify areas and volumes of media for which remediation is required either (a) to eliminate or control conditions at the Site posing a potentially unacceptable risk to human health and/or the environment or (b) to prevent the migration of constituents from the Site that could

potentially cause or contribute to an unacceptable risk to human health or the environment. All calculations related to area and volume estimates will be documented in the FFS Report. For the areas where a remediation requirement is identified, remedial action objectives (RAOs) and goals will be developed in consultation with the USEPA. The preliminary remediation goals will be developed based on Site-specific migration, exposure and risk considerations. The Baseline Risk Assessment will provide the basis for the development of narrative risk goals and for the development of preliminary remediation goals to be used as benchmarks to assess the attainment of risk objectives. The FFS Report will describe the rationale for, and procedure for use of, any preliminary remediation goals established for the Site.

The objectives of the FFS are to (a) identify remediation requirements and establish cleanup objectives as necessary to eliminate, control, or prevent potentially unacceptable risks to human health and the environment, and (b) identify, screen and evaluate potential remedial alternatives. Various steps involved in the FFS process are described in the following paragraphs.

5.10.2 Remedial Action Objectives

The first step in the FFS process is to identify the RAOs for each environmental medium of interest (e.g., soil, groundwater). The RAOs are Site-specific goals for protecting human health and the environment based on the nature and extent of potential impacts identified at the Site. The following factors will be considered in developing the RAOs:

- Chemicals of Potential Concern
- Potential migration pathways, receptors and exposure scenarios
- Acceptable constituent levels or ranges of levels for each potential exposure pathway

The RAOs will be used as a guide in determining the extent of any further remediation. The RAOs will be used to derive the General Response Actions (GRAs) as the first step in the identification of appropriate remedial technologies. The GRAs, which are broad classes of remedies, are selected to satisfy the RAOs at the Site. A preliminary CSM was prepared as a component of the SCSR and is reproduced in this Work Plan as Section 3.0. As part of the CSM, the aforementioned factors were evaluated to a greater extent. However, subsequent to the

DNAPL delineation and varved clay investigation activities specified in this Work Plan, the same factors will be revisited in developing the RAOs.

5.10.3 General Response Actions Objectives

GRAs are broad classes of remedial actions which might be implemented alone, or in combination, to satisfy the RAOs. As part of the FFS, the GRAs will be developed for each medium of interest defining containment, treatment, excavation, pumping, or other actions, singly or in combination. Typical GRAs include:

- No Further Action: leaves sources in their existing condition with no control or remediation.
- Institutional Controls: legal restrictions that are intended to control or prevent present and future exposure to Site constituents
- Engineering Controls: Use of physical restrictions (e.g., fences, barriers, caps) to prevent exposure to, or emission of constituents
- Administrative Controls: Use of work practices or other restrictions (e.g., policies and procedures or security measures) to prohibit prolonged exposure to constituents
- Containment: involves physical measures (e.g., barrier walls) to control the movement of contaminants and prevent direct contact or exposure to constituents
- Treatment: involves physical or chemical measures applied to the constituents to reduce toxicity, mobility, and/or volume of the contaminants present
- Removal, Transport, and Disposal: involves a partial or complete removal of source material followed by transportation to and disposal at a different location

As part of the FFS activities, the listed GRAs will be further defined through the screening and evaluation of remedial technologies and process options. Following this screening, the technologies retained will be assembled into remedial action alternatives aimed at achieving the proposed RAOs and will be summarized in the FFS Report.

5.10.4 Identify and Screen Remedial Technologies

Remedial technologies will be identified and screened to develop representative process options for assembly into a range of alternatives. The screening process includes:

- Development of GRAs that address the RAOs
- Identification of volumes or areas of media to which the GRAs would be applied

- Identification of candidate technologies applicable to the various GRAs and a screening out of those technologies that cannot be implemented for technical reasons
- Identification and screening of technology process options to select representative process options for each technology type retained for consideration (e.g., a slurry wall is a process option for the barrier wall technology which is a component of the containment general response action)

Screening of the technologies will be based on effectiveness, implementability, and relative cost. Technologies retained after the screening process will be assembled into alternatives for each remediation area.

5.10.5 Development of Remedial Alternatives

A focused set of technologies that have the potential to achieve the RAOs will be identified and screened as part of the FFS. GRAs to achieve the RAOs will be developed and technologies and process options applicable for each GRA will be screened to eliminate those that cannot be implemented at the Site or are likely to be ineffective. The technologies, either on their own, or in combination with one another, will form a number of remedial alternatives to undergo a detailed analysis. The existing IRMs and IRA components will be included in each remedial alternative to be evaluated. Consistent with USEPA guidance, the range of remedial options to be considered will include, at a minimum:

- Alternatives in which treatment is used to reduce the toxicity, mobility or volume of contaminants
- Alternatives that involve containment with little or no treatment, and
- A no-action alternative

5.10.6 Detailed Analysis of Remedial Alternatives

A detailed analysis will be conducted for the alternatives that are developed based on the technology screening. This detailed analysis will consist of an individual evaluation of each alternative against the following evaluation criteria and a comparative evaluation of all alternatives against the evaluation criteria with respect to one another:

Threshold Criteria

- Overall protection of human health and the environment;
- Compliance with applicable or relevant and appropriate requirements;

Balancing Criteria

- Long-term effectiveness and performance;
- Reduction of toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability;
- Cost;

Modifying Criteria

- State acceptance; and,
- Community acceptance

5.10.7 Summary and Conclusions (Recommended Alternative)

A summary of the remedial alternatives analysis including 1) the various alternatives identified, 2) alternatives that were discarded during the screening process and the rationale for same, and 3) alternatives that were considered appropriate to meet the RAOs will be provided in the Draft FFS Report. A recommended alternative based on the detailed analysis will be provided separately to USEPA (e.g., in the cover letter).

6.0 SCHEDULE

A preliminary proposed project schedule has been prepared (Figure 6-1) showing the duration of various tasks to be performed in accordance with this Work Plan, associated HASP, FSP, QAPP and CRSWP, and subsequent activities/submittals. The future task durations correspond to the required durations/deadlines specified in the SOW. This schedule will be revised with actual calendar dates upon the final approval of the Work Plan. The schedule is based upon the scope of work proposed herein. Should additional work, beyond that contemplated herein, be required to achieve project objectives, the schedule will be updated accordingly and provided to USEPA.

7.0 PROJECT MANAGEMENT

It has been assumed that the RI/FFS activities will be performed principally by KEY (or its subcontractors) on behalf of the Group. The project will be overseen by the USEPA to ensure compliance with the SOW requirements. The Group's representatives will maintain direct communication with the USEPA and the KEY Project Manager will support the Group's representatives as needed. The KEY Project Manager may interface directly with USEPA on technical matters related to the project. Responsibilities for the primary project personnel are described in the following paragraphs:

The Group's Representatives:

- Mitchell Brourman, Beazer East, Inc.
- Nelson Olavarria, Cooper Industries, LLC
- Enrique Castro, Tierra Solutions, Inc. on behalf of Occidental Chemical Corporation
- John McTigue, The Isosceles Group on behalf of Apogent Transition Corporation

The above referenced Group's representatives' responsibilities include:

- Representing the Group's management;
- Reviewing KEY's work;
- Primary interface with USEPA;
- Securing project funding; and,
- Reviewing all project documents before submission to USEPA.

KEY Project Manager

The KEY Project Manager, Mr. James Zubrow P.G., has responsibility for day-to-day management of

- Technical and scheduling matters related to the project. Other duties, as necessary, of the KEY Project Manager include:
- Subcontractor procurement,
- Assignment of duties to project staff and orientation of the staff to the specific needs and requirements of the project,
- Ensuring that data assessment activities are conducted in accordance with the QAPP,
- Approval of project-specific procedures and internally prepared plans, drawings, and reports,
- Serving as the focus for coordination of all field and laboratory task activities, communications, reports, and technical reviews, and other support functions, and facilitating Site activities with the technical requirements of the project, and
- Maintenance of the project files.

Mr. Zubrow has also been designated as the Group's Project Coordinator pursuant to Paragraph 40 of the Agreement.

KEY Technical Leader/ Project QA Officer

The KEY Project Manager will be assisted by Technical Leader/ Project QA officer, Mr. Robert Hubbard P.E., whose duties will include:

- Ensuring data assessment activities are conducted in accordance with the QAPP,
- Serving as the focus for coordination of all field and laboratory task activities, communications, reports, and technical reviews, and other support functions, and facilitating Site activities with the technical requirements of the project,
- Technical review and/or approval of project-specific procedures and internally prepared plans, drawings, and reports,
- Serving as the focus for coordination of all field and laboratory task activities, communications, reports, and technical reviews, and other support functions, and facilitating Site activities with the technical requirements of the project
- Updating the QAPP as needed,

- Reviewing and approving QA procedures, including any modifications to existing approved procedures,
- Ensuring that QA audits of the various phases of the project are conducted as required,
- Providing QA technical assistance to project staff, and
- Ensuring that data validation/data assessment is conducted in accordance with the QAPP.

KEY Analytical Task Manager

The KEY Data Manager/Laboratory Coordinator, Ms. Angela Gatchie, will be responsible for managing the subcontractor laboratories, serving as the liaison between field, laboratory personnel, data validation and database teams and assessing the quality of the analytical data.

KEY Health and Safety Officer

The KEY Project Health and Safety Officer, Mr. John Francis C.I.H., will serve as a health and safety advisor to the Project Manager and KEY staff including:

- Reviewing and approving Health and Safety Plans,
- Reviewing subcontractor safety records,
- Conducting safety audits,
- Recommending appropriate PPE to protect KEY personnel from potential hazards, and
- Conducting accident investigations.

KEY Field Team Leader

The KEY Field Team Leader, Mr. Vamsee Veera, has overall responsibility for completion of all field activities in accordance with the QAPP and is the communication link between KEY

project management and the field team. Specific responsibilities of the KEY Field Team Leader include:

- Coordinating activities at the Site,
- Assigning specific duties to field team members,
- Mobilizing and demobilizing of the field team and subcontractors to and from the Site,
- Directing the activities of subcontractors on Site,
- Resolving any logistical problems that could potentially hinder field activities, such as personnel conflicts, or weather dependent working conditions,
- Implementing field QC including issuance and tracking of measurement and test equipment; the proper labeling, handling, storage, shipping, and chain-of-custody procedures used at the time of sampling; and control and collection of all field documentation, and
- Communicating any non-conformances or potential data quality issues to KEY project management.

KEY Field Staff

The field staff reports directly to the KEY Field Team Leader, although the Field Team Leader in some cases will be conducting the duties of the field staff listed below. The responsibilities of the field team include:

- Collecting samples, conducting field measurements, and decontaminating equipment according to documented procedures stated in the QAPP,
- Ensuring that field instruments are properly operated, calibrated, and maintained, and that adequate documentation is kept for all instruments,
- Collecting the required QC samples and thoroughly documenting QC sample collection,
- Ensuring that field documentation and data are complete and accurate, and

- Documenting and communicating any nonconformance or potential data quality issues to the KEY Field Team Leader.

KEY Subcontractors

KEY specialty subcontractors may include, but are not limited to, drilling, surveying, analytical laboratories, waste management, and equipment rentals. These subcontractors will work under the direct supervision of KEY field staff to carry out specific scope requirements.

8.0 REFERENCES

This section provides a comprehensive list of all references considered during scoping of the RI/FFS for the SCCC Site. Documents referenced in this Work Plan, as well as those that were considered during preparation of the SCSR are provided for the sake of completeness.

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Geo-Trans, Inc., June 23, 2006. Groundwater Flow and Transport Model and Barrier Wall Evaluation – Standard Chlorine Chemical Co., Inc. Site and Diamond Shamrock Site, Kearny, New Jersey. Louisville, CO.

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KEY (Key Environmental, Inc.), April 2008. Site-Specific Sampling and Analysis Plan for Containerized Materials - Standard Chlorine Chemical Company Site, Kearny, New Jersey. Carnegie, PA.

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KEY (Key Environmental, Inc.), September 14, 2009. Applicable or Relevant and Appropriate Requirements, Interim Response Action Work Plan, Diamond Site and Standard Chlorine Chemical Co., Inc. Site, Kearny, New Jersey.

KEY (Key Environmental, Inc.), March 2010. Work Plan for Building 16, 19, and 20 Demolition and Asbestos Removal - Standard Chlorine Chemical Co. Inc. Site, Kearny, New Jersey. Carnegie, PA.

KEY (Key Environmental, Inc.), April 28, 2010. Draft Shoreline Restoration and Tidal Emergent Wetland Mitigation Plan, Department of Land Use Regulation Permit No. 0907-08-0001.1, Waterfront Development, Flood Hazard.

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KEY (Key Environmental, Inc.), June 2010. Standard Chlorine Chemical Company Superfund Site – Northeastern Area Buildings – Work Plan for Closure of Building Openings. Carnegie, PA.

KEY (Key Environmental, Inc.), September 2010. Self-Implementing On-Site Cleanup and Disposal Plan - Transformer Pad Area. Standard Chlorine Chemical Co. Inc. (SCCC) Site 1025-1035 Belleville Turnpike, Kearny, New Jersey. Letter to Ms. Judith Enck – Regional Administrator, USEPA Region 2. Carnegie, PA.

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KEY (Key Environmental, Inc.), March 30, 2012. Remedial Action Report for the Demolition of Buildings 15, 17, 18, & 21 – Standard Chlorine Chemical Company, Inc. Site, Kearny, New Jersey. Carnegie, PA.

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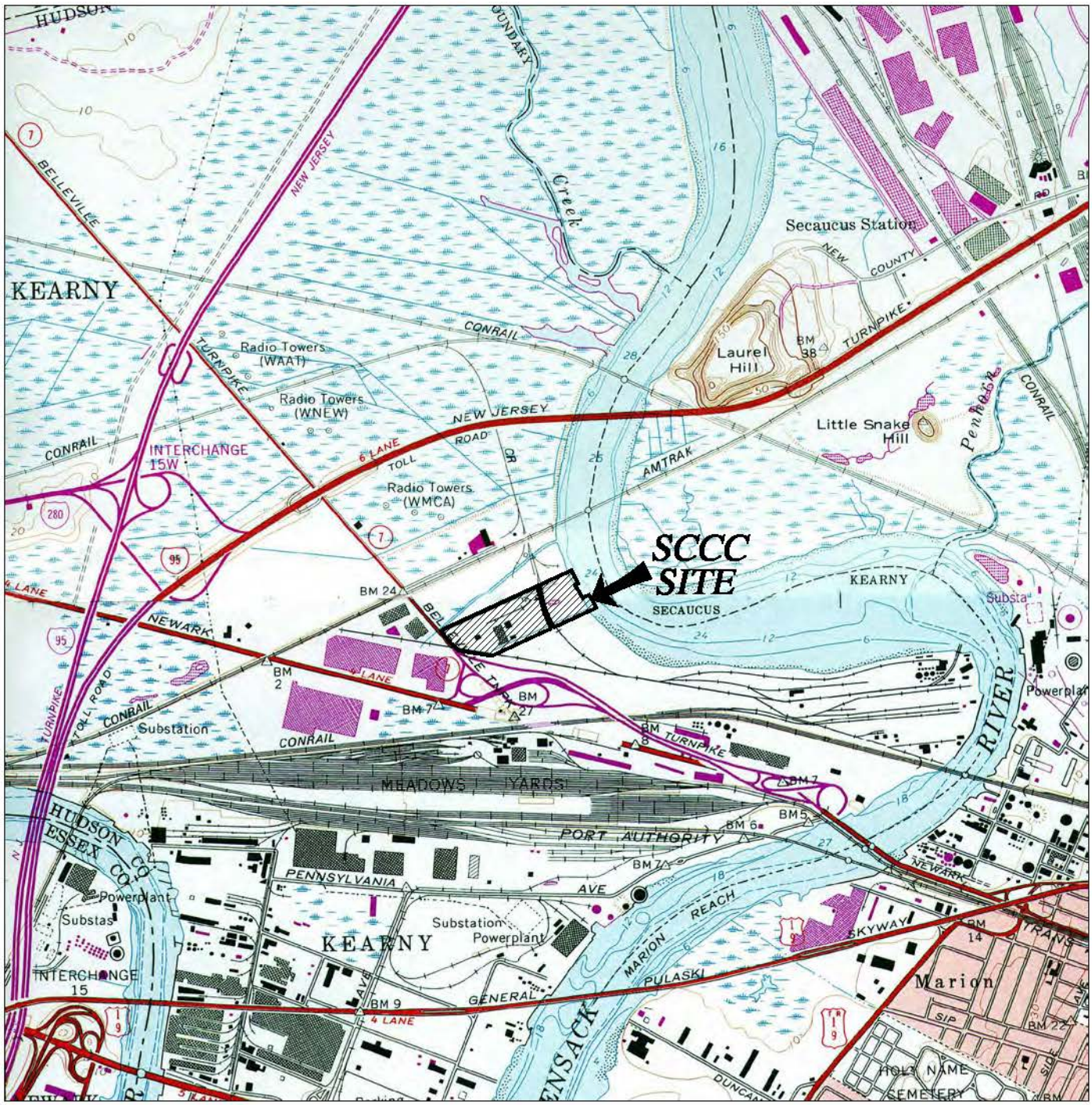
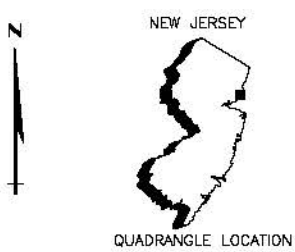
FIGURES





PERFORMING PARTIES GROUP

DRWN: SCC	DATE: 03/25/13	KEY ENVIRONMENTAL INCORPORATED
CHKD: RJH	DATE: 03/25/13	
APPD: JSZ	DATE: 03/25/13	
SCALE: 1"= 2000'		

REMEDIAL INVESTIGATION/
FOCUSED FEASIBILITY STUDY WORK PLAN
STANDARD CHLORINE CHEMICAL CO., INC. SITE
KEARNY, HUDSON COUNTY, NEW JERSEY

REFERENCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLES OF JERSEY CITY, AND WEEHAWKEN, NEW JERSEY.
THE QUADRANGLES HAS BEEN EDITED BY KEY TO REFLECT THE DEMOLITION OF THE MAJORITY OF THE ONSITE STRUCTURES AND TO DEPICT THE SITE LOCATION.

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

SITE LOCATION MAP

PROJECT NO: 2012-14

FIGURE 1-1

y:\DOcivil\kearny\ri-ffs work plan\figure 1-1 site location map.dwg Last Saved By: Scamer 7/25/2013 9:02 AM Plotted By: Shelly Comer 7/25/2013 9:12 AM Scale: 1:1.016827

LEGEND

- EXISTING ACCESS ROAD
- EXISTING NEW JERSEY TRANSIT RAILROAD (ACTIVE)
- EXISTING FENCE
- EXISTING STRUCTURES
- EXISTING UTILITY POLES
- EXISTING LIGHT STANDARD
- EXISTING OVERHEAD POWER LINE
- PROPERTY BOUNDARY
- EXISTING CONCRETE PAD
- EXISTING GROUND SURFACE ELEVATION CONTOURS
- EXISTING VEGETATION
- EXISTING STREAM, POND AND RIVER BANK
- EXISTING ELEVATION (FEET–MSL)
- SLURRY WALL LOCATION
- STEEL SHEET PILE WALL LOCATION
- GROUNDWATER CONVEYANCE PIPING TRENCH ALIGNMENT
- MEAN HIGH WATER (MHW)
- HCWU–21 — FILL UNIT GROUNDWATER EXTRACTION (HYDRAULIC CONTROL) WELL LOCATION
- DRWU–3 — FILL UNIT DNAPL RECOVERY WELL LOCATION
- DRWL–6 — SAND UNIT DNAPL RECOVERY WELL LOCATION
- HC–PZ–10U — HYDRAULIC CONTROL PIEZOMETER UPPER ZONE
- HC–PZ–10L — HYDRAULIC CONTROL PIEZOMETER LOWER ZONE
- AW–01 — SEMI–DEEP ANODE WELL LOCATION
- TREATED WATER PERMITTED DISCHARGE PIPING TRENCH ALIGNMENT
- EXISTING STORM DRAIN (48" PIPE)
- CULVERT
- EXISTING DROP INLET
- DROP INLET
- WATER LINE TO TREATMENT BUILDING
- EXISTING BUILDING
- FORMER BUILDING FOUNDATION/SLAB
- NEAR–SHORE SEDIMENT REMOVAL
- WETLANDS
- NON–PERMITTED PRE–IRAW WETLAND AREAS
- CONSOLIDATION AREA COVER SYSTEM (REFER TO FIGURE 3)
- VEGETATIVE COVER
- NON–PLANTED PARTIALLY VEGETATIVE AREA OF WORKING PLATFORM
- GENERAL STONE COVER 6" LAYER OF NJDOT #4 STONE, UNDERLAIN BY 10 OZ./S.Y. NON–WOVEN GEOTEXTILE
- ASPHALT
- 12 — CONSOLIDATION AREA FINAL GRADE

PERFORMING PARTIES GROUP

DRWN: SCC	DATE: 03/25/13
CHKD: JAB	DATE: 03/25/13
APPD: JSZ	DATE: 03/25/13
SCALE: AS SHOWN	

KEY ENVIRONMENTAL INCORPORATED

REMEDIAL INVESTIGATION/
FOCUSED FEASIBILITY STUDY WORK PLAN
STANDARD CHLORINE CHEMICAL CO., INC. SITE
KEARNY, HUDSON COUNTY, NEW JERSEY

CURRENT SITE CONDITIONS (2012)

PROJECT NO: 2012–14

FIGURE 2–1

REV #	DATE	DESCRIPTION	APPD
1			
2			
3			

REFERENCE:

1. EXISTING GROUND SURFACE CONTOURS PER AIR SURVEY, DULLES, VIRGINIA, APRIL 14, 2001. HORIZONTAL REFERENCE: NEW JERSEY STATE PLANE COORDINATES (NAD 1927). VERTICAL REFERENCE:NATIONAL GEODETIC VERTICAL DATUM (NGVD 1929).
2. PROPERTY BOUNDARY SHOWN HEREON FROM SHEET 1 OF 1 TITLED "SURVEY OF PROPERTY, TAX LOTS 32.02, 46, 47 & 47R, BLOCK 287, TAX LOTS 48, 49, 50, 51, 52 AND 52R, BLOCK 287, TOWN OF KEARNY, HUDSON COUNTY, NEW JERSEY," DATED JULY 1, 2009 (REVISION 2: JULY 29, 2009), PREPARED BY DYKSTRA ASSOCIATES, PC.
3. EXISTING WETLANDS PER WETLAND DELINEATION BY PRINCETON HYDRO, LLC FOR KEY ENVIRONMENTAL, INC. PERFORMED IN MARCH 2009.

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

y:\0Civil\kearny\rl-ffs work plan\figure 2-1 site plan-current conditions.dwg Last Saved By: Scomer 7/25/2013 8:16 AM Plotted By: Shelly Comer 7/25/2013 5:00 PM Scale: 1:2

LEGEND

PROPERTY BOUNDARY

0 150 300 FEET

REV #	DATE	DESCRIPTION	APPD
△			
△			
△			

REFERENCE:

1. PROPERTY BOUNDARY SHOWN HEREON FROM SHEET 1 OF 1 TITLED "SURVEY OF PROPERTY, TAX LOTS 32.02, 46, 47 & 47R, BLOCK 287, TAX LOTS 48, 49, 80, 81, 82 AND 52R, BLOCK 287, TOWN OF KEARNY, HUDSON COUNTY, NEW JERSEY," DATED JULY 1, 2009 (REVISION 2: JULY 29, 2009), PREPARED BY DYKSTRA ASSOCIATES, PC.
2. IMAGE PROVIDED BY GOOGLE EARTH DATED JUNE, 2012.

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

PERFORMING PARTIES GROUP

DRWN: SCC	DATE: 03/25/13	KEY ENVIRONMENTAL INCORPORATED
CHKD: RJH	DATE: 03/25/13	
APPD: JSC	DATE: 03/25/13	
SCALE: AS SHOWN		

REMEDIAL INVESTIGATION/
FOCUSED FEASIBILITY STUDY WORK PLAN
STANDARD CHLORINE CHEMICAL CO., INC. SITE
KEARNY, HUDSON COUNTY, NEW JERSEY

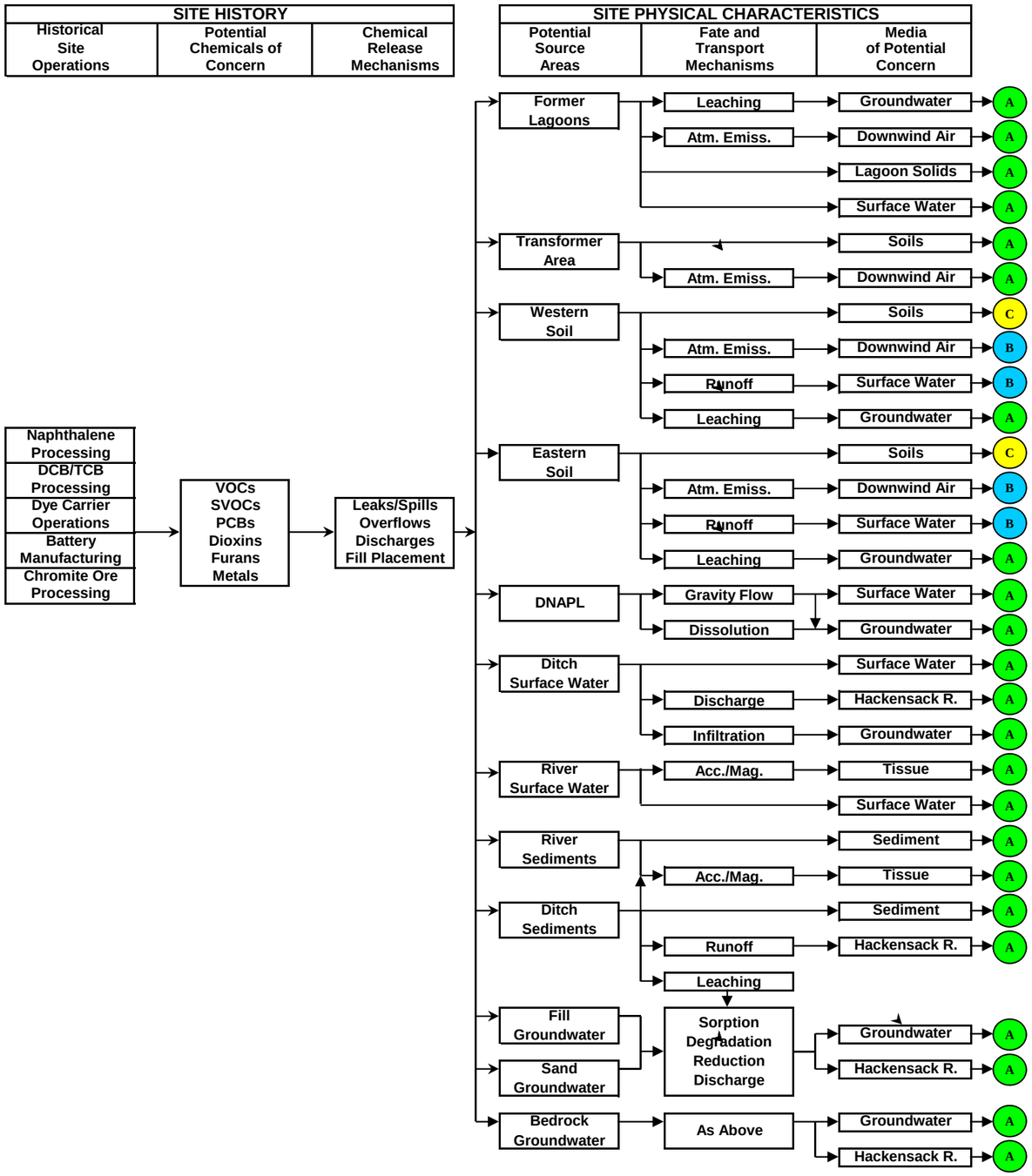
2012 AERIAL PHOTOGRAPH

PROJECT NO: 2012-14

FIGURE 2-2

FIGURE 3-1

PRELIMINARY CONCEPTUAL SITE MODEL
SCCC SITE - KEARNY, NEW JERSEY



RECEPTORS											
Potential Exposure Pathways	ONSITE HUMAN				OFFSITE HUMAN			BIOTA			
	On-site Workers	Occasional Visitors	Construction Workers	Utility Workers	Residential Receptors	Recreational Users	Sport Fisherman	Benthic Community	Fish	Aquatic Birds	Feeding Mammals
Scenario A - Pathways are Incomplete (Current Conditions)											
Ingestion											
Dermal											
Inhalation											
Scenario B - Pathways are Potentially Complete but Insignificant (Current Conditions)											
Ingestion											
Dermal											
Inhalation											
Scenario C - Pathways are Potentially Complete and Potentialy Significant (Future Conditions)											
Ingestion											
Dermal											
Inhalation											

Pathway is incomplete at present as a result of implementation of IRMs and IRA and is expected to remain so in the future.

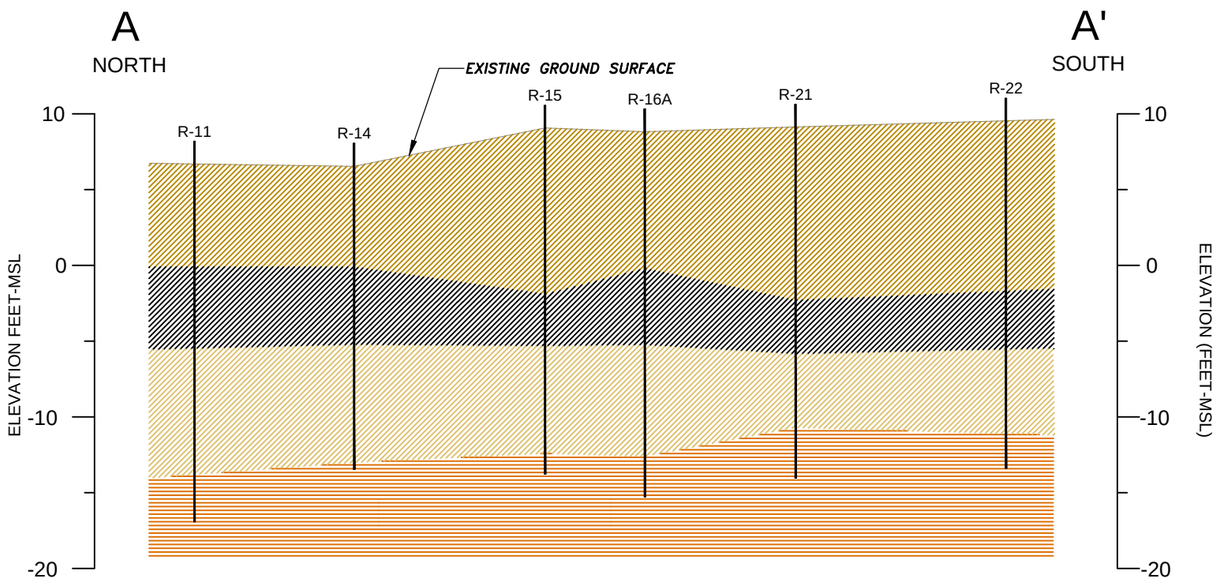
All direct groundwater exposure pathways (no groundwater use).
All potential exposure pathways associated with the lagoons (capped).
Discharge of DNAPL to the south ditch or Hackensack River (barrier walls in place).
Discharge of all groundwater to the Hackensack River (barrier walls in place).
Direct contact with transformer area soils eliminated via removal.
Atmospheric emission of dust from transformer area eliminated via removal.
Potential for direct contact with surface water in the South Ditch eliminated via removal and new stormwater management system.
Discharge of surface water from the South Ditch (will be noncontact surface water, sediments removed).
All potential nongroundwater exposures associated with the south ditch (impacted sediment removed).
Direct contact with eastern area soils by outdoor site workers and visitors (cover placed).
Direct contact with Hackensack River surface water (does not consider other sources).
Accumulation and magnification of Hackensack River constituents in surface water (does not consider other sources).
Human and ecological receptor direct contact with Hackensack River sediments (sediments removedl).
Accumulation and magnification of Hackensack River constituents in sediments (does not consider other sources - river sediments removed).

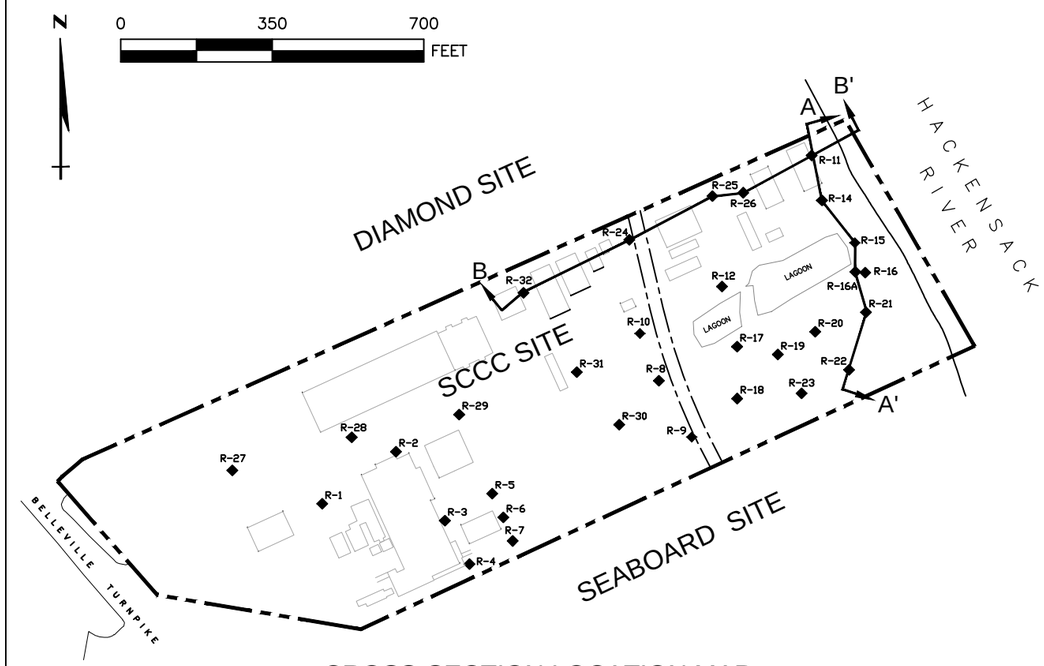
Pathway may be complete after IRA implementation but is expected to be insignificant.

Atmospheric emission of volatiles or fugitive dust from non-remediated areas (monitoring data show no risk).
Runoff of western area soil to receiving surface waters (western soils relatively unimpacted).
Runoff of eastern area soil (stormwater management and revegetation in place).
Under a future disturbance scenario, residents, recreators, onsite worker, visitors, and fishermen could experience low risk.

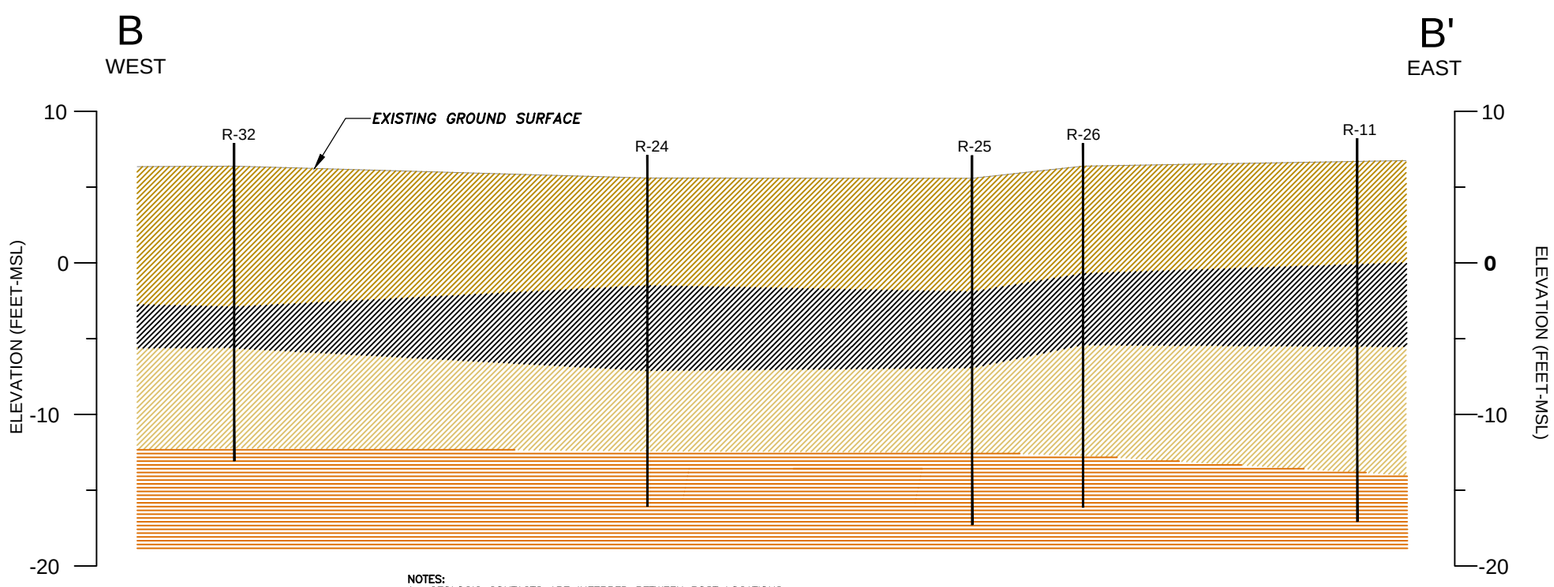
Pathway is complete after IRA implementation and may be significant for humans and ecological receptors.

Potential for direct contact with western area soils by utility workers and construction workers exists under a future scenario.
Potential for direct contact with eastern area soils by utility workers and construction workers exists under a future scenario.
If land disturbance occurs without erosion and sediment control, ecological receptors could be at risk.





CROSS-SECTION LOCATION MAP



NOTES:
1. GEOLOGIC CONTACTS ARE INFERRED BETWEEN ROST LOCATIONS.
2. HISTORICAL SITE CONDITIONS DEPICTED ON CROSS-SECTION LOCATION MAP.

LEGEND

- SHALLOW FILL MATERIAL
- MEADOW MAT
- DEEPER FINE SAND
- VARVED CLAY
- R-16A — ROST BORING LOCATION (CROSS-SECTION)
- R-27 — ROST BORING LOCATION
- SITE BOUNDARY
- STRUCTURES/BUILDINGS
- RIGHT OF WAY
- B B' — CROSS SECTION LOCATION

10 0 100
SCALES IN FEET

REV #	DATE	DESCRIPTION	APPD
3			
2			
1			

REFERENCE: 1. STANDARD CHLORINE CHEMICAL COMPANY SITE SURVEY, NEGLIA ENGINEERING ASSOCIATES, JANUARY 1999. ADDITIONAL BUILDING LOCATIONS OBTAINED FROM ERM, INC. FIGURES 1, 3-1, 3-2, 3-3 AND 3-4, PROPOSED REMEDIAL ACTION PLAN, STANDARD CHLORINE SITE, KEARNY NEW JERSEY.

2. VERTICAL REFERENCE: NATIONAL GEODETIC VERTICAL DATUM (NGVD 1929).

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

PERFORMING PARTIES GROUP

DRWN: SCC	DATE: 03/25/13
CHKD: RJH	DATE: 03/25/13
APPD: JSZ	DATE: 03/25/13
SCALE: AS SHOWN	

KEY ENVIRONMENTAL INCORPORATED

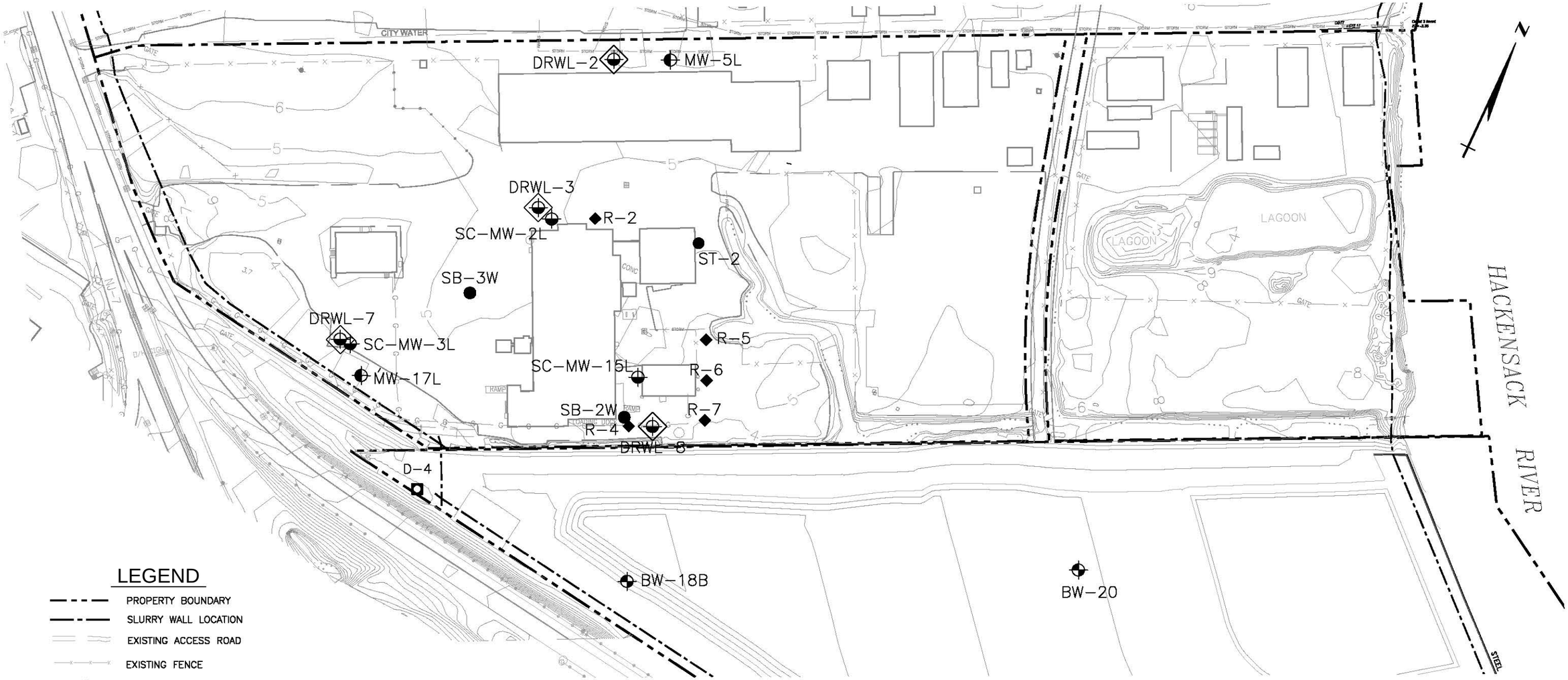
REMEDIAL INVESTIGATION/
FOCUSED FEASIBILITY STUDY WORK PLAN
STANDARD CHLORINE CHEMICAL CO., INC. SITE
KEARNY, HUDSON COUNTY, NEW JERSEY

GEOLOGIC CROSS-SECTION LOCATIONS AND GEOLOGIC CROSS-SECTIONS

PROJECT NO: 2012-14

FIGURE 4-1

y:\GOcivil\kearny\ri-ffs work plan\figure 4-1 geologic cross-section.dwg Last Saved By: Scomer 7/15/2013 2:34 PM Plotted By: Shelly Corner 7/25/2013 8:16 AM Scale: 1:1



LEGEND

- PROPERTY BOUNDARY
- SLURRY WALL LOCATION
- EXISTING ACCESS ROAD
- EXISTING FENCE
- STRUCTURES
- EXISTING GROUND SURFACE ELEVATION CONTOURS
- EXISTING VEGETATION
- EXISTING STREAM, POND AND RIVER BANK
- SAND ZONE MONITORING WELL LOCATION
- ROST BORING LOCATION
- SOIL BORING LOCATION
- SAND UNIT DNAPL RECOVERY WELL LOCATION
- DNAPL DELINEATION BORING LOCATION
- BARRIER WALL ALIGNMENT SOIL BORING LOCATION

0 150 300 FEET

PERFORMING PARTIES GROUP

DRWN: SCC	DATE: 03/22/13
CHKD: RJH	DATE: 03/22/13
APPD: JSZ	DATE: 03/22/13
SCALE: AS SHOWN	

KEY ENVIRONMENTAL INCORPORATED

REMEDIAL INVESTIGATION/
FOCUSED FEASIBILITY STUDY WORK PLAN
STANDARD CHLORINE CHEMICAL CO., INC. SITE
KEARNY, HUDSON COUNTY, NEW JERSEY

REV #	DATE	DESCRIPTION	APPD
3			
2			
1			

REFERENCE:

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

RELEVANT HISTORICAL OR EXISTING BORING AND WELL LOCATIONS

PROJECT NO: 2012-14

FIGURE 4-2

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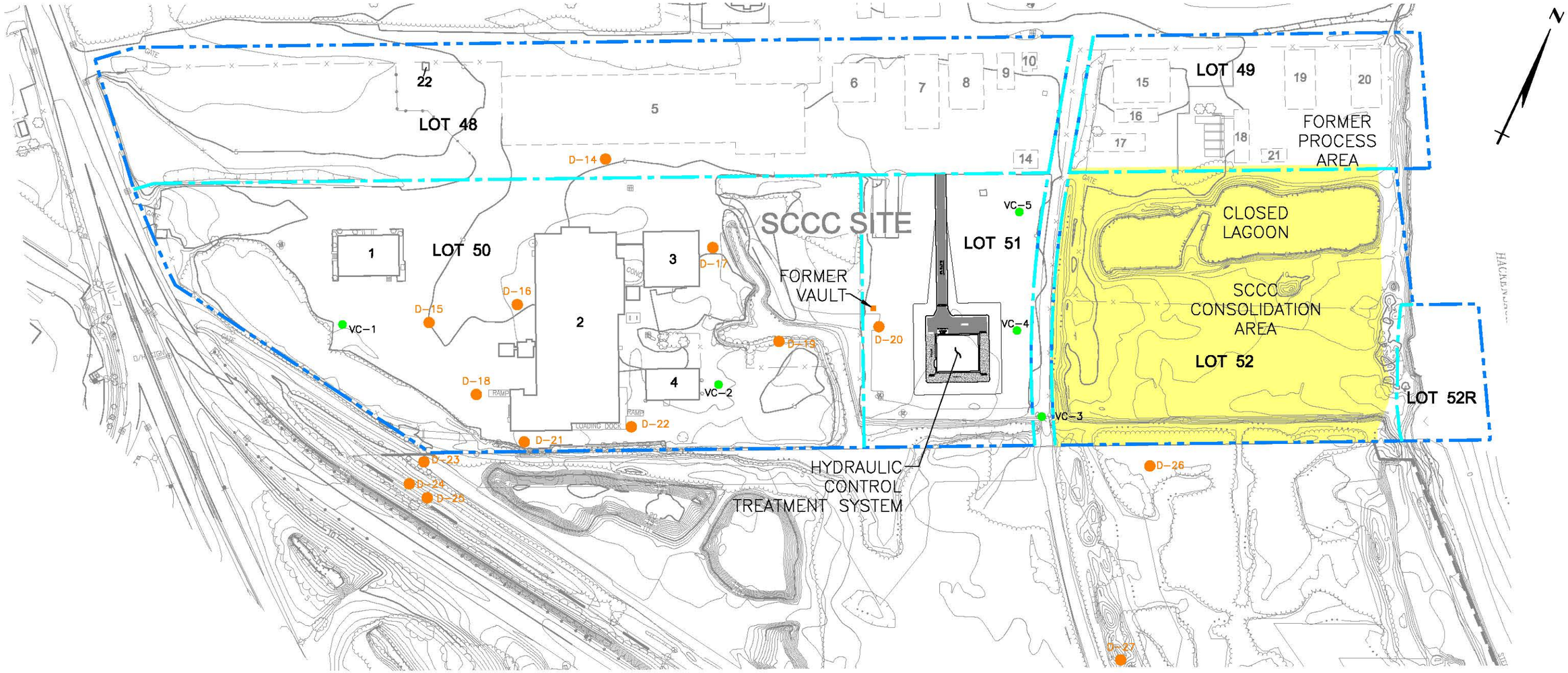
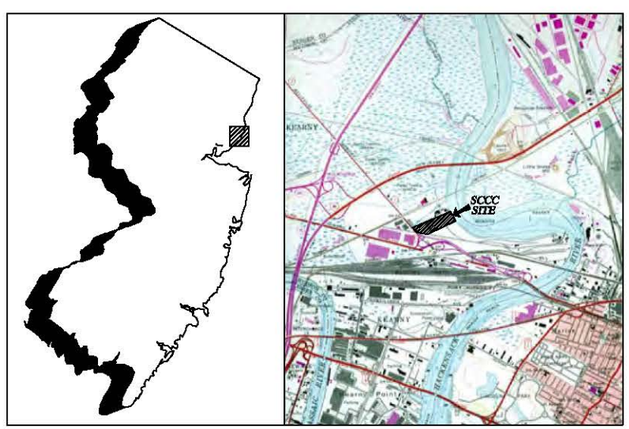




SITE LOCATION

LEGEND

- PROPERTY BOUNDARY
- LOT BOUNDARY
- EXISTING GROUND SURFACE ELEVATION CONTOURS
- EXISTING STREAM, POND AND RIVER BANK
- EXISTING VEGETATION
- CONSOLIDATION AREA COVER SYSTEM
- EXISTING ACCESS ROAD
- EXISTING FENCE
- EXISTING STRUCTURES
- FORMER STRUCTURE
- EXISTING UTILITY POLES
- PROPOSED DNAPL DELINEATION BORINGS
- PROPOSED VARVED CLAY SAMPLE LOCATION

0 150 300 FEET

PERFORMING PARTIES GROUP

DRWN: SCC	DATE: 07/15/13	KEY ENVIRONMENTAL INCORPORATED
CHKD: RJH	DATE: 07/15/13	
APPD: JSZ	DATE: 07/15/13	
SCALE: AS SHOWN		

REMEDIAL INVESTIGATION/
FOCUSED FEASIBILITY STUDY WORK PLAN
STANDARD CHLORINE CHEMICAL CO., INC. SITE
KEARNY, HUDSON COUNTY, NEW JERSEY

REV #	DATE	DESCRIPTION	APPD
3			
2			
1			

REFERENCE:

ISSUE DATE:

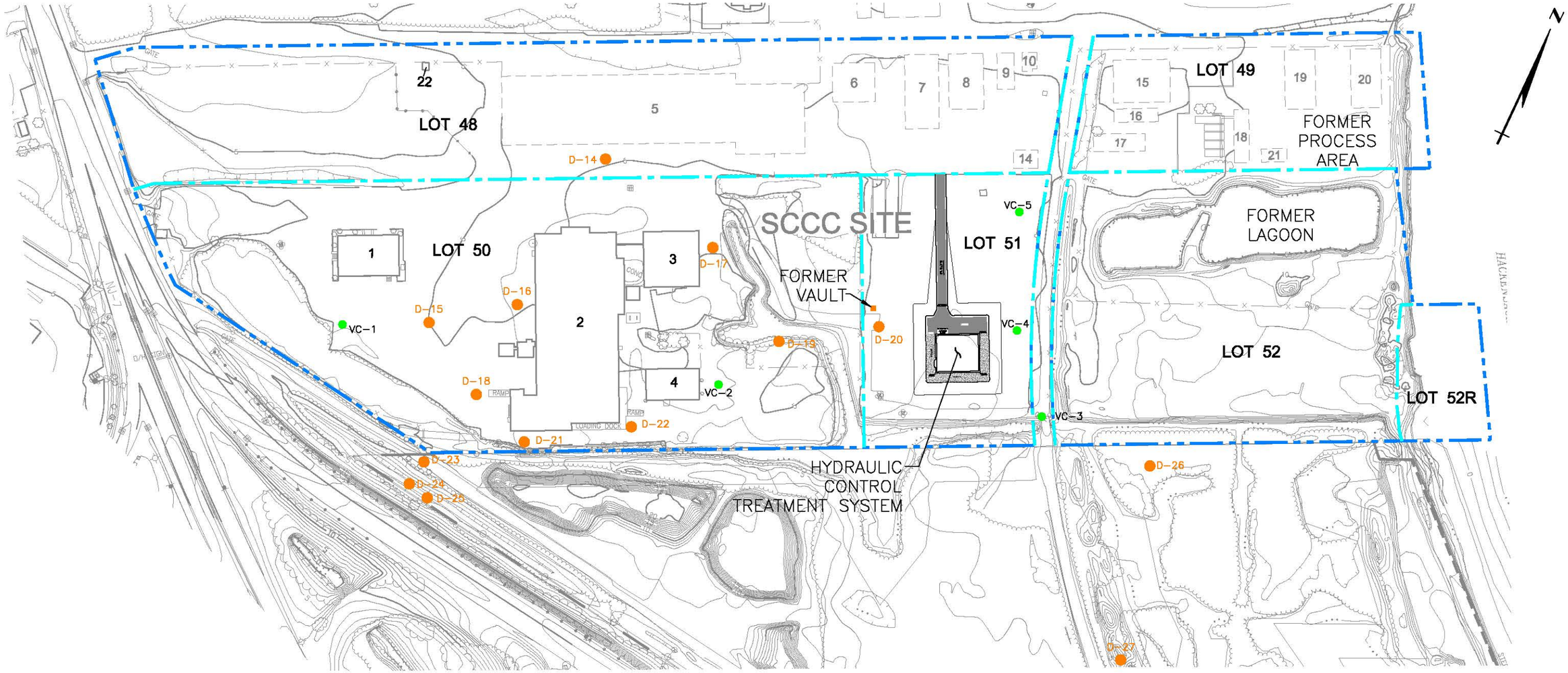
KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

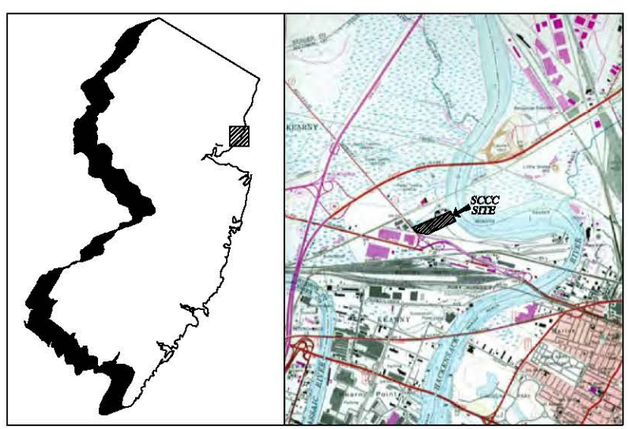
PROPOSED DELINEATION LOCATION MAP

PROJECT NO: 2013-03

FIGURE 4-3

y:\00civil\kearny\ri-ffs work plan\figure 4-3.dwg Last Saved By: Scomer 7/25/2013 8:17 AM Plotted By: Shelly Comer 7/25/2013 9:28 AM Scale: 1:1





SITE LOCATION

LEGEND

- PROPERTY BOUNDARY
- LOT BOUNDARY
- EXISTING GROUND SURFACE ELEVATION CONTOURS
- EXISTING STREAM, POND AND RIVER BANK
- EXISTING VEGETATION
- EXISTING ACCESS ROAD
- EXISTING FENCE
- EXISTING STRUCTURES
- FORMER STRUCTURE
- EXISTING UTILITY POLES
- PROPOSED DNAPL DELINEATION BORINGS
- PROPOSED VARVED CLAY SAMPLE LOCATION

0 150 300 FEET

PERFORMING PARTIES GROUP

DRWN: SCC	DATE: 07/15/13	KEY ENVIRONMENTAL INCORPORATED
CHKD: RJH	DATE: 07/15/13	
APPD: JSZ	DATE: 07/15/13	
SCALE: AS SHOWN		

REMEDIAL INVESTIGATION/
FOCUSED FEASIBILITY STUDY WORK PLAN
STANDARD CHLORINE CHEMICAL CO., INC. SITE
KEARNY, HUDSON COUNTY, NEW JERSEY

REV #	DATE	DESCRIPTION	APPD
3			
2			
1			

REFERENCE:

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

PROPOSED DELINEATION LOCATION MAP

PROJECT NO: 2013-03

FIGURE 5-1

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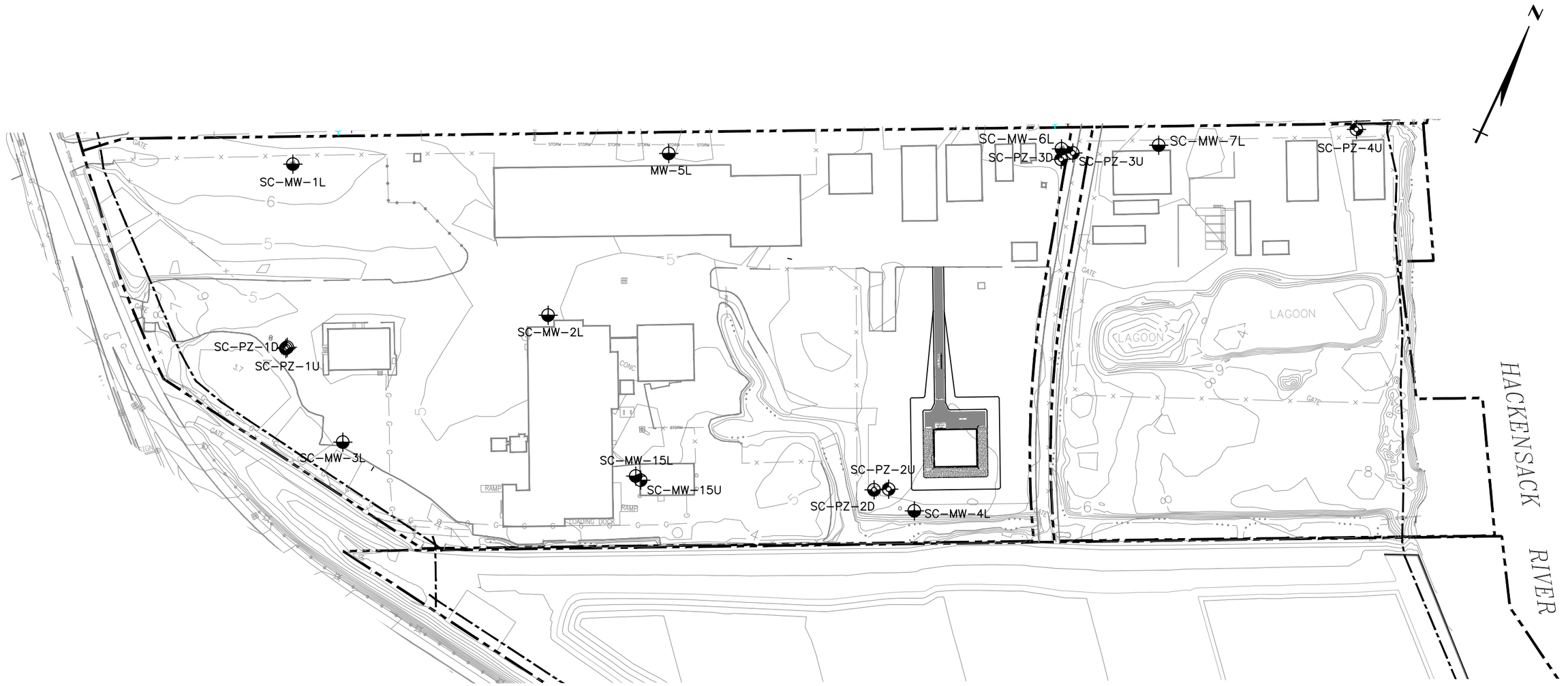


LEGEND

- PROPERTY BOUNDARY
- SLURRY WALL LOCATION
- EXISTING ACCESS ROAD
- EXISTING FENCE
- STRUCTURES
- EXISTING GROUND SURFACE ELEVATION CONTOURS
- EXISTING VEGETATION
- EXISTING STREAM, POND AND RIVER BANK
- MONITORING WELL/PIEZOMETER LOCATION

0 150 300 FEET

PERFORMING PARTIES GROUP

DRWN: SCC	DATE: 03/22/13	KEY ENVIRONMENTAL INCORPORATED
CHKD: JP	DATE: 03/22/13	
APPD: JSZ	DATE: 03/22/13	
SCALE: AS SHOWN		

REMEDIAL INVESTIGATION/
FOCUSED FEASIBILITY STUDY WORK PLAN
STANDARD CHLORINE CHEMICAL CO., INC. SITE
KEARNY, HUDSON COUNTY, NEW JERSEY

REV #	DATE	DESCRIPTION	APPD
3			
2			
1			

REFERENCE:

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

PROPOSED MONITORING WELL AND PIEZOMETER ABANDONMENT LOCATIONS

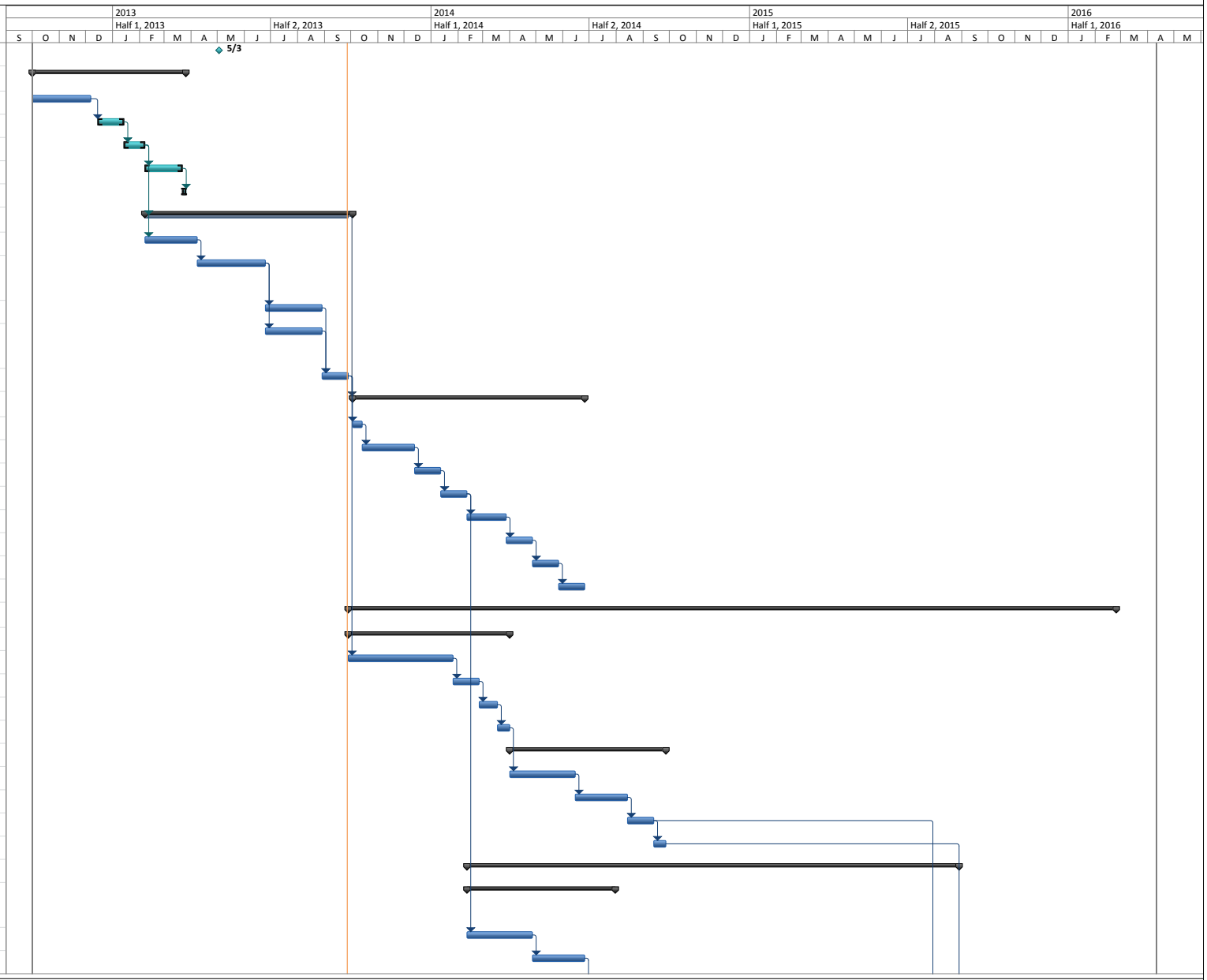
PROJECT NO: 2012-14

FIGURE 5-2

y:\00civil\kearny\ri-ffs work plan\figure 5-2.dwg Last Saved By: Scomer 7/15/2013 2:37 PM Plotted By: Shelly Comer 7/25/2013 8:18 AM Scale: 1:1

FIGURE 6-1
RI/FFS SCHEDULE
STANDARD CHLORINE CHEMICAL CO. INC. SITE
KEARNY, NEW JERSEY

ID	Task Name	Duration
1	**Effective Date of Agreement**	0 days
2	**Site Characterization Summary Report**	**176 days**
3	Prepare and Submit SCSR	67 days
4	Presentation to EPA	30 days
5	EPA Comments on SCSR	24 days
6	Revise SCSR and Submit to EPA	43 days
7	EPA Review and Approval	4 days
8	**RI/FFS Workplan**	**238 days**
9	Submit Draft RI/FFS Workplan to EPA	60 days
10	EPA Review and Comment on RI/FFS Workplan	78 days
11	Revise and Resubmit RI/FFS Workplan	65 days
12	Update and Submit QAPP, SAP, HASP and CRSWP	65 days
13	EPA Review and Approval	30 days
14	**Remedial Investigation**	**266 days**
15	Procurement and Mobilization	11 days
16	Sample Collection	60 days
17	Sample Analyses	30 days
18	Data Validation	30 days
19	SCSR Addendum	45 days
20	EPA Presentation	30 days
21	EPA Comments on SCSR Addendum	30 days
22	Revise SCSR Addendum and Submit to EPA	30 days
23	**Baseline Risk Assessment**	**880 days**
24	**Pathway Analysis Report (PAR)**	**185 days**
25	Prepare and Submit Draft PAR	120 days
26	EPA Comments on PAR	30 days
27	Revise PAR and Submit to EPA	21 days
28	EPA Review and Approval	14 days
29	**Baseline Human Health Risk Assessment**	**179 days**
30	Prepare and Submit Draft BHHRAR	75 days
31	EPA Comments on BHHRAR	60 days
32	Revise BHHRAR and Submit to EPA	30 days
33	EPA Review and Approval	14 days
34	**Baseline Ecological Risk Assessment**	**564 days**
35	**Screening Level Ecological Risk Assessment**	**170 days**
36	Prepare and Submit Draft SLERA	75 days
37	EPA Comments on SLERA	60 days

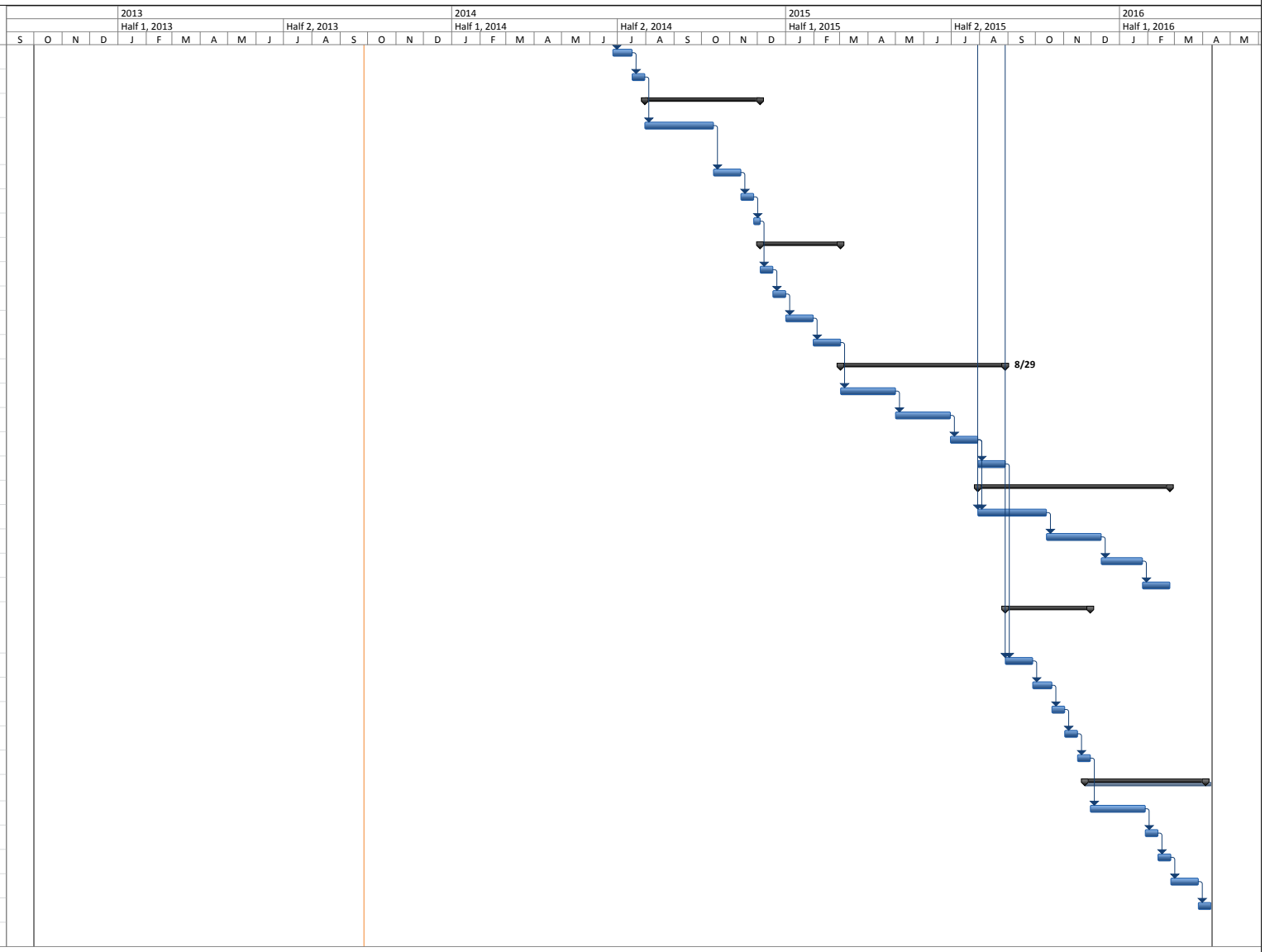


Project: 20130723_Draft_SCCC M
Date: 9/27/13

Task		Summary		External Milestone		Inactive Summary		Manual Summary Rollup		Finish-only	
Split		Project Summary		Inactive Task		Manual Task		Manual Summary		Deadline	
Milestone		External Tasks		Inactive Milestone		Duration-only		Start-only		Progress	

FIGURE 6-1
RI/FFS SCHEDULE
STANDARD CHLORINE CHEMICAL CO. INC. SITE
KEARNY, NEW JERSEY

ID	Task Name	Duration
38	Revise SLERA and Submit to EPA	21 days
39	EPA Review and Approval	14 days
40	**BERA Work Plan**	**126 days**
41	Prepare and Submit draft BERA Workplan	75 days
42	EPA Comments on BERA Workplan	30 days
43	Submit Revised BERA Workplan	14 days
44	EPA Review and Approval	7 days
45	**BERA Investigation**	**88 days**
46	Procurement and Mobilization	14 days
47	Sample Collection	14 days
48	Sample Analyses	30 days
49	Data Validation	30 days
50	**BERA Report**	**180 days**
51	Draft BERA Report	60 days
52	EPA Review and Comment on BERA	60 days
53	Revise and Submit Revised BERA Report	30 days
54	EPA Review and Approval	30 days
55	**Remedial Investigation Report**	**210 days**
56	Prepare and Submit Draft RI Report	75 days
57	EPA Review and Comment on RI Report	60 days
58	Revise and Submit RI Report	45 days
59	EPA Review and Approval	30 days
60	**Development and Screening of Remedial Alternatives**	**93 days**
61	Draft DSRA Technical Memo	30 days
62	EPA Presentation	21 days
63	EPA Comments on DSRA Tech Memo	14 days
64	Revise DRSA Tech Memo and Submit to EPA	14 days
65	EPA Review and Approval	14 days
66	**Focused Feasibility Study Report**	**132 days**
67	Prepare and Submit Draft FFS Report	60 days
68	EPA Presentation	14 days
69	EPA Review and Comment on FFS Report	14 days
70	Revise and Submit FFS Report	30 days
71	EPA Review and Approval	14 days
72		



Project: 20130723_Draft_SCCC M
Date: 9/27/13

Task		Summary		External Milestone		Inactive Summary		Manual Summary Rollup		Finish-only	
Split		Project Summary		Inactive Task		Manual Task		Manual Summary		Deadline	
Milestone		External Tasks		Inactive Milestone		Duration-only		Start-only		Progress	

TABLES

TABLE 5-1

SOIL SAMPLING AND ANALYSIS SUMMARY
SCCC SITE REMEDIAL INVESTIGATION
KEARNY, NEW JERSEY

Matrix Sample Summary			QA Sample Frequency[1]				Analytical Requirements Summary				
Sample Location	**Analytical Parameter[2]**	**No. of Samples**	**Field Duplicates**	**Rinsate Blanks**	**MS**	**MSD**	**Method Reference[3]**	**Bottle Type**	**Required Sample Volume[4]**	**Preservation**	**Holding Time**
SURFACE SOIL SAMPLES											
D-14 through D-22 VC-1 through VC-5	TCL VOCs	14[5]	1	2	1	1	SW846 5035A SW846 8260B	Glass	Encore™ (3) or TerraCor Kits	1 x 5 ml methanol; 2 x 5 ml sodium bisulfate; 1 x 5 ml	14 days from collection if field preserved. Preservation within 48 hours if lab preserved.
D-14 through D-22 VC-1 through VC-5	TCL SVOCs	14[5]	1	2	1	1	SW846 8270C	Glass	100 grams	4°C	7 days to extraction/40 days to analysis.
D-14 through D-22 VC-1 through VC-5	TCL PCBs	14[5]	1	2	1	1	SW846 8082	Glass	4 ounces	4°C	7 days to extraction/40 days to analysis.
D-14 through D-22 VC-1 through VC-5	PCDD/PCDF	14[5]	1	2	1	1	SW846 8290	4-oz glass	25 mg	4°C	1 year
D-14 through D-22 VC-1 through VC-5	TAL Metals (includes total Cr)	14[5]	1	2	1	1	SW846 6000 and 7000 series	Glass	100 grams	4°C	28 days for Hg; 6 months for other metals
D-14 through D-22 VC-1 through VC-5	Hexavalent Chromium	14[5]	1	2	1	1	SW846 7199[11]	Plastic or glass	100 grams	4°C	28 days for soil matrix; 24 hours for aqueous matrix
D-14 through D-22 VC-1 through VC-5	Hydronium Ion (pH)	14[5]	1	2	1	1	SW846 9045C	Glass	4 ounces	4°C	As soon as possible after sample receipt
D-14 through D-22 VC-1 through VC-5	Oxidation-Reduction Potential	14[5]	1	2	1	1	ASTM D1498	Glass	4 ounces	4°C	As soon as possible after sample receipt
FILL/MEADOW MAT SUBSURFACE SOIL SAMPLES											
D-14 through D-27 VC-1 through VC-5	TCL VOCs	TBD[6] [max = 19]	1[7]	1[7]	1[7]	1[7]	SW846 5035A SW846 8260B	Glass	Encore™ (3) or TerraCor Kits	1 x 5 ml methanol; 2 x 5 ml sodium bisulfate; 1 x 5 ml	14 days from collection if field preserved. Preservation within 48 hours if lab preserved.
D-14 through D-27 VC-1 through VC-5	TCL SVOCs	TBD[6] [max = 19]	1[7]	1[7]	1[7]	1[7]	SW846 8270C	Glass	100 grams	4°C	7 days to extraction/40 days to analysis.
D-14 through D-27 VC-1 through VC-5	TCL PCBs	TBD[8] [max = 10]	--	--	--	--	SW846 8082	Glass	4 ounces	4°C	7 days to extraction/40 days to analysis.
D-14 through D-27 VC-1 through VC-5	PCDD/PCDF	TBD[8] [max = 10]	--	--	--	--	SW846 8290	4-oz glass	25 mg	4°C	1 year
DEEP SAND SUBSURFACE SOIL SAMPLES											
D-14 through D-27 VC-1 through VC-5	TCL VOCs	19[9]	1	1	1	1	SW846 5035A SW846 8260B	Glass	Encore™ (3) or TerraCor Kits	1 x 5 ml methanol; 2 x 5 ml sodium bisulfate; 1 x 5 ml	14 days from collection if field preserved. Preservation within 48 hours if lab preserved.
D-14 through D-27 VC-1 through VC-5	TCL SVOCs	19[9]	1	1	1	1	SW846 8270C	Glass	100 grams	4°C	7 days to extraction/40 days to analysis.
D-14 through D-27 VC-1 through VC-5	TCL PCBs	TBD[8] [max = 10]	--	--	--	--	SW846 8082	Glass	4 ounces	4°C	7 days to extraction/40 days to analysis.
D-14 through D-27 VC-1 through VC-5	PCDD/PCDF	TBD[8] [max = 10]	--	--	--	--	SW846 8290	4-oz glass	25 mg	4°C	1 year
VARVED CLAY SUBSURFACE SOIL SAMPLES											
D-14 through D-27 VC-1 through VC-5	TCL VOCs	19+19[10]	1	1	1	1	SW846 5035A SW846 8260B	Glass	Encore™ (3) or TerraCor Kits	1 x 5 ml methanol; 2 x 5 ml sodium bisulfate; 1 x 5 ml	14 days from collection if field preserved. Preservation within 48 hours if lab preserved.
D-14 through D-27 VC-1 through VC-5	TCL SVOCs	19+19[10]	1	1	1	1	SW846 8270C	Glass	100 grams	4°C	7 days to extraction/40 days to analysis.
VC-1 through VC-5	TAL Metals (includes total Cr)	5+5[10]	1	1	1	1	SW846 6000 and 7000 series	Glass	100 grams	4°C	28 days for Hg; 6 months for other metals
VC-1 through VC-5	Hexavalent Chromium	5+5[10]	1	1	1	1	SW846 7199[11]	Plastic or glass	100 grams	4°C	28 days for soil matrix; 24 hours for aqueous matrix
VC-1 through VC-5	Hydronium Ion (pH)	5+5[10]	1	1	1	1	SW846 9045C	Glass	4 ounces	4°C	As soon as possible after sample receipt
VC-1 through VC-5	Oxidation-Reduction Potential	5+5[10]	1	1	1	1	ASTM D1498	Glass	4 ounces	4°C	As soon as possible after sample receipt

1. Quality assurance samples to be obtained at a frequency of 1 per 20 samples with the exception of equipment blanks (rinsate samples). Rinsate samples to be collected at a frequency of 1 per 10 samples.
2. Abbreviations for analyses are as follows:
   TCL - Target Compound List
   TAL - Target Analyte List
   VOCs - Volatile Organic Compounds (including all 3 trichlorobenzene isomers)
   SVOCs - Semivolatile Organic Compounds
   PCBs - Polychlorinated Biphenyls as Aroclors
   PCDD/PCDF - Polychlorinated-dibenzo-p-dioxins and Polychlorinated-dibenzo-
3. Abbreviations for analytical methods are as follows:
   SW846 - Environmental Protection Agency methods per Test Methods for Evaluating Solid Waste - Physical/Chemical Methods - SW846 (3rd Ed). (as revised and updated)
   ASTM - American Society for Testing and Materials.
4. Precleaned and preveserved sample bottles to be provided by the laboratory. Sample volumes to be minimized as possible based on minimum laboratory volume requirements.
5. Surface soil samples will not be obtained on the adjacent Seaboard site given that processed dredge material has been placed. Surface soil samples will be obtained from all DNAPL (D) and Varved Clay (VC) borings on the SCCC Site.
6. The number of samples to be collected from the fill or meadow mat is to be determined based on field observations. One such sample will be obtained from each of the 19 borings if field observations indicate that either residual or free-phase DNAPL is present. The DNAPL Ranking System as defined in the Field Sampling Plan will be the basis to determine if a fill/meadow mat sample is to be obtained. If the sample is assigned a DNAPL ranking of 2 (residual DNAPL) or 3 (free phase DNAPL) a sample will be obtained for analysis. The most highly impacted material encountered in the fill or meadow mat will be sampled from each boring where residual or free phase DNAPL is encountered. Samples will be obtained as discrete grab samples of sufficient volume to satistfy aliquot requirements for analytical purposes.
7. In the event that no fill or meadow mat samples are obtained as the result of the absence of any residual or free phase DNAPL in the horizons of interest, the associated QA/QC samples will be unnecessary.
8. Selected subsurface soil samples from DNAPL impacted material will be analyzed for PCBs and PCDD/PCDF in addition to VOC and SVOC analysis. A maximum of 10 such samples will be obtained from the fill/meadow mat and the deep sand across both the DNAPL (D) and Varved Clay (VC) borings. The first 10 such samples encountered will be subjected to the PCB and PCDD/PCDF analysis.
9. One subsurface soil sample will be obtained from the deep sand for each of the DNAPL (D) and Varved Clay (VC) borings. The sample will be obtained from the most highly DNAPL-impacted zone if DNAPL is present, or from the base of the deep sand if DNAPL is not present. If a DNAPL-impacted zone is present, a discrete grab sample of sufficient volume to satisfy aliquot requirements for analytical purposes will be obtained.
10. Organic analysis samples for varved clay investigation consist of a sample from the upper horizon (1 foot) of the varved clay (19 samples total) and, if DNAPL is present in the deep sand, up to 19 additional samples obtained approximately 5 feet below the initial samples (to be held in the laboratory for analysis if needed). Inorganic analysis samples for varved clay investigation consist of a sample from the upper horizon (1 foot) of the varved clay (5 samples total) and 5 additional samples obtained approximately 5 feet below the initial samples (to be held in the laboratory for analysis if needed).
11. Hexavalent chromium analysis to be completed pursuant to SW-846 Method 7199 subject to the additional pH/ORP measurement requirements for determination of oxidizing or reducing conditions and hexavalent chromium spiking requirements stipulated by the NJDEP.

APPENDIX A

HEALTH AND SAFETY PLAN

SITE SPECIFIC HEALTH AND SAFETY PLAN
For
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY AND OPERATIONS, MAINTENANCE, AND MONITORING PLAN

STANDARD CHLORINE CHEMICAL COMPANY SITE
KEARNY, NEW JERSEY

Prepared for:

Performing Parties Group
(Beazer East, Inc., Cooper Industries, LLC, Tierra Solutions, Inc., on behalf of Occidental Chemical Corporation, and Apogent Transition Corporation)

Prepared by:

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July 2013

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REVISIONS/ADDENDA TO HEALTH AND SAFETY PLAN

Revision	Date	Issued By	Revisions Made

1.0 INTRODUCTION

This Health and Safety Plan (HASP) for the Standard Chlorine Chemical Co. Inc. (SCCC) Site (Site) located in Kearny, New Jersey has been prepared by Key Environmental, Inc., (KEY) on behalf of the Performing Parties Group ("Group"). The Group consists of Beazer East, Inc., Cooper Industries, LLC, Tierra Solutions, Inc. on behalf of Occidental Chemical Corporation, and Apogent Transition Corporation.

The SCCC Site is located at 1025-1035 Belleville Turnpike in Kearny, New Jersey. Figure 1 is a Site location map which shows the existing Site boundaries on a base map which consists of combined portions of two United States Geologic Survey 7.5 minute quadrangles (Jersey City and Weehawken, New Jersey). The Site is situated adjacent to the Hackensack River in Hudson County, New Jersey, and is located approximately 4,000 feet east of the intersection of I-95 and I-280. The Site is bounded to east by the Hackensack River, to the south by the adjacent Seaboard Site, to the north by the adjacent Diamond Site, and to the west by the Belleville Turnpike.

This HASP has been prepared for activities associated with the Remedial Investigation/Focused Feasibility Study as well as for Site monitoring and inspection, and operations and maintenance activities at the SCCC. All work must be performed in accordance with applicable federal, state, and local regulations, including, but not limited to:

- U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) - 29 Code of Federal Regulations (CFR) 1910.120, "Hazardous Waste Operations and Emergency Response"; and,
- OSHA - 29 CFR 1926, "Safety and Health Regulations for Construction."

The health and safety practices, procedures, and personal protective equipment (PPE) requirements established within this HASP are based on hazards known to be present at this Site. All protective measures employed must be commensurate with known hazards associated with specific work activities and job tasks and must be modified if other hazards are identified during the course of the work.

This HASP should not be used for activities other than those outlined in the scope of work unless a task-specific hazard and exposure assessment is performed and any additional protective measures incorporated into the HASP.

2.0 PROGRAM ORGANIZATION AND RESPONSIBILITIES

The design and implementation of the HASP are accomplished through an integral team effort comprised of the following:

- Project Manager - The Project Manager is responsible for assuring that all activities are conducted in accordance with the HASP. The Project Manager has the authority to suspend field operations if employees are in danger of injury or overexposure to harmful agents. The Project Manager's responsibilities include:

  - Coordinating the development of a Site-specific HASP for all phases of the project;
  - Ensuring that the appropriate health and safety equipment and PPE are available for project personnel;
  - Ensuring that all personnel have received the appropriate training before they engage in activities that are potentially hazardous;
  - Ensuring that all required personnel have received the required medical examination, testing, and screening before engaging in work activities; and
  - Designating a Site Health and Safety Officer (SHSO) and other Site personnel who will assure compliance with the HASP.

- Project Site Supervisor/SHSO - The Site Supervisor also acts as the SHSO and is responsible for ensuring that all Site activities are conducted in accordance with the HASP. The Site Supervisor reports to the Project Manager. The Site Supervisor's responsibilities include:

  - Ensuring that personnel, subcontractor personnel, and visitors comply with the requirements of this HASP;
  - Notifying the Project Manager of any changes in work conditions or tasks which may require changes to the HASP;
  - Suspending field activities if necessary, and resume activities when appropriate;
  - Coordinating safety meetings and daily safety briefings, as necessary;
  - Managing health and safety equipment, including instruments, respirators, gloves, suits, and other PPE, used in field activities;
  - Acting as the Emergency Coordinator at the Site and arrange for emergency response in cooperation with local emergency and health officials;
  - Monitoring conditions during field activities to assure compliance with HASP;
  - Monitoring conditions during field activities to determine if more stringent procedures or a higher level of PPE should be implemented;
  - Maintaining a log to record conditions, personnel involved in field activities, and other pertinent health and safety data;

- Overseeing the arrangement and execution of personnel and equipment decontamination;
- Controlling visitor, subcontractor, and employee access to hazardous areas; and
- Delegating, if necessary and appropriate, some of these responsibilities to other on-Site qualified employees.

• Employees and Subcontractors - Employees and subcontractors will be responsible for the following:

- Becoming familiar with, and complying with, the HASP;
- Attending training sessions to review the HASP and other safety and health information;
- Being alert to identified and non-identified hazards;
- Reporting unidentified hazards to the SHSO; and
- Conducting themselves in a manner that is orderly and appropriate for the Site.

3.0 SITE CHARACTERIZATION AND HAZARD ASSESSMENT

3.1 SITE BACKGROUND AND DESCRIPTION

The SCCC Site is located at 1025-1035 Belleville Turnpike in Kearny, New Jersey. Figure 1 is a Site location map which shows the existing Site boundaries on a base map which consists of combined portions of two United States Geologic Survey 7.5 minute quadrangles (Jersey City and Weehawken, New Jersey). The Site is situated adjacent to the Hackensack River in Hudson County, New Jersey, and is located approximately 4,000 feet east of the intersection of I-95 and I-280. The Site is bounded to east by the Hackensack River, to the south by the adjacent Seaboard Site, to the north by the adjacent Diamond Site, and to the west by the Belleville Turnpike.

The Site is relatively flat and is fenced along most of the perimeter. The Site consists of seven (7) different parcels of land located adjacent to the Hackensack River. Various forms of chemical manufacturing and/or processing have occurred on the different parcels of the Site since 1916. These activities included naphthalene refining and product formulation, dye-carrier production, dichlorobenzene refining and product formulation, and lead-acid battery manufacture. These activities were performed by multiple different corporate entities on different parcels of the Site.

Multiple historical investigations and studies have been completed at the Site and surrounding properties dating back to the 1980s. In addition, the Site has undergone substantial remedial efforts in the form of Interim Remedial Measures and an Interim Response Action which were completed pursuant to one or more Administrative Consent Orders with the NJDEP.

Currently, the Site is fully enclosed by a barrier wall system and groundwater recovery and treatment and Dense Non Aqueous Phase Liquid (DNAPL) recovery and offsite disposal (DNAPL) are underway. In addition, various material consolidation efforts, engineering control measures, stormwater management system upgrades, management unit closure, and near-shore

river sediment remediation efforts have been completed. The general configuration of the Site under current conditions is depicted on Figure 2.

3.2 SCOPE OF WORK

This HASP covers actions associated with the Remedial Investigation/Focused Feasibility Study (RI/FFS) as well as ongoing operation, maintenance and monitoring (OM&M) activities at the Site.

RI/FFS activities include:

- Surface soil sampling and analysis - Surface soil sampling is planned for the western portion of the SCCC site, outside the former process area. The existing ground surface at these locations constitutes an Interim Remedial Measures (IRM) cover, comprised of either asphalt and sub-base or stone and geomembrane lining. Fourteen (14) surface soil samples will be collected from the 0 to 6 inch interval directly below the IRM material to target the fill beneath.

- DNAPL delineation - Fourteen (14) soil borings are planned to be completed to further delineate the extent of potential DNAPL on the SCCC and Seaboard Sites. Borings will be advanced to the top of the varved clay layer (a depth of approximately 20 feet bgs) using either a combination of hollow-stem auger (HSA) and wash rotary techniques, or sonic drilling methods. Temporary steel casing will be keyed into the meadow mat prior to advancement beneath the fill materials to eliminate the potential for impacts to the deep sand aquifer. The casing will be set in a bentonite slurry seal at the meadow mat-fill interface. A second sealed casing will be keyed into the varved clay to eliminate the possibility of downward migration of DNAPL. Continuous split spoon samples will be obtained throughout the entire depth of each borehole to accommodate visual determination of the presence/absence of DNAPL. The soil samples will be field screened and logged by the supervising field geologist. Surface soil samples will be obtained for each of the DNAPL borings to be completed.

- Varved clay sampling and analysis - Five (5) borings will be completed into the varved clay unit in selected areas. Collection of the soil will be continuous from ground surface to the final boring depth (2 foot split spoon samples or cores). Samples for laboratory analysis will be collected in discrete 6 inch intervals (subject to volume requirements and recovery constraints). Drilling methods may include a combination of HSA and wash rotary techniques, or the use of sonic drilling equipment. Temporary, telescopic, steel casings will be set and sealed into both the meadow mat and the varved clay during drilling. Field screening of the varved clay will be used to determine the interval to be sampled.

- Monitoring well/piezometer abandonment - A total of eight (8) monitoring wells and seven (7) piezometers located on the SCCC Site are proposed to be abandoned. Prior to well abandonment, the total depth of the well will be measured, wells will also be checked for removable product before abandonment. If product is encountered the well will be purged immediately prior to sealing. Abandonment will be completed by tremie grouting cement-bentonite slurry from the base of the well to ground surface. After the cement-bentonite grout has cured, any settling of the grout will be topped off and the well casing will be capped with concrete.

- Investigation-derived waste management - Various types of Investigation-Derived Waste (IDW) will be generated during the course of the supplemental field investigation activities. IDW will consist of the following:

  - Drill cuttings
  - Drilling fluids
  - Decontamination fluids
  - Personnel protective equipment
  - Disposable sampling equipment
  - Plastic sheeting

Management of IDW will be conducted according to the applicable procedures provided in KEY SOP No. 122 (Management of Investigation Derived Wastes).

Soils will be segregated between those above and below the Meadow Mat. The segregated materials will be containerized and labeled accordingly. Likewise, drilling fluids will be containerized based on depth from above or below the Meadow Mat and handled in the same manner as the soils. Personal protective equipment and sampling equipment will be containerized together and staged for offsite disposal based on previous waste characterization classifications.

Decontamination water will be transferred from the decontamination pad into a polyethylene (or similar) storage tank or other suitable container and subsequently transported to and treated at the onsite HCTS. All remaining IDW will be containerized in 55-gallon drums and staged in a secure area on the Site. Drums will be securely closed and the exteriors cleaned prior to staging. The drums will be clearly labeled and the staged drums placed on pallets and covered with plastic sheeting.

The *OM&M activities* include:

Site monitoring activities:

- Steel sheet pile (SSP) Wall Inspections;
- SSP wall cathodic protection system inspections;
- Consolidation Area (CA) cover inspections;
- Interim Remedial Measure (IRM) cover systems inspections;
- Groundwater potentiometric surface elevation monitoring;
- Dense non-aqueous phase liquid (DNAPL) thickness gauging;
  Hydraulic Control Treatment System (HCTS) influent and effluent monitoring;
- Stormwater management, erosion and sediment (E&S) control, and permanent vegetation inspections;
- Slurry wall working platform inspections; and,
- Site security and access inspections.

Potential Site maintenance could result in the repairs for the following components:

- Steel sheet pile (SSP) wall;
- CA cover;
- IRM cover systems;
- Monitoring wells and piezometers;
- Stormwater/E&S control features and vegetation;
- Slurry wall platform; and,
- Site security access features.

Operation and maintenance activities (O&M) activities include:

- Hydraulic control wells;
- DNAPL recovery wells; and,
- The SSP wall cathodic protection system.

Personnel who perform activities outside the scope of this HASP must develop their own site-specific HASP or Job Safety Analyses (JSAs) to address the work they will perform at the Site.

3.3 CHEMICAL HEALTH HAZARDS

Potential health hazards at the SCCC Site include the potential exposure to volatile and semivolatile organic compounds (VOCs and SVOCs), particularly chlorobenzenes and naphthalene; chromium and hexavalent chromium.

Groundwater at the SCCC Site contains VOCs, dichlorobenzenes, chlorobenzene, 1,2,4-trichlorobenzene, and naphthalene. DNAPL at the Site is comprised primarily of 1,2,4-trichlorobenzene, naphthalene, and dichlorobenzenes. Chromium slag was used as fill material at the SCCC Site; however, surface cover of pavement or stone installed during construction has mitigated potential exposure in the western area of the Site. Hexavalent chromium concentrations are low in most areas of the Site.

A summary of health hazard data is given in the following sections. **Table 1** presents exposure limits and other properties of chemicals that may be present at this Site.

The main route of exposure for Site chemicals through the RI/FFS and OM&M activities associated is skin/eye contact and absorption; a second potential route of exposure is inhalation of vapors/dust. Incidental ingestion is also a possible route of exposure. Potential exposures will be reduced or eliminated by following the work practices and using the PPE designated in this HASP. The overall chemical health hazard assessment for activities covered by this HASP at the Site is low to moderate depending on the activity. Inspection activities have a very low potential for exposure to Site constituents; certain sampling and operations and maintenance activities may have a moderate potential for contact with Site constituents.

3.3.1 VOCs

The VOCs found on site may irritate skin on contact and irritate the respiratory tract on inhalation. Eye contact may cause eye irritation, burning and inflammation. Ingestion may result in nausea, vomiting, abdominal pain, rapid pulse, respiratory distress and shock. Absorption into the body systems by any route may cause trouble breathing, dizziness, headache, nausea, vomiting, salivation, and convulsions. Overexposure by inhalation may cause drunkenness, drowsiness, incoordination, tremors and restlessness, and an increase in heart rate and pressure. Chronic or long-term effects of overexposure to site constituents may cause dermatitis, and cancer of the liver, kidneys, and respiratory tract.

3.3.2 SVOCs/PAHs

SVOCs found on-site include chlorobenzene, dichlorobenzenes, trichlorobenzene and naphthalene and low concentrations of PAHs. The DNAPL found in monitoring wells is comprised primarily of 1,2,4-trichlorobenzene, naphthalene, and dichlorobenzenes.

Certain high molecular weight polynuclear aromatic hydrogen compounds (PAHs) were found at low concentrations in groundwater. Primary entry routes into the body are inhalation, ingestion, and skin contact. These materials pose less of an inhalation hazard than VOCs because they are less likely to volatilize. However, PAHs can be a potential constituent of airborne dust and pose an inhalation hazard. Inhalation of coal tar constituents and PAHs may irritate the respiratory

tract. Eye contact may cause eye irritation, burning and inflammation. Immediate or acute effects from short-term skin exposure to coal tar compounds include irritation; burning, itching, redness, skin color changes, and rashes from skin contact with coal tar compounds.

Photosensitization, a tendency to sunburn more easily or a worsening of rash with exposure to sunlight may occur with skin contact to coal tar compounds. If dust which contains PAHs contacts the skin minor burning and irritation may result, especially with exposure to sunlight. Wash any exposed skin, apply sunscreen (SPF 30), and cover the area with clothing. Skin contact and exposure to coal tar during Site activities can be eliminated by the use of gloves and skin protection.

Material Safety Data Sheets (MSDSs) for select Site constituents are found in **Appendix A**. Exposure to Site constituents can be avoided or limited by the use of gloves and skin protection. For these reasons, potential exposure risks to Site constituents are considered to be low.

3.3.3 Other Hazardous Substances Used at the Site/Hazard Communication

A list of hazardous chemicals and MSDSs for hazardous chemicals used at the Site must be kept at the Site. All containers of hazardous substances must be labeled with the name of the chemical and appropriate hazard warnings. Employees and contractors who use hazardous substances must read the labels and know where MSDSs are located in case of an emergency

3.3.4 Work Task Hazard Assessment

Table 1 presents exposure limits and other properties of chemicals that may be present at this Site. More information concerning the health effects of Site chemicals can be found in the Material Safety Data Sheets (MSDS) in **Appendix A**. The overall chemical health hazard assessment for activities at this Site is low. **Table 2** summarizes the chemical hazards associated with Site work tasks, a relative hazard assessment, proposed initial levels of personal protection, and air monitoring requirements.

3.4 PHYSICAL HAZARDS

The primary physical hazards on the Site are those associated with driving and walking around the Site, recover DNAPL from wells, monitor and sample wells, uneven terrain, working along the Hackensack River, construction equipment and activities, heat stress/cold stress and snow in winter. Safe work practices for these potential hazards are outlined in Section 3.6 (heat stress), Section 3.7, (cold stress) and Section 5.0.

3.5 CONFINED SPACES

Entry into confined spaces is not permitted for KEY employees. The treatment tanks for the HCTS building are labeled as confined spaces and access will only be allowed to certified/qualified confined space contractors.

3.6 HEAT STRESS

Heat stress may be a concern during warm weather. *Heat cramps* are the least severe form of heat stress, cramps occur due to the depletion of body salts from sweating. *Heat exhaustion* results from significant loss of body salts and fluid. Its symptoms may include weakness or fatigue, nausea, headaches, and in more serious cases, clammy, moist skin with pale or flushed complexion. *Heat stroke* is the most serious heat-related condition and occurs when the body's system to regulate internal temperature fails. Symptoms are hot, dry skin; mental confusion or delirium; convulsions or unconsciousness; and body temperature of 105 degrees Fahrenheit (^{o}F) or higher. In this situation, <u>medical attention is needed immediately; heat stroke may be fatal</u>.

To prevent heat disorders, attention must be paid to such variables as temperature, humidity, air movement, and the physical condition of employees. In addition, breaks must be taken as needed to let the body cool. Liquids designed to replace lost body salts must be provided regularly.

3.6.1 Heat Stress Prevention

Heat stress can occur even when temperatures are considered moderate. The following recommendations should be followed to help reduce heat stress:

- Personnel must drink plenty of liquids to replace body fluids lost to sweating. To prevent dehydration, personnel should be encouraged to drink generous amounts of water even if not thirsty. Heat-related problems can happen before the sensation of thirst occurs.
- Cool drinking water, 50°F to 60°F, should be made available to all personnel.
- Only water, or occasionally, electrolyte-balanced drinks, such as Gatorade®, should be used to replace lost fluids due to sweating.
- Beverages containing caffeine, such as colas, coffee, or tea, should be limited or not used because of their diuretic (water depleting) effects.
- Salt tablets should not be used unless prescribed by a physician.
- Self-monitoring of physical condition and buddy monitoring will be essential in order to prevent any heat stress illness. All personnel should be aware of heat stress symptoms and the proper precautions to take if heat stress is observed.
- Rest periods must be provided for all personnel. This means at least 15 minutes in the morning and in the afternoon and at least 30 minutes for lunch. A more frequent rest schedule may be implemented by the SHSO depending on weather conditions and the type of work performed.

3.7 COLD STRESS

Cold weather conditions may result in cold stress ranging from mild frostbite to severe hypothermia. Cold injury and impaired ability to work are dangers at low temperatures and when the wind chill factor is low. Cold stress normally occurs in temperatures at or below freezing, or under certain circumstances, at temperatures of 40 °F. Extreme cold for a short period of time may cause severe injury to exposed body surfaces or result in profound generalized cooling, causing death. Areas of the body that have high surface area to volume ratio, such as fingers, toes and ears, are the most susceptible. Two factors influence the development of a cold weather injury: ambient temperature and wind speed. For instance, 10 °F with a wind of 15 miles per hour is equivalent in chilling effect to still air at –7 °F. A wind chill chart is presented on the following page.

It does not have to be extremely cold for systemic hypothermia to occur. *Hypothermia* may occur at outdoor temperatures approaching 50 °F. Systemic hypothermia occurs when the body core temperature decreases. Symptoms begin with shivering, apathy, loss of coordination, followed by lethargy and coma; if allowed to continue, hypothermia may result in death. Get the victim out of the cold and into dry clothing. Warm up his or her body slowly. Give nothing to eat or drink until the victim is fully conscious. Warm fluids, but no stimulants such as tea, coffee, alcohol or tobacco should be given. Get medical attention immediately.

Frostnip, or incipient frostbite, usually involves the ears, nose, chin, cheeks, and fingertips and toe tips. It occurs during high wind, low temperature, or both. The skin suddenly blanches (becomes white). Frostnip is painless and can be reversed without tissue damage by warming the affected area by using warm water. The area should not be rubbed.

Superficial frostbite is a more severe local cold injury. This involves the skin and superficial tissue just beneath it. The skin becomes white, waxy, and firm; the tissue beneath it remains soft. Affected personnel should be taken out of the cold and the affected area slowly and carefully rewarmed. Again, the area should not be rubbed. Stinging and burning may follow warming and superficial blisters may occur.

Deep frostbite involves freezing not only of skin and subcutaneous tissue but even muscle and bone. The emergency treatment for deep frostbite is immediate warming. Affected persons should be kept dry, provided with external warming, and the frostbitten part covered by a dressing while being transported promptly to the nearest emergency department. Warm fluids, but no stimulants such as tea, coffee, alcohol or tobacco should be given to frostbite or hypothermia victims.

3.7.1 Cold Stress Prevention

To prevent or minimize the effects of cold stress, the following work practices should be followed:

- Use dry, insulated and/or layered work clothing, warm gloves, hard hat liners, and boots. Combine winter gear with chemical resistant personal protective equipment

and waterproof gear to provide the best protection for the given site task and weather conditions.

- Provide rest breaks in warm areas as necessary.
- Use the following wind chill chart to estimate the effects of wind and temperature on the body. Be especially careful to note when frostbite is a potential hazard.

WIND CHILL CHART																		
Wind Speed	**Temperature (°F)**																	
Calm	40	35	30	25		15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98
Frostbite Times							30 min.		10 min.		5 min.							

Wind Chill (ºF) = $35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$
Where T = Air Temperature (ºF), V = Wind Speed (mph)
From National Oceanographic and Aeronautics Administration and the National Weather Service, 2002

3.8 BIOLOGICAL HAZARDS

Biological hazards present at the Site may include poisonous plants, insects, and animals. Poison ivy and poison oak may be present. Contact with the leaves, vine, roots, or sap causes a skin rash on many people. All workers must be familiar with the appearance of poison ivy (three leaves) and wear impervious protective clothing as necessary to prevent contact with poison ivy.

Ticks may be present throughout the Site on brush, grass, and weeds. Some ticks carry disease, such as Lyme disease or Rocky Mountain spotted fever. Wear protective clothing or secure pant legs to lower leg or boot and apply bug repellent to this area. Frequently assist each other in inspecting for ticks. If a tick is found attached to the skin, do not attempt to pick the tick off the skin with fingernails or scrape with a credit card, etc. Carefully remove the tick with tweezers taking care that all parts are removed. Thoroughly scrub the area with soap and water. Save the tick in a small jar or plastic bag and take it to a doctor or health department for identification. If

a red circle or rash forms in the area of the tick bite or if flu-like symptoms appear in a few days or weeks consult a doctor for treatment.

A particular hazard at this Site during warmer weather is mosquitoes. Besides the annoyance of the buzzing insects and ordinary mosquito bites, some mosquitoes can transmit West Nile Virus and other diseases. West Nile Virus can be a serious disease, especially for people over 50 years old. Most people have no symptoms after infection but some people have mild symptoms that can include fever, headache, body aches, nausea, vomiting, and swollen lymph glands or a skin rash on the chest, stomach and back. Symptoms last a few days to several weeks. A few people develop severe illness. Symptoms may include high fever, headache, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, vision loss, numbness and paralysis. Symptoms may last several weeks and neurological effects may be permanent. People older than 50 are at a higher risk to get sick, a very few people may die from a West Nile virus infection.

The best way to prevent West Nile Virus is to avoid being bitten by mosquitoes. When working outdoors wears light-colored long sleeve shirts, long pants and socks sprayed with insect repellent. Use repellent carefully! Follow the manufacturer's directions for the repellent you are using. Repellents with DEET (N, N-diethyl-meta-toluamide) or permethrin are effective against mosquitoes and other biting insects. You can use DEET directly on your skin and clothing but do not use on skin under clothing. Use permethrin only on clothing, not directly on skin, and let sprayed clothing dry before use. Repellents with a higher concentration do not mean they work better but that they work longer.

According to the Centers for Disease Control (CDC), a recent study indicated the following:

- A product containing 23.8% DEET provided an average of 5 hours of protection from mosquito bites.
- A product containing 20% DEET provided almost 4 hours of protection.
- A product containing 6.65% DEET provided almost 2 hours of protection.
- Products containing 4.75% DEET and 2% soybean oil were both able to provide roughly 90 minutes or protection.

Sweating or getting wet may mean you need to re-apply repellent more frequently. If possible wash exposed skin before re-applying repellent. Be sure to wash skin that was sprayed with repellent at the end of the day. Wash hands before eating or using the restroom.

Wasps, bees and other stinging insects may also be found at the Site. Use of DEET of repellent containing permethrin will help keep wasps and bees away. However, if a nest is disturbed the repellent will not help. Be alert for bees flying into and out of a particular area, hanging nests, and nests in logs, pipes and other structures. Wear light-colored clothes as darker clothes tend to annoy some stinging insects.

First aid for insect bites and stings includes: applying a baking soda paste of ice wrapped in a wet cloth. Commercial bee sting kits may be helpful. A first aid kit is located in the HCTS building. Honeybees leave their stingers in the body; these can be removed by gently scraping the skin, working side to side of the stinger. A bee sting or snake suction device can also be used. If an insect bite becomes red or inflamed or the person becomes dizzy, nauseous, or short of breath then get to medical care immediately.

Avoid unnecessary contact with animals. Some animals may carry disease or poison or may cause injury by biting. If an animal is acting strangely, or if a wild animal approaches humans, leave the area. If necessary, call animal control personnel. Do not try to feed wild animals.

Snakes may also be present on the Site. Leave snakes alone, do not attempt to catch or kill. Stay out of tall grass, brush, and wood or rock piles. Keep hands and feet out of areas you cannot see. If bitten, get the person to medical help immediately. If practical, try to quickly identify the type of snake or at least the color and markings and size. First aid for snake bites includes: Wash the bite with soap and water or antiseptic cleanser, immobilize the bitten area and keep it lower than the heart, cover the area with a clean, cool compress or a moist dressing to minimize pain and swelling. Keep the victim calm and comfortable. If the victim cannot reach medical care within 30 minutes apply a bandage, wrapped 2 to 4 inches above the bite, to help slow the venom. This should not cut off the flow of blood from a vein or artery – the band should be loose enough to

slip a finger under it. Without cutting, place a suction device over the bite to help draw venom out of the wound. Continue alternating suction and application of a compress while transporting to a doctor or hospital. Do not give the victim food or alcohol and only limited other liquids as necessary.

4.0 MEDICAL SURVEILLANCE

All medical examinations and procedures are performed by or under the supervision of a licensed physician at no cost to employees, without loss of pay, and at a reasonable time and place.

4.1 PRE-ASSIGNMENT SCREENING

Employees who perform the work tasks outlined in this HASP must have a current medical screening and approval for work at hazardous waste sites in accordance with 29 CFR 1910.120(f) and the company medical screening policies and procedures. This screening includes:

- Comprehensive medical/occupational history and physical examination;
- Visual acuity and color vision;
- Audiometry (OSHA) - 500, 1000, 2000, 3000, 4000, and 6000 Hz, both ears;
- Complete blood count, including platelets;
- Complete serum profile (including serum chemistry, liver profile and serum lipids);
- Chest X-ray, posterior/anterior view, if not taken in the past three years (results must be available to examining physician), or if indicated by medical necessity;
- Spirometry (pulmonary function test);
- Urinalysis; and
- Electrocardiogram (EKG), if medically necessary.

The physician will provide a written opinion regarding the potential employee's fitness for working at a hazardous waste site, ability to wear a respirator, and any limitations upon the employees assigned work. Employees are furnished a copy of the written opinion, and results of the medical examination and tests upon request.

The company will schedule medical examinations, select appropriate clinics or physicians, review physicians' reports, and maintain employee medical files. Employee medical files are confidential and will not be released without the express written approval of the employee. A copy of all physicians' reports, results and opinions and medical monitoring data will be made available to the employee upon request.

Repeat tests or additional tests or examinations recommended by the physician, based on the initial medical screening and related to the employee's ability to work in hazardous environments, will be arranged by the company.

4.2 PERIODIC MEDICAL EXAMINATIONS

Employees engaged in work with potential exposure to hazardous materials will undergo an annual update of medical and occupational history and an annual physical examination. More frequent medical examinations, consultations, and/or laboratory testing will be provided:

- For employees who, in an emergency situation, may have been exposed to hazardous substances at or near permissible exposure limits (PELs);
- As soon as possible, upon notification by an employee, that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards; and,
- If the examining physician determines that an increased frequency of examination is medically required.

The company will arrange for periodic medical examinations and maintain records in the employee's medical file.

4.3 MEDICAL RECORDS

All medical records, including pre-employment medical screening, periodic medical examinations, emergency and non-emergency treatment records, and accident reports, will be maintained in accordance with the following:

- OSHA 29 CFR 1910.1020 - Medical records.
- OSHA 29 CFR 1904 - Injuries, illnesses, and annual summaries.

4.4 TERMINATION EXAMINATION

Upon termination from employment, all employees whose work involved potential exposure to hazardous materials and who have not received a medical examination within the previous six months will be provided a termination examination. Records of the termination examination will be maintained in accordance with 29 CFR 1910.1020. Employees will be notified regarding termination physical examination requirements.

4.5 SUBCONTRACTORS

Subcontractors who will perform work at this Site where there is a potential for contact with Site constituents are required to follow the medical surveillance requirements of 29 CFR 1910.120 and a medical surveillance program. Subcontractors who perform work where there is no potential for exposure to Site constituents, are not required to follow the medical surveillance requirements of 29 CFR 1910.120.

4.6 PHYSICIAN'S NAME AND ADDRESS

KEY Pittsburgh office employees:

Huwaida Mansour, M.D., Medical Director
Business Fit
Pittsburgh's Ohio Valley General Hospital
25 Heckel Road
McKees Rocks, PA 15136
(412) 777-6369

KEY New Jersey employees:

Medical Director
US HealthWorks
370 Campus Drive
Somerset, NJ 08873
(732) 748-1900

4.7 MEDICAL SURVEILLANCE CERTIFICATION

I certify that Key Environmental, Inc. employees engaging in on-site activities for more than 30 days or more per year are included in a medical surveillance program as stated above.

John E. Francis

John E. Francis, CIH, CSP
Health & Safety Manager – Key Environmental, Inc.

5.0 WORK PRACTICES AND SITE CONTROL

5.1 ROUTINE SAFE WORK PRACTICES

Hygienic practices consistent with work hazards are necessary. Eating and food preparation will be prohibited in any area other than those designated and properly protected. Employees who handle potentially contaminated materials or articles will wash with soap or mild detergent and water before eating or using the rest room.

5.2 WORK RESTRICTIONS

All outdoor work at the Site must be conducted during daylight hours unless adequate lighting is provided. Outdoor work must cease immediately upon the signs of impending thunderstorms and lightning or other severe weather, as determined by the SHSO.

5.3 SURFACE SOIL SAMPLING

Surface soil sampling may involve the use of metal scoops or hand augers to collect samples. Wear work gloves when using a hand auger. Wear nitrile gloves when collecting the soil sample being careful not to cut oneself on the auger blades. Use a pad to kneel on as needed when sampling.

5.4 SOIL BORING - DRILL RIGS – GENERAL

Personnel working on or near drill rigs must be aware of the hazards of moving vehicles, pinch points, noise hazards, and overhead and underground utility hazards during the drilling process.

- Clear away all debris from the immediate area
- Be sure that the area to be drilled is free of underground power lines, gas lines, water mains, sewers, or other utilities.
- Before erecting the derrick, be sure that there are no overhead power lines, tree branches, or other obstructions in the path.

- Stay a safe distance from the rig unless cleared by the driller.
- Be aware of and avoid pinch points on the drill rig.
- Keep fingers, clothing and tools clear of any rotating parts.
- Do not place hands or feet under an auger section when it is being hoisted.
- Do not attempt to remove cuttings form rotating augers.
- Open and handle split spoons carefully to avoid pinch points and possible lacerations.

5.5 ROTOSONIC DRILLING

In addition to the general drilling precautions the following precautions also should be taken during Rotosonic drilling:

- Only drilling company employees are allowed on the drill rig and drill platform.
- Make sure that the drill platform is securely supported on a flat, stable surface before drilling.
- Watch for slip hazards, especially during and after rain events. The drill platform, ladders and other parts of the rig may become slippery, especially when muddy.

5.6 WELL ABANDONMENT

Well abandonment may include cutting off the casing below ground, removing the cut casing, removing the well pad, and grouting the well hole. If it is deemed necessary to remove the casing a special drill bit may be lowered into the casing to cut the well casing below the surface then the drill rig will grab the casing and pull it out of the ground as well as the cement well pad. Wells may also have to be overdrilled to remove casings. Once the casing and well pad have been removed a cement grout mixture will be used to fill the well hole and the well casing capped with concrete.

- Before erecting the derrick, be sure that there are no overhead power lines, tree branches, or other obstructions in the path.
- Stay a safe distance from the lines being used for hoisting and pulling. Never straddle or reach across them.
- Use proper lifting and material handling techniques to avoid strains and sprains.
- Be aware of and avoid pinch points on the drill rig.

- Always stand clear of the cable, hoisting plug, and rods while the operator releases the tension on the cable. The bail or hoisting plug may spin rapidly when the tension is released.
- Avoid overexertion/twisting/ bending when handling materials and bags of cement and bentonite.
- Avoid overexposure to dust from cement and bentonite. Pour bags slowly to avoid creating excessive dust. Use water mist if necessary to keep dust under control.
- Wet cement is very irritating to the skin, avoid direct contact with wet cement and rinse skin immediately and thoroughly if cement dust comes into contact with skin.
- Wear Level D protection, including appropriate work gloves.

5.7 INVESTIGATION-DERIVED WASTE HANDLING

Waste may be generated during drilling and sampling activities. Drill cuttings drill fluids, used PPE and sampling equipment, and used plastic sheeting will be placed into drums. Decontamination water will be transferred from the decontamination pad into a polyethylene (or similar) storage tank or other suitable container and subsequently transported to and treated at the onsite HCTS. In any event, it is necessary to use caution when transferring materials into drums and the tank to reduce or eliminate spillage. Other precautions include wearing proper PPE, lifting properly, and use of mechanical means to move drums. Avoid pinch points when closing and bolting drum covers.

5.8 MOWING AND VEGETATION CONTROL

Mowing and vegetation operations may involve the use of a brush hog, chain saw, weed cutter and other equipment. Employees must follow the manufacturer's operation and safety recommendations for all equipment used. Wear eye protection, hearing protection, gloves, safety boots and adequate clothing to prevent lacerations and abrasions. Do not wear loose clothing or jewelry that could get caught in the chain or cutting edges. Avoid poison ivy when possible and wear protective clothing and boots and wash thoroughly after clearing to reduce the potential for contracting a rash from poison ivy. Be alert for snakes, bees, and other hazards while clearing. Store gasoline in approved safety cans and be careful when refueling gasoline powered tools. Gasoline is extremely flammable; the engine should be stopped and cooled before refueling. Do not spill fuel when refueling.

5.9 UNDERGROUND AND OVERHEAD UTILITIES

Underground utilities and pipelines can present special hazards such as electrocution, sudden release of pressure (gas or liquid), and explosion and fire. Underground installations such as sewer, fuel, natural gas, electrical, water, and other lines as well as underground tanks must be identified and marked before and digging, drilling or excavation. Activities covered by the New Jersey One-Call System include, but are not limited to, excavations or trenching, blasting, installation of tents, sign posts or fence posts, and removing or planting of trees. Obtain plant information such as drawings, etc. as to the location of underground utilities, tanks, etc. Contact New Jersey One-Call at (800) 272-1000 at least three full working days, but not more than ten days before the planned start of underground work.

Be prepared to give the one-call agency the name and address of the site; the nearest cross street; and the date of the intended excavation or drilling. The one-call agency will provide a reference number for the site - mark this down for future referral. There should also be an associated expiration date for the work, make sure this is recorded also and keep it available during field work. Inquire as to which utilities and/or companies will be contacted by the agency. It is the responsibility of the company/person doing the underground work to notify any utilities and/or companies that the one-call agency does not.

Utility location agencies generally do not contact water and sewer departments that are often part of the local public works department. These must be contacted directly by the company/person performing the underground work. Ask the utility location service and/or public works department to mark-out private hook-ups from the main line to the property. These may not be marked unless you specifically ask them to do so. If additional excavation or drilling is needed at the site and these fall outside the original area described to the one-call agency contact the agency again. Also, if the work is scheduled to take place outside the one-call expiration date then the agency must be contacted again (refer to the original site number).

Never take the exact location of even marked utilities for granted. Begin each excavation or borehole slowly and cautiously, taking care to check for the presence of structures or lines for at least the first three feet of depth. In some cases hand augering and probing with a non-conductive probe may be necessary.

Check for any overhead wires before work. Keep equipment at least 20 feet away from overhead lines.

5.10 OPERATING HAZARDS

Operating hazards during work activities may include work near construction and heavy equipment, noise, electrical equipment and power lines, and excavations. The employees who are most at risk of being injured are individuals unfamiliar with the site and/or construction equipment.

Working Near Construction Equipment

- Never stand directly in front of a fork-lift, backhoe or front end loader; the operator cannot see you.
- Never stand or walk under a backhoe shovel or crane boom.
- Never walk or stand under loading or unloading equipment (i.e., when you are in an excavation). Also beware that equipment such as cranes and trucks with hydraulic lift beds can tip. Avoid standing next to them when in use.
- Wear light or brightly colored clothing. This may include safety vests.
- Maintain visual contact with machine operators. Coordinate with the operators a safe place to stand when you are not directly involved with site activities such as sampling or air monitoring.
- Prearrange a hand signal communication system with machine operators. The use of whistles, hand radios, and horns to communicate is also appropriate.
- If you are not familiar with the hand signals to guide heavy equipment operations or cranes do not attempt to direct their activities. Only trained signal persons may direct crane and other activities that use specialized hand signals.
- Two or more people should not simultaneously climb a ladder or access/egress ramp.
- Communicate with machine operators to ensure that your means of access/egress is not blocked by the equipment.

Noise

- Wear hearing protection as required by facility rules and in any marked area requiring hearing protection.
- Wear hearing protection while operating or working near heavy equipment, drill rigs, power tools, etc.
- A field rule is to use hearing protection if you cannot hear normal conversation within an arm's length of the person talking.
- Wear hearing protection if sound levels exceed those shown on the following table:

Duration per day, hours	Sound level, dBA slow response
8	85
4	90
2	95
1	100
½	105
¼	110
Impact noise	140

Electrical Hazards

Overhead power lines, downed electrical wires, and buried cables all pose a danger of shock or electrocution if workers contact or sever them during site operations. Electrical equipment used on site may also pose a hazard to workers.

- Use low voltage equipment equipped with ground fault circuit interrupters and corrosion resistant connection cables while working on site.
- Inspect all electrical equipment periodically to ensure that the ground pathway is in working order.
- Monitor weather conditions and suspend work during electrical storms.
- Ground and discharge capacitors and other electrical equipment that may retain a charge before handling.

Excavations

To avoid cave-ins, excavation/trenching preplanning is of the utmost importance. Factors to be consider these items when planning any excavation or trenching operation:

- Location of underground utilities
- Soil type

- Soil moisture
- Previous soil disturbance
- Size and depth of excavation
- Length of time that excavation will be opened
- Weather conditions
- Type of excavation equipment
- Distance from excavation to existing structures
- Type and quantity of traffic in the vicinity of the excavation
- Possible sources of shock and vibration near the excavation
- Need for shoring.

5.11 OPENING WELLS AND PIEZOMETERS

Opening wells and piezometers may release vapors of potentially hazardous site constituents that have concentrated in the headspace of wells. Precautions to prevent exposure include:

- Clear away all debris from the immediate area
- Open wells carefully and allow to vent before taking measurements or sampling.
- Stand to the side and avert face when opening wells.

5.12 OPENING AND ENTERING RECOVERY WELL VAULTS

The groundwater supply and recovery well vaults are flush-mounted, concrete-sided vaults with a heavy aluminum cover. Vaults have a soil floor approximately 40 inches deep. An electrical control panel is located outside of the vault on a wooded post. Well casings and associated piping are located in the vault. Care must be taken when opening the vaults to avoid muscle strain and/or dropping the cover and crushing or cutting hands or feet. The cover must be positively latched after opening to ensure it does not fall and injure someone. These vaults have been evaluated and have been determined to be non-permit confined spaces. However, if conditions change and there are atmospheric or other hazards present the vaults will be reevaluated before entry.

5.13 ELECTRICAL SAFETY AND LOCKOUT/TAGOUT

Electrical Safety-related Work Practices

- Only qualified persons may work on or near exposed, energized electrical parts.
- No employee is permitted to work in such proximity to any part of an electric power circuit that the employee could contact the circuit in the course of work, unless the employee is protected against electric shock by deenergizing the circuit and grounding it or by guarding it effectively by insulation or other means, or unless the employee is trained as a qualified person (electrical training and experience).
- Working spaces, walkways, and similar locations must be kept clear of cords so as not to create a hazard to employees.
- No changes in circuit protection are allowed to increase the load in excess of the load rating of the circuit wiring.
- Extension cords must not be fastened with staples, hung from nails, or suspended by wire.
- Portable lighting, or other electric equipment, used in wet or conductive locations, must be operated at no more than 12 volts or must be protected by ground-fault circuit interrupters (GFCIs).
- Worn or frayed electrical cords or cables must not be used.
- Extension cords must be of the three-wire type. Extension cords used with temporary or portable equipment must be designed for hard or extra-hard usage (for example, Types S, SD, and SO).
- Electric equipment and lines must be considered energized until determined otherwise by testing, or until grounded.
- Operating voltage of equipment and lines must be determined before working on or near energized parts.
- All electric tools must be either three prong, grounded, double insulated, or rechargeable battery type.
- Portable ladders must have non-conductive side rails in situations where the employee or the ladder could contact exposed energized parts.

- All work on electrical equipment must be performed strictly in accordance with lockout/tagout procedures. Lockout/tagout rules apply to energized and deenergized electrical equipment.

- Verification of deenergization is mandatory and must be performed by a qualified person.

- Reenergization must be performed by a qualified and authorized person.

- All employees in the area must be warned that reenergization is being performed.

Lockout/Tagout

Lockout/tagout refers to the control of hazardous energy by a system of positive control (locks) and warning labels (tags). All energized equipment must be deenergized and locked out and tagged before repairs or maintenance is performed on the equipment (except for equipment that is designed to be maintained while in operation). Specific lockout/tagout procedures have been developed and for all energized equipment associated with the pump and treat system. These procedures identify the piece of equipment and all energy sources associated with the equipment; explain how to lock out the equipment, and how to safely reenergize equipment. The lockout procedures are found in Appendix B and follow these general steps:

Step 1 - Notify Affected Employees
Step 2 - Prepare for Shutdown
Step 3 - Shutdown the Machine/Equipment
Step 4 - Isolate the Machine/Equipment from All Energy Sources
Step 5 - Apply the Lockout/Tagout Device
Step 6 - Release/Disconnect Any Stored Energy
Step 7 - Verify Isolation
Step 8 - Perform Task
Step 9 - Release from Lockout or Tagout

5.14 HAND AND POWER TOOL SAFETY

The following are general guidelines to prevent accidents while using hand and power tools when working on treatment system equipment:

- Inspect each tool for damage before use;
- Use the right tool for the job;

- Operate tools according to manufacturer's instructions;
- Keep tools in good working condition with proper maintenance;
- Use the proper protective equipment; and
- Do not use "cheater bars" to exceed the design capacity of the tool.

Power tools include electric, pneumatic, liquid fuel, and hydraulic tools. General safety precautions for these tools include:

- Never carry a power tool by the cord or hose;
- Never yank the tool's cord or hose to disconnect from a receptacle;
- Keep cords and hoses away from heat, oil, and sharp edges;
- Disconnect tools when not in use, before servicing, and when changing accessories (i.e., blades, bits, cutters);
- Secure work items with clamps or vises to keep both hands free to operate the tool;
- Maintain good footing and balance during operation of tools;
- Never leave tools, electrical cords, or hoses where they might create a tripping hazard;
- Keep tool guards in place at all times;
- Use double insulated, three wire grounded plugs, or low voltage electric tools to prevent shock;
- Use ground fault circuit interrupters (GFCIs) for portable electric tools and when running any electric extension cords outside the building;
- Perform maintenance routinely.

5.15 SLIP, TRIP, FALL

Hazards throughout the Site include uneven terrain, holes, ditches, unstable slopes, slippery surfaces, unmarked projections, and ground debris that can cause employees to trip and fall. Sediment and surface water sampling in the river requires walking down slopes and walking on the river sediment. Take care to notice and avoid unsafe site conditions.

- Visually examine slopes for stability;
- Test your footing;
- Take sure the walking/work area is adequately lit;
- Be aware of ground debris; remove broken glass, nails, wire, and other debris if possible, or mark off and avoid areas of heavy debris.

5.16 WORKING OVER OR NEAR WATER

- Employees who work over or near water where the danger of drowning exists must wear U.S. Coast Guard-approved life jackets.
- Inspect life jackets before and after each use for defects which could alter their strength and buoyancy.
- Ring buoys with at least 90 feet of line must be provided and readily available for emergency rescue operations. Distance between ring buoys must not exceed 200 feet.
- At least one lifesaving skiff must be immediately available at locations where employees are working over or adjacent to water.
- Keep an emergency horn or radio immediately available.
- Make sure that others in the area know of the planned activities and are alert for potential emergencies.
- All personnel must know the signs and symptoms of hypothermia in case someone falls into the water.

Working on a boat can present many hazards such as falling in the water; drowning; slips, trips and falls; onset of severe weather while on the water; and an accident with another vessel. To prevent or control such hazards use the following precautions:

- Wear approved personal flotation devices;
- Use the buddy system for warning of danger;
- Have a life-ring or buoy immediately available (on boat and on shore);
- Keep an emergency air horn available;
- Ensure the deck of the boat is clear of debris and not slippery; and,
- Monitor the weather radio, track tides and other water movements.

5.17 HOT WORK

If hot work needs to be performed, then all hot work will be performed by authorized personnel in accordance with a hot work permit.

- Remove, shield, or cover with noncombustible material all flammable or combustible materials within 35 feet of hot work. Clean the work piece of oil, grease, paint, or chemical residue. Remove any combustible floor debris.
- No hot work may be performed in areas where flammable paints or other flammable materials or heavy concentrations of dust may create a hazard.
- Test the oxygen content and LEL before performing hot work in confined spaces, trenches or other areas where flammable gases may accumulate.

- Provide a fire watch person for the duration of the hot work (if all fire precautions cannot be maintained), and for 30 minutes after the completion of work.
- Provide fire extinguishing equipment for use while hot work is performed.
- Post warning signs around the area of hot work.
- Use the appropriate ventilation, welding helmets and goggles, respiratory protection, and other PPE to protect from air contaminants, sparks, welding rays, and other hazards involved with the specific welding job.
- Protect yourself and others from hot and/or falling objects while cutting or welding by supporting the object to be worked on, changing procedures, or tying off the work with noncombustible line.
- Tanks, drums piping, or other containers must be emptied and cleaned thoroughly, disconnected or blanked, and vented or purged before performing hot work.
- For work in confined spaces follow confined space entry procedures and permit requirements as well as hot work procedures. Ventilate the space or use airline respirators, continuously monitor the atmosphere for oxygen and flammables, keep compressed gas cylinders outside the space, and shut off the gas supply to torches outside the space and remove the hoses when not in the space.

5.18 SITE ACCESS/SITE CONTROL

5.18.1 Site Access

Access to the Site is from Belleville Turnpike via a gate. The Site is fenced along its perimeter. The HCTS operator maintains control of the site during working hours and must be contacted to gain access. Other authorized KEY employees may also have keys for access to the Site for monitoring, inspection, and maintenance.

5.18.2 Work Zones

Site work zones will be determined by KEY. For any work performed by KEY representative(s), the work zone will be the immediate area surrounding their work activities. Separate Exclusion Zone and Decontamination Zone areas will not be necessary for the representative(s) work. KEY personnel will warn outsiders away from work activities as necessary. In general, decontamination will consist of removing and disposing of nitrile gloves used during sampling and other activities. For other than routine tasks the possibility of exposure or transfer of

contaminated substances will be reduced or eliminated in a number of ways, such as the following as appropriate:

- Setting up barriers to exclude personnel from contaminated areas;
- Minimizing the number of personnel and equipment at the Site;
- Establishing work zones within the Site;
- Establishing control points with regular access to and egress from work zones;
- Conducting operations in a manner to reduce exposure of personnel and equipment; and,
- Implementing appropriate decontamination procedures.

KEY personnel will establish work zone restrictions and rules and will convey requirements to any Contractors performing work on the site. Typical exclusion zones related to routine O&M activities include around any recovery well where work is being conducted or where a well vault is open to access recovery well components, and where any other site related O&M or construction activity is being conducted that may expose Site constituents. Non-routine tasks will require that job specific exclusion zones be established during preparation of Job Safety Analyses.

5.19 SITE HOUSEKEEPING

Used disposable clothing and equipment will be placed in plastic bags immediately upon removal and the bags closed. PPE may be placed in a drum staged either within the HCTS building or with the hazardous waste storage unit located onsite pending subsequent disposal.

5.20 SANITATION/CHANGING FACILITIES

A portable toilet will be located near the HCTS building and a utility sink is available inside the HCTS building. Potable water is available at the HCTS building.

5.21 CONTAMINATION AND EXPOSURE PREVENTION

Personnel must wear Level D protection at a minimum and upgrade as necessary. Personnel must not walk in areas with potential Site constituents unless necessary.

5.22 SITE COMMUNICATIONS

There is a landline available at the HCTS building. The site operator also has a cell phone that can be used for on-Site and off-Site communication. Cell phones and two-way radios may also be used for on-site and off-site communication. Emergency contact numbers are listed in Appendix D. This list and a hospital route map are posted in the HCTS building.

6.0 PERSONAL PROTECTIVE EQUIPMENT

The objective of the protective equipment (PPE) program is to protect employees from safety and health hazards present at the Site and to prevent injury to workers from incorrect use and/or malfunction of PPE. No single combination of protective equipment and clothing is capable of protection against all hazards. PPE must be used in conjunction with safe work practices, decontamination, and good personal hygiene.

6.1 SITE-SPECIFIC LEVELS OF PROTECTION

The level of protection for most Site activities will be Level D or a modified Level D. Level D will consist of:

- Long or short-sleeve shirts and long pants;
- Appropriate gloves for material handling activities, as needed. Use nitrile gloves when handling potentially impacted materials and process equipment as well as groundwater that may contain Site constituents;
- Steel-toe and shank safety boots;
- Hard hat;
- Safety glasses with side shields; and,
- Hearing protection as required when working inside the HCTS building and when operating equipment used in routine DNAPL recovery and site maintenance activities such as mowing and weed control.

Modified Level D will consist of Level D as above plus:

- Regular or polycoated Tyvek (or similar material) as necessary to prevent skin contact;
- Nitrile gloves; and,
- Nitrile or other chemically resistant overboots.

6.2 UPGRADE CONDITIONS

If conditions should change where there is a possibility of overexposure to site constituents or chemicals used with the treatment process, additional dermal protection such as Tyvek or respiratory protection such as a respirator must be used

Level C protection will consist of:

- NIOSH-approved half or full-face, air-purifying respirator equipped with appropriate combination organic vapor and P100 dust cartridges. Dust-resistant safety goggles will be required if half-face respirators are worn. Beards that interfere with respirator fit are not allowed for field personnel that will be required to wear a respirator. Respirator cartridges must be changed at the end of each work shift and new cartridges installed before the next shift when respirators are required. Respirator cartridges also must be changed if breathing becomes difficult or if the filters become wetted.
- Chemical-resistant clothing over work clothes, regular Tyvek®, or polycoated Tyvek®, as necessary.
- Nitrile outer gloves and nitrile inner gloves.
- Steel-toe, steel shank safety boots with nitrile, butyl rubber or neoprene chemical-resistant outer boots.
- Hard hat.
- Hearing protection as required.

Organic vapor respirator cartridges may be used for one 8-hour shift only. Once a respirator cartridge is removed from the manufacturer's sealed bag it must be used or discarded.

Level B protection is not expected to be necessary during Site activities. The SHSO has the responsibility for monitoring Site and work task conditions and deciding the appropriate level of protection based on the air monitoring guidelines presented in Section 7.0 and any other indications of potential exposure.

6.3 PPE USE AND LIMITATIONS

PPE is selected to protect employees from the specific hazards that they are likely to encounter during their work on site. Selection of appropriate PPE is a complex process that must take into consideration a variety of factors. Key factors involved in this process are:

- Hazard identification;
- Potential exposure routes;
- Performance of PPE materials;
- Work tasks to be performed:
  - Durability of PPE;

- Heat stress and task duration; and,
- Matching of PPE to work tasks.

The more that is known about site hazards, the easier the job of PPE selection becomes. As more information about site hazards becomes available, the PSHO or SHSO can make decisions to upgrade or downgrade the level of protection to match the tasks at hand. PPE selection, evaluation, and re-selection is an ongoing process.

The following are guidelines for the selection of appropriate PPE. Site-specific information may suggest the use of combinations of PPE selected from the different levels described below as being more suitable to the hazards of the work.

Levels of Protection - Selection Criteria and Description of Categories

Levels of protection have been divided into four categories based on the degree of protection afforded:

Level A

Level A protection is selected when the greatest level of skin, respiratory, and eye protection is required. Level A should be used when:

- The hazardous substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system (based on measured or potential concentrations and work functions involving a high potential for splash, immersion, or exposure)
- Substances with a high degree of hazard to the skin or are capable of being absorbed through intact skin are known or suspected to be present
- Operations must be conducted in confined, poorly ventilated areas where the absence of conditions requiring Level A has not yet been determined.

Level A equipment includes:

1. Pressure-demand, full facepiece, self-contained breathing apparatus (SCBA), or pressure-demand supplied-air respirator (SAR) with escape SCBA (NIOSH approved);
2. Totally encapsulating chemical-protective suit;
3. Coveralls*;
4. Long underwear*;
5. Chemical-resistant outer gloves;

6. Chemical-resistant inner gloves;
7. Chemical-resistant steel toe and shank boots;
8. Hard hat (under suit)*;
9. Disposable protective suit, gloves, and boot covers (may be worn over totally-encapsulating suit)*; and,
10. Two way radios (worn inside encapsulating suit).

*Optional; as applicable.

Level B

Level B is selected when the highest level of respiratory protection is necessary but a lesser level of skin protection is required. Level B should be used when:

- The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection but less skin protection;

(NOTE: This involves atmospheres with IDLH concentrations of specific substances that do not present a severe skin hazard or do not meet the criteria for air purifying respirators.)

- The atmosphere contains less than 19.5 percent oxygen;
- Direct-reading instruments or organic vapor monitors detect the presence of high levels of incompletely identified gases or vapors that are not suspected to be harmful to or absorbed by the skin; and,
- When entering an uncontrolled hazardous waste site where airborne contaminant concentrations are unknown. (Note: This is minimum requirement under OSHA regulations. Level A may also be used in this situation).

Level B equipment includes:

1 SCBA or pressure-demand SAR with escape SCBA;
2 Hooded chemical-resistant clothing (coveralls; one or two piece chemical-splash suit; disposable chemical-resistant coveralls);
3 Coveralls*;
4 Chemical-resistant outer gloves;
5 Chemical-resistant inner gloves;
6 Chemical-resistant steel toe and shank boots;
7 Disposable boot covers, chemical-resistant*;
8 Hard hat;
9 Two way radios; and,
10 Face shield.*.

*Optional; as applicable.

Level C

Level C is selected when the concentration(s) and type(s) of airborne contaminants are known and the criteria for use of air purifying respirators are met. Level C should be used when:

- The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect or be absorbed through any exposed skin;
- The types and concentrations of air contaminants have been identified and a canister or cartridge respirator is available that is capable of removing the contaminants; and,
- All criteria for the use of air purifying respirators are met (see Section 14.2.1.1).

Level C equipment includes:

1. Full-face or half-mask air purifying canister-equipped respirators (NIOSH-approved);
2. Hooded, chemical-resistant clothing;
3. Coveralls*;
4. Chemical-resistant outer gloves;
5. Chemical-resistant inner gloves;
6. Chemical-resistant steel toe and shank boots*;
7. Chemical-resistant disposable boot covers*;
8. Safety glasses with sideshields (or chemical splash goggles*);
9. Hard hat;
10. Escape respirator*;
11. Two way radios; and,
12. Face shield.*.

*Optional; as applicable.

Level D

Level D is primarily a work uniform affording minimal protection. It should be worn only in areas where there is no possibility of contact with contamination. Level D protection should be used when:

- The atmosphere contains no known hazard; and,
- Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

Level D equipment includes:

1. Coveralls/work clothes;
2. Gloves*;
3. Boots/shoes, leather or chemical-resistant, with steel toes and shanks;

4. Chemical-resistant disposable outer boots*;
5. Safety glasses with sideshields (or chemical splash goggles*);
6. Hard hat;
7. Escape respirator*; and,
8. Face shield.*.

*Optional; if applicable.

Combinations of PPE other than those described for Levels A, B, C, or D protection may be more appropriate and may be used to provide the proper level of protection.

Facial hair, long hair or stubble that may interfere with the sealing surface of a respirator is prohibited. Eyeglasses with temple pieces may not be used with respirators; a compatible spectacle kit and lenses must be worn. There is to be no gum or tobacco chewing during respirator use.

6.4 WORK MISSION DURATION

Before workers actually begin work in their PPE ensembles, the anticipated duration of the work mission will be established. Several factors may limit mission length. These include:

- Oxygen/air supply consumption.
- Suit/ensemble penetration/permeation.
- Coolant supply.
- Ambient temperature.

For this project daily work mission length is expected to be 8 to 10 hours in Level D protection. Work missions may be shortened to include a 15-minute rest period every two hours if Level C protection is used. Also refer to Section 3.6, Heat Stress for further restrictions if heat stress may be an issue during the project duration.

6.5 PPE MAINTENANCE AND STORAGE

For this Site there is little maintenance required for Level D PPE to be used. Protective clothing and gloves are disposable; safety glasses, hard hats, and safety shoes are able to be washed clean

with detergent and water. Respirators will be disassembled and cleaned and stored per manufacturer's instructions.

Clothing that will be reused must be stored properly to prevent damage or malfunction from exposure to dust, moisture, sunlight, damaging chemicals, extreme temperatures and impact. Some guidelines for general storage of chemical protective clothing include:

- Potentially contaminated clothing should be stored in an area separate from street clothing or unused protective clothing.
- Potentially contaminated clothing should be stored in a well-ventilated area, with good air flow around each item, if possible.
- Different types and materials of clothing and gloves should be stored separately to prevent issuing the wrong material by mistake (e.g. many glove materials are black and cannot be identified by appearance alone).
- Protective clothing should be folded or hung in accordance with manufacturer instructions.

6.6 PPE TRAINING AND PROPER FITTING

Workers are trained in the proper use and fitting of PPE during the initial 40-hour hazardous waste course. This training is re-emphasized during the annual 8-hour refresher training. In addition, at the start of the project employees are reminded of the proper fitting of PPE for the tasks to be performed. If respirators may be used during a project workers are also trained according to the OSHA respiratory protection standard, 29 CFR 1910.134.

At a minimum the training points out the user's responsibilities and explains the following, using both classroom and field training when necessary, as follows:

- The proper use and maintenance of selected protective clothing, including capabilities and limitations.
- The nature of the hazards and the consequences of not using the protective clothing.
- The human factors influencing protective clothing performance.
- Instructions in inspecting, donning, checking, fitting, and using protective clothing.
- Use of protective clothing in normal air for a long familiarity period.
- The user's responsibility (if any) for decontamination, cleaning, maintenance, and repair of protective clothing.

- Emergency procedures and self-rescue in the event of protective clothing/ equipment failure.
- The buddy system.

6.7 PPE DONNING AND DOFFING PROCEDURES

Donning Procedures

- Inspect clothing and respiratory equipment before donning.
- Adjust hard hat or headpiece if worn, to fit user's head.
- If wearing protective clothing - Standing or sitting, step into the legs of the suit; ensure proper placement of the feet within the suit; then gather the suit around the waist.
- Put on safety boots now.
- If using a respirator - Perform negative and positive respirator facepiece seal test procedures.
- To conduct a negative-pressure test, close the inlet part with the palm of the hand or squeeze the breathing tube so it does not pass air, and gently inhale for about 10 seconds. Any inward rushing of air indicates a poor fit. Note that a leaking facepiece may be drawn tightly to the face to form a good seal, giving a false indication of adequate fit.
- To conduct a positive-pressure test, gently exhale while covering the exhalation valve to ensure that a positive pressure can be built up. Failure to build a positive pressure indicates a poor fit.
- Depending on type of suit:
- Put on inner gloves.
- Additional overgloves, worn over attached suit gloves, may be donned later.
- Put on hard hat.
- Secure the suit by closing all fasteners.
- Ensure that the wearer is comfortable and that the equipment is functioning properly.

Doffing Procedures

- Remove any extraneous or disposable clothing, boot covers, outer gloves, and tape.
- Remove safety shoes or boots.
- Remove arms, one at a time, from suit.
- Leave inner gloves on, if any.
- Sitting, if possible, remove both legs from the suit.
- After suit is removed, remove internal gloves by rolling them off the hand, inside out.

6.8 PPE INSPECTION PROCEDURES PRIOR TO, DURING, AND AFTER USE

An effective chemical protective clothing inspection program should feature five different inspections:

- Inspection and operational testing of equipment received as new from the factory or distributor.
- Inspection of equipment as it is selected for a particular chemical operation.
- Inspection of equipment after use or training and prior to maintenance.
- Periodic inspection of stored equipment.
- Periodic inspection when a question arises concerning the appropriateness of selected equipment, or when problems with similar equipment are discovered.

Each inspection will cover different areas with varying degrees of depth. Those personnel responsible for clothing inspection should follow manufacturer directions.

Clothing

Before use: Determine that the clothing material is correct for the specified task at hand. Visually inspect for: Imperfect seams; non-uniform coatings; tears; and malfunctioning closures. Hold up to light and check for pinholes; flex product and observe for cracks. Check for other signs of shelf deterioration.

If the product has been used previously, inspect inside and out for signs of chemical attack: discoloration, swelling and stiffness

During the work task, periodically inspect for: Evidence of chemical attack such as discoloration, swelling, stiffening and softening. Keep in mind, however, that chemical permeation can occur without any visible effects. Check for closure failure, tears, punctures and seam discontinuities.

Gloves - Before use: Pressurize glove to check for pinholes. Either blow into glove, then roll gauntlet towards fingers or inflate glove and hold under water. In either case, no air should escape.

Safety Glasses - Check for proper fit, cracks, cleanliness and visibility.

Safety Shoes/Boots – Check for cracks, tears, holes, tread wear, and proper lacing.

Respirators – Check for proper fit; conduct positive and negative fit checks. Check for cracks in facepiece; elasticity of straps and sealing surface. Make sure the facepiece is clean.

6.9 PPE IN USE MONITORING

During the work task, periodically inspect for evidence of chemical attack such as discoloration, swelling, stiffening and softening. Keep in mind, however, that chemical permeation can occur without any visible effects. Check for closure failure, tears, punctures and seam discontinuities in protective clothing. If clothing or other PPE is soiled remove the soil and or change the clothing or PPE.

6.10 EVALUATION OF THE EFFECTIVENESS OF THE PPE PROGRAM

The PPE management program is reviewed at least annually. Elements considered in the review include:

- The number of person-hours that personnel wear various forms of chemical protective clothing and other equipment;
- Accident and illness experience;
- Levels of exposure;
- Adequacy of equipment selection;
- Adequacy of the operational guidelines;
- Adequacy of decontamination, cleaning, inspection, maintenance, and storage programs;
- Adequacy and effectiveness of training and fitting programs;
- Coordination with overall safety and health program;
- The degree of fulfillment of program objectives;
- The adequacy of program records;

- Recommendations for program improvement and modification; and
- Program costs.

On the Site, the effectiveness of the PPE program is evaluated by observing the workers for fit of equipment, proper use of equipment, wear and tear on equipment, and whether there is evidence of contamination beneath the PPE upon removal.

7.0 MONITORING

Air monitoring is an integral part of the HASP and is used to help determine the appropriate level of protection for field personnel. The SHSO, or qualified designee, is responsible for all air monitoring at the Site. Air monitoring action levels are presented on the next page. The SHSO will use these action levels when determining the need to upgrade or downgrade the level of PPE.

7.1 REAL-TIME MONITORING

Monitoring should be performed in the breathing zone prior to and during intrusive activities and any other activities where there is a potential for exposure to airborne contaminants. If contaminants are consistently detected above background in the work areas then additional area or personal air monitoring or sampling may be necessary to identify the contaminants contributing to meter readings. Readings may be recorded in the Site field log or on the health and safety form - the Real-Time Monitoring Log.

The types of instruments used for air monitoring and the contaminants they can detect are listed below:

Air Monitoring Instrument Name	Contaminant(s) Monitored
Combustible Gas Indicator or multi-gas meter (CGI)	Combustible Gas, Oxygen (LEL, O_2)
Photo Ionization Detector (PID)	Organic Vapors (non-specific)
MIE Data Ram or equivalent	Dust Monitoring

For any work activity, a sustained (greater than 5 minutes) PID reading in the breathing zone above the levels in the table in Section 7.3 will require vapor suppression or avoidance techniques. If these methods are not feasible or do not reduce the potential exposure below acceptable levels, then employees must upgrade to Level C protection, as necessary.

7.2 INSTRUMENT CALIBRATION

Monitoring equipment will be calibrated and checked for proper operation daily before the start-up of any activities requiring monitoring. Before initiating field activities, background measurements will be obtained with each instrument upwind and away from potential Site influences. Instrument calibrations and background levels will be documented on daily air monitoring logs or in a field log.

7.3 AIR MONITORING ACTION LEVELS

Constituent	Concentration	Location	Response
Total Organics (PID)	Above background to 0.5 ppm	Worker Breathing Zone – Intrusive activities	Continue monitoring until reading drops to background or other action is called for.
Total organic vapors (PID)	5 to 25 ppm	Worker Breathing Zone – intrusive activities	Upgrade to Level C – half or full-face respirator with combination organic vapor and P100 dust cartridges.
Total organic vapors (OID)	Above 25 ppm	Worker Breathing Zone – intrusive activities	If vapors cannot be controlled, stop work and evacuate the area until vapors dissipate. Monitor from a distance.
Total Organics (PID)	Consistently above background.	Worker Breathing Zone – intrusive activities	Arrange for air sampling to identify and quantify the potential VOCs.
Combustible Gas (CGI)	≥ 10% LEL	In work area	Shut down machinery, remove personnel from work area and ventilate
Oxygen	≤ 19.5%	In work area	Cease work/ventilate.

8.0 MATERIAL HANDLING AND DECONTAMINATION

All waste material, decontamination liquids, and decontamination equipment will be handled in a safe and healthful manner. Decontamination and material handling activities will be carried out within the appropriate work zone.

8.1 DECONTAMINATION

For sampling and monitoring activities decontamination may consist of removing and disposing of soiled gloves and cleaning or disposing of soiled equipment and materials. When construction activities are planned a personnel and equipment decontamination area will be provided by the Construction Contractor where surface contamination and outer protective equipment are removed. This area will be determined upon arrival at the Site and before any intrusive activities begin. The KEY representative should be careful to verify appropriate decontamination depending on the procedures implemented.

8.1.1 Personnel Decontamination

During regular maintenance, sampling and monitoring personnel decontamination consists of removal and disposal of gloves after use then washing with soap and water.

The general decontamination procedure during construction activities is as follows.

Level D Decontamination:

- Equipment drop onto plastic drop cloth.
- Wash and rinse boot covers and gloves if to be reused.
- Remove and dispose of Tyvek® suit in a plastic-lined container or plastic bag.
- Remove boot covers and gloves, dispose in plastic bag or lined containers if not to be reused. Place in "decontaminated PPE" container if to be used again.
- Field-wash hands and face.

Level C Decontamination:

- Equipment drop onto plastic drop cloth.
- Wash and rinse boot covers and outer gloves if to be reused.
- Remove boot covers and other gloves; dispose in plastic bag or lined container if not to be reused. Place in "decontaminated PPE" container if to be used again.
- Remove and dispose of Tyvek® suit in a plastic bag or plastic-lined container.
- Wash and rinse inner gloves.
- Remove respirator and place in bin for later cleaning.
- Remove and dispose inner gloves.
- Field-wash face and hands.

There may be partial field decontamination before traveling from one work location to another. This may consist of removing or cleaning boots and gloves after completing an activity and before moving to the next work station. The SHSO will advise the field crew of any necessary field decontamination procedures.

Respirators, non-disposable protective clothing, and other personal articles must be sanitized before they can be used again unless they are assigned to individuals. The SHSO is responsible for monitoring the effectiveness of decontamination procedures and modifying the procedures as necessary to ensure proper decontamination.

8.1.2 Equipment Decontamination

All equipment used in an exclusion zone must be decontaminated before it leaves the Site or is taken into a clean area. Small tools and equipment used in the EZ that become contaminated may be taken to the decontamination area taking care to isolate the tools/equipment from clean materials and equipment. Equipment may be decontaminated by steam cleaning, washing with detergent and water then rinsing, or other appropriate decontamination methods as detailed in the Work Plan for the Site. Verification that equipment/vehicles leaving the Site have been adequately decontaminated is the responsibility of the SHSO.

9.0 EMERGENCY PROCEDURES

Emergency telephone numbers, directions to the nearest hospital, and a route map to the hospital are presented at the beginning of this HASP.

9.1 SITE TOPOGRAPHY AND LAYOUT

The Sites are located on relatively flat terrain; however a lagoon, marshland, standing water, thick brush, and ditches are present on some areas of the Sites.

9.2 OVERVIEW

Pre-emergency planning consists of the preparation of this emergency response plan, posting of the emergency contact list and hospital route map, assigning emergency functions to on-Site personnel, training of personnel as necessary, and ensuring that emergency procedures and equipment are in place.

The KEY supervisor/SHSO is designated as the Site Emergency Coordinator for KEY's activities and is responsible for field implementation this emergency response plan and has full authority for KEY personnel and KEY subcontractors in the event of an emergency. If outside agencies respond to an emergency the Site Emergency Coordinator will pass the responsibility and authority for emergency response to the Incident Commander for the outside agency as appropriate. The Site Emergency Coordinator will assist outside emergency response agencies as much as possible to control and resolve the emergency. In general, on-site personnel would immediately evacuate the area to the designated safe place of refuge. Communications consist of verbal and hand signals on-site and use of a portable telephone for off-site communication.

The Site Emergency Coordinator, or if the Site Emergency Coordinator is unavailable, the designated alternate on Site, will contact emergency personnel. In the event of severe injury to KEY personnel or subcontractors, KEY may start first aid then contact outside personnel for assistance.

PPE and emergency equipment will be available on-Site for response to minor emergencies. PPE includes gloves, protective clothing, protective booties, and safety glasses.

Safe distances and places of refuge will be upwind of the site activities and will be determined at the time of the emergency based on a combination of site-specific and incident-specific factors. Evacuation routes and places of refuge will be determined before the start of work at the Site and the locations made known to all personnel who enter the Site. The SHSO will maintain security around the immediate Site work zones. Because of the limited number of personnel expected to be working on the Site, the SHSO will know who is on Site and can control entry of personnel into hazardous areas in an emergency.

There are several potential causes of emergencies at hazardous waste sites. Worker-related emergencies may include:

- Minor accidents like slips, trips, and falls.
- Chemical exposure.
- Medical problems such as heat stress, heat stroke and aggravation of pre-existing conditions.
- Failure of personal protective equipment (tearing or permeation of protective clothing).
- Physical injury, e.g., from flying objects, loose clothing entangled in machinery, serious falls.
- Electrocution.

Waste-related emergencies may include:

- Fire.
- Explosion.
- Leaks.
- Release of toxic vapors.
- Incompatible reactions.
- Collapse of containers.

Weather Related Emergencies may include:

- Severe thunderstorm
- Tornados

- Hurricanes
- Snow/ice storms
- Floods

Personnel planning work and working at the Site must monitor weather conditions for severe weather watches and warnings. Stop work and secure equipment before exiting the Site. Do not work in Thunderstorms. If conditions change rapidly, consider sheltering in place in the HCTS building. In the event of a flood transfer equipment to higher ground if possible. Secure drums and other containers of chemicals and materials to avoid spills. Spill supplies are available in the HCTS building and the waste storage containers.

All personnel, especially the supervisors and SHSO, must be constantly alert for indicators of potentially hazardous situations and for symptoms in themselves and others that warn of hazardous conditions and exposures. Before daily assignments the tasks to be performed, time constraints, potential hazards and emergency procedures are reviewed.

Hazard/Recognition	Emergency Action
Fire/explosion – flames/smoke/heat	If small fire use fire extinguisher to put out. If fire spreads beyond control of employees, call the local fire department at 911.
Minor accidents and physical injury	First-aid trained person to examine victim and treat as needed. If more than first-aid is required summon ambulance or transport or hospital.
Chemical exposure (PAHs)	Wash skin, flush eyes. Put sun lotion on affected area and cover skin. See a physician if severe reaction. See first aid procedures below.
Severe Weather	Monitor weather; stop work and exit Site severe weather threatens. If no time to exit the Site gather at/in the HCTS building until conditions are stable.
PPE in poor condition or missing.	Stop work and ensure that employees wear proper PPE.

Emergency alerting on-site consists of the use of hand signals and/or radio/cell phone communication. Cell phones will be used for off-site communication. Workers notify the Site Supervisor or SHSO of any emergency. The Site Supervisor or SHSO decides the appropriate action and implements emergency procedures.

Pre-emergency planning consists of the preparation of this emergency response plan, keeping the emergency contact list and hospital route map in the Site vehicle and ensuring that a first aid kit is available.

Personnel working alone or in small groups are responsible for their own safety and for contacting emergency services as necessary. A cell phone will be used for off-site communication.

9.3 EMERGENCY MEDICAL TREATMENT AND FIRST AID

In the event of a safety or health emergency at the Site, appropriate emergency measures will immediately be taken to assist those who have been injured or exposed and to protect others from hazards. The project field personnel will take the injured party and transport (if possible) to the nearest hospital for treatment, after determining whether personnel decontamination can be performed on the injured party.

If the injury to a worker is chemical in nature (e.g., overexposure), the following first-aid procedures will be instituted:

- Eye Exposure - If a solid or liquid gets into the eyes, wash the eyes immediately at the emergency eyewash station using large amounts of water and lifting the lower and upper lids occasionally to help flush the eye. Do not let the victim rub eyes or keep eyes tightly closed. Flush for at least 15 minutes. Obtain medical attention immediately.
- Skin Exposure - Promptly wash the area using mild soap and flooding amounts of water for at least 15 minutes while removing contaminated clothing and shoes. Consult a physician for reddened or blistered skin.
- Swallowing - Do not induce vomiting! Never give anything by mouth to an unconscious person. Call poison control center: 1-800-222-1222.
- Breathing - If a person has difficulty breathing, move the exposed person to fresh air at once. Do not use mouth-to-mouth respiration. If breathing has ceased apply artificial respiration using oxygen and a suitable mechanical device such as a bag and mask. Keep the affected person warm and at rest. Obtain medical attention as soon as possible.

A first aid kit is located in the HCTS building. Construction vehicles should also carry a first aid kit.

9.4 EMERGENCY EVALUATION, INVESTIGATION, AND DOCUMENTATION

The KEY Project Manager and/or KEY Health & Safety Manager will evaluate the available information about the incident and KEY's emergency response about what happened, any injuries or casualties, further accident potential, and what can be done to remedy the emergency. The type of response will be based on the available information about the emergency incident.

The emergency incident will be investigated and all findings put in writing as soon as conditions return to normal. Ensure that documentation is as complete as possible by including a chronological history of the incident, facts about the incident and when they became available, titles and names of personnel, actions taken, samples and results, possible exposures, and history of all injuries or illness during or as a result of the emergency. After the situation has returned to normal, all aspects of the emergency incident and the response will be reviewed to assess procedures used, how to improve response, and how to prevent further emergencies.

9.5 SPILL CONTAINMENT

Most spills are expected to be small and easily managed with squeegees, mops, secondary containment vessels and sorbent materials. Any employee discovering a spill or leak must take immediate action to control flow and notify the KEY Supervisor and Manager as soon as possible. Sorbent material, shovels and drums are located in the hazardous waste storage container, mobile trailer to handle spills of materials. Soils or sediments that spill will be picked up immediately and containerized as appropriate.

10.0 TRAINING

10.1 GENERAL

All employees or other personnel involved in Site operations which could involve exposure to hazardous waste will receive training in compliance with OSHA 29 CFR 1910.120.

The training requirements are intended to provide employees with the knowledge and skills necessary to perform hazardous waste Site operations while minimizing the potential for injury. Initial training consists of a minimum of 40 hours of off-Site classroom and practical exercise training and 3 days of actual field experience. Training must be updated annually with 8 hours of off-Site training. Supervising personnel will complete an 8-hour training session for supervisors. Training will be certified by record and/or certificate.

Initial 40-hour off-site training for hazardous waste site workers consists of classroom coursework and practical exercises that include:

- Safety, health and other hazards present at hazardous waste sites;
- Selection and use of personal protective equipment;
- Work practices to minimize risks from site hazards;
- Safe use of engineering controls and equipment on sites;
- Medical surveillance requirements, including recognition of symptoms and signs which might indicate overexposure to hazards;
- Site control measures;
- Decontamination procedures; and,
- Emergency response and contingency planning.

In addition to the 40-hour training, site workers perform actual field activities for at least 3 days under the direct supervision of a trained, experienced supervisor.

Supervisors who are responsible for directing others receive the same training as general site workers plus an additional 8 hours of training on topics such as the overall corporate health and safety program and employee training program, management of site zones, PPE, spill containment, monitoring procedures and techniques, and supervisory skills.

Annual 8 hour refresher training is required for all field personnel. This training consists of a review of the elements of the 40-hour course, critique of the past year's incidents, and other relevant topics. Information and training on new technologies or equipment for the improved protection of employees is also presented.

All construction employees are required to have the 40-hour initial training. There are no site-specific task limitations on this project that qualify on-site construction personnel for the 24-hour minimum initial training. Workers on site for a specific limited task, such as land surveying, and who are unlikely to be exposed over permissible exposure limits and published exposure limits must have a minimum 24 hours of off-site instruction and a minimum one day actual field experience under the direct supervision of a trained, experienced supervisor.

Personnel responding to Site emergencies have the training and experience to recognize, evaluate, and respond to expected emergency situations. Training includes first aid/CPR courses and the 8-hour supervisor course.

10.2 SITE-SPECIFIC TRAINING

Site-specific training will consist of a health and safety briefing on the following information before the personnel collecting samples travels to the Site:

- Names of individuals responsible for Site health and safety and methods of communicating safety and health concerns;
- Site-specific health and safety hazards;
- Use of PPE;
- Work practices by which employees can minimize risk;
- Safe use of equipment on-Site;
- Recognition of symptoms and signs of exposure to hazardous materials;
- Site control measures;
- Decontamination procedures; and,
- Emergency response procedures.

The Health and Safety Manager or designee will give the health and safety briefing prior to initiation of field activities. This briefing will be of sufficient duration to address all of the material covered in this HASP. All personnel that will be participating in field activities will have had the opportunity to read this HASP prior to this initial meeting so that any questions they have can be addressed at the initial meeting.

10.3 SAFETY MEETINGS

Prior to commencing field activities each day, a short briefing will be conducted by the Site Supervisor to address the day's activities. The daily briefing will provide the opportunity for the SHSO to address any special health and safety issues and to notify individuals of any deficient areas that need to be corrected or operational changes made that affect field work. The briefing will emphasize the specific concerns associated with the day's planned field activities. Daily weather reports will be reviewed to determine work/rest regimens.

TABLES

TABLE 1

Exposure Limits and Other Properties of Principal Constituents of Interest
Standard Chlorine Chemical Company Site
Kearny, NJ

Chemical Compound	Exposure Limits [b]	STEL [c]	IDLH [d]	Vapor Pressure [e]	Ionization Potential[f]
Coal Tar Pitch Volatiles (PAHs)[a]	0.2 mg/m^3	NE	80 mg/m^3	Varies	Varies
Naphthalene	10 ppm	15 ppm	250 ppm	0.08 mm	8.12 eV
Benzene	0.5 ppm	5 ppm	500 ppm	75 mm	9.24 eV
Ethylbenzene	100 ppm	125 ppm	800 ppm	7 mm	8.76 eV
Toluene	50 ppm	NE	500 ppm	21 mm	8.82 eV
Xylene	100 ppm	150 ppm	900 ppm	9 mm	8.56 eV
Chlorobenzene	10 ppm	NE	1,000 ppm	9 mm	9.07 eV
1,2-Dichlorobenzene	25 ppm	50 ppm	200 ppm	1 mm	9.06 eV
1,4-Dichlorobenzene	10 ppm	---	150 ppm	1.3 mm	8.98
1,2,4-Trichlorobenzene	---	5 ppm (c)	100 ppm	19 mm	11.00 eV
Chromium, as Cr VI	0.05 mg/m^3	0.025 mg/m^3	15 mg/m^3	NA	NA
Tetrachloroethylene (Perchloroethylene)	25 ppm	100 ppm	150 ppm	14 mm	9.32 eV
Trichloroethylene	50 ppm	100 ppm	1,000 ppm	58 mm	9.45 eV

Chemical Compound	Carcinogen[g]	Skin Exposure [h]	LEL/UEL [I]	Odor Threshold [j]	3M/NIOSH Respirator Selection [k]
Coal Tar Pitch Volatiles (PAHs)	YES	YES	---	---	R95 or P95
Naphthalene	YES	NO	0.9 - 5.9%	0.015 ppm	OV
Benzene	YES	NO	1.2 - 7.8%	8.65 ppm	OV
Ethylbenzene	NO	NO	0.8 - 6.7%	2.3 ppm	OV
Toluene	NO	YES	1.1 - 7.1%	0.16 ppm	OV
Xylene	NO	NO	1.0 – 7.0%	0.324 ppm	OV
Chlorobenzene	NO	NO	1.3-9.6%	0.741 ppm	OV
1,2-Dichlorobenzene	NO	NO	2.2-9.2	0.072 ppm	(F)OV
1,4-Dichlorobenzene	YES	NO	2.5-?	0.048 ppm	(F)OV/N95
1,2,4-Trichlorobenzene	YES	NO	2.5-6.6	2.91 ppm	OV
Chromium, as Cr VI	YES	NO	NA	NA	N100
Tetrachloroethylene (Perchloroethylene)	YES	NO	NA	6.17 ppm	(F)OV
Trichloroethylene	YES	NO	8-10.5	1.36 ppm	OV

TABLE 1 (cont.)
Exposure Limits and Other Properties of Principal Constituents of Interest
Standard Chlorine Chemical Company Site
Kearny, NJ

Notes:

[a] OSHA has not established individual exposure limits for most PAHs. Coal Tar Pitch Volatiles is a category containing several compounds, most of which are classified as PAHs; so Coal Tar Pitch Volatiles can be used as a surrogate for PAHs.
[b] Exposure Limit: 8-hour Time Weighted Average (TWA) from the Threshold Limit Values of the ACGIH, or OSHA Permissible Exposure Limit (PEL), whichever is lower.
[c] STEL: Short Term Exposure Limit denotes a 15 minute average that may not be exceeded.
[d] IDLH: Immediately Dangerous to Life or Health - Maximum concentration from which one could escape within 30 minutes without a respirator and without experiencing any irreversible health effects.
[e] Vapor Pressure: From NIOSH Pocket Guide to Chemical Hazards. Water = 0 mm. Above 1 mm is considered volatile; above 100 mm is considered highly volatile
[f] Ionization Potential: Expressed in electron volts (eV) from NIOSH Pocket Guide to Chemical Hazards. Used to determine type of detector bulb for the PID.
[g] Carcinogen: "Yes" indicates compound is a confirmed or suspected human carcinogen by NIOSH, OSHA or ACGIH.
[h] Skin Exposure: "Yes" indicates potential significant exposure through skin and mucous membranes, either by airborne or, more particularly, by direct contact to ambient vapors.
[I] LEL/UEL: Lower and upper explosive limits. Percent of material needed in air for ignition when exposed to an ignition source.
[j] Odor Threshold: Air concentration at which most people can smell the chemical.
[k] 3M/NIOSH Respirator Selection: Type of respirator recommended by the 3M Respirator Selection Guide or the NIOSH Pocket Guide to Chemical Hazards. SA = Supplied Air (Level B); OV = Organic Vapor Respirator (Level C); N, R, or P 95, 97, or 100 = Dust and mist respirator (Level C).

TABLE 2

Task-Specific Hazard Assessment with Proposed Initial Levels of Protection and Air Monitoring Requirements Standard Chlorine Chemical Company Site Kearny, NJ

Task	Chemical Hazard Assessment			Estimated Initial Level of Protection*	Real-Time Air Monitoring	
	VOCs	PAHs	Hex. Chrome		VOCs	Dust
RI/FFS						
Surface Soil Sampling	LOW	LOW	LOW	D	NO	NO
DNAPL Delineation	LOW	LOW /MED	LOW	D	YES	NO
Varved Clay Sampling	LOW	LOW	LOW	D	NO	NO
Monitoring Well/Piezometer Abandonment	LOW	LOW	LOW	D	NO	NO
Investigation-Derived Waste Management	LOW	LOW	LOW	D	NO	NO
Site Monitoring:						
Steel sheet pile Wall Inspections	LOW	LOW	LOW	D	NO	NO
SSP wall cathodic protection system inspections	LOW	LOW	LOW	D	NO	NO
Consolidation Area (CA) cover inspections	LOW	LOW	LOW	D	NO	NO
Interim Remedial Measure (IRM) cover systems inspections	LOW	LOW	LOW	D	NO	NO
Groundwater potentiometric surface elevation monitoring	LOW	LOW	LOW	D	NO	NO
DNAPL thickness gauging	LOW/ MED	MED	LOW	D	NO	NO
HCTS influent and effluent monitoring	LOW	LOW	LOW	D	NO	NO
Stormwater management, erosion and sediment (E&S) control, and permanent vegetation inspections	LOW	LOW	LOW	D	NO	NO
Slurry wall working platform inspections;	LOW	LOW	LOW	D	NO	NO
Site security and access inspections	LOW	LOW	LOW	D	NO	NO
Repairs for the following components:						
Steel sheet pile (SSP) wall;	LOW	LOW	LOW	D	NO	NO
CA cover	LOW	LOW	LOW	D	NO	YES
IRM cover systems	LOW	LOW	LOW	D	NO	YES
Monitoring wells and piezometers	LOW/ MED	LOW /MED	LOW	D	NO	NO
Stormwater/E&S control features and vegetation	LOW	LOW	LOW	D	NO	NO
Slurry wall platform	LOW	LOW	LOW	D	NO	NO
Site security access features	LOW	LOW	LOW	D	NO	NO

Task	Chemical Hazard Assessment			Estimated Initial Level of Protection*	Real-Time Air Monitoring	
	VOCs	PAHs	Hex. Chrome		VOCs	Dust
Operation and maintenance activities (O&M) activities						
Hydraulic control wells	LOW	LOW	LOW	D	YES	NO
DNAPL recovery wells	LOW/ MED	LOW /MED	LOW	D	YES	NO
The SSP wall cathodic protection system	LOW	LOW	LOW	D	NO	NO

***** Also wear nitrile gloves for activities where there may be hand contact with potentially impacted soil, sediment, groundwater and DNAPL.

FIGURES

COOPERATING PARTIES GROUP

DRWN: SCC	DATE: 03/25/13	KEY ENVIRONMENTAL INCORPORATED
CHKD: RJH	DATE: 03/25/13	
APPD: JSZ	DATE: 03/25/13	
SCALE:	1"= 2000'	

REMEDIAL INVESTIGATION/
FOCUSED FEASIBILITY STUDY WORK PLAN
STANDARD CHLORINE CHEMICAL CO., INC. SITE
KEARNY, HUDSON COUNTY, NEW JERSEY

REFERENCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLES OF JERSEY CITY, AND WEEHAWKEN, NEW JERSEY

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

SITE LOCATION MAP

PROJECT NO: 2012-14

FIGURE 1

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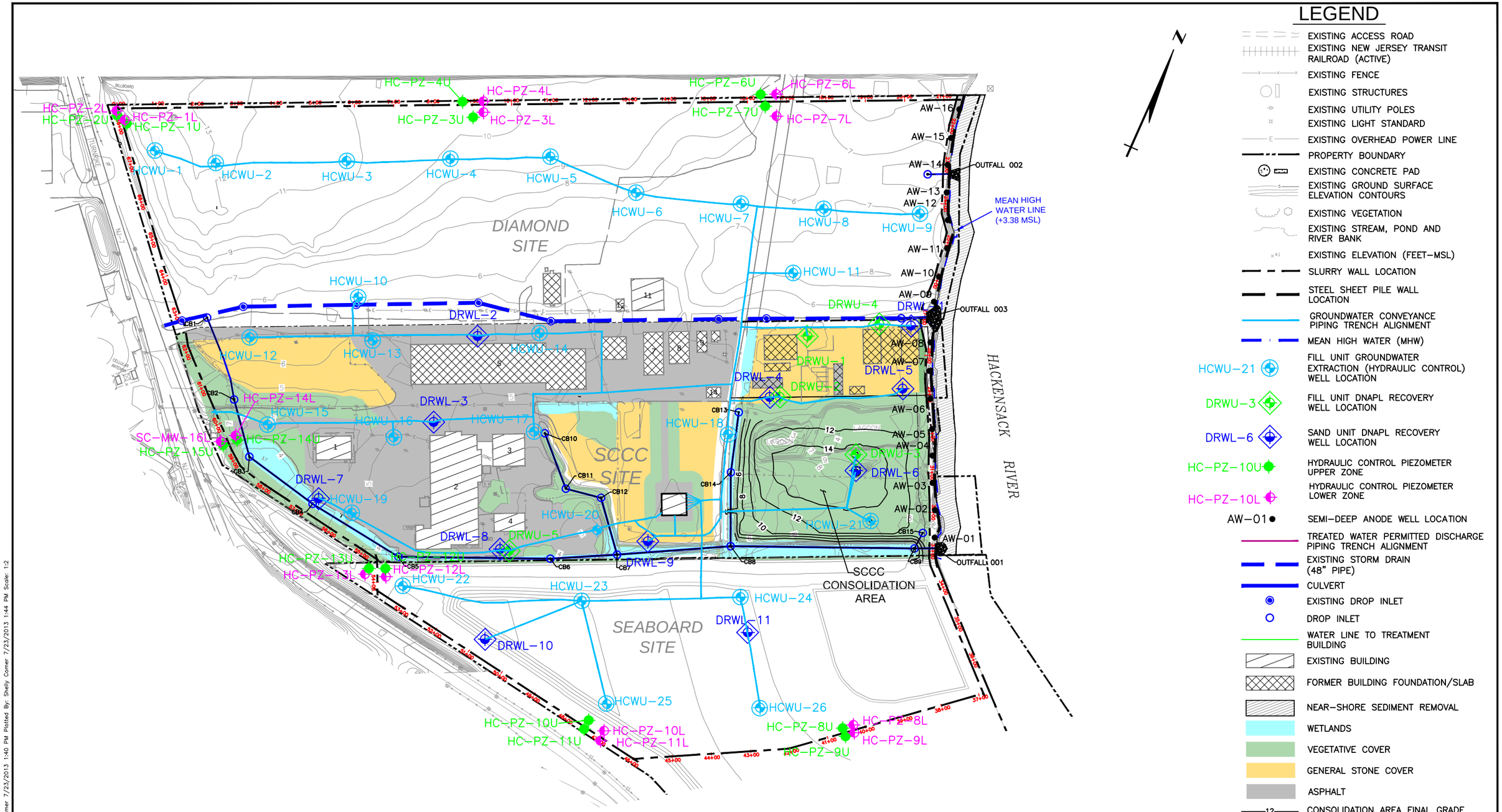

LEGEND

- EXISTING ACCESS ROAD
- EXISTING NEW JERSEY TRANSIT RAILROAD (ACTIVE)
- EXISTING FENCE
- EXISTING STRUCTURES
- EXISTING UTILITY POLES
- EXISTING LIGHT STANDARD
- EXISTING OVERHEAD POWER LINE
- PROPERTY BOUNDARY
- EXISTING CONCRETE PAD
- EXISTING GROUND SURFACE ELEVATION CONTOURS
- EXISTING VEGETATION
- EXISTING STREAM, POND AND RIVER BANK
- EXISTING ELEVATION (FEET–MSL)
- SLURRY WALL LOCATION
- STEEL SHEET PILE WALL LOCATION
- GROUNDWATER CONVEYANCE PIPING TRENCH ALIGNMENT
- MEAN HIGH WATER (MHW)
- HCWU–21 — FILL UNIT GROUNDWATER EXTRACTION (HYDRAULIC CONTROL) WELL LOCATION
- DRWU–3 — FILL UNIT DNAPL RECOVERY WELL LOCATION
- DRWL–6 — SAND UNIT DNAPL RECOVERY WELL LOCATION
- HC–PZ–10U — HYDRAULIC CONTROL PIEZOMETER UPPER ZONE
- HC–PZ–10L — HYDRAULIC CONTROL PIEZOMETER LOWER ZONE
- AW–01 — SEMI–DEEP ANODE WELL LOCATION
- TREATED WATER PERMITTED DISCHARGE PIPING TRENCH ALIGNMENT
- EXISTING STORM DRAIN (48" PIPE)
- CULVERT
- EXISTING DROP INLET
- DROP INLET
- WATER LINE TO TREATMENT BUILDING
- EXISTING BUILDING
- FORMER BUILDING FOUNDATION/SLAB
- NEAR–SHORE SEDIMENT REMOVAL
- WETLANDS
- VEGETATIVE COVER
- GENERAL STONE COVER
- ASPHALT
- 12 — CONSOLIDATION AREA FINAL GRADE

0 120 240 FEET

COOPERATING PARTIES GROUP

DRWN: SCC	DATE: 03/25/13	KEY ENVIRONMENTAL INCORPORATED
CHKD: JAB	DATE: 03/25/13	
APPD: JSZ	DATE: 03/25/13	
SCALE: AS SHOWN		

REMEDIAL INVESTIGATION/
FOCUSED FEASIBILITY STUDY WORK PLAN
STANDARD CHLORINE CHEMICAL CO., INC. SITE
KEARNY, HUDSON COUNTY, NEW JERSEY

CURRENT SITE CONDITIONS (2012)

PROJECT NO: 2012–14

FIGURE 2

REV #	DATE	DESCRIPTION	APPD
1			
2			
3			

REFERENCE:

1. EXISTING GROUND SURFACE CONTOURS PER AIR SURVEY, DULLES, VIRGINIA, APRIL 14, 2001. HORIZONTAL REFERENCE: NEW JERSEY STATE PLANE COORDINATES (NAD 1927). VERTICAL REFERENCE:NATIONAL GEODETIC VERTICAL DATUM (NGVD 1929).
2. PROPERTY BOUNDARY SHOWN HEREON FROM SHEET 1 OF 1 TITLED "SURVEY OF PROPERTY, TAX LOTS 32.02, 46, 47 & 47R, BLOCK 287, TAX LOTS 48, 49, 50, 51, 52 AND 52R, BLOCK 287, TOWN OF KEARNY, HUDSON COUNTY, NEW JERSEY, DATED JULY 1, 2009 (REVISION 2: JULY 29, 2009), PREPARED BY DYKSTRA ASSOCIATES, PC.
3. EXISTING WETLANDS PER WETLAND DELINEATION BY PRINCETON HYDRO, LLC FOR KEY ENVIRONMENTAL, INC. PERFORMED IN MARCH 2009.

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

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APPENDIX A

MATERIAL SAFETY DATA SHEETS

The following Material Safety Data Sheets (MSDSs) are provided for general information on the chemical and physical properties and potential health hazards of constituents that may be present at the Site. The use of manufacturer names does not imply that these products were in fact used at the Site; nor imply or infer any liability on the part of the manufacturer of any product represented, or the preparer of the MSDS.

Health	1
Fire	1
Reactivity	0
Personal Protection	A

Material Safety Data Sheet
Coal tar MSDS

Section 1: Chemical Product and Company Identification

Product Name: Coal tar

Catalog Codes: SLC1108

CAS#: 8007-45-2

RTECS: GF8600000

TSCA: TSCA 8(b) inventory: Coal tar

CI#: Not available.

Synonym: Estar; Lavatar; Zetar; Tar, coal; Pixalbol; Tar, coking; coke oven emissions

Chemical Name: Coal Tar

Chemical Formula: Not available.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Coal tar	8007-45-2	100

Toxicological Data on Ingredients: Coal tar LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified 1 (Proven for human.) by IARC, 1 (Clear evidence; known carcinogen) by NTP. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to skin. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: CLOSED CUP: 96°C (204.8°F).

Flammable Limits: Not available.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances:
Slightly flammable to flammable in presence of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: On ignition it burns with reddish, luminous, and very sooty flame.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not breathe gas/ fumes/ vapor/spray. Wear suitable protective clothing. If you feel unwell, seek medical attention and show the label when possible. Keep away from incompatibles such as oxidizing agents.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection: Safety glasses. Lab coat.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Boots. Gloves. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Viscous liquid.)

Odor: Tar-like; naphthalene-like

Taste: Sharp burning.

Molecular Weight: Not available.

Color: Black

pH (1% soln/water): Not applicable.

Boiling Point: 66°C (150.8°F)

Melting Point: Not available.

Critical Temperature: Not available.

Specific Gravity: 1.2 (Water = 1)

Vapor Pressure: <0.1 kPa (@ 20°C)

Vapor Density: >1 (Air = 1)

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether, acetone.

Solubility:
Partially soluble in methanol, diethyl ether, acetone. Insoluble in cold water, hot water. Soluble in benzene, nitrobenzene. Partly dissolves in alcohol, chloroform, carbon disulfide, petroleum ether, sodium hydroxide solution, hexane

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Excess heat, incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Not considered to be corrosive for metals and glass.

Special Remarks on Reactivity:

It reacts violently with strong oxidizers such as liquid chlorine, sodium or potassium hypochlorite, nitric acid and peroxides.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 1 (Proven for human.) by IARC, 1 (Clear evidence; known carcinogen.) by NTP. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. May cause damage to the following organs: skin.

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May affect genetic material (mutagenic). May cause cancer

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: It can cause skin irritation. Existing skin disorders (e.g. eczema) may be aggravated by exposure to this material. Eyes: It can cause eye irritation. Inhalation: Inhalation of mist or vapor can irritate the respiratory tract. Ingestion: Ingestion can cause severe gastrointestinal tract irriation with nausea, vomiting. It may also affect behavior/ central nervous system and cause central nervous system depression. Aspiration can cause lung inflammation and damage. Chronic Potential Health Effects: Skin: Prolonged or repeated exposure to coal tar may cause irritation and dermatitis (including acne), melanosis, or photosensitization dermatitis. Eyes: Repeated or prolonged exposure may cause eye damage. Inhalation: Prolonged or repeated inhalation may contribute to gallbladder disease, pneumonitis, and pulmonary vessel thrombosis.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: Not available.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: No DOT per N50 Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Coal tar California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Coal tar (listed as coke oven emissions New York release reporting list: Coal tar Rhode Island RTK hazardous substances: Coal tar Pennsylvania RTK: Coal tar Massachusetts RTK: Coal tar California Director's List of Hazardous Substances: Coal tar TSCA 8(b) inventory: Coal tar

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): Classification not yet available

DSCL (EEC):
R45- May cause cancer. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). S53- Avoid exposure - obtain special instructions before use.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 1

Reactivity: 0

Personal Protection: a

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Not applicable. Lab coat. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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Last Updated: 05/21/2013 12:00 PM

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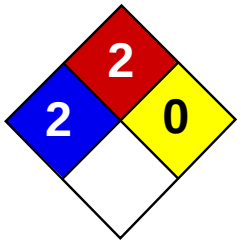

Health	2
Fire	2
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Naphthalene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Naphthalene

Catalog Codes: SLN1789, SLN2401

CAS#: 91-20-3

RTECS: QJ0525000

TSCA: TSCA 8(b) inventory: Naphthalene

CI#: Not available.

Synonym:

Chemical Name: Not available.

Chemical Formula: C10H8

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Naphthalene	91-20-3	100

Toxicological Data on Ingredients: Naphthalene: ORAL (LD50): Acute: 490 mg/kg [Rat]. 533 mg/kg [Mouse]. 1200 mg/kg [Guinea pig]. DERMAL (LD50): Acute: 20001 mg/kg [Rabbit]. VAPOR (LC50): Acute: 170 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of ingestion. Hazardous in case of eye contact (irritant), of inhalation. Slightly hazardous in case of skin contact (irritant, permeator). Severe over-exposure can result in death.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Classified Development toxin [POSSIBLE]. The substance is toxic to blood, kidneys, the nervous system, the reproductive system, liver, mucous membranes, gastrointestinal tract, upper respiratory tract, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure to an highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 567°C (1052.6°F)

Flash Points: CLOSED CUP: 88°C (190.4°F). OPEN CUP: 79°C (174.2°F).

Flammable Limits: LOWER: 0.9% UPPER: 5.9%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Flammable solid. Stop leak if without risk. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe dust. Avoid contact with eyes Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. Keep container dry. Keep in a cool place.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
Israel: TWA: 10 (ppm) TWA: 10 STEL: 15 (ppm) from ACGIH (TLV) [1995] TWA: 52 STEL: 79 (mg/m3) from ACGIH [1995]
Australia: STEL: 15 (ppm) Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Crystalline solid.)

Odor: Aromatic.

Taste: Not available.

Molecular Weight: 128.19 g/mole

Color: White.

pH (1% soln/water): Not available.

Boiling Point: 218°C (424.4°F)

Melting Point: 80.2°C (176.4°F)

Critical Temperature: Not available.

Specific Gravity: 1.162 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: 4.4 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.038 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties:
Partially dispersed in hot water, methanol, n-octanol. Very slightly dispersed in cold water. See solubility in methanol, n-octanol.

Solubility:
Partially soluble in methanol, n-octanol. Very slightly soluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Highly reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: May attack some forms of rubber and plastic

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 490 mg/kg [Rat]. Acute dermal toxicity (LD50): 20001 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 170 ppm 4 hour(s) [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH. DEVELOPMENTAL TOXICITY: Classified Development toxin [POSSIBLE]. The substance is toxic to blood, kidneys, the nervous system, the reproductive system, liver, mucous membranes, gastrointestinal tract, upper respiratory tract, central nervous system (CNS).

Other Toxic Effects on Humans:
Very hazardous in case of ingestion. Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant, permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Ecotoxicity in water (LC50): 305.2 ppm 96 hour(s) [Trout].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 4.1: Flammable solid.

Identification: : Naphthalene, refined : UN1334 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Rhode Island RTK hazardous substances: Naphthalene Pennsylvania RTK: Naphthalene Florida: Naphthalene Minnesota: Naphthalene Massachusetts RTK: Naphthalene TSCA 8(b) inventory: Naphthalene TSCA 8(a) PAIR: Naphthalene TSCA 8(d) H and S data reporting: Naphthalene: 06/01/87 SARA 313 toxic chemical notification and release reporting: Naphthalene: 1% CERCLA: Hazardous substances.: Naphthalene: 100 lbs. (45.36 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-4: Flammable solid. CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R36- Irritating to eyes. R40- Possible risks of irreversible effects. R48/22- Harmful: danger of serious damage to health by prolonged exposure if swallowed. R48/23- Toxic: danger of serious damage to health by prolonged exposure through inhalation. R63- Possible risk of harm to the unborn child.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 2

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 2

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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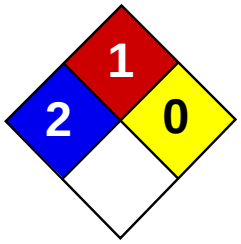

Health	2
Fire	1
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
1,2,4-Trichlorobenzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: 1,2,4-Trichlorobenzene

Catalog Codes: SLT3619

CAS#: 120-82-1

RTECS: DC2100000

TSCA: TSCA 8(b) inventory: 1,2,4-Trichlorobenzene

CI#: Not applicable.

Synonym:

Chemical Name: 1,2,4,-Trichlorobenzene

Chemical Formula: C6H3Cl3

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{1,2,4-}Trichlorobenzene	120-82-1	100

Toxicological Data on Ingredients: 1,2,4-Trichlorobenzene: ORAL (LD50): Acute: 756 mg/kg [Rat.]. 300 mg/kg [Mouse]. DERMAL (LD50): Acute: 6139 mg/kg [Rat.].

Section 3: Hazards Identification

Potential Acute Health Effects:
Extremely hazardous in case of skin contact (irritant, permeator), of eye contact (irritant). Very hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (sensitizer). Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to blood, kidneys, liver, upper respiratory tract. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: 571°C (1059.8°F)

Flash Points: CLOSED CUP: 110°C (230°F).

Flammable Limits: LOWER: 2.5% UPPER: 6.6%

Products of Combustion: These products are carbon oxides (CO, CO2), halogenated compounds.

Fire Hazards in Presence of Various Substances:
Flammable in presence of open flames and sparks, of oxidizing materials. Slightly flammable to flammable in presence of heat, of reducing materials, of combustible materials. Non-flammable in presence of moisture.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Keep container tightly closed.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
If the product is in its solid form: Use a shovel to put the material into a convenient waste disposal container. If the product is in its liquid form: Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as oxidizing agents, reducing agents, organic materials, metals, acids, alkalis.

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Keep container tightly closed. Keep in a cool, well-ventilated place. Combustible materials should be stored away from extreme heat and away from strong oxidizing agents.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 5 (ppm) TWA: 37 (mg/m3) Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Liquid.)

Odor: Pungent. (Slight.)

Taste: Toxic by ingestion.

Molecular Weight: 181.46 g/mole

Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 213°C (415.4°F)

Melting Point: 17°C (62.6°F)

Critical Temperature: Not available.

Specific Gravity: 1.45 (Water = 1)

Vapor Pressure: Not available.

Vapor Density: 6.26 (Air = 1)

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether, n-octanol.

Solubility:
Easily soluble in diethyl ether. Soluble in methanol, n-octanol. Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances:
Highly reactive with oxidizing agents. Reactive with reducing agents, organic materials, metals, acids, alkalis.

Corrosivity:
Slightly corrosive to corrosive in presence of steel, of copper. Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
Acute oral toxicity (LD50): 300 mg/kg [Mouse]. Acute dermal toxicity (LD50): 6139 mg/kg [Rat.].

Chronic Effects on Humans: The substance is toxic to blood, kidneys, liver, upper respiratory tract.

Other Toxic Effects on Humans:
Extremely hazardous in case of skin contact (irritant, permeator). Very hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (sensitizer).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Can cause gastrointestinal disturbances.

Special Remarks on other Toxic Effects on Humans: Exposure can cause nausea, headache and vomiting.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Trichlorobenzene : UN2321 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: 1,2,4-Trichlorobenzene Florida: 1,2,4-Trichlorobenzene Minnesota: 1,2,4-Trichlorobenzene Massachusetts RTK: 1,2,4-Trichlorobenzene New Jersey: 1,2,4-Trichlorobenzene TSCA 8(b) inventory: 1,2,4-Trichlorobenzene SARA 313 toxic chemical notification and release reporting: 1,2,4-Trichlorobenzene CERCLA: Hazardous substances.: 1,2,4-Trichlorobenzene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R38- Irritating to skin. R41- Risk of serious damage to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References:
-Material safety data sheet emitted by: la Commission de la SantÃ© et de la SÃ©curitÃ© du Travail du QuÃ©bec. -Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II.

Other Special Considerations: Not available.

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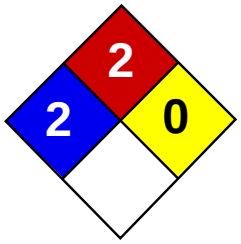

Health	2
Fire	2
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
1,4-Dichlorobenzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: 1,4-Dichlorobenzene

Catalog Codes: SLD4093

CAS#: 106-46-7

RTECS: CZ4550000

TSCA: TSCA 8(b) inventory: 1,4-Dichlorobenzene

CI#: Not available.

Synonym:

Chemical Formula: C6H4Cl2

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{1,4-}Dichlorobenzene	106-46-7	100

Toxicological Data on Ingredients: 1,4-Dichlorobenzene: ORAL (LD50): Acute: 500 mg/kg [Rat]. DERMAL (LD50): Acute: 6000 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion, of inhalation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Very hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion, of inhalation. CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2 (Reasonably anticipated.) by NTP. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to kidneys, lungs, liver, mucous membranes. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged inhalation of dust may lead to chronic respiratory irritation.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: 413°C (775.4°F)

Flash Points: CLOSED CUP: 65.56°C (150°F). (TAG)

Flammable Limits: LOWER: 2.5% UPPER: 16%

Products of Combustion: These products are carbon oxides (CO, CO2), halogenated compounds.

Fire Hazards in Presence of Various Substances: Slightly flammable to flammable in presence of oxidizing materials.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Slightly explosive to explosive in presence of oxidizing materials.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Carcinogenic, teratogenic or mutagenic materials should be stored in a separate locked safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 75 CEIL: 110 (ppm) TWA: 450 CEIL: 675 (mg/m3) Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 147 g/mole

Color: Not available.

pH (1% soln/water): Not available.

Boiling Point: 174.12°C (345.4°F)

Melting Point: 53.75°C (128.8°F)

Critical Temperature: Not available.

Specific Gravity: 1.46 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: 5.08 (Air = 1)

Volatility: Not available.

Odor Threshold: 15 ppm

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether, acetone.

Solubility:
Soluble in methanol, diethyl ether, acetone. Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
Acute oral toxicity (LD50): 500 mg/kg [Rat]. Acute dermal toxicity (LD50): 6000 mg/kg [Rabbit].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2 (Reasonably anticipated.) by NTP. The substance is toxic to kidneys, lungs, liver, mucous membranes.

Other Toxic Effects on Humans: Very hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 9: Miscellaneous hazardous material.

Identification: : Environmentally hazardous substance, solid, n.o.s. (p-Dichlorobenzene) : UN3077 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: 1,4-Dichlorobenzene California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: 1,4-Dichlorobenzene Pennsylvania RTK: 1,4-Dichlorobenzene Massachusetts RTK: 1,4-Dichlorobenzene TSCA 8(b) inventory: 1,4-Dichlorobenzene SARA 313 toxic chemical notification and release reporting: 1,4-Dichlorobenzene CERCLA: Hazardous substances.: 1,4-Dichlorobenzene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R38- Irritating to skin. R41- Risk of serious damage to eyes. R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 2

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 2

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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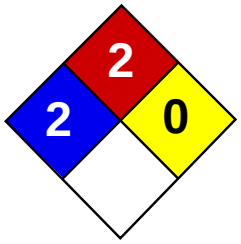

Health	2
Fire	2
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
1,2-Dichlorobenzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: 1,2-Dichlorobenzene

Catalog Codes: SLD2728

CAS#: 95-50-1

RTECS: CZ4500000

TSCA: TSCA 8(b) inventory: 1,2-Dichlorobenzene

CI#: Not available.

Synonym:

Chemical Name: Not available.

Chemical Formula: C6H4Cl2

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{1,2-}Dichlorobenzene	95-50-1	100

Toxicological Data on Ingredients: 1,2-Dichlorobenzene: ORAL (LD50): Acute: 500 mg/kg [Rat]. 500 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion. Hazardous in case of skin contact (permeator), of inhalation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion. Hazardous in case of skin contact (permeator), of inhalation. CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to kidneys, liver, mucous membranes. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged inhalation of vapors may lead to chronic respiratory irritation.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Combustible.

Auto-Ignition Temperature: 648°C (1198.4°F)

Flash Points: CLOSED CUP: 66°C (150.8°F). OPEN CUP: 68°C (154.4°F).

Flammable Limits: LOWER: 2.2% UPPER: 9.2%

Products of Combustion: These products are carbon oxides (CO, CO2), halogenated compounds.

Fire Hazards in Presence of Various Substances: Slightly flammable to flammable in presence of oxidizing materials.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Slightly explosive to explosive in presence of oxidizing materials.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Combustible material. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. Keep container dry. Keep in a cool place.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 50 (ppm) TWA: 300 (mg/m3)Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Pleasant.

Taste: Not available.

Molecular Weight: 147 g/mole

Color: Colorless to light yellow.

pH (1% soln/water): Not available.

Boiling Point: 180°C (356°F)

Melting Point: -17.6°C (0.3°F)

Critical Temperature: Not available.

Specific Gravity: 1.3059 (Water = 1)

Vapor Pressure: 1.2 mm of Hg (@ 20°C)

Vapor Density: 5.07 (Air = 1)

Volatility: Not available.

Odor Threshold: 2 ppm

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 500 mg/kg [Rabbit].

Chronic Effects on Humans: The substance is toxic to kidneys, liver, mucous membranes.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant), of ingestion. Hazardous in case of skin contact (permeator), of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : o-Dichlorobenzene : UN1591 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: 1,2-Dichlorobenzene Massachusetts RTK: 1,2-Dichlorobenzene TSCA 8(b) inventory: 1,2-Dichlorobenzene SARA 313 toxic chemical notification and release reporting: 1,2-Dichlorobenzene CERCLA: Hazardous substances.: 1,2-Dichlorobenzene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS B-3: Combustible liquid with a flash point between 37.8°C (100°F) and 93.3°C (200°F). CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R38- Irritating to skin. R41- Risk of serious damage to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 2

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 2

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/09/2005 05:07 PM

Last Updated: 05/21/2013 12:00 PM

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Material Safety Data Sheet

Version 4.2
Revision Date 11/22/2012
Print Date 07/16/2013

1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	1,3-Dichlorobenzene
Product Number	:	113808
Brand	:	Aldrich
Supplier	:	Sigma-Aldrich 3050 Spruce Street SAINT LOUIS MO 63103 USA
Telephone	:	+1 800-325-5832
Fax	:	+1 800-325-5052
Emergency Phone # (For both supplier and manufacturer)	:	(314) 776-6555
Preparation Information	:	Sigma-Aldrich Corporation Product Safety - Americas Region 1-800-521-8956

2. HAZARDS IDENTIFICATION

Emergency Overview

OSHA Hazards
Combustible Liquid, Harmful by ingestion.

GHS Classification
Flammable liquids (Category 4)
Acute toxicity, Oral (Category 4)
Acute aquatic toxicity (Category 2)
Chronic aquatic toxicity (Category 2)

GHS Label elements, including precautionary statements

Pictogram

Signal word Warning

Hazard statement(s)

H227	Combustible liquid
H302	Harmful if swallowed.
H411	Toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P273	Avoid release to the environment.

HMIS Classification

Health hazard:	0
Flammability:	2
Physical hazards:	0

NFPA Rating

Health hazard:	0
Fire:	2
Reactivity Hazard:	0

Potential Health Effects

Inhalation	May be harmful if inhaled. May cause respiratory tract irritation.
Skin	May be harmful if absorbed through skin. May cause skin irritation.
Eyes	May cause eye irritation.
Ingestion	May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Formula : $C_6H_4Cl_2$

Molecular Weight : 147.00 g/mol

Component		Concentration
1,3-Dichlorobenzene		
CAS-No.	541-73-1	-
EC-No.	208-792-1	
Index-No.	602-067-00-7	

4. FIRST AID MEASURES

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIREFIGHTING MEASURES

Conditions of flammability
Flammable in the presence of a source of ignition when the temperature is above the flash point. Keep away from heat/sparks/open flame/hot surface. No smoking.

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Special protective equipment for firefighters
Wear self contained breathing apparatus for fire fighting if necessary.

Hazardous combustion products
Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas

Further information
Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions
Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

Methods and materials for containment and cleaning up
Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13). Keep in suitable, closed containers for disposal.

7. HANDLING AND STORAGE

Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

Conditions for safe storage

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Contains no substances with occupational exposure limit values.

Personal protective equipment

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Fluorinated rubber
Minimum layer thickness: 0.7 mm
Break through time: > 480 min
Material tested:Vitoject® (Aldrich Z677698, Size M)

Splash protection
Material: Nitrile rubber
Minimum layer thickness: 0.4 mm
Break through time: > 30 min
Material tested:Camatril® (Aldrich Z677442, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an Industrial Hygienist familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Eye protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin and body protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form	liquid, clear
Colour	colourless

Safety data

pH	no data available
Melting point/freezing point	Melting point/range: -25 - -22 °C (-13 - -8 °F) - lit.
Boiling point	172 - 173 °C (342 - 343 °F) - lit.
Flash point	67.0 °C (152.6 °F) - closed cup
Ignition temperature	no data available
Autoignition temperature	no data available
Lower explosion limit	no data available
Upper explosion limit	no data available
Vapour pressure	no data available
Density	1.288 g/cm3 at 25 °C (77 °F)
Water solubility	no data available
Partition coefficient: n-octanol/water	no data available
Relative vapour density	no data available
Odour	no data available
Odour Threshold	no data available
Evaporation rate	no data available

10. STABILITY AND REACTIVITY

Chemical stability
Stable under recommended storage conditions.

Possibility of hazardous reactions
no data available

Conditions to avoid
Heat, flames and sparks.

Materials to avoid
Strong oxidizing agents

Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas
Other decomposition products - no data available

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Oral LD50
no data available

Inhalation LC50
no data available

Dermal LD50
no data available

Other information on acute toxicity
LD50 Intraperitoneal - mouse - 1,062 mg/kg

Skin corrosion/irritation
no data available

Serious eye damage/eye irritation
no data available

Respiratory or skin sensitization
no data available

Germ cell mutagenicity
no data available

Carcinogenicity

IARC:	3 - Group 3: Not classifiable as to its carcinogenicity to humans (1,3-Dichlorobenzene)
ACGIH:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.
NTP:	No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity

no data available

Teratogenicity

no data available

Specific target organ toxicity - single exposure (Globally Harmonized System)
no data available

Specific target organ toxicity - repeated exposure (Globally Harmonized System)
no data available

Aspiration hazard
no data available

Potential health effects

Inhalation	May be harmful if inhaled. May cause respiratory tract irritation.
Ingestion	May be harmful if swallowed.
Skin	May be harmful if absorbed through skin. May cause skin irritation.
Eyes	May cause eye irritation.

Signs and Symptoms of Exposure
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Synergistic effects
no data available

Additional Information
RTECS: CZ4499000

12. ECOLOGICAL INFORMATION

Toxicity

Toxicity to fish	LC50 - Pimephales promelas (fathead minnow) - 7.8 mg/l - 96.0 h
Toxicity to daphnia and other aquatic invertebrates	LC50 - Daphnia magna (Water flea) - 1.7 mg/l - 48 h

Persistence and degradability
no data available

Bioaccumulative potential

Bioaccumulation	Pimephales promelas (fathead minnow) - 32 d Bioconcentration factor (BCF): 97

Mobility in soil
no data available

PBT and vPvB assessment
no data available

Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Toxic to aquatic life with long lasting effects.

13. DISPOSAL CONSIDERATIONS

Product
This combustible material may be burned in a chemical incinerator equipped with an afterburner and scrubber. Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 3082 Class: 9 Packing group: III
Proper shipping name: Environmentally hazardous substances, liquid, n.o.s. (1,3-Dichlorobenzene)
Reportable Quantity (RQ): 100 lbs
Marine pollutant: No
Poison Inhalation Hazard: No

IMDG
UN number: 3082 Class: 9 Packing group: III EMS-No: F-A, S-F
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (1,3-Dichlorobenzene)
Marine pollutant: Marine pollutant

IATA
UN number: 3082 Class: 9 Packing group: III
Proper shipping name: Environmentally hazardous substance, liquid, n.o.s. (1,3-Dichlorobenzene)

15. REGULATORY INFORMATION

OSHA Hazards
Combustible Liquid, Harmful by ingestion.

SARA 302 Components
SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
1,3-Dichlorobenzene	541-73-1	2007-07-01

SARA 311/312 Hazards
Fire Hazard, Acute Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
1,3-Dichlorobenzene	541-73-1	2007-07-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
1,3-Dichlorobenzene	541-73-1	2007-07-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
1,3-Dichlorobenzene	541-73-1	2007-07-01

California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. OTHER INFORMATION

Further information

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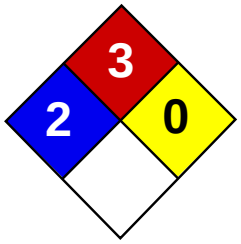
The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.



Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Chlorobenzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Chlorobenzene

Catalog Codes: SLC1654

CAS#: 108-90-7

RTECS: CZ0175000

TSCA: TSCA 8(b) inventory: Chlorobenzene

CI#: Not available.

Synonym: Monochlorobenzene

Chemical Name: Not available.

Chemical Formula: C6H5Cl

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Chlorobenzene	108-90-7	100

Toxicological Data on Ingredients: Chlorobenzene: ORAL (LD50): Acute: 1110 mg/kg [Rat]. 2300 mg/kg [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (corrosive, sensitizer, permeator). Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (corrosive, sensitizer, permeator). CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to kidneys, lungs, the nervous system, liver, mucous membranes. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged inhalation of vapors may lead to chronic respiratory irritation.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
If the chemical got onto the clothed portion of the body, remove the contaminated clothes as quickly as possible, protecting your own hands and body. Place the victim under a deluge shower. If the chemical got on the victim's exposed skin, such as the hands : Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 638°C (1180.4°F)

Flash Points: CLOSED CUP: 29.44°C (85°F).

Flammable Limits: LOWER: 1.3% UPPER: 7.1%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Flammable in presence of open flames and sparks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep container dry. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. Never add water to this product In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. A refrigerated room would be preferable for materials with a flash point lower than 37.8°C (100°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 10 (ppm) TWA: 46 (mg/m3) Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Almond-like.

Taste: Not available.

Molecular Weight: 112.56 g/mole

Color: Colorless.

pH (1% soln/water): Not available.

Boiling Point: 132°C (269.6°F)

Melting Point: -45.6°C (-50.1°F)

Critical Temperature: Not available.

Specific Gravity: 1.1058 (Water = 1)

Vapor Pressure: 8.8 mm of Hg (@ 20°C)

Vapor Density: 3.88 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.2 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether.

Solubility:
Soluble in methanol, diethyl ether. Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Not available.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 1110 mg/kg [Rat].

Chronic Effects on Humans: The substance is toxic to kidneys, lungs, the nervous system, liver, mucous membranes.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (corrosive, sensitizer, permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : Chlorobenzene : UN1134 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: Chlorobenzene Massachusetts RTK: Chlorobenzene TSCA 8(b) inventory: Chlorobenzene SARA 313 toxic chemical notification and release reporting: Chlorobenzene CERCLA: Hazardous substances.: Chlorobenzene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R10- Flammable. R22- Harmful if swallowed. R38- Irritating to skin. R41- Risk of serious damage to eyes. R43- May cause sensitization by skin contact.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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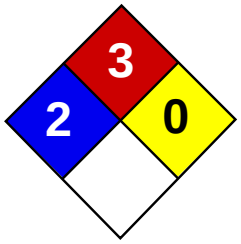

Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Benzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Benzene

Catalog Codes: SLB1564, SLB3055, SLB2881

CAS#: 71-43-2

RTECS: CY1400000

TSCA: TSCA 8(b) inventory: Benzene

CI#: Not available.

Synonym: Benzol; Benzine

Chemical Name: Benzene

Chemical Formula: C6-H6

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Benzene	71-43-2	100

Toxicological Data on Ingredients: Benzene: ORAL (LD50): Acute: 930 mg/kg [Rat]. 4700 mg/kg [Mouse]. DERMAL (LD50): Acute: >9400 mg/kg [Rabbit]. VAPOR (LC50): Acute: 10000 ppm 7 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of eye contact (irritant), of inhalation. Hazardous in case of skin contact (irritant, permeator), of ingestion. Inflammation of the eye is characterized by redness, watering, and itching.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC. MUTAGENIC EFFECTS: Classified POSSIBLE for human. Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female [POSSIBLE]. The substance is toxic to blood, bone marrow, central nervous system (CNS). The substance may be toxic to liver, Urinary System. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 497.78°C (928°F)

Flash Points: CLOSED CUP: -11.1°C (12°F). (Setaflash)

Flammable Limits: LOWER: 1.2% UPPER: 7.8%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat. Slightly flammable to flammable in presence of oxidizing materials. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Explosive in presence of oxidizing materials, of acids.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:
Extremely flammable liquid and vapor. Vapor may cause flash fire. Reacts on contact with iodine heptafluoride gas. Dioxygenyl tetrafluoroborate is as very powferful oxidant. The addition of a small particle to small samples of benzene, at ambient temperature, causes ignition. Contact with sodium peroxide with benzene causes ignition. Benzene ignites in contact with powdered chromic anhydride. Virgorous or incandescent reaction with hydrogen + Raney nickel (above 210 C) and bromine trifluoride.

Special Remarks on Explosion Hazards:
Benzene vapors + chlorine and light causes explosion. Reacts explosively with bromine pentafluoride, chlorine, chlorine trifluoride, diborane, nitric acid, nitryl perchlorate, liquid oxygen, ozone, silver perchlorate. Benzene + pentafluoride and methoxide (from arsenic pentafluoride and potassium methoxide) in trichlorotrifluoroethane causes explosion. Interaction

of nitryl perchlorate with benzene gave a slight explosion and flash. The solution of permanganic acid (or its explosive anhydride, dimaganese heptoxide) produced by interaction of permanganates and sulfuric acid will explode on contact with benzene. Peroxodisulfuric acid is a very powferful oxidant. Uncontrolled contact with benzene may cause explosion. Mixtures of peroxomonsulfuric acid with benzene explodes.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.5 STEL: 2.5 (ppm) from ACGIH (TLV) [United States] TWA: 1.6 STEL: 8 (mg/m3) from ACGIH (TLV) [United States] TWA: 0.1 STEL: 1 from NIOSH TWA: 1 STEL: 5 (ppm) from OSHA (PEL) [United States] TWA: 10 (ppm) from OSHA (PEL) [United States] TWA: 3 (ppm) [United Kingdom (UK)] TWA: 1.6 (mg/m3) [United Kingdom (UK)] TWA: 1 (ppm) [Canada] TWA: 3.2 (mg/m3) [Canada] TWA: 0.5 (ppm) [Canada]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor:
Aromatic. Gasoline-like, rather pleasant. (Strong.)

Taste: Not available.

Molecular Weight: 78.11 g/mole

Color: Clear Colorless. Colorless to light yellow.

pH (1% soln/water): Not available.

Boiling Point: 80.1 (176.2°F)

Melting Point: 5.5°C (41.9°F)

Critical Temperature: 288.9°C (552°F)

Specific Gravity: 0.8787 @ 15 C (Water = 1)

Vapor Pressure: 10 kPa (@ 20°C)

Vapor Density: 2.8 (Air = 1)

Volatility: Not available.

Odor Threshold: 4.68 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 2.1

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:
Miscible in alcohol, chloroform, carbon disulfide oils, carbon tetrachloride, glacial acetic acid, diethyl ether, acetone. Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, incompatibles.

Incompatibility with various substances: Highly reactive with oxidizing agents, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Benzene vapors + chlorine and light causes explosion. Reacts explosively with bromine pentafluoride, chlorine, chlorine trifluoride, diborane, nitric acid, nitryl perchlorate, liquid oxygen, ozone, silver perchlorate. Benzene + pentafluoride and methoxide (from arsenic pentafluoride and potassium methoxide) in trichlorotrifluoroethane causes explosion. Interaction of nitryl perchlorate with benzene gave a slight explosion and flash. The solution of permanganic acid (or its explosive anhydride, dimaganese heptoxide) produced by interaction of permanganates and sulfuric acid will explode on contact with benzene. Peroxodisulfuric acid is a very powferful oxidant. Uncontrolled contact with benzene may cause explosion. Mixtures of peroxomonsulfuric acid with benzene explodes.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 930 mg/kg [Rat]. Acute dermal toxicity (LD50): >9400 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 10000 7 hours [Rat].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC. MUTAGENIC EFFECTS: Classified POSSIBLE for human. Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female [POSSIBLE]. Causes damage to the following organs: blood, bone marrow, central nervous system (CNS). May cause damage to the following organs: liver, Urinary System.

Other Toxic Effects on Humans:
Very hazardous in case of inhalation. Hazardous in case of skin contact (irritant, permeator), of ingestion.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (female fertility, Embryotoxic and/or foetotoxic in animal) and birth defects. May affect genetic material (mutagenic). May cause cancer (tumorigenic, leukemia)) Human: passes the placental barrier, detected in maternal milk.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation. It can be absorbed through intact skin and affect the liver, blood, metabolism,and urinary system. Eyes: Causes eye irritation. Inhalation: Causes respiratory tract and mucous membrane irritation. Can be absorbed through the lungs. May affect behavior/Central and Peripheral nervous systems (somnolence, muscle weakness, general anesthetic, and other symptoms similar to ingestion), gastrointestinal tract (nausea), blood metabolism, urinary system. Ingestion: May be harmful if swallowed. May cause gastrointestinal tract irritation including vomiting. May affect behavior/Central and Peripheral nervous systems (convulsions, seizures, tremor, irritability, initial CNS stimulation followed by depression, loss of coordination, dizziness, headache, weakness, pallor, flushing), respiration (breathlessness and chest constriction), cardiovascular system, (shallow/rapid pulse), and blood.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Benzene UNNA: 1114 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Benzene California prop. 65 (no significant risk level): Benzene: 0.007 mg/day (value) California prop. 65: This product contains the following ingredients

for which the State of California has found to cause cancer which would require a warning under the statute: Benzene Connecticut carcinogen reporting list.: Benzene Connecticut hazardous material survey.: Benzene Illinois toxic substances disclosure to employee act: Benzene Illinois chemical safety act: Benzene New York release reporting list: Benzene Rhode Island RTK hazardous substances: Benzene Pennsylvania RTK: Benzene Minnesota: Benzene Michigan critical material: Benzene Massachusetts RTK: Benzene Massachusetts spill list: Benzene New Jersey: Benzene New Jersey spill list: Benzene Louisiana spill reporting: Benzene California Director's list of Hazardous Substances: Benzene TSCA 8(b) inventory: Benzene SARA 313 toxic chemical notification and release reporting: Benzene CERCLA: Hazardous substances.: Benzene: 10 lbs. (4.536 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R11- Highly flammable. R22- Harmful if swallowed. R38- Irritating to skin. R41- Risk of serious damage to eyes. R45- May cause cancer. R62- Possible risk of impaired fertility. S2- Keep out of the reach of children. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S39- Wear eye/face protection. S46- If swallowed, seek medical advice immediately and show this container or label. S53- Avoid exposure - obtain special instructions before use.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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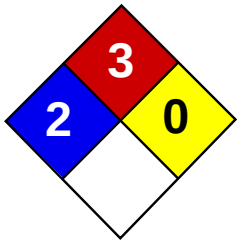

Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Ethylbenzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Ethylbenzene

Catalog Codes: SLE2044

CAS#: 100-41-4

RTECS: DA0700000

TSCA: TSCA 8(b) inventory: Ethylbenzene

CI#: Not available.

Synonym: Ethyl Benzene; Ethylbenzol; Phenylethane

Chemical Name: Ethylbenzene

Chemical Formula: C8H10

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Ethylbenzene	100-41-4	100

Toxicological Data on Ingredients: Ethylbenzene: ORAL (LD50): Acute: 3500 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, permeator).

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (irritant, sensitizer). CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 432°C (809.6°F)

Flash Points:
CLOSED CUP: 15°C (59°F). (Tagliabue.) OPEN CUP: 26.667°C (80°F) (Cleveland) (CHRIS, 2001) CLOSED CUP: 12.8 C (55 F) (Bingham et al, 2001; NIOSH, 2001) CLOSED CUP: 21 C (70 F) (NFPA)

Flammable Limits: LOWER: 0.8% - 1.6%UPPER: 6.7% - 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Slightly explosive in presence of heat.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:
Vapor may travel considerable distance to source of ignition and flash back. Vapors may form explosive mixtures with air. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards: Vapors may form explosive mixtures in air.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with eyes. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Sensitive to light. Store in light-resistant containers.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 STEL: 125 (ppm) from OSHA (PEL) [United States] TWA: 435 STEL: 545 from OSHA (PEL) [United States] TWA: 435 STEL: 545 (mg/m3) from NIOSH [United States] TWA: 100 STEL: 125 (ppm) from NIOSH [United States] TWA: 100 STEL: 125 (ppm) from ACGIH (TLV) [United States] TWA: 100 STEL: 125 (ppm) [United Kingdom (UK)] TWA: 100 STEL: 125 (ppm) [Belgium] TWA: 100 STEL: 125 (ppm) [Finland] TWA: 50 (ppm) [Norway] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweetish. Gasoline-like. Aromatic.

Taste: Not available.

Molecular Weight: 106.16 g/mole

Color: Colorless.

pH (1% soln/water): Not available.

Boiling Point: 136°C (276.8°F)

Melting Point: -94.9 (-138.8°F)

Critical Temperature: 617.15°C (1142.9°F)

Specific Gravity: 0.867 (Water = 1)

Vapor Pressure: 0.9 kPa (@ 20°C)

Vapor Density: 3.66 (Air = 1)

Volatility: 100% (v/v).

Odor Threshold: 140 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.1

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility:
Easily soluble in diethyl ether. Very slightly soluble in cold water or practically insoluble in water. Soluble in all proportions in Ethyl alcohol. Soluble in Carbon tetrachloride, Benzene. Insoluble in Ammonia. Slightly soluble in Chloroform. Solubility in Water: 169 mg/l @ 25 deg. C.; 0.014 g/100 ml @ 15 deg. C.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ingnition sources (flames, sparks, static), incompatible materials, light

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Not considered to be corrosive for metals and glass.

Special Remarks on Reactivity:
Can react vigorously with oxidizing materials. Sensitive to light.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Inhalation.

Toxicity to Animals: Acute oral toxicity (LD50): 3500 mg/kg [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. May cause damage to the following organs: central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, permeator).

Special Remarks on Toxicity to Animals:
Lethal Dose/Conc 50% Kill: LD50 [Rabbit] - Route: Skin; Dose: 17800 ul/kg Lowest Published Lethal Dose/Conc: LDL[Rat] - Route: Inhalation (vapor); Dose: 4000 ppm/4 H

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects and birth defects (teratogenic) based on animal test data. May cause cancer based on animals data. IARC evidence for carcinogenicity in animals is sufficient. IARC evidence of carcinogenicity in humans inadequate. May affect genetic material (mutagenic).

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Can cause mild skin irritation. It can be absorbed through intact skin. Eyes: Contact with vapor or liquid can cause severe eye irritation depending on concentration. It may also cause conjunctivitis. At a vapor exposure level of 85 - 200 ppm , it is mildly and transiently irritating to the eyes; 1000 ppm causes further irritation and tearing; 2000 ppm results in immediate and severe irritation and tearing; 5,000 ppm is intolerable (ACGIH, 1991; Clayton and Clayton, 1994). Standard draize test for eye irritation using 500 mg resulted in severe irritation (RTECS) Inhalation: Exposure to high concentrations can cause nasal, mucous membrane and respiratory tract irritation and can also result in chest constriction and, trouble breathing, respiratory failure, and even death. It can also affect behavior/Central Nervous System. The effective dose for CNS depression in experimental animals was 10,000 ppm (ACGIH, 1991). Symptoms of CNS depression include

headache, nausea, weakness, dizziness, vertigo, irritability, fatigue, lightheadedness, sleepiness, tremor, loss of coordination, judgement and conciousness, coma, and death. It can also cause pulmonary edema. Inhalation of 85 ppm can produce fatigue, insomnia, headache, and mild irritation of the respiratory tract (Haley & Berndt, 1987). Ingestion: Do not drink, pipet or siphon by mouth. May cause gastroinestinal/digestive tract irritation with Abdominal pain, nausea, vomiting. Ethylbenzene is a pulmonary aspiration hazard. Pulmonary aspiration of even small amounts of the liquid may cause fatal pneumonitis. It may also affect behavior/central nervous system with

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 14 mg/l 96 hours [Fish (Trout)] (static). 12.1 mg/l 96 hours [Fish (Fathead Minnow)] (flow-through)]. 150 mg/l 96 hours [Fish (Blue Gill/Sunfish)] (static). 275 mg/l 96 hours [Fish (Sheepshead Minnow)]. 42.3 mg/l 96 hours [Fish (Fathead Minnow)](soft water). 87.6mg/l 96 hours [Shrimp].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Ethylbenzene UNNA: 1175 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Ethylbenzene Illinois toxic substances disclosure to employee act: Ethylbenzene Illinois chemical safety act: Ethylbenzene New York release reporting list: Ethylbenzene Rhode Island RTK hazardous substances: Ethylbenzene Pennsylvania RTK: Ethylbenzene Minnesota: Ethylbenzene Massachusetts RTK: Ethylbenzene Massachusetts spill list: Ethylbenzene New Jersey: Ethylbenzene New Jersey spill list: Ethylbenzene Louisiana spill reporting: Ethylbenzene California Director's List of Hazardous Substances: Ethylbenzene TSCA 8(b) inventory: Ethylbenzene TSCA 4(a) proposed test rules: Ethylbenzene TSCA 8(d) H and S data reporting: Ethylbenzene: Effective Date: 6/19/87; Sunset Date: 6/19/97 SARA 313 toxic chemical notification and release reporting: Ethylbenzene

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASSE D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R11- Highly flammable. R20- Harmful by inhalation. S16- Keep away from sources of ignition - No smoking. S24/25- Avoid contact with skin and eyes. S29- Do not empty into drains.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References:
-Manufacturer's Material Safety Data Sheet. -Fire Protection Guide to Hazardous Materials, 13th ed., Nationial Fire Protection Association (NFPA) -Registry of Toxic Effects of Chemical Substances (RTECS) -Chemical Hazard Response Information System (CHRIS) -Hazardous Substance Data Bank (HSDB) -New Jersey Hazardous Substance Fact Sheet -Ariel Global View -Reprotext System

Other Special Considerations: Not available.

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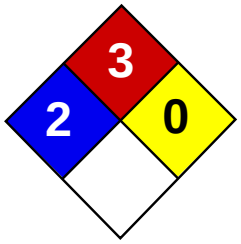

Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Toluene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Toluene

Catalog Codes: SLT2857, SLT3277

CAS#: 108-88-3

RTECS: XS5250000

TSCA: TSCA 8(b) inventory: Toluene

CI#: Not available.

Synonym: Toluol, Tolu-Sol; Methylbenzene; Methacide; Phenylmethane; Methylbenzol

Chemical Name: Toluene

Chemical Formula: C6-H5-CH3 or C7-H8

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Toluene	108-88-3	100

Toxicological Data on Ingredients: Toluene: ORAL (LD50): Acute: 636 mg/kg [Rat]. DERMAL (LD50): Acute: 14100 mg/kg [Rabbit]. VAPOR (LC50): Acute: 49000 mg/m 4 hours [Rat]. 440 ppm 24 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, the nervous system, liver, brain, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 480°C (896°F)

Flash Points: CLOSED CUP: 4.4444°C (40°F). (Setaflash) OPEN CUP: 16°C (60.8°F).

Flammable Limits: LOWER: 1.1% UPPER: 7.1%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards:
Toluene forms explosive reaction with 1,3-dichloro-5,5-dimethyl-2,4-imidazolididione; dinitrogen tetraoxide; concentrated nitric acid, sulfuric acid + nitric acid; N2O4; AgClO4; BrF3; Uranium hexafluoride; sulfur dichloride. Also forms an explosive mixture with tetranitromethane.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Toxic flammable liquid, insoluble or very slightly soluble in water. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 200 STEL: 500 CEIL: 300 (ppm) from OSHA (PEL) [United States] TWA: 50 (ppm) from ACGIH (TLV) [United States] SKIN TWA: 100 STEL: 150 from NIOSH [United States] TWA: 375 STEL: 560 (mg/m3) from NIOSH [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweet, pungent, Benzene-like.

Taste: Not available.

Molecular Weight: 92.14 g/mole

Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 110.6°C (231.1°F)

Melting Point: -95°C (-139°F)

Critical Temperature: 318.6°C (605.5°F)

Specific Gravity: 0.8636 (Water = 1)

Vapor Pressure: 3.8 kPa (@ 25°C)

Vapor Density: 3.1 (Air = 1)

Volatility: Not available.

Odor Threshold: 1.6 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 2.7

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:
Soluble in diethyl ether, acetone. Practically insoluble in cold water. Soluble in ethanol, benzene, chloroform, glacial acetic acid, carbon disulfide. Solubility in water: 0.561 g/l @ 25 deg. C.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources (flames, sparks, static), incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with strong oxidizers, silver perchlorate, sodium difluoride, Tetranitromethane, Uranium Hexafluoride. Frozen Bromine Trifluoride reacts violently with Toluene at -80 deg. C. Reacts chemically with nitrogen oxides, or halogens to form nitrotoluene, nitrobenzene, and nitrophenol and halogenated products, respectively.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 636 mg/kg [Rat]. Acute dermal toxicity (LD50): 14100 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 440 24 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. May cause damage to the following organs: blood, kidneys, the nervous system, liver, brain, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose: LDL [Human] - Route: Oral; Dose: 50 mg/kg LCL [Rabbit] - Route: Inhalation; Dose: 55000 ppm/40min

Special Remarks on Chronic Effects on Humans:
Detected in maternal milk in human. Passes through the placental barrier in human. Embryotoxic and/or foetotoxic in animal. May cause adverse reproductive effects and birth defects (teratogenic). May affect genetic material (mutagenic)

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: Causes mild to moderate skin irritation. It can be absorbed to some extent through the skin. Eyes: Cauess mild to moderate eye irritation with a burning sensation. Splash contact with eyes also causes conjunctivitis, blepharospasm, corneal edema, corneal abraisons. This usually resolves in 2 days. Inhalation: Inhalation of vapor may cause respiratory tract irritation causing coughing and wheezing, and nasal discharge. Inhalation of high concentrations may affect behavior and cause central nervous system effects characterized by nausea, headache, dizziness, tremors, restlessness, lightheadedness, exhilaration, memory loss, insomnia, impaired reaction time, drowsiness, ataxia, hallucinations, somnolence, muscle contraction or spasticity, unconsciousness and coma. Inhalation of high concentration of vapor may also affect the cardiovascular system (rapid heart beat, heart palpitations, increased or decreased blood pressure, dysrhythmia,), respiration (acute pulmonary edema, respiratory depression, apnea, asphyxia), cause vision disturbances and dilated pupils, and cause loss of appetite. Ingestion: Aspiration hazard. Aspiration of Toluene into the lungs may cause chemical pneumonitis. May cause irritation of the digestive tract with nausea, vomiting, pain. May have effects similar to that of acute inhalation. Chronic Potential Health Effects: Inhalation and Ingestion: Prolonged or repeated exposure via inhalation may cause central nervous system and cardiovascular symptoms similar to that of acute inhalation and ingestion as well liver damage/failure, kidney damage/failure (with hematuria, proteinuria, oliguria, renal tubular acidosis), brain damage, weight loss, blood (pigmented or nucleated red blood cells, changes in white blood cell count), bone marrow changes, electrolyte imbalances (Hypokalemia, Hypophostatemia), severe, muscle weakness and Rhabdomyolysis. Skin: Repeated or prolonged skin contact may cause defatting dermatitis.

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 313 mg/l 48 hours [Daphnia (daphnia)]. 17 mg/l 24 hours [Fish (Blue Gill)]. 13 mg/l 96 hours [Fish (Blue Gill)]. 56 mg/l 24 hours [Fish (Fathead minnow)]. 34 mg/l 96 hours [Fish (Fathead minnow)]. 56.8 ppm any hours [Fish (Goldfish)].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Toluene UNNA: 1294 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Toluene California prop. 65 (no significant risk level): Toluene: 7 mg/day (value) California prop. 65 (acceptable daily intake level): Toluene: 7 mg/day (value) California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Toluene Connecticut hazardous material survey.: Toluene Illinois

toxic substances disclosure to employee act: Toluene Illinois chemical safety act: Toluene New York release reporting list: Toluene Rhode Island RTK hazardous substances: Toluene Pennsylvania RTK: Toluene Florida: Toluene Minnesota: Toluene Michigan critical material: Toluene Massachusetts RTK: Toluene Massachusetts spill list: Toluene New Jersey: Toluene New Jersey spill list: Toluene Louisiana spill reporting: Toluene California Director's List of Hazardous Substances.: Toluene TSCA 8(b) inventory: Toluene TSCA 8(d) H and S data reporting: Toluene: Effective date: 10/04/82; Sunset Date: 10/0/92 SARA 313 toxic chemical notification and release reporting: Toluene CERCLA: Hazardous substances.: Toluene: 1000 lbs. (453.6 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R11- Highly flammable. R20- Harmful by inhalation. S16- Keep away from sources of ignition - No smoking. S25- Avoid contact with eyes. S29- Do not empty into drains. S33- Take precautionary measures against static discharges.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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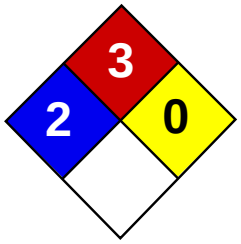

Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Xylenes MSDS

Section 1: Chemical Product and Company Identification

Product Name: Xylenes

Catalog Codes: SLX1075, SLX1129, SLX1042, SLX1096

CAS#: 1330-20-7

RTECS: ZE2100000

TSCA: TSCA 8(b) inventory: Xylenes

CI#: Not available.

Synonym: Xylenes; Dimethylbenzene; xylol; methyltoluene

Chemical Name: Xylenes (o-, m-, p- isomers)

Chemical Formula: C6H4(CH3)2

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Xylenes	1330-20-7	100

Toxicological Data on Ingredients: Xylenes: ORAL (LD50): Acute: 4300 mg/kg [Rat]. 2119 mg/kg [Mouse]. DERMAL (LD50): Acute: >1700 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, liver, mucous membranes, bone marrow, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 464°C (867.2°F)

Flash Points: CLOSED CUP: 24°C (75.2°F). (Tagliabue.) OPEN CUP: 37.8°C (100°F).

Flammable Limits: LOWER: 1% UPPER: 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Slightly explosive in presence of open flames and sparks, of heat.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Vapors may travel to source of ignition and flash back.

Special Remarks on Explosion Hazards:
Vapors may form explosive mixtures with air. Containers may explode when heated. May polymerize explosively when heated. An attempt to chlorinate xylene with 1,3-Dichloro-5,5-dimethyl-2,4-imidazolidindione (dichlorohydrantoin) caused a violent explosion

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined

areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 (ppm) [Canada] TWA: 435 (mg/m3) [Canada] TWA: 434 STEL: 651 (mg/m3) from ACGIH (TLV) [United States] TWA: 100 STEL: 150 (ppm) from ACGIH (TLV) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweetish.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless. Clear

pH (1% soln/water): Not available.

Boiling Point: 138.5°C (281.3°F)

Melting Point: -47.4°C (-53.3°F)

Critical Temperature: Not available.

Specific Gravity: 0.864 (Water = 1)

Vapor Pressure: 0.9 kPa (@ 20°C)

Vapor Density: 3.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 1 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.1

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Insoluble in cold water, hot water. Miscible with absolute alcohol, ether, and many other organic liquids.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, incompatibles

Incompatibility with various substances: Reactive with oxidizing agents, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Store away from acetic acid, nitric acid, chlorine, bromine, and fluorine.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 2119 mg/kg [Mouse]. Acute dermal toxicity (LD50): >1700 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 5000 4 hours [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: 3 (Not classifiable for human.) by IARC. May cause damage to the following organs: blood, kidneys, liver, mucous membranes, bone marrow, central nervous system (CNS).

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals:
Lowest Lethal Dose: LDL [Human] - Route: Oral; Dose: 50 mg/kg LCL [Man] - Route: Oral; Dose: 10000 ppm/6H

Special Remarks on Chronic Effects on Humans:
Detected in maternal milk in human. Passes through the placental barrier in animal. Embryotoxic and/or foetotoxic in animal. May cause adverse reproductive effects (male and femael fertility (spontaneous abortion and fetotoxicity)) and birth defects based animal data.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation. Can be absorbed through skin. Eyes: Causes eye irritation. Inhalation: Vapor causes respiratory tract and mucous membrane irritation. May affect central nervous system and behavior (General anesthetic/CNS depressant with effects including headache, weakness, memory loss, irritability, dizziness, giddiness, loss of coordination and judgement, respiratory depression/arrest or difficulty breathing, loss of appetite, nausea, vomiting, shivering, and possible coma and death). May also affects blood, sense organs, liver, and peripheral nerves. Ingestion: May cause gastrointestinal irritation including abdominal pain, vomiting, and nausea. May also affect liver and urinary system/ kidneys. May cause effects similar to those of acute inhalation. Chronic Potential Health Effects: Chronic inhalation may affect the urinary system (kidneys) blood (anemia), bone marrow (hyperplasia of bone marrow) brain/behavior/Central Nervous system. Chronic inhalation may alsocause mucosal bleeding. Chronic ingestion may affect the liver and metabolism (loss of appetite) and may affect urinary system (kidney damage)

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Xylenes UNNA: 1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Xylenes Illinois chemical safety act: Xylenes New York acutely hazardous substances: Xylenes Rhode Island RTK hazardous substances: Xylenes Pennsylvania RTK: Xylenes Minnesota: Xylenes Michigan critical material: Xylenes Massachusetts RTK: Xylenes Massachusetts spill list: Xylenes New Jersey: Xylenes New Jersey spill list: Xylenes Louisiana spill reporting: Xylenes California Director's List of Hazardous Substances: Xylenes TSCA 8(b) inventory: Xylenes SARA 302/304/311/312 hazardous chemicals: Xylenes SARA 313 toxic chemical notification and release reporting: Xylenes CERCLA: Hazardous substances.: Xylenes: 100 lbs. (45.36 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R10- Flammable. R21- Harmful in contact with skin. R36/38- Irritating to eyes and skin. S2- Keep out of the reach of children. S36/37- Wear suitable protective clothing and gloves. S46- If swallowed, seek medical advice immediately and show this container or label.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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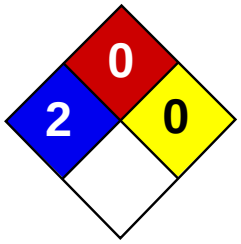

Health	2
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Chromium oxide MSDS

Section 1: Chemical Product and Company Identification

Product Name: Chromium oxide

Catalog Codes: SLC2284

CAS#: 1308-38-9

RTECS: GB6475000

TSCA: TSCA 8(b) inventory: Chromium oxide

CI#: Not available.

Synonym: Chromium Oxide greens; Chromium Oxide Green Powder; Chromium Sesquioxide; Green Chromium (III) Oxide powder; C.I. Pigment Gren 17; C.I. Number 77288; Dichromium trioxide

Chemical Name: Chromium Oxide

Chemical Formula: Cr2O3

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Chromium oxide	1308-38-9	100

Toxicological Data on Ingredients: Chromium oxide LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
Hazardous in case of inhalation. Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: A4 (Not classifiable for human) by ACGIH, 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to upper respiratory tract, skin. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion:
A small amount (less than 0.1% as Cr) of reversion to hexavalent chromium may occur if this product is exposed to elevated temperatures.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Chlorine trifluoride reacts violently with Chromium oxide producing flame.

Special Remarks on Explosion Hazards: Contact between glycerol and Chromium oxide may produce explosion.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.

Storage:
Hygroscopic. Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 25°C (77°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.5 (mg(Cr)/m) from ACGIH (TLV) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Crystalline solid. Powdered solid.)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 151.99 g/mole

Color: Green. (Dark.)

pH (1% soln/water): Not applicable.

Boiling Point: 4000°C (7232°F)

Melting Point: 2435°C (4415°F)

Critical Temperature: Not available.

Specific Gravity: 5.21 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Insoluble in cold water, acetone, and alcohol. Slightly soluble in acids, and alkalies.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Hygroscopic. Turns brown on heating, but reverts to green color on cooling. Can react with molten alkali at very high temperatures under oxidizing conditions. May react with Chlorine trifluoride, lithium, nitroalkanes, oxygen difluoride, rubidium acetylide, and other strong oxidizers. A vigorous reaction occurs between oxygen difluoride and chromium oxide. Chromium (III) compounds are reduced to Chromium (II) compounds by hypophosphites, concentrated perchloric acid, sodium bismuthate, permanganate, electrolysis, reducing metals such as zinc, magnesium and aluminum in acid solution. In basic solution, Cr(III) is readily oxidized to CrO4(-2) by hypclorite, hyprobromite, peroxide, and oxygen under pressure at high temperature. Chromium oxide and rubidium acetylide react exothermically.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. May cause damage to the following organs: upper respiratory tract, skin.

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: May cause cancer (tumorigenic) based on animal data.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: May cause skin irritation. Eyes: May cause eye irritation. Inhalation: May cause respiratory tract irritation. Ingestion: May cause gastrointestinal tract irritation. Chronic Potential Health Effects: Skin: May cause sensitization dermatitis Inhalation: Contains trivalent chromium compound. As noted by ACGHI, in their publication, "Documentation of Threshold Limit Values" repeated and prolonged exposures may cause delayed effects involving the respiratory system such as chronic bronchitis, pneumoconiosis.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
Massachusetts RTK: Chromium oxide New Jersey: Chromium oxide TSCA 8(b) inventory: Chromium oxide SARA 313 toxic chemical notification and release reporting: Chromium oxide CERCLA: Hazardous substances.: Chromium oxide

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): Not controlled under WHMIS (Canada).

DSCL (EEC):
R36/38- Irritating to eyes and skin. R40- Possible risks of irreversible effects. S2- Keep out of the reach of children. S36/37- Wear suitable protective clothing and gloves. S46- If swallowed, seek medical advice immediately and show this container or label.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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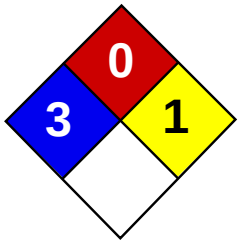

Health	3
Fire	0
Reactivity	0
Personal Protection	J

Material Safety Data Sheet
Chromium Trioxide MSDS

Section 1: Chemical Product and Company Identification

Product Name: Chromium Trioxide

Catalog Codes: SLC2068, SLC3859

CAS#: 1333-82-0

RTECS: GB6650000

TSCA: TSCA 8(b) inventory: Chromium Trioxide

CI#: Not available.

Synonym: Chromium (VI) Oxide; Chromic anhydride; Chromium (6+) Trioxide; Monochromium trioxide

Chemical Name: Chromium Trioxide

Chemical Formula: CrO3

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Chromium Trioxide	1333-82-0	100

Toxicological Data on Ingredients: Chromium Trioxide: ORAL (LD50): Acute: 80 mg/kg [Rat]. 127 mg/kg [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (corrosive, permeator), of eye contact (corrosive). Slightly hazardous in case of skin contact (sensitizer). The amount of tissue damage depends on length of contact. Eye contact can result in corneal damage or blindness. Skin contact can produce inflammation and blistering. Inhalation of dust will produce irritation to gastro-intestinal or respiratory tract, characterized by burning, sneezing and coughing. Severe over-exposure can produce lung damage, choking, unconsciousness or death. Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant). CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available.

The substance may be toxic to kidneys, liver, gastrointestinal tract, upper respiratory tract, skin, eyes. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure of the eyes to a low level of dust can produce eye irritation. Repeated skin exposure can produce local skin destruction, or dermatitis. Repeated inhalation of dust can produce varying degree of respiratory irritation or lung damage. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of combustible materials of organic materials

Explosion Hazards in Presence of Various Substances:
Explosive in presence of open flames and sparks, of heat, of organic materials. Non-explosive in presence of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Arsenic reacts with Chromium trioxide with incandescence. A violent reaction or flaming is likely in the reaction of chromium oxide and aluminum powder. Benzene ignites on contact with chromium trioxide. Reacts with Sodium or Potassium with incandescence. A mixture of chromium trioxide, and sulfur ignites on warming. Ignites on contact with alcohols, acetic anhydride + tetrahydronaphthalene, acetone, butanol, chromium (II) sulfide, cyclohexanol, dimethyl formamide, ethanol, ethylene glycol, methanol, 2-propanol, pyridine. Contact with combustible or organic materials may cause fire.

Special Remarks on Explosion Hazards:
An explosion can occur when Chromium trioxide is mixed with potassium ferricyanide when dust is ignited by a spark. Chromium trioxide + potassium permanganate will explode. Can react explosively with acetic anhydride + heat, acetic acid + heat,, ethyl acetate, isoamyl alcohol, benzaldehyde, benzene, benzylthylaniline, butraldehyde, 1,3-dimethylhexahydropyrimidone, diethyl ether, ethyl acetate, isopropyl acetate, methyl dioxane, pelargonic acid, pentyl acetate, phosphorus + heat, propionaldehyde, and other organic materials or solvents.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Oxidizing material. Corrosive solid. Poisonous solid. Stop leak if without risk. Do not get water inside container. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep container dry. Keep away from heat. Keep away from sources of ignition. Keep away from combustible material.. Do not ingest. Do not breathe dust. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as combustible materials, organic materials, metals, acids, alkalis.

Storage:
Keep container tightly closed. Keep container in a cool, well-ventilated area. Separate from acids, alkalies, reducing agents and combustibles. See NFPA 43A, Code for the Storage of Liquid and Solid Oxidizers.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor and dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.05 (mg(Cr)/m) from ACGIH (TLV) [United States] Inhalation CEIL: 0.1 (mg(Cr)/m) from OSHA (PEL) [United States] Inhalation TWA: 0.001 (mg(Cr)/m) from NIOSH [United States] Inhalation Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Flakes solid. Powdered solid.)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 99.99 g/mole

Color: Red. (Dark.)

pH (1% soln/water): 1.1 [Acidic.]

Boiling Point: Decomposes.

Melting Point: 197°C (386.6°F)

Critical Temperature: Not available.

Specific Gravity: Density: 2.7 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility:
Easily soluble in cold water, hot water. Soluble in diethyl ether. Soluble in ethyl alcohol, nitric acid, acetic acid, acetone, and sulfuric acid. Solubility in water: 61.7 g/100 ml water @ 0 deg. C; 67.45 g/100 ml water @ 100 deg. C

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, dust generation, excess heat

Incompatibility with various substances: Reactive with combustible materials, organic materials, metals, acids, alkalis.

Corrosivity: Not available.

Special Remarks on Reactivity:
Hygroscopic. Incompatible with alcohol, spirit nitrous ether, almost every organic substance, bromides, chlorides, iodides, hypophosphites, sulfites, sulfides, methanol, furfuryl, ethylene glycol, glycerol, bromine pentafluoride, hydrogen sulfide, butanol, isobutanol, acetaldehyde, propionaldehyde, butylaldehyde, benzaldehyde, benzene, perlargonic acid, isopropyl acetate, pentyl acetate, methyldioxane, dimethyldioxane, acetone, benzylethlyaniline, oils, greases or any easily oxidizable material. Acetylene is oxidized violently. Reacts violently with diethyl ether. It will reactly violently with naphthalene, camphor, glycerol, or turpentine. It will ignite ethy alcohol. Selenium reacts violently with Chromium Trioxide. Can react violently with most metal powders, ammonia, ammonium salts, phosphorus, sulfur, acids, finely divided organic compounds, flammable liquids.

Special Remarks on Corrosivity:
Corrosive because of oxidizing potency. Corrosive to some metals

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 80 mg/kg [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. May cause damage to the following organs: kidneys, liver, gastrointestinal tract, upper respiratory tract, skin, eyes.

Other Toxic Effects on Humans:
Extremely hazardous in case of inhalation (lung corrosive). Very hazardous in case of skin contact (irritant), of ingestion, . Hazardous in case of skin contact (corrosive, permeator), of eye contact (corrosive). Slightly hazardous in case of skin contact (sensitizer).

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose LDL [Rat] - Route: Skin; Dose: 55 mg/kg

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (effects on fertility: fetotoxicity or post-implantation mortality) and birth defects. May affect genetic material (mutagenic). May cause cancer (tumorigenic). Epidemiological studies indicate long term exposure to dusts and mists at levels above the current PEL in chrome processing is associated with increases in respiratory tract cancer in man.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation and possible burns. Contact with broken skin may lead to formation of firmly marginated "chrome sores." May cause allergic contact dermatitis. Dermal absorption of large amounts may affect behavior and may result in kidney failure Eyes: Causes eye irritation. May cause severe damage including burns and blindness. Inhalation: Causes irritation of the respiratory tract. May cause severe burns of the nasal septum and respiratory tract, perforation of the nasal septum, congestion, and pulmonary edema. Ingestion: Causes gastrointestinal tract irritation with violent epigrastic pain, nausea, vomiting and severe diarrhea. May cause tissue destruction resulting in hemorrhaging, circulatory collapse, unconciousness and possible death. May affect respiration (cyanosis), blood (anemia, thrombocytopenia) May cause kidney failure and liver damage. Chronic Potential Health Effects: Skin: Repeated or prolonged skin contact may cause "chrome sores" on skin (especially broken skin). Eyes: Repeated or prolonged eye contact may cause conjunctivitis. Inhalation: Repeated or prolonged inhalation may cause chronic respiratory tract irritation with chronic rhinitis, hyperemia, chronic catarrh, congestion of the larynx, inflammation of the larynx, polyps of the upper respiratory tract, chronic inflammation of the lungs, emphysema, tracheitis, chronic bronchitis, chronic pharyngitis, bronchopneumonia, ulceration and perforation of the nasal septum. Ingestion: Repeated or prolonged ingestion may cause nausea, vomiting, loss of appetite, kidney damage, inflammation of the liver or even hepatitis with jaundice, leukocytosis, leukopenia, monocytosis, and eosinophilia

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification:
CLASS 5.1: Oxidizing material. Class 8: Corrosive material

Identification: : Chromium Trioxide, Anhydrous UNNA: 1463 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Chromium Trioxide California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Chromium Trioxide Connecticut hazardous material survey.: Chromium Trioxide Rhode Island RTK hazardous substances: Chromium Trioxide Pennsylvania RTK: Chromium Trioxide Massachusetts RTK: Chromium Trioxide Massachusetts spill list: Chromium Trioxide New Jersey: Chromium Trioxide New Jersey spill list: Chromium Trioxide TSCA 8(b) inventory: Chromium Trioxide TSCA 6 final risk management: Chromium Trioxide TSCA 8(a) IUR: Chromium Trioxide TSCA 12(b) annual export notification: Chromium Trioxide

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS C: Oxidizing material. CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive solid.

DSCL (EEC):
R8- Contact with combustible material may cause fire. R25- Toxic if swallowed. R35- Causes severe burns. R43- May cause sensitization by skin contact. R49- May cause cancer by inhalation. R50/53- Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). S53- Avoid exposure - obtain special instructions before use. S60- This material and its container must be disposed of as hazardous waste. S61- Avoid release to the environment. Refer to special instructions/Safety data sheets.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/09/2005 04:55 PM

Last Updated: 05/21/2013 12:00 PM

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OSHA/EPA Occupational Chemical Database

Chemical Identification

Chemical Name: **2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN**

CAS #: 1746-01-6 **UN No:** 2811 **Formula:** C12H4Cl4O2

Synonyms: Dioxin; Dioxine; TCDBD; TCDD; 2,3,7,8-TCDD [Note: Formed during past production of 2,4,5-trichlorophenol, 2,4,5-T & 2(2,4,5-trichlorophenoxy)propionic acid.]

Physical Properties

Physical Description: Colorless to white, crystalline solid. [Note: Exposure may occur through contact at previously contaminated worksites.]

BP: Decomposes	**MW:** 322.0	**LEL:** NA	**NFPA Fire Rating:** NA
FRZ/MLT: MLT: 581ºF	**VP:** (77ºF): 0.000002 mmHg	**UEL:** NA	**NFPA Health Rating:** NA
FP: NA	**VD:** NA		**NFPA Reactivity Rating:** NA
Sp. GR: NA	**IP:** NA		**NFPA Sp. Inst.:** NA

Exposure Limits

OSHA	NIOSH	Related Information
PEL-TWA ppm: NA	**REL-TWA ppm:** NA	**AIHA Emergency Response Planning Guidelines - ERPG-1/ERPG-2/ERPG-3:** NA
PEL-TWA mg/m3: NA	**REL-TWA mg/m3:** NA	
PEL-STEL ppm: NA	**REL-STEL ppm:** NA	
PEL-STEL mg/m3: NA	**REL-STEL mg/m3:** NA	
PEL-C ppm: NA	**REL-C ppm:** NA	
PEL-C mg/m3: NA	**REL-C mg/m3:** NA	**Carcinogen Classifications:** IARC-1, NIOSH-Ca, NTP-K
Skin Notation: No	**Skin Notation:** No	
Notes: NA	**Notes:** CARCINOGEN (Ca); REDUCE EXPOSURE TO LOWEST FEASIBLE CONCENTRATION	
	IDLH ppm: NA	
	IDLH mg/m3: NA	
	IDLH Notes: Ca	

NIOSH Pocket Guide to Chemical Hazards (Current through June 2006)

2,3,7,8-Tetrachloro-dibenzo-p-dioxin	CAS: 1746-01-6
Formula: C12H4Cl4O2	RTECS: HP3500000
Synonyms & Trade Names: Dioxin; Dioxine; TCDBD; TCDD; 2,3,7,8-TCDD	DOT ID & Guide: NA

Exposure Limits

NIOSH REL: Ca See Appendix A	OSHA PEL: none
IDLH: Ca [N.D.]	Conversion: NA

Physical Description

Colorless to white, crystalline solid. [Note: Exposure may occur through contact at previously contaminated

worksites.]			
MW: 322.0	BP: Decomposes	MLT: 581F	Sol: 0.00000002%
VP(77F): 0.000002 mmHg	IP: ?	RGasD: NA	Sp.Gr: ?
Fl.P: ?	UEL: ?	LEL: ?	MEC: NA

NA (See flammable and combustible liquid classes)

Incompatibilities & Reactivities

UV light (decomposes)

Measurement Methods

None available

Personal Protection & Sanitation	First Aid
Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contam/Daily Remove: When wet or contam Change: Daily Provide: Eyewash, Quick drench	Eye: Irr immed Skin: Soap flush immed Breath: Resp support Swallow: Medical attention immed (See procedures)

NIOSH Respirator Recommendations

NIOSH : SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOVHiE/SCBAE
(See symbols and codes)

Exposure Routes

Inh Abs Ing Con

Symptoms

Irrit eyes; allergic derm, chloracne; porphyria; GI dist; possible repro, terato effects; in animals: liver, kidney damage; hemorr; [carc]
(See abbreviations)

Target Organs

Eyes, skin, liver, kidneys, repro sys
(See abbreviations)

DOT Emergency Response Guidebook (ERG 2004)

Guide Number: 154
154 Substances - Toxic and/or Corrosive (Non-Combustible)
POTENTIAL HAZARDS
HEALTH

* TOXIC; inhalation, ingestion, or skin contact with material may cause severe injury or death.
* Contact with molten substance may cause severe burns to skin and eyes.
* Avoid any skin contact.
* Effects of contact or inhalation may be delayed.
* Fire may produce irritating, corrosive and/or toxic gases.
* Runoff from fire control or dilution water may be corrosive and/or toxic and cause pollution.

FIRE OR EXPLOSION

* Non-combustible, substance itself does not burn but may decompose upon heating to produce corrosive and/or toxic fumes.
* Some are oxidizers and may ignite combustibles (wood, paper, oil, clothing, etc.).
* Contact with metals may evolve flammable hydrogen gas.
* Containers may explode when heated.

PUBLIC SAFETY

* CALL Emergency Response Telephone Number on Shipping Paper first. If

Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.

* Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions.
* Keep unauthorized personnel away.
* Stay upwind.
* Keep out of low areas.
* Ventilate enclosed areas.

PROTECTIVE CLOTHING

* Wear positive pressure self-contained breathing apparatus (SCBA).
* Wear chemical protective clothing which is specifically recommended by the manufacturer. It may provide little or no thermal protection.
* Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations.

EVACUATION

Spill

* See the Table of Initial Isolation and Protective Action Distances for highlighted substances. For non-highlighted substances, increase, in the downwind direction, as necessary, the isolation distance shown under **PUBLIC SAFETY**.

Fire

* If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.

EMERGENCY RESPONSE

FIRE

Small Fires

* Dry chemical, CO2 or water spray.

Large Fires

* Dry chemical, CO2, alcohol-resistant foam or water spray.
* Move containers from fire area if you can do it without risk.
* Dike fire control water for later disposal; do not scatter the material.

Fire involving Tanks or Car/Trailer Loads

* Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
* Do not get water inside containers.
* Cool containers with flooding quantities of water until well after fire is out.
* Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
* ALWAYS stay away from tanks engulfed in fire.

SPILL OR LEAK

* ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area).
* Do not touch damaged containers or spilled material unless wearing appropriate protective clothing.
* Stop leak if you can do it without risk.
* Prevent entry into waterways, sewers, basements or confined areas.
* Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers.
* DO NOT GET WATER INSIDE CONTAINERS.

FIRST AID

* Move victim to fresh air.
* Call 911 or emergency medical service.
* Apply artificial respiration if victim is not breathing.
* Do not use mouth-to-mouth method if victim ingested or inhaled the substance; induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device.
* Administer oxygen if breathing is difficult.

* Remove and isolate contaminated clothing and shoes.
* In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
* For minor skin contact, avoid spreading material on unaffected skin.
* Keep victim warm and quiet.
* Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed.
* Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

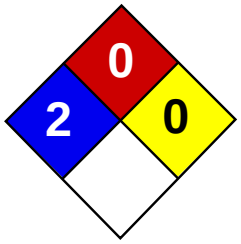
Additional Emergency Response Information (CAMEO Data)

Non-fire Spill Response: SMALL SPILLS AND LEAKAGE: If you spill this chemical, FIRST REMOVE ALL SOURCES OF IGNITION, then dampen the solid spill material with toluene, then using absorbent paper transfer the dampened material to a suitable container. Use absorbent paper dampened with toluene to pick up any remaining material. Your contaminated clothing and absorbent paper should be sealed in a vapor-tight plastic bag for eventual disposal. Solvent-wash all contaminated surfaces with toluene followed by washing with a soap and water solution. Do not reenter the contaminated area until the Safety Officer (or other responsible person) has verified that the area has been properly cleaned.STORAGE PRECAUTIONS: You should protect this container from damage. Store at room temperature and protect from light. Allow only your most experienced personnel access to this aliquot. (NTP, 1992)

Firefighting: Fires involving this material can be controlled with a dry chemical, carbon dioxide or Halon extinguisher. (NTP, 1992)

Reactivity: STABILITY: This chemical undergoes slow photochemical degradation and slow bacterial degradation. It is extremely stable but is chemically degraded by temperature in excess of 932 F or by irradiation with ultraviolet light under certain conditions. Photodecomposition is negligible in aqueous solutions. Solutions of this chemical in water, DMSO, 95% ethanol or acetone should be stable for 24 hours when protected from light.REACTIVITY: This chemical is changed chemically when exposed as solutions in iso-octane or n-octanol to ultraviolet light. It undergoes catalytic perchlorination. (NTP, 1992)

First Aid: EYES: First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center. Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician. IMMEDIATELY transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop. SKIN: IMMEDIATELY flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water. IMMEDIATELY call a hospital or poison control center even if no symptoms (such as redness or irritation) develop. IMMEDIATELY transport the victim to a hospital for treatment after washing the affected areas. INHALATION: IMMEDIATELY leave the contaminated area; take deep breaths of fresh air. IMMEDIATELY call a physician and be prepared to transport the victim to a hospital even if no symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, Self-Contained Breathing Apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Protective Clothing. INGESTION: If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and IMMEDIATELY call a hospital or poison control center. Generally, the induction of vomiting is NOT recommended outside of a physician's care due to the risk of aspirating the chemical into the victim's lungs. However, if the victim is conscious and not convulsing and if medical help is not readily available, consider the risk of inducing vomiting because of the high toxicity of the chemical ingested. Ipecac syrup or salt water may be used in such an emergency. IMMEDIATELY transport the victim to a hospital. If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. DO NOT INDUCE VOMITING. IMMEDIATELY transport the victim to a hospital. OTHER: Since this chemical is a known or suspected carcinogen you should contact a physician for advice regarding the possible long term health effects and potential recommendation for medical monitoring. Recommendations from the physician will depend upon the specific compound, its chemical, physical and toxicity properties, the exposure level, length of exposure, and the route of exposure. (NTP, 1992)



Health	2
Fire	0
Reactivity	0
Personal Protection	G

Material Safety Data Sheet
Tetrachloroethylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Tetrachloroethylene

Catalog Codes: SLT3220

CAS#: 127-18-4

RTECS: KX3850000

TSCA: TSCA 8(b) inventory: Tetrachloroethylene

CI#: Not available.

Synonym: Perchloroethylene; 1,1,2,2-Tetrachloroethylene; Carbon bichloride; Carbon dichloride; Ankilostin; Didakene; Dilatin PT; Ethene, tetrachloro-; Ethylene tetrachloride; Perawin; Perchlor; Perclene; Perclene D; Percosolvel; Tetrachloroethene; Tetraleno; Tetralex; Tetravec; Tetroguer; Tetropil

Chemical Name: Ethylene, tetrachloro-

Chemical Formula: C2-Cl4

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Tetrachloroethylene	127-18-4	100

Toxicological Data on Ingredients: Tetrachloroethylene: ORAL (LD50): Acute: 2629 mg/kg [Rat]. DERMAL (LD): Acute: >3228 mg/kg [Rabbit]. MIST(LC50): Acute: 34200 mg/m 8 hours [Rat]. VAPOR (LC50): Acute: 5200 ppm 4 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (anticipated carcinogen) by NTP. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, peripheral nervous system, respiratory tract, skin, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with skin. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, metals, acids, alkalis.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

Personal Protection:
Safety glasses. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 25 (ppm) from OSHA (PEL) [United States] TWA: 25 STEL: 100 (ppm) from ACGIH (TLV) [United States] TWA: 170 (mg/m3) from OSHA (PEL) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Ethereal.

Taste: Not available.

Molecular Weight: 165.83 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not available.

Boiling Point: 121.3°C (250.3°F)

Melting Point: -22.3°C (-8.1°F)

Critical Temperature: 347.1°C (656.8°F)

Specific Gravity: 1.6227 (Water = 1)

Vapor Pressure: 1.7 kPa (@ 20°C)

Vapor Density: 5.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 5 - 50 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.4

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Miscible with alcohol, ether, chloroform, benzene, hexane. It dissolves in most of the fixed and volatile oils. Solubility in water: 0.015 g/100 ml @ 25 deg. C It slowly decomposes in water to yield Trichloroacetic and Hydrochloric acids.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, metals, acids, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Oxidized by strong oxidizing agents. Incompatible with sodium hydroxide, finely divided or powdered metals such as zinc, aluminum, magnesium, potassium, chemically active metals such as lithium, beryllium , barium. Protect from light.

Special Remarks on Corrosivity: Slowly corrodes aluminum, iron, and zinc.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 2629 mg/kg [Rat]. Acute dermal toxicity (LD50): >3228 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 5200 4 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (Some evidence.) by NTP. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. May cause damage to the following organs: kidneys, liver, peripheral nervous system, upper respiratory tract, skin, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of ingestion.

Special Remarks on Toxicity to Animals:
Lowest Publishe Lethal Dose/Conc: LDL [Rabbit] - Route: Oral; Dose: 5000 mg/kg LDL [Dog] - Route: Oral; Dose: 4000 mg/kg LDL [Cat] - Route: Oral; Dose: 4000 mg/kg

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects and birth defects(teratogenic). May affect genetic material (mutagenic). May cause cancer.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation with possible dermal blistering or burns. Symtoms may include redness, itching, pain, and possible dermal blistering or burns. It may be absorbed through the skin with possible systemic effects. A single prolonged skin exposure is not likely to result in the material being absorbed in harmful amounts. Eyes: Contact causes transient eye irritation, lacrimation. Vapors cause eye/conjunctival irritation. Symptoms may include redness and pain. Inhalation: The main route to occupational exposure is by inhalation since it is readily absorbed through the lungs. It causes respiratory tract irritation, . It can affect behavior/central nervous system (CNS depressant and anesthesia ranging from slight inebriation to death, vertigo, somnolence, anxiety, headache, excitement, hallucinations, muscle incoordination, dizziness, lightheadness, disorentiation, seizures, enotional instability, stupor, coma). It may cause pulmonary edema Ingestion: It can cause nausea, vomiting, anorexia, diarrhea, bloody stool. It may affect the liver, urinary system (proteinuria, hematuria, renal failure, renal tubular disorder), heart (arrhythmias). It may affect behavior/central nervous system with symptoms similar to that of inhalation. Chronic Potential Health Effects: Skin: Prolonged or repeated skin contact may result in excessive drying of the skin, and irritation. Ingestion/Inhalation: Chronic exposure can affect the liver(hepatitis,fatty liver degeneration), kidneys, spleen, and heart (irregular heartbeat/arrhythmias, cardiomyopathy, abnormal EEG), brain, behavior/ central nervous system/peripheral nervous system (impaired memory, numbness of extremeties, peripheral neuropathy and other

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 18.4 mg/l 96 hours [Fish (Fatthead Minnow)]. 18 mg/l 48 hours [Daphnia (daphnia)]. 5 mg/l 96 hours [Fish (Rainbow Trout)]. 13 mg/l 96 hours [Fish (Bluegill sunfish)].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Tetrachloroethylene UNNA: 1897 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Tetrachloroethylene California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Tetrachloroethylene Connecticut hazardous material survey.: Tetrachloroethylene Illinois toxic substances disclosure to employee act: Tetrachloroethylene Illinois chemical safety act: Tetrachloroethylene New York release reporting list: Tetrachloroethylene Rhode Island RTK hazardous substances: Tetrachloroethylene Pennsylvania RTK: Tetrachloroethylene Minnesota: Tetrachloroethylene Michigan critical material: Tetrachloroethylene Massachusetts RTK: Tetrachloroethylene Massachusetts spill list: Tetrachloroethylene New Jersey: Tetrachloroethylene New Jersey spill list: Tetrachloroethylene Louisiana spill reporting: Tetrachloroethylene California Director's List of Hazardous Substances: Tetrachloroethylene TSCA 8(b) inventory: Tetrachloroethylene TSCA 8(d) H and S data reporting: Tetrachloroethylene: Effective date: 6/1/87; Sunset date: 6/1/97 SARA 313 toxic chemical notification and release reporting: Tetrachloroethylene CERCLA: Hazardous substances.: Tetrachloroethylene: 100 lbs. (45.36 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R40- Possible risks of irreversible effects. R51/53- Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. S23- Do not breathe gas/fumes/vapour/spray S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S37- Wear suitable gloves. S61- Avoid release to the environment. Refer to special instructions/Safety data sheets.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: g

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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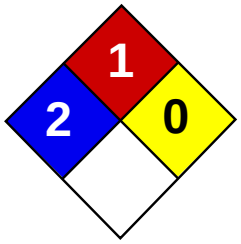

Health	2
Fire	1
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Trichloroethylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Trichloroethylene

Catalog Codes: SLT3310, SLT2590

CAS#: 79-01-6

RTECS: KX4560000

TSCA: TSCA 8(b) inventory: Trichloroethylene

CI#: Not available.

Synonym:

Chemical Formula: C2HCl3

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Trichloroethylene	79-01-6	100

Toxicological Data on Ingredients: Trichloroethylene: ORAL (LD50): Acute: 5650 mg/kg [Rat]. 2402 mg/kg [Mouse]. DERMAL (LD50): Acute: 20001 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified A5 (Not suspected for human.) by ACGIH. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to kidneys, the nervous system, liver, heart, upper respiratory tract. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: 420°C (788°F)

Flash Points: Not available.

Flammable Limits: LOWER: 8% UPPER: 10.5%

Products of Combustion: These products are carbon oxides (CO, CO2), halogenated compounds.

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/

spray. Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Carcinogenic, teratogenic or mutagenic materials should be stored in a separate locked safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 50 STEL: 200 (ppm) from ACGIH (TLV) TWA: 269 STEL: 1070 (mg/m3) from ACGIH Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 131.39 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not available.

Boiling Point: 86.7°C (188.1°F)

Melting Point: -87.1°C (-124.8°F)

Critical Temperature: Not available.

Specific Gravity: 1.4649 (Water = 1)

Vapor Pressure: 58 mm of Hg (@ 20°C)

Vapor Density: 4.53 (Air = 1)

Volatility: Not available.

Odor Threshold: 20 ppm

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether, acetone.

Solubility:
Easily soluble in methanol, diethyl ether, acetone. Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity:
Extremely corrosive in presence of aluminum. Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
Acute oral toxicity (LD50): 2402 mg/kg [Mouse]. Acute dermal toxicity (LD50): 20001 mg/kg [Rabbit].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified A5 (Not suspected for human.) by ACGIH. The substance is toxic to kidneys, the nervous system, liver, heart, upper respiratory tract.

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Passes through the placental barrier in human. Detected in maternal milk in human.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Trichloroethylene : UN1710 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Trichloroethylene California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Trichloroethylene Pennsylvania RTK: Trichloroethylene Florida: Trichloroethylene Minnesota: Trichloroethylene Massachusetts RTK: Trichloroethylene New Jersey: Trichloroethylene TSCA 8(b) inventory: Trichloroethylene CERCLA: Hazardous substances.: Trichloroethylene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R36/38- Irritating to eyes and skin. R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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APPENDIX B

HEALTH AND SAFETY FORMS

TAILGATE SAFETY MEETING

Project Name:	**Date:**
Project Number:	**Time: Start: Stop:**
Location:	**Sheet: ___ of ___**
Presented By:	
Topics Covered:	

I have reviewed the Site Health and Safety Plan for the _____ Site and understand the potential health and safety hazards at this operation and the emergency response procedures. I agree to conduct all on-site work in conformity with the requirements of the Health and Safety Plan.

NAME (print)	SIGNATURE	COMPANY

Safety and Health Concerns Expressed during Meeting:

Corrective Actions Taken or Planned:

INCIDENT AND INJURY REPORT

This form must be completed and forwarded to Corporate Health and Safety within 24 hours of any incident/injury.
For serious injuries, also complete page 2 and forward the entire form to Corporate Health and Safety by the end of the day.

Employer Name:	
Employer Address:	
Employer Phone #	Employers FAX #

EMPLOYEE		
Name:	Soc. Sec. #	
Home Address:		
County:	Zip Code:	
Home Telephone:	Date of Birth:	Age:
Occupation: (Job Title):	Sex: Male □ Female □	
Department:	Married: Yes □ No □	
How long employed: Years Mo.	No. Children under 18 yrs.	

ACCIDENT/INJURY	
Project Name:	Project Number:
Address of Accident:	
County:	Zip Code:
Was accident on company property: Yes □ No □	
Date and Time of Injury:	Date Reported:
What was Employee doing when injured? (Be specific – include tools, equipment, materials, or objects involved):	
How did the injury occur? (Describe the event that resulted in injury):	
Body Part injured and nature of injury (Be specific):	
Name of object or substance that directly injured the employee:	

MEDICAL	
First aid given by:	
Date of medical assistance:	Was accident fatal?
Name of medical provider:	
Address of medical provider:	
Diagnosis:	
If hospitalized, name and address of hospital:	
EMPLOYEE'S SIGNATURE:	**Date:**
PREPARER'S SIGNATURE:	**Date:**
SUPERVISOR'S SIGNATURE:	**Date:**
HEALTH & SAFETY SIGNATURE:	**Date:**

INCIDENT AND INJURY REPORT

ACCIDENT INVESTIGATION AND FOLLOW-UP	
Provide additional information on what the employee was doing and how the injury occurred:	
Witness names (also addresses and phone numbers if not company personnel):	
What did the employee do or fail to do that caused or contributed to the accident?	
What caused or influenced the unsafe act?	
What condition of tools, equipment or the jobsite caused or contributed to the accident?	
What caused or influenced the unsafe condition?	
What action has been taken or is planned to prevent recurrence?	
Person(s) responsible for completion of the action:	
Target date:	Actual completion date:
Completed by:	

OFFICE USE ONLY	
Case Type: First Aid ☐ Medical ☐ Restricted or Job Transfer ☐ Days Away from Work ☐	
OSHA Recordable: Yes ☐ No ☐	
Worker's Comp Claim Filed: Yes ☐ No ☐	Date Filed:
Project Manager:	
Date lost work time began:	
Total days away from work:	
Date of restricted activity or job transfer:	
Total restricted/job transfer workdays:	
Date returned to full duty:	

REAL-TIME MONITORING INSTRUMENT CALIBRATION LOG

Project Name:		**Project Number:**
Location:		
Instrument (s):		
Model Number(s):		**Serial Number(s):**
Calibration Gas(es):	**Concentration**	

DATE	TIME	READING	CALIBRATED BY	COMMENTS

REAL-TIME MONITORING LOG

Date:	Person performing sampling:
Project Name:	Signature:
Project No.:	

Time	Monitoring Location (be specific)	READINGS						COMMENTS (Where was sample taken? e.g., breathing zone or other) and **Duration of Monitoring**
		O_2 %	LEL %	NH_3 ppm	Dust mg/m^3	Noise dB	Detect or Tube (spec. tube)	

Real Time Instrument Calibration Log should accompany this form.

APPENDIX C

EMERGENCY CONTACTS AND HOSPITAL ROUTE MAP

EMERGENCY NUMBERS Standard Chlorine Chemical Company Site Kearny, NJ	
Fire	911
Police	911
Ambulance	911
HOSPITAL - West Hudson Hospital 206 Bergen Ave. Kearny, NJ 07032	(201) 955-7040 (emergency)
Poison Control Center	(800) 222-1222
Key Environmental, Inc. - Health & Safety - John Francis	(412) 279-3363 (412) 527-1644 (c)

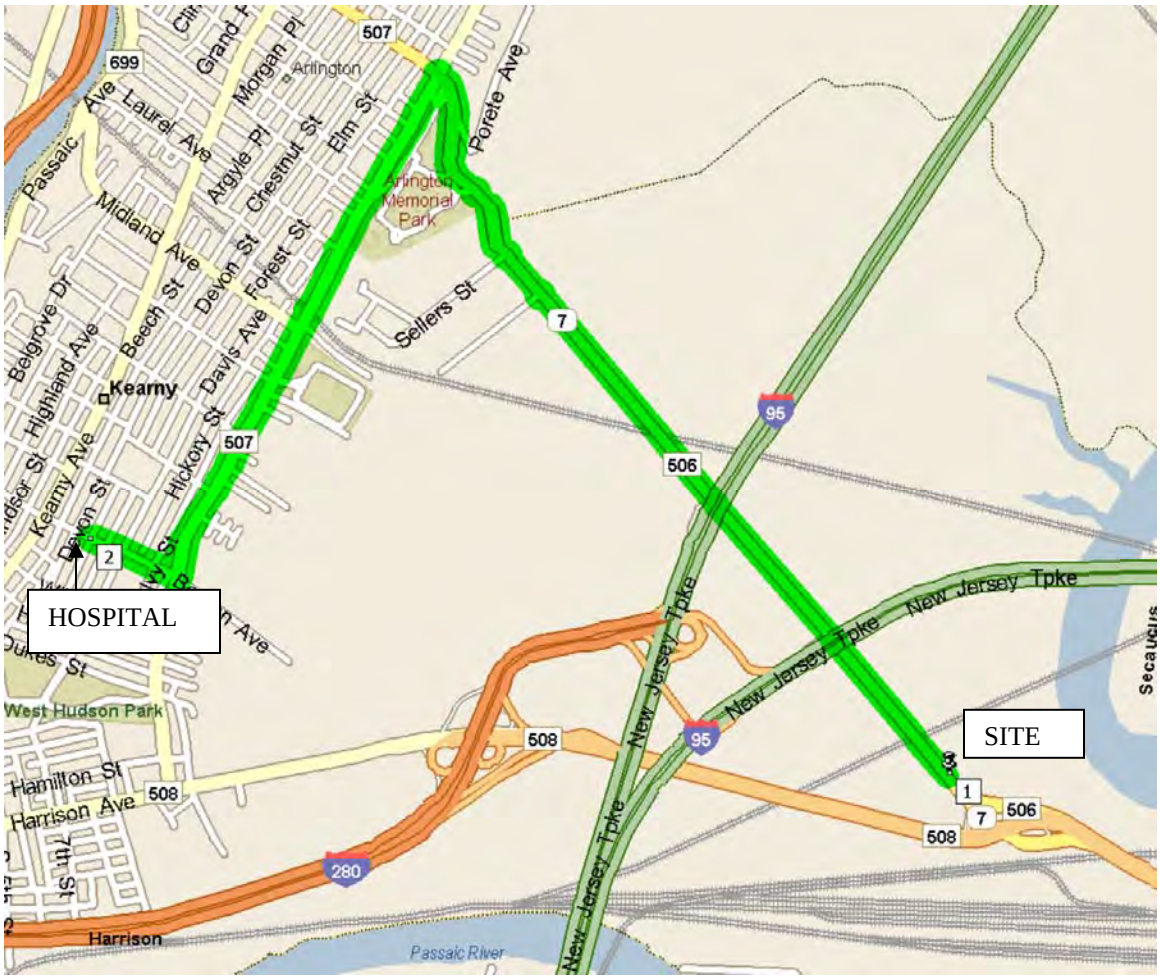
DIRECTIONS TO EMERGENCY ROOM

West Hudson Hospital (201) 995-7000
206 Bergen Avenue
Kearny, NJ 07322

Turn right onto Belleville Pike and follow west to Schuyler Avenue (near the cemetery),
Turn left onto Schuyler Avenue at the cemetery,
Follow Schuyler to Bergen Avenue,
Turn right onto Bergen Avenue and follow approximately two blocks to the hospital.
Approximately 4 miles (10 minutes) to hospital.

UTILITY NUMBERS

Call Before You Dig (Garden State Underground Plant Location Service)	800-272-1000
Public Service Electric and Gas	800-436-7734



West Hudson Hospital (201) 995-7000
206 Bergen Avenue
Kearny, NJ 07322

Turn right onto Belleville Pike and follow west to Schuyler Avenue (near the cemetery),
Turn left onto Schuyler Avenue at the cemetery,
Follow Schuyler to Bergen Avenue,
Turn right onto Bergen Avenue and follow approximately two blocks to the hospital.
Approximately 4 miles (10 minutes) to hospital.

APPENDIX B

FIELD SAMPLING PLAN

REMEDIAL INVESTIGATION/ FOCUSED FEASIBILITY STUDY WORK PLAN
FIELD SAMPLING PLAN

STANDARD CHLORINE CHEMICAL COMPANY SITE
KEARNY, NEW JERSEY

Prepared for:

Performing Parties Group
(Beazer East, Inc., Cooper Industries, LLC, Tierra Solutions, Inc. on behalf of Occidental Chemical Corporation, and Apogent Transition Corporation)

Prepared by:

Key Environmental, Inc.
200 Third Avenue
Carnegie, Pennsylvania 15106

July 2013

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SOP No. 03 – Field Logbook
SOP No. 04 – Management of Investigation-Derived Wastes
SOP No. 10 – Drilling Methods for Subsurface Investigations and Well Installations
SOP No. 20 – Volatile Organic Screening
SOP No. 22 – Environmental Sample Preparation
SOP No. 23 – Sample Handling, Preservation, Packaging and Shipping
SOP No. 24 – Chain of Custody
SOP No. 25 – Equipment Decontamination
SOP No. 32 – Surface Soil Sampling
SOP No. 33 – Subsurface Soil Sampling

1.0 INTRODUCTION

1.1 STATEMENT OF PURPOSE

This document has been prepared by Key Environmental, Inc. (KEY) on behalf of the Performing Parties Group (Group) to present a Field Sampling Plan (FSP) for the Standard Chlorine Chemical Company (SCCC) Site located in Kearny, New Jersey. Figure 1 provides a location map for the Site. The Group is comprised of Beazer East, Inc. (Beazer), Cooper Industries, LLC (Cooper), Tierra Solutions, Inc., (Tierra) on behalf of Occidental Chemical Corporation (OCC), and Apogent Transition Corporation (Apogent).

This FSP is a component of the overall Remedial Investigation/Focused Feasibility Study (RI/FFS) Work Plan for the SCCC Site. The RI/FFS Work Plan has been prepared to address a specific requirement of a RI/FFS Statement of Work (SOW) prepared by the United States Environmental Protection Agency (USEPA). The referenced SOW is provided as Appendix A of the Administrative Settlement Agreement and Order on Consent (AOC) for Remedial Investigation/Focused Feasibility Study for the SCCC Site effective May 3, 2013. Specifically, this plan has been prepared to address the requirements listed in Section III of the USEPA RI/FFS SOW dated March 28, 2013 (Task 2 - RI/FFS Work Plan).This FSP presents the field procedures and data acquisition methods necessary for execution of the RI/FFS Work Plan.

The FSP was prepared to be consistent as appropriate with the applicable components of the New Jersey Department of Environmental Protection (NJDEP) Field Sampling Procedures Manual (FSPM) dated August 2005, USEPA's A Compendium of Superfund Field Operations Methods (CSFM) dated August 1987 and is complimented by other documents that outline the RI/FFS Work Plan implementation procedures including the Quality Assurance Project Plan (QAPP), and the Health and Safety Plan (HASP). Applicable KEY Standard Operating Procedures (SOPs) are included in Attachment A and are referenced herein where appropriate. Where a discrepancy exists between an SOP and specific protocol included in this FSP, the procedure specified in the main body of the FSP takes precedence. Where a discrepancy exists between the FSP and a specific protocol included in the FSPM, the procedure specified in the FSPM takes precedence. Where a discrepancy exists between the FSPM and the CSFM, the CSFM will take precedence subject to sensitivity to the FSPM requirements. Specifically, drilling method associated with sonic technology and quality assurance requirements associated with hexavalent chromium analysis were included as per NJDEP stipulations.

1.2 SITE BACKGROUND

A detailed discussion of Site information, including Site History, Physical Settings, and Site Characteristic Data is provided in Section 2.0 of the RI/FFS Work Plan.

1.3 DESCRIPTION OF REMEDIAL INVESTIGATION COMPONENTS

Sections 4.0 and 5.0 of the RI/FFS provide descriptions of the various remedial investigation components. The design data acquisition activities will focus on collection of data to support these RI/FFS components, which consist of the following:

- Surface Soil Sampling and Analysis
- DNAPL Delineation
- Varved Clay Sampling and Analysis

The plan locations of the RI/FFS delineation/sampling locations are shown on Figure 2. The data acquisition procedures outlined in this FSP will focus on collection of data to support the preceding RI/FFS components.

2.0 SCOPE OF WORK OVERVIEW

Section 5.0 of the RI/FFS Work Plan provides a detailed description of the data acquisition activities. The scope of work, identifying the sample collection locations, descriptions, sample matrix, boring depth, sample depth, required analytical suite, sampling method, and intended use of the data is summarized in Table 1. Figure 2 depicts planned boring and sample locations. Detailed procedures for various aspects for the data acquisition activities are provided in the remainder of this FSP.

3.0 SOIL SAMPLING PROCEDURES

This section presents the procedures for surface and subsurface soil sampling. Soil samples will be obtained from borings advanced into the unconsolidated materials at the Site. All drilling activities will be performed by New Jersey-licensed well drillers under the direction of a qualified geologist or engineer. All necessary drilling permits required by N.J.S.A. 58:4A-14 will be obtained. Prior to any intrusive work, underground structures including tanks, septic systems, and utilities will be identified in accordance with KEY SOP No. 02. The remainder of this section discusses the boring operations and sampling procedures in detail.

3.1 PILOT HOLES IN INTERIM REMEDIAL MEASURES (IRM) AREAS

The proposed soil borings on the SCCC Site are located in areas where IRM coverings have been constructed. IRM coverings at the SCCC Site in the proposed boring locations include the following:

- Paved IRM consisting of a porous geotextile overlain by four (4) to six (6)-inches of coarse aggregate overlain by approximately 4 inches of asphalt,
- Aggregate-Covered IRM consisting of four (4) to six (6)-inches of coarse aggregate overlain by sandwich layer of geotextile-geomembrane-geotextile overlain by six (6) to 12-inches of coarse aggregate,
- Six (6) inches of aggregate with porous geotextile above and below, overlain by zero (0) to one (1) foot of fill/stone.

Two (2) of the proposed soil borings (D-26 & D-27) on the Seaboard site are located in areas where surface grading material and capillary break cover materials have been constructed. The materials at the Seaboard site on the above referenced boring locations include the following:

- At boring location D-26, six (6) inches of aggregate with porous geotextile above and below, overlain by zero (0) to one (1) foot of processed dredge materials (PDM).
- At boring location D-27, six (6) inches of aggregate with porous geotextile above and below, overlain by one (1) to three (3) foot of PDM.

Pilot hole procedures are as follows:

- Where aggregate-covered IRM exists, hand excavate the aggregate to the first layer of geotextile. The diameter of the excavation shall be one (1)-foot larger than the diameter of the tooling that will be used for advancing the borehole. If pavement is present, it will be saw cut. Aggregate removed from the excavation will be stockpiled on polyethylene sheeting away from the borehole. The excavated pavement will be collected in bulk containers for disposal off-site. Instances where PDM and capillary

break are present, the outer casing will be driven below the capillary break (sealed in the meadow mat) and remain throughout the duration of the boring installation. The casing will prevent intermingling of PDM and gravel and allow for a controlled backfill and replacement of capillary break material during backfill activities. Replacement of the capillary break is discussed in Section 3.4.

- Carefully cut each layer of geotextile and/or geomembrane with a utility knife.
- Continue excavation of aggregate until original pavement or soil is reached and stockpile aggregate on a separate polyethylene sheet.
- Drive appropriate size casing (precut to length) six (6)-inches into the ground immediately below IRM covering, if present, using casing driver. Alternatively, casings required as part of certain drilling methods may be used. This casing will keep the excavated hole open and will serve as a conduit for soil cuttings, thereby keeping potential subsurface contamination from coming in contact with the IRM covering. The casing will also protect the geomembrane and/or geotextile layer, where present.
- Place a four (4)-foot by eight (8)-foot sheet of plywood staging, or a 10 foot x 10 foot 30 mil polyethylene sheeting around the borehole. This staging will keep drill cuttings from contacting the IRM covering.
- Advance borehole using methods outlined in Section 3.2.
- After necessary information and/or samples have been collected, repair IRM using methods outlined in Section 3.4.2 or 3.4.3, as appropriate.

All excavated material shall be stockpiled on polyethylene sheeting away from the borehole, and after the soil boring is abandoned, the IRM covering shall be repaired as appropriate.

3.2 DRILLING METHODS

Drilling methods for subsurface soil sampling are discussed in detail in KEY SOP No. 10 (Attachment A). Borings are not anticipated to penetrate more than 10 feet into the varved clay unit, therefore small diameter rods (e.g. 3 to 4 inch internal diameter, ID) will be advanced to the final depth of the boring. Advancement of the tooling will be incremental to allow for collection of soil samples using core samplers or as specified in Section 3.3.1.

A telescopic casing approach will be utilized during drilling through meadow mat and varved clay interfaces. Based on this approach, a steel casing will be set in the borehole at the fill/meadow mat interface prior to penetrating deeper with the casing sealed at the fill/meadow mat interface with bentonite pellets or equivalent. Approximately one (1) foot of bentonite seal will be established at the fill/meadow mat interface and allowed to hydrate for a minimum of 30 minutes. Subsequently, a second casing will be pushed from the inside of the first casing that will extend to the deep sand/varved clay interfaces. This second casing will be sealed to the sand/varved clay interface in-place with bentonite pellets or equivalent as described above. The bentonite medium will be allowed to hydrate for a minimum of 30 minutes before the boring is

advanced to its final depth. The proposed approach for this investigation, including a modified direct push method of sonic drilling has the benefit of an outer casing that follows the inner core barrel after each sample is collected. The outer casing facilitates maintenance of an open borehole and limits the possibility of downward migration of impacted materials. This method also eliminates cuttings and reduces the need for water during advancement, minimizing the amount of IDW generated during drilling activities.

3.3 SOIL SAMPLE COLLECTION PROCEDURES

Surface and subsurface soil sampling will be conducted according to the procedures presented in the following subsections and the applicable procedures specified in KEY SOP No. 32 and 33 (Attachment A) respectively.

3.3.1 Surface Sample Collection

Surface core samples will be collected in accordance with ASTM Method D6282 for field and laboratory analysis. Specific procedures to be followed are as follows:

- For a four (4) to five (5) foot long direct-push coring barrel tool, advance initial length of core with polycarbonate liner to depth.
- Override core barrel to equal depth with larger diameter outer casing.
- Remove inner core barrel and extract the liner-contained sample onto observation area.
- Immediately after the liner is cut open, the sample will be screened for the presence of VOCs, as described in KEY SOP No. 20 (Attachment A), by scanning the length of the core with a photoionization detector (PID) or a flame ionization detector (FID). The maximum sustained PID/FID reading will be recorded.
- Record the percent recovery or the length of soil sample recovered.
- Describe the soil samples recovered with regard to such characteristics as composition, color, stratification, and other pertinent information. The majority of surficial fill material at the Site contains some amount of chromite ore processing residue (COPR). COPR has several distinctive features generally not found in natural soil or in manmade fills originating from other sources. To assist in the identification of COPR, the following description is provided: COPR is predominantly reddish in color (due to a high iron oxide concentration), but may exhibit a greenish or yellowish "blush" on the surface where chromium salts have migrated to the surface via capillary action or evapotranspiration, and have been left behind when the water evaporated. The residue is typically coarsely granular, ranging in size from fine to medium sand-size particles to small gravel-sized particles. The granules are also typically rounded and pitted, due to their slag origins (recrystallization of the material in air after processing typically produces rounded and pitted particles).
- The sample will be inspected for the presence of DNAPL. The presence/absence of DNAPL will be recorded according to the following numeric ranking system:

0 – No visual evidence of impact observed
1 – Soil staining or sheen observed
2 – Residual DNAPL present
3 – Free Phase DNAPL present

- Obtain a representative sample for chemical analyses if the sample is assigned a DNAPL ranking of 2 (Residual DNAPL) or 3 (Free Phase DNAPL). If duplicate soil samples are required, discrete grab sample of sufficient volume should be removed from the same location and depth range to satisfy aliquot requirements for analysis purposes.

3.3.2 Subsurface Sample Collection

Subsurface core samples will be collected in accordance with ASTM Method D6282 for field and laboratory analysis. Specific procedures to be followed are as follows:

- For a four (4) to five (5) foot long direct-push coring barrel tool, advance initial length of core with polycarbonate liner to depth.
- Override core barrel to equal depth with larger diameter outer casing.
- Remove inner core barrel and extract the liner-contained sample onto observation area.
- Immediately after the liner is cut open, the sample will be screened for the presence of VOCs, as described in KEY SOP No. 20 (Attachment A), by scanning the length of the core with a photoionization detector (PID) or a flame ionization detector (FID). The maximum sustained PID/FID reading will be recorded.
- Record the percent recovery or the length of soil sample recovered.
- Describe the soil samples recovered with regard to such characteristics as composition, color, stratification, and other pertinent information. The majority of surficial fill material at the Site contains some amount of COPR. COPR has several distinctive features generally not found in natural soil or in manmade fills originating from other sources. To assist in the identification of COPR, the following description is provided: COPR is predominantly reddish in color (due to a high iron oxide concentration), but may exhibit a greenish or yellowish "blush" on the surface where chromium salts have migrated to the surface via capillary action or evapotranspiration, and have been left behind when the water evaporated. The residue is typically coarsely granular, ranging in size from fine to medium sand-size particles to small gravel-sized particles. The granules are also typically rounded and pitted, due to their slag origins (recrystallization of the material in air after processing typically produces rounded and pitted particles).
- The sample will be inspected for the presence of DNAPL. The presence/absence of DNAPL will be recorded according to the following numeric ranking system.

  0 – No visual evidence of impact observed
  1 – Soil staining or sheen observed

2 – Residual DNAPL present
3 – Free Phase DNAPL present

- Obtain a representative sample for chemical analyses if the sample is assigned a DNAPL ranking of 2 (Residual DNAPL) or 3 (Free Phase DNAPL). If duplicate soil samples are required, discrete grab sample of sufficient volume should be removed from the same location and depth range to satisfy aliquot requirements for analysis purposes.
- Continue the above sequence to the final boring depth.

3.4 BORING ABANDONMENT

Soil borings will be permanently abandoned by grouting as soon as possible following completion. Borehole plugging will conform to the requirements outlined in N.J.A.C. 7:9-9 including the submittal of appropriate documentation by a certified well sealer, as necessary. The borehole will be backfilled with a cement-bentonite grout mixture emplaced from the bottom of the boring through a tremie pipe (or drill rods) and applying the appropriate surface treatment to repair the IRM covering, where applicable. Soil boring locations will be staked for subsequent surveying, as outlined in Section 8, to determine the plan location and ground surface elevations of each boring. Specific procedures for borehole abandonment in areas within or outside IRM coverings are set forth in the following subsections.

3.4.1 Boreholes Outside IRM Site Areas

Soil borings in areas where there have been no IRM coverings will be sealed using the following procedures:

- Prepare grouting material with the following specifications:
  - Eight (8) gallons of potable water
  - Five (5) pounds of bentonite powder
  - 94 pound bag of cement
- Calculate the volume of the borehole based on the bit or tool head diameter plus 10 percent (%), and the boring depth, and determine the volume of grout to be emplaced. Generally, the total mixed volume is the borehole volume plus 20%.
- Mix the grout to be emplaced.
- Record the type and amount of materials used during the mixing operation. Check to verify that the ratios are within specification tolerance.
- Place tremie pipe near bottom of borehole and begin pumping the grout.
- Continue pumping until return circulation of grout is observed.
- Remove tremie pipe, drilling rods, and casings in reverse order of installation.

- Completely fill the borehole and clean surface near the borehole. Level the ground to about the pre-existing grade. Add grout or cement as necessary to the area near the borehole.
- Make a follow-up check at each sealed borehole within 7 to 10 days of completion. Document the visit and record any action taken.

3.4.2 Boreholes in Paved IRM Site Areas

- Grout borehole to original surface, but below IRM covering, using the methods outlined above. Allow 24 hours for cement grout to cure.
- Clean surface around borehole. Remove surface casing.
- Enlarge excavation of IRM surface to a diameter six (6) inches larger than the hole cut in the geotextile. Stockpile coarse aggregate on polyethylene sheeting.
- Place patch of geotextile over hole. Provide for a minimum six (6)-inch overlap and restore IRM layers as applicable in the same order as before.
- Replace stockpiled coarse aggregate. Fill remainder of hole with appropriate IRM material.

3.4.3 Boreholes in Aggregate-Covered IRM Site Areas

- Grout borehole to original surface, but below IRM covering, using the methods outlined above. Allow 24 hours for cement grout to cure.
- Clean surface around borehole by removing the 10 foot by 10 foot, polyethylene sheeting protecting the IRM surface adjacent to the borehole. Remove steel plate and temporary casing which was used to also protect the IRM covering while drilling.
- Cut top layer of geotextile and geomembrane to allow for patching of lower geotextile layer. Patch lower layer of geotextile, providing appropriate overlap.
- Patch geomembrane layer using manufacturer-recommended geomembrane patch and appropriate patching technique.
- Patch top layer of geotextile, providing a minimum six (6)-inch overlap.
- Replace stockpiled coarse aggregate to appropriate elevation.

3.4.4 Boreholes in Capillary Break Areas

- Grout and remove casing to the lower limit of the capillary break and allow time for grout to cure.
- Place lower geotextile layer, then aggregate similar to existing size and thickness, followed by top layer of geotextile.
- Replace top layer of geotextile.
- Replace stockpiled PDM/surface material, if applicable, to pre-existing elevation.

4.0 EQUIPMENT DECONTAMINATION

All equipment involved in sample collection must be either new and disposable or decontaminated prior to initiation of on-site activities, between each use and prior to demobilization from the site. Sampling equipment decontamination will be conducted according to the applicable procedures provided in KEY SOP No. 25 (Attachment A), Section 2.4 of the NJDEP FSPM and Section 3.4 of the USEPA CSFM.

Heavy equipment such as drill rigs and backhoes, including all downhole equipment such as casing, drill rods, and drill bits shall be decontaminated before arrival at the Site and between each drilling location by pressure steam cleaning with potable water and, if needed, manual scrubbing at a designated decontamination pad.

Soil sampling is primarily being conducted for subsurface delineation of DNAPL-related Site constituents and to supplement existing surface and subsurface sampling data. Soil sample collection equipment, such as drill bits, will be decontaminated between each use by detergent solution wash and potable water rinse. For sampling equipment used to collect samples for laboratory analysis for VOCs and SVOCs, an isopropyl alcohol rinse and de-ionized water rinse will be completed following the detergent wash and potable water rinse.

5.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTES

Investigation-derived waste (IDW) generated during sampling activities will likely include the following:

- Drill cuttings,
- Purge water,
- Decontamination fluids,
- Personal protective equipment (PPE), and
- Disposable sampling equipment.

Management of IDW will be conducted according to the applicable procedures provided in KEY SOP No. 04 (Attachment A).

IDW will be containerized, staged, and characterized before being managed in an appropriate manner conforming to USEPA CSFM Section 13.4 and NJDEP FSPM Section 6.5. The following presents preferred approaches to management of the potentially impacted IDW which are consistent with the USEPA CSFM and the NJDEP FSPM.

- Potentially-impacted soils will be containerized and stored in a designated area on the SCCC Site. Ultimately, the soils will be removed from the Site and transported to an appropriate disposal facility. Soils will be segregated based on their origin relative to the meadow mat. Fill material and meadow mat will be containerized separately from the deep sand and varved clay soils. For borings located on the Seaboard site, the same segregation protocols will be adhered to, with the exception of existing PDM remaining that will be stockpiled near the borehole and used for borehole completion purposes.
- Non-impacted PPE or disposable sampling equipment will be managed as general refuse. Such materials that have been affected by site constituents will be containerized for subsequent off-site disposal at a permitted facility.

6.0 SAMPLE HANDLING

The following sections detail the procedures for the handling, documentation, and analysis of soil samples for chemical analysis. The sampling procedures will be conducted in accordance with the USEPA CSFM Section 6, and the NJDEP FSPM Chapter 6.

6.1 SAMPLE ANALYSIS

Chemical analyses of soil samples will be completed according to the requirements presented in the RI/FFS Work Plan, QAPP and this FSP. A summary of the analytical parameters and methods is provided in Section 2.0. All chemical analyses will be performed by a New Jersey Certified Laboratory. Laboratory certification shall be in accordance with N.J.A.C. 7:18, Section 5 of the USEPA CSFM, and the NJDEP FSPM 6.9.2.2.4.

6.2 SAMPLE CONTAINERS

Sample containers and appropriate preservatives (where necessary) will be supplied by the analytical laboratory. After the respective sample containers have been filled with appropriate sample media and preserved as necessary, samples will be properly identified using sample container labels. Sample container specifications are described in the QAPP (Appendix E of the RI/FFS Work Plan) and KEY SOPs No. 22 and 23 (Attachment A).

6.3 SAMPLE DESIGNATIONS

The sample designation system that exists for the SCCC Site will be carried through the design data acquisition activities. Sample location designations are depicted on Figure 2 and are listed in Table 1.

6.4 LABELING, PRESERVATION, AND CHAIN OF CUSTODY

Post sampling activities will be performed in accordance with Section 6 of the USEPA CSFM and the NJDEP FSPM, 6.1.7. Each sample bottle will be labeled prior to filling. The sample labels will include, but not be limited to, the following information:

- Project/Site Name;
- Sample Identification (Location and Depth);
- Sample Collection Time and Date;
- Sampler's Initials;
- Preservative, if applicable, mark "None" if unpreserved; and,
- Requested Analyses.

Samples for chemical analysis shall be preserved as necessary. Preservation requirements are described in KEY SOPs No. 22 and 23 (Attachment A). Filled sample bottles will be placed in a cooler and chilled to a temperature of four (4) degrees Celsius (C) and maintained at this temperature pending delivery to the laboratory. Ice or re-freezable ice packs will be used to maintain proper sample temperature. If ice is used, samples will be packaged in sealable plastic bags to minimize contact of water with the sample containers. A temperature blank is to be provided by the laboratory for each sample shipment container, and will accompany the sample shipping container and samples back to the laboratory. The laboratory will use the temperature blank vial to check the temperature of the samples when they are received at the laboratory.

A record of all samples collected will be maintained in the project field logbook, associated field monitoring and sampling forms, and chain-of-custody (COC). The original copy of the completed COC will accompany all samples shipped from the Site to the laboratory. The COC will either be placed in the sample shipping package (e.g., cooler), or hand-delivered to the laboratory courier or sample receiving department personnel. If the COC is shipped within the sample cooler, the COC will be placed in a sealable water-resistant bag (e.g., Ziploc® bag) and taped to the inside of the cooler's lid. A copy of the completed COC will be retained by the sampling personnel. A detailed description of COC requirements are described in KEY SOP No. 24 (Attachment A).

6.5 SAMPLE SHIPPING

All samples will be transported to the analytical laboratory in durable, waterproof, and secured plastic coolers. Sample coolers will generally be supplied by the laboratory. All samples will be packaged very carefully to prevent sample breakage. Samples will be shipped via overnight carrier (e.g., Federal Express, Airborne, United Parcel Service), courier service provided by the laboratory or hand delivered to the analytical laboratory, generally within 36 hours of collection. However, shipments containing aqueous samples for analysis of hexavalent chromium will be delivered to the laboratory as soon as possible after collection due to holding time considerations. Additionally, the sample security and preservation must be maintained if samples are not to be transported immediately to the laboratory. A detailed description of the sample shipment procedures are provided as KEY SOP No. 23 (Attachment A).

6.6 SAMPLE DOCUMENTATION

All data and information generated in the field will be recorded directly into bound notebooks. Field logbooks are the primary source of documentation for all site activities. They serve as legal record of all investigative activities. All pertinent information regarding the site and sampling procedures must be documented.

Information recorded in the notebook should be noted with the date and time of entry. The following items should be included as logbook entries in addition to the field data and measurements acquired during the investigation:

- Name and location of site;
- Date and time of arrival and departure;
- Sampling event description;
- Prevailing weather conditions;
- Names and affiliations of persons on-site and purpose of visit;
- Subcontractor equipment on-site;
- Name of person keeping log;
- Equipment calibration record;
- IDW log
- Photographic log.

The sampling event description should include methodology, sample numbers and volumes, description of samples, date and time of sample collection, and name of sample collector. All information should be recorded in permanent ink for the legal record. The page of the logbook should be numbered for ease of reference. At the end of each field day, the project scientist/engineer or his designee should sign and date the notebook to verify the day's activities. A detailed description of the field logbook documentation procedure is provided as KEY SOP No. 03 (Attachment A).

7.0 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Quality assurance/quality control (QA/QC) for field sampling efforts will be conducted in accordance with the NJDEP FSPM, 2.5 and Section 8.1.6.3 of the USEPA CSFM, and primarily be measured via the collection of field QC samples, which consist of the following:

- Field duplicates;
- Equipment blanks;
- Trip blanks.

7.1 FIELD DUPLICATES

Field duplicates are used to evaluate the sample collection and analyses effects on the reproducibility of data. Field duplicates are collected by splitting a sample evenly between the primary sample and QA/QC sample containers.

Field duplicates of soil samples for all analyses except volatile organics will be taken by homogenizing the soil in a stainless steel bowl and then placing replicate portions into the sample containers. Field duplicates for volatile analyses will be collected as separate discrete grab samples from the same location and boring depth. Preservation will be performed as necessary for the appropriate analysis. One field duplicate for each analysis for each sampling event or one (1) per every 20 samples will be collected, whichever is greater.

7.2 EQUIPMENT BLANKS

Equipment blank data are used to evaluate field decontamination procedures. Equipment blanks will be collected by pouring analyte-free water, supplied by the analytical laboratory, through a decontaminated sample bailer or over decontaminated soil sampling utensils into the sample bottles. Preservation and filtration will be performed as necessary for the appropriate analyses. For equipment that is decontaminated and re-used, one equipment blank will be collected per day for each type of equipment used or one per every 10 samples will be collected, whichever is greater.

If disposable equipment is used, the field blank will be taken from a rinse of the equipment prior to sampling use. One field blank per sampling event will be sufficient for each type of disposable instrument used.

7.3 TRIP BLANKS

Trip blank data will be used to evaluate exposure to volatile organic constituents during sampling, shipping and storage at the laboratory. The prepared trip blanks are to be transported

with the VOC vials to the field. Trip blanks for a particular date of submission will, if practical, be transported back to the various sample locations and transported back to the laboratory in the sample shipment container with all other VOC samples for that data. One set of trip blanks will be included in each cooler containing VOC sample vials and will be analyzed for the same list of VOCs as the primary samples.

8.0 SURVEY OF SAMPLE LOCATIONS

Soil boring locations will be surveyed under the direction of a New Jersey-licensed surveyor. Horizontal control for these boring locations will be tied into the New Jersey State Plane Coordinate System referenced to the North American Datum of 1983 (NAD 1983). Vertical control will be tied to the North American Vertical Datum of 1988 (NGVD 1988).

The ground surface elevation for each soil boring will be surveyed to the nearest 0.01 foot above mean sea level. The plan location of each boring will be surveyed to an accuracy of approximately 0.1 foot.

TABLE

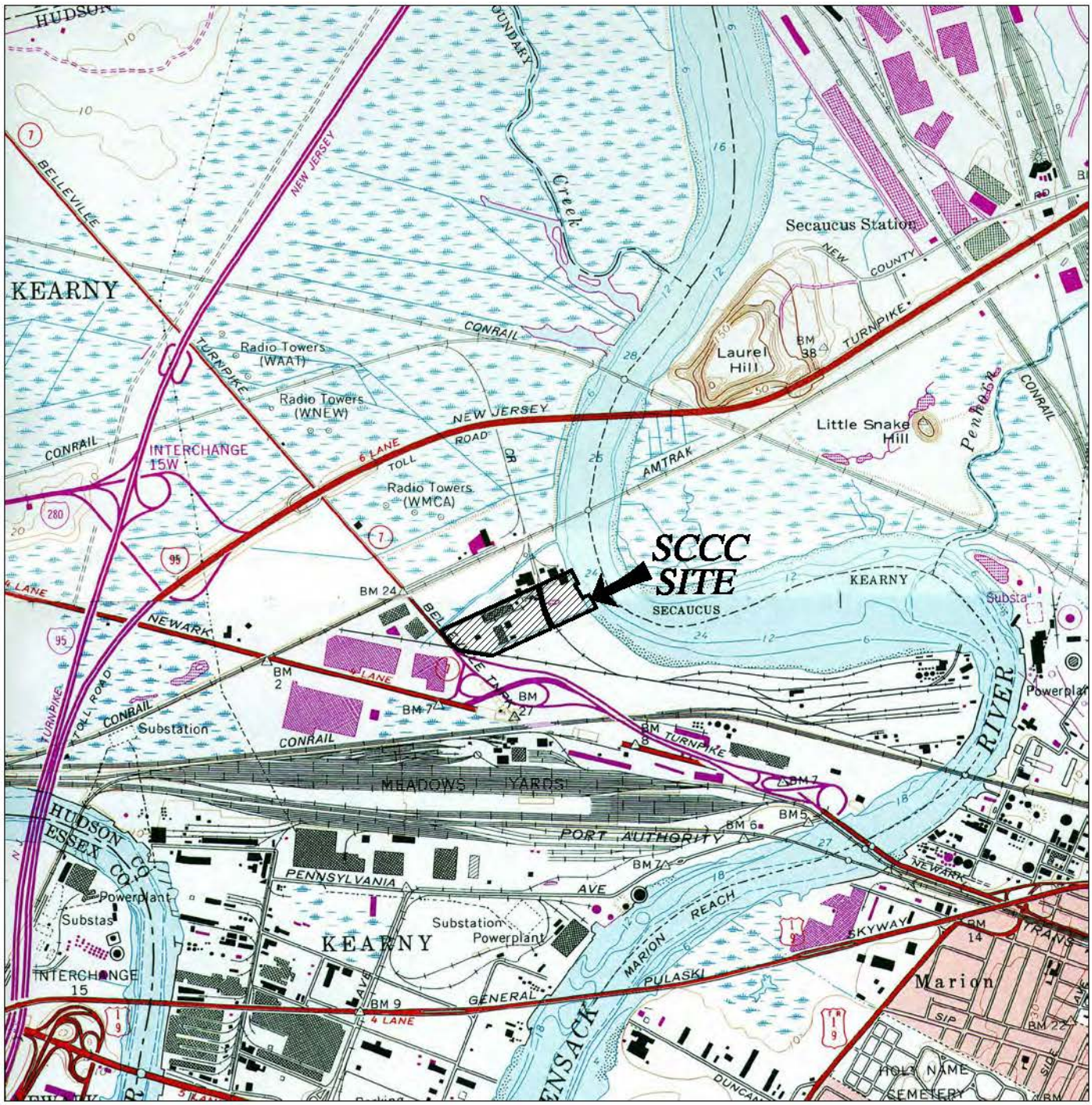
TABLE 1

SOIL SAMPLING AND ANALYSIS SUMMARY
SCCC SITE REMEDIAL INVESTIGATION
KEARNY, NEW JERSEY

Matrix Sample Summary			QA Sample Frequency[1]				Analytical Requirements Summary				
Sample Location	**Analytical Parameter[2]**	**No. of Samples**	**Field Duplicates**	**Rinsate Blanks**	**MS**	**MSD**	**Method Reference[3]**	**Bottle Type**	**Required Sample Volume[4]**	**Preservation**	**Holding Time**
SURFACE SOIL SAMPLES											
D-14 through D-22 VC-1 through VC-5	TCL VOCs	14[5]	1	2	1	1	SW846 5035A SW846 8260B/8121[11]	Glass	Encore™ (3) or TerraCor Kits	1 x 5 ml methanol; 2 x 5 ml sodium bisulfate; 1 x 5 ml	14 days from collection if field preserved. Preservation within 48 hours if lab preserved.
D-14 through D-22 VC-1 through VC-5	TCL SVOCs	14[5]	1	2	1	1	SW846 8270C	Glass	100 grams	4°C	7 days to extraction/40 days to analysis.
D-14 through D-22 VC-1 through VC-5	TCL PCBs	14[5]	1	2	1	1	SW846 8082	Glass	4 ounces	4°C	7 days to extraction/40 days to analysis.
D-14 through D-22 VC-1 through VC-5	PCDD/PCDF	14[5]	1	2	1	1	SW846 8290	4-oz glass	25 mg	4°C	1 year
D-14 through D-22 VC-1 through VC-5	TAL Metals (includes total Cr)	14[5]	1	2	1	1	SW846 6000 and 7000 series	Glass	100 grams	4°C	28 days for Hg; 6 months for other metals
D-14 through D-22 VC-1 through VC-5	Hexavalent Chromium	14[5]	1	2	1	1	SW846 7199[12]	Plastic or glass	100 grams	4°C	28 days for soil matrix; 24 hours for aqueous matrix
D-14 through D-22 VC-1 through VC-5	Hydronium Ion (pH)	14[5]	1	2	1	1	SW846 9045C	Glass	4 ounces	4°C	As soon as possible after sample receipt
D-14 through D-22 VC-1 through VC-5	Oxidation-Reduction Potential	14[5]	1	2	1	1	ASTM D1498	Glass	4 ounces	4°C	As soon as possible after sample receipt
FILL/MEADOW MAT SUBSURFACE SOIL SAMPLES											
D-14 through D-27 VC-1 through VC-5	TCL VOCs	TBD[6] [max = 19]	1[7]	1[7]	1[7]	1[7]	SW846 5035A SW846 8260B/8121[11]	Glass	Encore™ (3) or TerraCor Kits	1 x 5 ml methanol; 2 x 5 ml sodium bisulfate; 1 x 5 ml	14 days from collection if field preserved. Preservation within 48 hours if lab preserved.
D-14 through D-27 VC-1 through VC-5	TCL SVOCs	TBD[6] [max = 19]	1[7]	1[7]	1[7]	1[7]	SW846 8270C	Glass	100 grams	4°C	7 days to extraction/40 days to analysis.
D-14 through D-27 VC-1 through VC-5	TCL PCBs	TBD[8] [max = 10]	--	--	--	--	SW846 8082	Glass	4 ounces	4°C	7 days to extraction/40 days to analysis.
D-14 through D-27 VC-1 through VC-5	PCDD/PCDF	TBD[8] [max = 10]	--	--	--	--	SW846 8290	4-oz glass	25 mg	4°C	1 year
DEEP SAND SUBSURFACE SOIL SAMPLES											
D-14 through D-27 VC-1 through VC-5	TCL VOCs	19[9]	1	1	1	1	SW846 5035A SW846 8260B/8121[11]	Glass	Encore™ (3) or TerraCor Kits	1 x 5 ml methanol; 2 x 5 ml sodium bisulfate; 1 x 5 ml	14 days from collection if field preserved. Preservation within 48 hours if lab preserved.
D-14 through D-27 VC-1 through VC-5	TCL SVOCs	19[9]	1	1	1	1	SW846 8270C	Glass	100 grams	4°C	7 days to extraction/40 days to analysis.
D-14 through D-27 VC-1 through VC-5	TCL PCBs	TBD[8] [max = 10]	--	--	--	--	SW846 8082	Glass	4 ounces	4°C	7 days to extraction/40 days to analysis.
D-14 through D-27 VC-1 through VC-5	PCDD/PCDF	TBD[8] [max = 10]	--	--	--	--	SW846 8290	4-oz glass	25 mg	4°C	1 year
VARVED CLAY SUBSURFACE SOIL SAMPLES											
D-14 through D-27 VC-1 through VC-5	TCL VOCs	19+19[10]	1	1	1	1	SW846 5035A SW846 8260B/8121[11]	Glass	Encore™ (3) or TerraCor Kits	1 x 5 ml methanol; 2 x 5 ml sodium bisulfate; 1 x 5 ml	14 days from collection if field preserved. Preservation within 48 hours if lab preserved.
D-14 through D-27 VC-1 through VC-5	TCL SVOCs	19+19[10]	1	1	1	1	SW846 8270C	Glass	100 grams	4°C	7 days to extraction/40 days to analysis.
VC-1 through VC-5	TAL Metals (includes total Cr)	5+5[10]	1	1	1	1	SW846 6000 and 7000 series	Glass	100 grams	4°C	28 days for Hg; 6 months for other metals
VC-1 through VC-5	Hexavalent Chromium	5+5[10]	1	1	1	1	SW846 7199[12]	Plastic or glass	100 grams	4°C	28 days for soil matrix; 24 hours for aqueous matrix
VC-1 through VC-5	Hydronium Ion (pH)	5+5[10]	1	1	1	1	SW846 9045C	Glass	4 ounces	4°C	As soon as possible after sample receipt
VC-1 through VC-5	Oxidation-Reduction Potential	5+5[10]	1	1	1	1	ASTM D1498	Glass	4 ounces	4°C	As soon as possible after sample receipt

1. Quality assurance samples to be obtained at a frequency of 1 per 20 samples with the exception of equipment blanks (rinsate samples). Rinsate samples to be collected at a frequency of 1 per 10 samples.
2. Abbreviations for analyses are as follows: TCL - Target Compound List; TAL - Target Analyte List; VOCs - Volatile Organic Compounds (including all 3 trichlorobenzene isomers); SVOCs - Semivolatile Organic Compounds; PCBs - Polychlorinated Biphenyls as Aroclors; PCDD/PCDF - Polychlorinated-dibenzo-p-dioxins and Polychlorinated-dibenzo-p-furans
3. Abbreviations for analytical methods are as follows: SW846 - Environmental Protection Agency methods per Test Methods for Evaluating Solid Waste - Physical/Chemical Methods - SW846 (3rd Ed) (as revised and updated); ASTM - American Society for Testing and Materials.
4. Precleaned and preveserved sample bottles to be provided by the laboratory. Sample volumes to be minimized as possible based on minimum laboratory volume requirements.
5. Surface soil samples will not be obtained on the adjacent Seaboard site given that processed dredge material has been placed. Surface soil samples will be obtained from all DNAPL (D) and Varved Clay (VC) borings on the SCCC Site.
6. The number of samples to be collected from the fill or meadow mat is to be determined based on field observations. One such sample will be obtained from each of the 19 borings if field observations indicate that either residual or free-phase DNAPL is present. The DNAPL Ranking System as defined in the Field Sampling Plan will be the basis to determine if a fill/meadow mat sample is to be obtained. If the sample is assigned a DNAPL ranking of 2 (residual DNAPL) or 3 (free phase DNAPL) a sample will be obtained for analysis. The most highly impacted material encountered in the fill or meadow mat will be sampled from each boring where residual or free phase DNAPL is encountered. Samples will be obtained as discrete grab samples of sufficient volume to satistfy aliquot requirements for analytical purposes.
7. In the event that no fill or meadow mat samples are obtained as the result of the absence of any residual or free phase DNAPL in the horizons of interest, the associated QA/QC samples will be unnecessary.
8. Selected subsurface soil samples from DNAPL impacted material will be analyzed for PCBs and PCDD/PCDF in addition to VOC and SVOC analysis. A maximum of 10 such samples will be obtained from the fill/meadow mat and the deep sand across both the DNAPL (D) and Varved Clay (VC) borings. The first 10 such samples encountered will be subjected to the PCB and PCDD/PCDF analysis.
9. One subsurface soil sample will be obtained from the deep sand for each of the DNAPL (D) and Varved Clay (VC) borings. The sample will be obtained from the most highly DNAPL-impacted zone if DNAPL is present, or from the base of the deep sand if DNAPL is not present. If a DNAPL-impacted zone is present, a discrete grab sample of sufficient volume to satisfy aliquot requirements for analytical purposes will be obtained.
10. Organic analysis samples for varved clay investigation consist of a sample from the upper horizon (1 foot) of the varved clay (19 samples total) and, if DNAPL is present in the deep sand, up to 19 additional samples obtained approximately 5 feet below the initial samples (to be held in the laboratory for analysis if needed). Inorganic analysis samples for varved clay investigation consist of a sample from the upper horizon (1 foot) of the varved clay (5 samples total) and 5 additional samples obtained approximately 5 feet below the initial samples (to be held in the laboratory for analysis if needed).
11. SW846 Method 8121 will be used for the quantitation o f 1,3,5-trichlorobenzene, which cannot be isolated via SW846 8260B analysis.
12. Hexavalent chromium analysis to be completed pursuant to SW-846 Method 7199 subject to the additional pH/ORP measurement requirements for determination of oxidizing or reducing conditions and hexavalent chromium spiking requirements stipulated by the NJDEP.

FIGURES



PERFORMING PARTIES GROUP

DRWN: SCC	DATE: 07/15/13	KEY ENVIRONMENTAL INCORPORATED
CHKD: RJH	DATE: 07/15/13	
APPD: JSZ	DATE: 07/15/13	
SCALE:	1"= 2000'	

RI/FFS FIELD SAMPLING PLAN
STANDARD CHLORINE CHEMICAL CO., INC. SITE
KEARNY, HUDSON COUNTY, NEW JERSEY

REFERENCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLES OF JERSEY CITY, AND WEEHAWKEN, NEW JERSEY

ISSUE DATE:

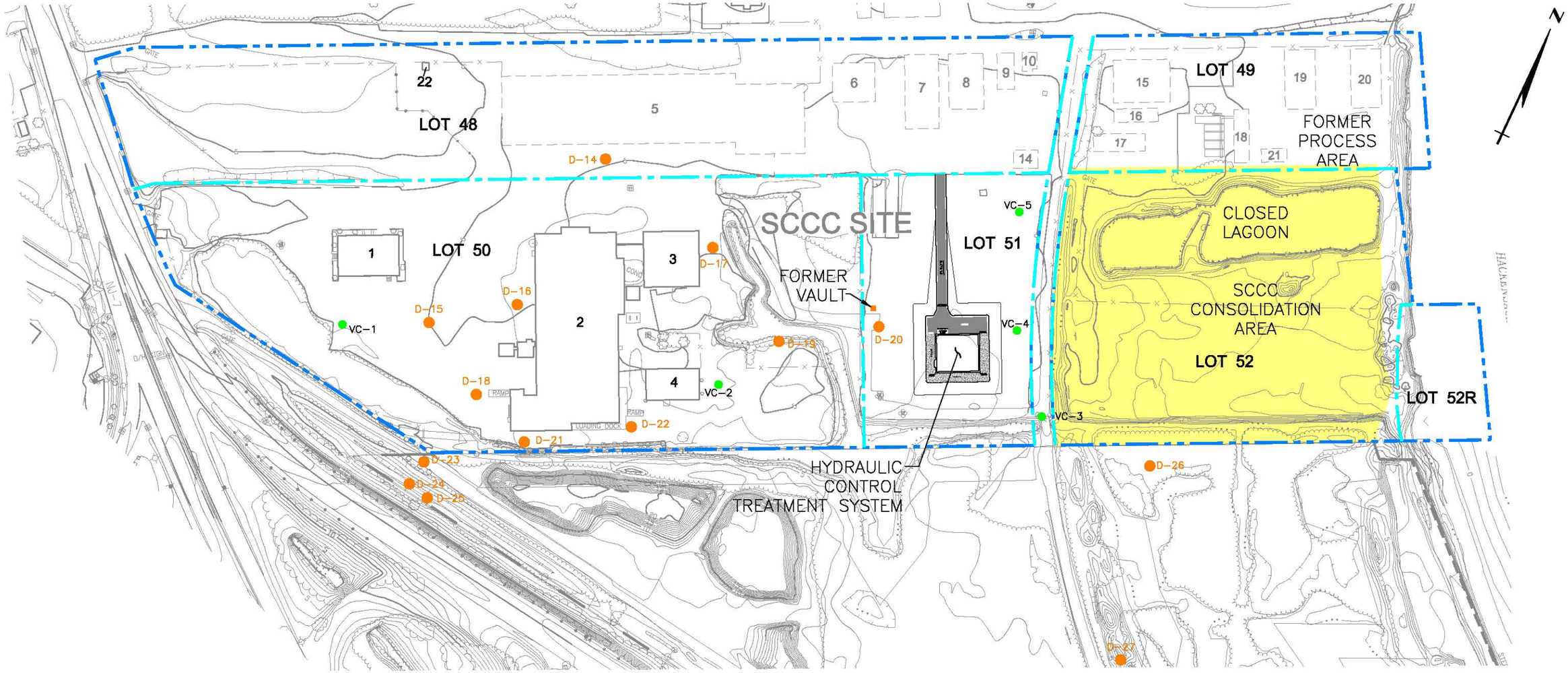
KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

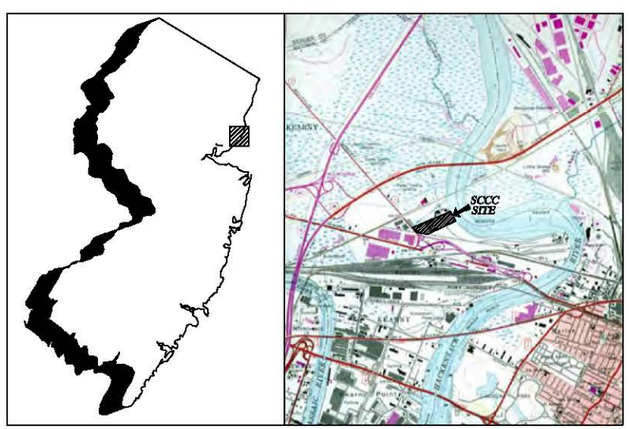
SITE LOCATION MAP

PROJECT NO: 2013-03

FIGURE 1

y:\DGcivil\kearny\ri-ffs work plan\ri-fss addendum\figure 1.dwg Last Saved By: Scanner 7/15/2013 2:40 PM Plotted By: Shelly Corner 7/25/2013 1:14 PM Scale: 1:1.016827





SITE LOCATION

LEGEND

- PROPERTY BOUNDARY
- LOT BOUNDARY
- EXISTING GROUND SURFACE ELEVATION CONTOURS
- EXISTING STREAM, POND AND RIVER BANK
- EXISTING VEGETATION
- CONSOLIDATION AREA COVER SYSTEM
- EXISTING ACCESS ROAD
- EXISTING FENCE
- EXISTING STRUCTURES
- FORMER STRUCTURE
- EXISTING UTILITY POLES
- PROPOSED DNAPL DELINEATION BORINGS
- PROPOSED VARVED CLAY SAMPLE LOCATION

0 150 300 FEET

PERFORMING PARTIES GROUP

DRWN: SCC	DATE: 07/15/13	KEY ENVIRONMENTAL INCORPORATED
CHKD: RJH	DATE: 07/15/13	
APPD: JSZ	DATE: 07/15/13	
SCALE: AS SHOWN		

RI/FFS FIELD SAMPLING PLAN
STANDARD CHLORINE CHEMICAL CO., INC. SITE
KEARNY, HUDSON COUNTY, NEW JERSEY

PROPOSED DELINEATION LOCATION MAP

PROJECT NO: 2013-03

FIGURE 2

REV #	DATE	DESCRIPTION	APPD
3			
2			
1			

REFERENCE: EXISTING GROUND SURFACE ELEVATION CONTOURS PER BORBAS SURVEYING & MAPPING, LLC.

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

y:\00civil\kearny\ri-ffs work plan\ri-fss addendum\figure 2.dwg Last Saved By: Scomer 7/23/2013 2:05 PM Plotted By: Shelly Comer 7/23/2013 1:16 PM Scale: 1:1

ATTACHMENT A

STANDARD OPERATING PROCEDURES (SOPs)

No. 02 – Utilities Clearance
No. 03 – Field Logbook
No. 04 – Management of Investigation-Derived Wastes
No. 10 – Drilling Methods for Subsurface Investigations and Well Installations
No. 20 – Volatile Organic Screening
No. 22 – Environmental Sample Preparation
No. 23 – Sample Handling, Preservation, Packaging and Shipping
No. 24 – Chain of Custody
No. 25 – Equipment Decontamination
No. 32 – Surface Soil Sampling
No. 33 – Subsurface Soil Sampling

02 – UTILITIES CLEARANCE

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) presents procedures for locating utilities, particularly underground utilities, prior to conducting intrusive field work. Information regarding the location of underground and overhead utilities may be obtained from the client or site owner in some instances. This, however, does not eliminate the need by Key Environmental, Inc. (KEY) to assure that utilities have been fully identified and to avoid those areas (where possible) where it is difficult or impossible to adequately locate underground utilities. If available information does not conclusively determine the presence/absence of utilities in a particular area, alternative measures (*i.e.,* metal detectors, magnetometers or hand excavation) may be employed.

Damage to gas and electric lines could result in loss of life or serious personal injuries. Damage to utilities may also result in loss of service to factories and home owners and potentially result in lawsuits filed by affected parties. The purpose of this section is to provide a procedure for KEY employees to follow in order to identify, locate, and avoid utility lines. This procedure does not, however, cover every possibility in terms of identifying utilities. The field crew must always be alert to the possibility of buried or overhead utilities whether known to be present in the area or not, as well as utilities embedded in walls, floors, or ceilings if working indoors. Thus, a visual inspection of the area must be conducted to identify any indication of the possible presence of utilities (*i.e.,* fire hydrants, meters, repaired pavement, disturbed soils, markers, *etc*.)

The location and identification of utilities is applicable to all sites, particularly when subsurface exploration is carried out.

1.1 Referenced SOPs

03 – Field Logbook

1.2 Definitions

One-Call System: A communication system established by utilities, governmental agencies, or other operators of underground utilities to provide a single telephone access number for excavating contractors and the general public to notify utilities of their intent to use equipment for excavating, tunneling, demolition, or any other similar work that could affect underground utilities. This system may go by other names (*e.g.*, “Miss Dig,” “Miss Utility,” or “Dig Safe”).

2.0 REQUIRED MATERIALS

The following equipment is required to document the utility clearance activities:

- Field logbook, with all contact information (names, organization, phone number);
- Utility clearance checklist forms; and
- Indelible ink pens.

3.0 METHODOLOGIES

No subsurface work should be performed until the presence or absence of all possible utilities has been verified. In some cases, it will not be possible to map the exact location of all known utilities on the site, but it should be possible to define those general areas where utilities are known to be present and those areas believed to be free of underground utilities.

If KEY is required to locate buried utilities, the utility representatives should be called and an on-site meeting will be required. At no time should KEY employees use equipment to locate utilities on their own. Often the most convenient initial step in locating buried utilities in an area is to contact the appropriate one-call telephone number. The one-call markings are only considered good for two weeks. For projects of longer durations, the one-call contact may need to be repeated periodically. After making the one-call, a reference or I.D. number will need to be recorded in the field notes.

All communications with utility companies should be documented in writing. When meeting in the field, include in the field notes and/or forms the name of the utility representative, the date and time of the meeting, a summary of the discussions, and a sketch of where utilities are located. A map of the utility locations should be made in the field notes since the physical marks (paint or flags) left by the utility representative may not survive to the completion of the investigation. Many times the utility will have area maps that show the location of their lines. Copies of these maps, if available, could be filed with the project notes. Ask the utilities' representatives to sign the summary in the field notes (they may not be willing to do this).

The KEY representative should ensure that the utility representative physically marks the utility locations. They should be identified for the entire area or as much as is feasible since it is difficult or impossible to know at the beginning of a study how extensive the investigation may be. It may also be important to know where utility lines may cross potential contaminant source area(s) as utility trenches may provide migration pathways. If discrepancies exist between utility locator's information and obvious signs of buried utilities or other location information (*e.g.*, utility maps), then work should not proceed at that location until the discrepancies have been resolved.

The KEY field supervisor should coordinate with the project manager and facility personnel to compile a list of all possible underground utilities. The following list of possible underground utilities should be used as a reference list; it is not, however, inclusive of all possible buried utilities:

Public Utilities	**How to Locate** [1]
Natural gas and petroleum pipelines	1
Water mains	1
Natural gas	1 and 2
Electrical power	1 and 2
Telephone	1 and 2
Cable television	1 and 2
Sanitary sewers	3

Storm sewers	3
Traffic control signals	4

Private or Facility Utilities

Natural gas	5, 6, 7, and 8
Electrical power	5, 6, 7, and 8
Telephone	5, 6, 7, and 8
Sanitary sewer	5, 6, 7, and 8
Process waste tanks and effluent pipes (National Pollutant Discharge Elimination System discharges)	5, 6, 7, and 8
Septic system drain fields	5, 6, 7, and 8
Storm sewers and rain gutters	5, 6, 7, and 8
Liquid feed stock tanks and distribution lines	5, 6, 7, and 8
Liquid fuel tanks and distribution lines	5, 6, 7, and 8
Cooling water	5, 6, 7, and 8

1. Call the pipeline or utility company for location information.

2. Call one-call or similar service.

3. Check utility maps at the city engineer's office (request field verification).

4. Check maps or other guidance with the city traffic engineer.

5. Use professional locator service.

6. Check with facility engineering department.

7. Identify where utility enters and exits property with the public utility.

8. Check with private contractors that have or are currently working for the facility.

The above methods of locating utilities should not be substituted for field observation and good judgment. Prior to initiating an excavation or boring, an inspection of the excavation/drilling zone may provide additional indications about the location of nearby underground utilities. Depressions or mounds on the ground surface, new paving patches, manholes, meters, valves, fill lines, vents, power line drops from power poles, sewer clean cuts, catch basins, outfalls, utility connections into nearby structures, areas with linear patches of cleared vegetation, and old utility markup points, such as spray painted lines on curbs and roadways, all may be indications of the presence of utilities. If questions remain regarding the presence of utilities in a work area, contracting a company that specializes in underground utility locating should be considered.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

(Reserved)

5.0 DOCUMMENTATION AND RECORD KEEPING

An accurate record of all people and organizations contacted during a site utilities search should be recorded in a field logbook (see *SOP 03 – Field Logbook*) and/or Attachment 1 of this SOP. A brief summary of any phone, or face to face conversations, should be recorded. Utilities identified should be sketched or mapped. Field observations (indications) that infer the presence of utilities should be described in the field logbook.

6.0 REFERENCES

(Reserved)

ATTACHMENT 1
SOP 02 – UTILITIES CLEARANCE
UTILITY NOTIFICATION COMPLETION CHECKLIST

UTILITY NOTIFICATION COMPLETION CHECKLIST

Notification Service (name): _____ _____ **Phone Number:** _____	To Be Provided by Utility Notification Operator **Assigned Serial Number:** _____ **Clearance Date and Time:** _____
KEY Project Number: _____ Project Name: _____ Project Location: _____	
Time and Date of Notification: _____ Caller's Name: _____	
Contractor Information Contractor Name: KEY Environmental, Inc. (address) 200 Third Avenue (address) _____ (address) Carnegie, PA 15106 Contact Person: _____ Contractor Phone Number: (412) 279 - 3363 Contractor FAX Number: (412) 279 - 4332	
Notification Type ☐ Construction (requires no less than 3 and no more than 10 working days) Dig Date: ____ Time: _____ Depth of excavation: _____ Diameter of drilling: _____ ☐ Design (requires no less than 10 and no more than 90 working days)	

Site Information:

County: _____

Municipality: (boro, township, etc.): _____

Street Address: _____

Nearest Intersection: _____

Site location relative to intersection (distance and orientation): _____

Description of Site Location: _____

Working In:

- ☐ Sidewalk
- ☐ Public Property
- ☐ Private Property
- ☐ Other (specify) _____

Property Owner: _____

Property Owner Contact: _____

Phone Number: _____

Additional Remarks: _____

Utilities to be notified: _____

Notes: _____

03 - FIELD LOGBOOK

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) establishes the requirements of the entry of information into logbooks to ensure that KEY field activities are properly documented. Field logbooks are the primary source of documentation for site activities, and serve as legal record of all occurrences during those activities. The project manager and the field team leader are responsible for ensuring the logbook entries provide sufficient information for the completion of an accurate and detailed description of field operations.

Complete and accurate logbook entries are essential to

- Ensure that data collection associated with field activities is sufficient to support the successful completion of the project
- Provide sufficient information that someone not affiliated with the project can independently reconstruct the field activities at a later date
- Maintain quality control throughout the project
- Document changes to or deviations from the Work Plan
- Fulfill administrative needs of a project
- Support potential legal proceedings associated with a specific project

1.1 Referenced SOPs

None

1.2 Definitions

(Reserved)

2.0 REQUIRED MATERIALS

The required materials for maintaining a field log book include a water-resistant, permanently bound notebook (such as *Rite in the Rain ALL-WEATHER ENVIRONMENTAL No. 550F* notebook (or equivalent) and a pen with permanent ink.

3.0 METHODOLOGIES

Pertinent information regarding the site and work procedures must be documented. Information recorded in the notebook should be noted with the date and time of entry. Each field crew shall maintain a single logbook. Legibility must be maintained. The following items are commonly included as logbook entries:

- Name and location of site
- Date and time of arrival and departure
- Name and affiliation of person keeping log
- Names and affiliations of project personnel present on site
- Sampling event description; including methodology, sample numbers and volumes, description of samples, date and time of sample collection, and name of collector
- Prevailing weather conditions and weather delays
- Technical measurements and readings, with notation of anomalous measurements
- Record of phone calls/and or contact with individuals at the site
- Record of approval of field changes to the scope of work
- Diagrams and sketches as needed to document sample locations
- Physical obstructions encountered during field activities
- Reference to global positioning system data collected, if applicable
- Description of equipment used
- Equipment problems encountered and resolution of such problems
- Management or disposal of investigation-derived wastes
- List and descriptions of photographs including camera used, photographer's name, and the direction or view angle of the photograph
- Equipment calibration information

Information should be recorded in permanent ink for the legal record. The company name, address, and phone number should be entered at the beginning of the log book. The title page should also include the start/finish dates for the activity, and whether more than one logbook is included in the record (e.g., Book __ of __). The pages of the logbook should be numbered for ease of reference. Blank spaces should be crossed out and initialed. No pages may be removed from the logbook for any reason.

All notes should be written at the time of observation. If this is not possible, the logbook should indicate when the observations were recorded and the reason for the delay. Changes or deletions should be crossed out with a single line and initialed by the individual making the change.

At the end of each field day, the project scientist/engineer or designee should sign and date each page of the notebook on which entries were made to verify the day's activities. Unused lines at the end of each day's work shall be marked with a diagonal line, signed and dated. The field team leader (or designee) must also sign and date the final daily entry page of each field crew member maintaining a separate logbook. Each day's work shall be recorded starting on a new page, with the date, time, weather conditions, and team members present.

On at least a weekly basis, completed pages must be copied to the project files on the office served so that the loss or accidental destruction of the logbook will result in a minimal loss of data. Copies shall be reviewed to ensure that they are legible.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

At the end of each day of field activities, the individual or individuals maintaining the field logbook should review the notes for accuracy and completeness. Corrections, deletions, or additions should be stricken, initialed and dated.

5.0 DOCUMENTATION AND RECORD KEEPING

The first page of all field logbooks must contain the holder's name and contact information.

It is recommended that a running activity log be maintained, indicating the times of activities and observations; recorded data be written in the form of tables with an appropriate title; and that diagrams be included to illustrate pertinent information. Logbooks should be labeled with the project name, project number, and a consecutive number for cataloging purposes.

Copies made for the project file will become the primary record of the job activities. The filled logbook remains a working copy until project completion, at which time the logbook is physically stored in the project files.

6.0 REFERENCES

Environmental Research Center, University of Nevada - Las Vegas, March 1989, Soil Sampling Quality Assurance User's Guide: U.S. Environmental Protection Agency EPA/600/8-89/046, 260 p.

Fetter, C.W., 1994, Applied Hydrogeology: New York, Macmillan College Press Publishing Company, 691 p.

U.S. EPA, November 1992, RCRA Ground-Water Monitoring: Draft Technical Guidance: Office of Solid Waste and Emergency Response, OSWER-9950.1.

U.S. EPA, 1987, A Compendium of Superfund Field Operations Methods: Office of Solid Waste and Emergency Response, OSWER 9355.0-14.

U.S. EPA, 2005, Compliance-Focused Environmental Management System – Enforcement Agreement Guidance: National Enforcement Investigations Center, EPA-330/9-97-002R. http://www.epa.gov/oecaerth/resources/policies/neic/cfems_05.pdf.

U.S. EPA, 2007, Contract Laboratory Program Guidance for Field Samplers: Office of Superfund Remediation and Technology Innovation, OSWER 9240.0-44, EPA 540-R-17-06. http://www.epa.gov/superfund/programs/clp/download/sampler/clp_sampler_guidance.pdf.

U.S. EPA, 1988, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA: Office of Solid Waste and Emergency Response, OSWER 9355.3-01. http://www.epa.gov/superfund/policy/remedy/pdfs/540g-89004-s.pdf.

U.S. EPA, 1991, Guidance for Performing Preliminary Assessments Under CERCLA: Office of Solid Waste and Emergency Response, OSWER 9345.0-01A. http://www.epa.gov/superfund/sites/npl/hrsres/.

U.S. EPA, 1991, Guidance for Performing Site Inspections Under CERCLA: Office of Solid Waste and Emergency Response, OSWER 9345.1-05. http://www.epa.gov/superfund/sites/npl/hrsres/.

04 - MANAGEMENT OF INVESTIGATION-DERIVED WASTES

1.0 SCOPE AND PURPOSE

This standard operating procedure (SOP) presents general guidelines for the management of investigation-derived wastes (IDWs), such as, but not limited to the following:

- Drill cuttings generated during soil boring investigations or well installations
- Drilling fluids generated during soil boring investigations or well installations
- Groundwater generated during well development, monitoring well purging, aquifer testing (i.e., pumping tests), or remedial activities
- Water and sediment generated during equipment decontamination
- Used personal protective equipment
- Miscellaneous debris (e.g., well construction materials generated through abandonment of monitoring wells)

Due to the wide range of materials which may be generated and the variety of situations which may arise, it is likely that these SOPs will need to be supplemented with project-specific procedures. Where project-specific procedures are necessary, they should be developed to be consistent with the general guidelines presented below. Determination of the need for and scope of the development of project-specific procedures, will be determined as part of the initial project planning.

1.1 Referenced SOPs

None

1.2 Definitions

(Reserved)

2.0 REQUIRED MATERIALS

Management of investigation-derived wastes requires limited equipment. The following should be available onsite:

- Clean, new 55-gallon drums with lids
- Grease pen or paint stick for labeling
- Labels indicating drum contents and origin

3.0 METHODOLOGIES

3.1 Containerization

Project-specific requirements for containerization of waste materials will be developed during initial project planning. If applicable, this information may be presented in a project-specific waste management plan. Project-specific containerization requirements should be developed to be consistent with the general guidelines provided below.

1. All potentially impacted materials generated during any investigation or remedial activity must be containerized unless one of the exceptions described below under Item 10 apply. Unless directed otherwise by the client, containers (drums, frac tanks, roll-off boxes, etc.) are to be provided by the consultant or contractor.

2. All potentially impacted materials shall be placed in new or reconditioned 55-gallon (DOT-UN1A2) drums. All drums brought onsite must be clean and in sound condition, free of any rust, dents, holes, or other types of damage.

3. Various types of waste materials (e.g., soils, groundwater, PPE, etc.) must be containerized separately without exception. Additionally, dry and wet soils should be containerized separately, if feasible.

4. Materials generated from various plant process areas, which may require potentially different waste classifications, should be containerized separately. As an example, soils generated in the vicinity of a surface impoundment which managed sludge from the treatment of wastewater from wood treating operations that use creosote and/or pentachlorophenol (EPA Hazardous Waste K001) should be containerized separately from soils generated in a creosote drip track area (EPA Hazardous Waste F034). Likewise, materials generated at off-site locations should be managed separately from those generated on-site.

5. If possible, drums should be filled to approximately 90% capacity. As necessary, drums containing liquids should have enough freeboard to prevent rupture in the event of freezing.

6. Containers inside of containers are not permitted by waste management regulations. As a result, PPE must be placed directly into the drum. **Do not place PPE in a plastic bag and in turn place the plastic bag into a drum.** This constitutes a violation of waste management regulations. Similarly, all soil samples must be removed from jars or plastic bags and the jars crushed or plastic bags torn prior to being placed in a drum.

7. All lids and gaskets must be securely fastened prior to moving from one location to another. The consultant or subcontractor is responsible for transporting containers to an on-site temporary staging area as directed by the Facility Waste Management Director. Containers must be loaded, transported and unloaded in a safe manner.

8. The exterior of all containers must be thoroughly cleaned prior to staging. All mud, dirt or debris must be removed, with no exception. Waste management facilities will not accept containers which are visibly dirty on the outside.

9. Under no circumstances shall non-waste materials or general trash be placed in waste containers. The consultant/subcontractor should provide a dumpster for management of non-waste materials and general trash.

10. Under certain circumstances, the following exceptions to the above requirements may be made if provided by regulations and state/federal concurrence:

    - Some regulatory agencies may allow for all or a portion of generated materials (i.e., auger cuttings, drilling fluids) to be placed back into or onto the ground from which they were generated. The consultant is responsible for identifying these requirements.

    - If an operating water treatment facility exists on-site, groundwater and/or decontamination liquids may be managed into the treatment system if the discharge permit for the treatment facility provides for management of those liquids, and the liquids do not contain materials (e.g., solids or oils) which could potentially effect the operation of the system in an adverse manner. In this instance, consideration must be given to the classification and management of waste materials generated through the treatment of the liquid (e.g., spent activated carbon, filtered soils, etc.)

3.2 Container Designation and Labeling

Project-specific requirements for container identification and labeling will be developed during initial project planning. If applicable, this information may be presented in a project-specific waste management plan. Project-specific container designation and labeling requirements should be developed to be consistent with the general guidelines provided below.

1. Each container will be assigned a unique designation. This designation should include a sequential number associated with each waste type, a code which identifies the type of waste (e.g., "S" for soil, "GW" for groundwater, etc.), and the date the material was placed in the container (e.g. 1-GW-12/12/98; 2-GW-12/12/98 etc...). The container designation must be clearly marked on the lid and the side of the container prior to transport to the temporary on-site staging area. The markings must be made in a manner such that the markings are legible, highly visible and permanent (i.e., weather resistant). A "Mean Streak®" grease pen or a paint stick is recommended for marking the container.

2. A "Non-Hazardous Waste" label shall initially be affixed to the exterior side of the drum at a location at least two-thirds of the way up from the bottom of the container. Under the optional information section on the label, the following statement may be included "Material Classification Pending Results of Analysis".

3. The following information is to be recorded by field personnel in the field logbook, as appropriate.

    - Container Designation
    - Contents (e.g., soil, groundwater, PPE)
    - Date that the container was filled
    - Location where the drums are staged
    - Location, and plant process area, where the material was generated (e.g., soil boring number, monitoring well designation)
    - Relative moisture content (e.g., dry, moist, damp, wet, saturated) for soils only, for the purpose of managing the materials for disposal, damp or moist soil are considered "liquid"
    - Approximate volume or percentage of the container filled

3.3 Container Storage

Project-specific container storage requirements will be developed during the initial planning phase. If applicable, this information may be presented in a project-specific waste management plan. Project-specific container storage requirements should be developed to be consistent with the general guidelines provided below.

1. If the investigative or remedial work is conducted at active or inactive sites owned formerly by the consultant's client, plans for container storage must be developed in conjunction with the current property owner.
2. If containers are to be transported to an on-site staging area, all container handling and moving must be conducted in a safe manner. Contractors are responsible for providing the necessary equipment (e.g., front-end loader, fork lift with drum grappler, etc.) to provide for safe and efficient staging of containers.
3. All containers shall be stored in a neat and organized fashion with all labels clearly visible. Containers shall not be stacked.
4. Containers holding materials of different waste classifications should be staged together to facilitate loading of the materials onto transport vehicles.
5. To the extent practicable, all containers should be protected from the elements.
6. If stored outdoors in an area where precipitation could accumulate, all containers must be placed on pallets.
7. In accordance with DOT requirements, all containers must be rust-free and in sound condition for shipment.
8. Prior to demobilization, field personnel should conduct an inspection of the container storage area to ensure all containers are clearly marked, clean and staged in a neat and organized manner.

3.4 Waste Material Inventory

KEY personnel are responsible for completing an inventory of waste materials stored at the project site. The inventory should be completed and entered into the central computer file at

KEY's main headquarters in Carnegie, Pennsylvania as soon as possible following field demobilization. The central file is located on the data server by site name in the general directory - Dataserver-P:\projects\IDW\Year\Sitename.exe. The inventory will include a tabular summary of all containers stored at the project site and their respective contents. An example is provided as Attachment 1. Information should be entered into a tabular summary located by site name in the central file under the following headings:

- **Related Activity of Waste Generation** (e.g., RFI, Pilot Study, Interim Measures, etc.)
- **Type of Container** (e.g., drum, roll-off box etc.)
- **Container Designation** (the unique label affixed to the drum)
- **Container Contents** (e.g., soil, groundwater, PPE)
- **Generation Date** (date that the container was filled)
- **Staged Location** (location where the drums are staged pending removal)
- **Location and Plant Process Area Where Waste Was Generated** (e.g., former Process Area, Former Drip Track Area, etc.)
- **Relative Moisture Content** (e.g., dry, moist, damp, wet, saturated) for soils only. For the purposes of managing these materials, damp or moist soils are considered wet.
- **Volume or Percentage Contained (gallons)** (volume or percentage of drum filled - not to exceed 90 percent)
- **Comments** (other pertinent information, as appropriate)
- **Date Removed** (the date the drums are removed from the site for disposal)

3.5 Waste Material Sampling and Analysis

Composite samples of the containerized materials for laboratory analysis may be collected for each IDW media. The results of the analysis may be used for waste profiling purposes required by the waste management facility and/or waste classification purposes. Project-specific requirements for waste sampling and analysis will be developed during initial project planning. If applicable, this information may be presented in a project-specific waste management plan. Project-specific waste material sampling and analysis requirements should be developed to be consistent with the standard procedures provided below. To the extent practicable, historical information, site-specific analytical data and knowledge of the waste composition should be utilized to minimize sampling and analysis requirements.

1. Specific details regarding the number and types of samples to be collected, required laboratory turn-around time, analytical parameters and analytical methods will be determined on a project-specific basis during the initial planning phase. If applicable, this information may be presented in a project-specific waste management plan.

2. At a minimum, samples must be collected and handled in accordance with standard industry protocols. If an approved project-specific Sampling and Analysis Plan or Quality Assurance Project Plan exists, then sample collection and handling procedures, as specified therein, must be followed.

3. All analyses must be performed using the appropriate analytical methods specified in EPA SW846 "Test Methods for the Evaluation of Solid Wastes".

4. The sampler must complete and maintain copies of all chain-of-custody documentation.

5. In accordance with Subpart CC or 40CFR Par 264/265 which became effective on December 6, 1996, hazardous wastes containing greater than 500 parts per million by weight total volatile organic compounds (VOCs), are subject to the emission control requirements of this rule. Determination of VOC content may be made through laboratory analyses or generator knowledge. Thus, analysis for VOCs will likely be required by the waste disposal facility for profiling purposes in the future. Analysis is to be performed using method 25D in 40CFR Part 60 Appendix A, or through the use of an approved alternate method. Knowledge-based waste determinations must be thoroughly documented.

6. Composite samples of similar waste classification of containerized materials will be profiled based on the characteristics presented in 40 CFR Part 261 Subpart C - Characteristics of Hazardous Wastes:

   - §261.21 - Characteristic of Ignitability
   - §261.22 - Characteristic of Corrosivity
   - §261.23 - Characteristic of Reactivity
   - §261.24 - Toxicity Characteristic

3.6 Transportation and Disposal

Transportation, disposal, and manifesting of IDW are generally the responsibility of the owner. However, on occasion, KEY may assume responsibility for this task upon client request.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

(Reserved)

5.0 DOCUMENTATION AND RECORD KEEPING

All field notes, waste inventories, and disposal manifests are to be kept as part of the permanent project records.

6.0 REFERENCES

(Reserved)

ATTACHMENT 1
SOP 04 – MANAGEMENT OF INVESTIGATION-DERIVED WASTES
IDW INVENTORY LOGSHEET

KEY ENVIRONMENTAL INCORPORATED

IDW INVENTORY LOG

Date:

Project Name: Project Number:

Location:

Container Identification Number	Type of IDW (SW, GW, NAPL, PPE, Other	Date Filled	Comment / Label Description	Staging Location

10 - DRILLING METHODS FOR SUBSURFACE INVESTIGATIONS AND WELL INSTALLATION

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) presents a brief summary of drilling methods commonly used for completing monitoring wells and test borings. The application and limitations of the following methods are discussed in this SOP:

- Hollow-stem auger
- Direct push
- Driven-casing
- Fluid-rotary
- Air-rotary
- Solid-stem auger
- Cable tool

Test borings are completed to determine both physical and chemical conditions of subsurface soils . Monitoring wells or piezometers may be installed within these borings for the purpose of collecting representative groundwater samples, for measuring water levels to determine groundwater flow direction, and for performing tests to determine physical aquifer characteristics.

The drilling method selected for a particular site, well, or borehole depends on subsurface conditions and, in some instances, regulations. In some cases, a combination of drilling techniques is needed to complete a boring when different formations are encountered. It is important to determine the inside diameter of each borehole so that the boring can provide adequate sample material for analysis or so it can be used for its intended purpose. For these reasons, the selection of drilling methods should be made in consultation with the Project Manager and Hydrogeology Task Manager. A qualified geologist or engineer must supervise the drilling activity.

1.1 Referenced SOPs

02 - Utilities Clearance
11 - Rock Coring
13 - Monitoring Well Grouting Techniques
25 - Equipment Decontamination
33 - Subsurface Soil Sampling

1.2 Definitions

(Reserved)

2.0 REQUIRED MATERIALS

Materials used for drilling and well installations will vary according to the chosen drilling and subsurface sampling methods, and well design and installation methods. Based upon the chosen drilling method, the subcontracted drilling firm will be responsible for providing a drilling rig, support equipment, and trained drilling crew capable of performing the requested subsurface boring, sampling, and well installation activities.

Any qualified drilling subcontractor will typically know, based on experience, what equipment will be required for specific situations. It is necessary, therefore, to provide the driller with as much information as possible regarding the requirements and objectives of the drilling program, as well as the subsurface conditions expected to be encountered.

A generalized list of materials and equipment to be utilized by the driller may include the following:

- Drill rig appropriately equipped to advance a borehole of the appropriate diameter, to the appropriate depth, through the anticipated subsurface materials

- Drilling support equipment capable of safely handling and maneuvering drilling equipment, including auger sections, casings, drilling rods and bits, bailers, pumps, *etc*.

  - Auxiliary compressor (for air rotary/hammer drilling)
  - Hydraulic or manual hammers (for split-spoon sampling)
  - Various pumps (mud, trash, grout, *etc*.)
  - Various hoses for fluids and air
  - Wellhead diverters
  - Cyclone separator
  - Mud tub(s)
  - Sampling devices (split-spoon samplers, Shelby tubes, rock core barrels);
  - Casing lifts (cables, clamps, hoists)
  - Portable water tank, transfer lines, and pump (if necessary)
  - Cutting torch and welder
  - High-pressure, hot water washing system (steam genny)
  - Decontamination solutions and equipment (buckets, brushes, *etc*.)
  - Lifting straps, chains, and cables
  - Various wrenches and specialized tools

Before mobilization to each boring location, the drill rig and all downhole equipment should be decontaminated. The drill rig must not leak any fluids that could enter the borehole or contaminate equipment placed in the boring.

The use of drilling mud, synthetic drilling fluids, or petroleum- or metal-based pipe joint compounds should be avoided unless absolutely necessary. Material safety data sheets should be provided by the drilling contractor for all such materials used. If drilling mud is needed to stabilize a hole or to control downhole fluid losses, only high-yield bentonite clay free of organic polymer additives should be used.

In addition to the equipment and material needs of the drilling subcontractor, the geologist, engineer, and/or hydrogeologist overseeing the drilling and construction activities will require particular items to assist in documenting sampling, drilling, and well construction activities. Equipment and materials likely to be used by oversight personnel may include:

- Field logbook
- Digital camera
- Marking pens
- Boring, sampling, and well construction log sheets
- Sample jars, coolers, ice, packing tape, and chains-of-custody (if samples are to be submitted for laboratory analyses)
- Sample containers for geotechnical samples
- Field screening sample containers (glass jars, Ziploc® bags, foil, *etc*.)
- Field screening equipment (PID, FID, pH paper, immuno-assay testing, field GC, *etc*.)
- Mud balance (for measuring grout and mud densities)
- Fine-mesh sieve or strainer (for collecting and washing drill cuttings for identification)
- Weighted tape for measuring borehole depths, and well construction material placement
- Tape measure and/or ruler
- Water-level and/or interface probe
- Water quality monitoring instrument (for well development documentation)
- Stopwatch
- Magnifying glass or hand lens
- Knife
- Hydrochloric acid
- Munsell Soil Color and Rock Color Charts
- Grain-size identification chart
- Hard hat
- Safety glasses
- Steel toe boots

3.0 METHODOLOGIES

Drilling methods should be selected after evaluating site subsurface conditions, including available information on contaminant characteristics, and be consistent with the intended data use and goals of the project work plan. Final selection of the drilling method to be used should be based on relative cost, time constraints, and sampling and testing requirements. A detailed discussion of drilling techniques is presented in Driscoll, 1986, Pages 268 to 533, and Aller, *et al.*, 1989, Pages 40 to 143.

An underground utilities clearance must be verified before drilling at any location. A comprehensive discussion of the procedures for locating utilities is contained in *SOP 02 – Utilities Clearanc*e.

3.1 Hollow-Stem Continuous-Flight Augering Method

This method of drilling consists of advancing hollow-stem augers into unconsolidated materials. As the borehole is advanced, cuttings are brought to the surface by the lifting action of the augers. Drill rods with an attached sampler can be passed through the center of the auger section to retrieve soil samples (*SOP 33 – Subsurface Soil Sampling*). After drilling has advanced to the desired depth, a monitoring well can be installed inside the auger stem and backfilled as the augers are simultaneously withdrawn from the borehole.

Boreholes should be advanced using pre-cleaned and decontaminated augers and sampling equipment. Boreholes that are not converted to monitoring wells or piezometers should be abandoned according to *SOP 13 – Monitoring Well Grouting Techniques*.

This method is fast and efficient for shallow drilling (less than 100 feet) and permits both sample collection and installation of small diameter wells. Advantages of this type of drilling include:

- Representative soil samples can be retrieved with either split-barrel or thin-wall samplers
- Water quality sampling can be done while drilling
- Monitoring well installation can be achieved in most unconsolidated formations
- The hollow-stem auger can serve as temporary casing for coring rock or advancing a bedrock borehole by other drilling methods
- Varying rig sizes can perform drilling in limited access areas, including indoors, and skid rigs are available for very limited spaces. Also, many firms maintain all-terrain auger rigs

Disadvantages and limitations of this method of drilling include:

- Augering can only be performed in unconsolidated materials or soft rock; more dense formations will limit capability at depth
- Preserving sample integrity in heaving formations is a concern
- Formation invasion by water or drilling mud is a concern when used to control heaving
- Cross contamination between aquifers can occur where the annular space is not positively controlled by water or drilling mud or surface casing
- Inside diameter of augers limits the well casing size generally to four inches in diameter or less
- Smearing of formation clays by the lifting action of the augers may seal off the aquifer to be monitored

3.2 Direct Push Systems

Direct push system (DPS) technologies involve a category of drilling equipment that hydraulically pushes or drives small-diameter, hollow steel rods into the subsurface without rotating the drill rods. Some drill rigs may be “combo rigs,” capable of conducting both direct push and rotating HAS drilling operations. DPS drilling uses a combination of a hydraulically-powered percussion hammer, a downward hydraulic push, and the weight of the vehicle on which the system is mounted to drive rods into the subsurface. DPS methods push a continuous tube sampler into the subsurface by

laterally displacing soil to make a path for the sampler, so no cuttings are generated. DPS drilling is commonly used for shallow applications (less than 50 feet).

DPS technology is typically limited to unconsolidated formations that are relatively free of cobbles or boulders. Refusal may occur if there are too many cobbles, boulders, or other consolidated formation materials. However, since DPS drilling is relatively fast, refusal at a desired location because of cobbles may be mitigated by abandoning the hole, moving to a nearby location, and re-drilling.

DPS boreholes generally cannot be sampled deeper than the water table because unconsolidated materials cave in once the drive rods are removed. However, caving may be mitigated by advancing a casing with an inner drill rod used for sampling, allowing for sampling and well installation far below the water table.

Outside diameters of samplers and boring tools generally range from 0.75 to 3.5 inches. If installation of monitoring wells is planned, the inside diameter of the boring should typically ranges from 1.5 to 3.5 inches (for 1- to 2-inch wells).

DPS technologies provide the following advantages over conventional drilling methods:

- Minimal ground disturbance, with a small-diameter boring that is easy to abandon
- No cuttings, which eliminates the need for handling, containerizing, sampling, and disposing of potentially contaminated IDW (unless samples are brought to the surface);
- Faster boring advancement
- Faster monitoring well installation if small-diameter wells (0.75 to 1 inch in diameter) with pre-packed screens are installed

Boreholes should be completed using pre-cleaned and decontaminated drive points, rods, and sampling equipment according to *SOP 25 - Equipment Decontamination*. Boreholes that are not converted to wells should be abandoned according to *SOP 13 – Monitoring Well Grouting Techniques.*

3.3 Driven-Casing Method

The driven-casing method consists of alternately driving casing into the ground and cleaning out material within the casing, using a rotary bit and air or potable water to flush out the materials. This method is used in unconsolidated formations or soft caving rock. When the boring is to be used for well installation, the driven casing used should be at least four inches larger in diameter than the well casing to be installed.

Advantages to this method of drilling include:

- Sampling can be conducted while drilling
- Well installation is easily accomplished
- Well development procedures are minimal

- Drill rigs used are relatively small and mobile

Some of the disadvantages include:

- Use restricted to unconsolidated, noncohesive formations
- Relatively slow advancement of the borehole
- Depth of the borehole will vary with the size of drill rig, the casing diameter used and the nature of the formations
- Introduction of drilling fluids into the borehole is discouraged by some regulatory agencies

3.4 Fluid-Rotary Drilling Method

During fluid-rotary drilling, the borehole is drilled by a rotating bit; cuttings are removed by continuous circulation of a drilling fluid as the bit penetrates the formation. The bit is attached to a string of drill rods that transmits the rotating action and drilling fluid from the rig to the bit.
There are a variety of fluids that can be used in conjunction with this drilling method. The usual drilling fluid is water or water mixed with bentonite (referred to as "mud-rotary"). Under some geologic conditions, it may be necessary to add other compounds to the drilling fluid to increase the fluid weight or viscosity. These additions may include inorganic compounds such as barite or organic polymers. For monitoring wells constructed to sample groundwater quality, the use of any organic polymers in the drilling fluid should be avoided and inorganic additions made only if they will not interfere with the groundwater sampling protocol. The Project Manager should be consulted before a drilling fluid other than clear water is to be used. The decision as to whether drilling fluid additives should be used should be based on consultation with the client and review of any guidance documents used by the lead regulatory agency, if appropriate. Even if an agency is not currently involved with the project, it may be advisable to utilize their method of preference so environmental data and analytical results cannot be questioned at a later date.

There are two general types of fluid-rotary drilling methods: direct circulation rotary drilling and reverse circulation rotary drilling. In direct circulation rotary drilling, the drilling fluid is circulated down through the drill rods, out the bit, and up the annular space to the settling pit at the surface. In the reverse circulation rotary method, the drilling fluid and cuttings move down the annulus and upward inside the drill rod to be discharged into the settling pit. Upon boring completion, clean water should be circulated through the system to remove residual additives from the borehole and facilitate subsequent well development.

Advantages to rotary drilling methods include:

- The ability to advance a hole in most formations at a relatively quick pace
- Split-barrel samples, Shelby tubes, and rock cores can be obtained
- Casing may not be needed because the drilling fluids may keep the borehole open
- They are relatively common methods that are used by water well drillers in most areas
- The open hole can be geophysically logged

Disadvantages to this method include:

- Formation logging is difficult if split-barrel samples are not taken
- Drilling fluid reduces formation permeability to some degree, may circulate contaminants, or alter groundwater quality in the vicinity of the well
- Limited or no information on depth to water and/or occurrence of water-bearing zones is obtainable while drilling
- Development techniques for wells may be more extensive when compared to other drilling methods
- Drill rigs are usually large and heavy and need proper access
- Federal and state regulatory agencies may prohibit the use of this method for some applications because of the addition of fluids in the hole
- Potable water is required for mixing drill fluids. This water should be sampled and the water source should remain the same throughout the program. This method may require a large volume of water. The availability of a potable water source should always be considered in the selection of this method.

3.5 Air-Rotary Drilling Methods

This method is similar to fluid-rotary drilling, except that compressed air is used to cool the drill bit and remove cuttings. Two drilling methods that use air as the primary drilling fluid are direct air-rotary and down-the-hole air hammer. Applications of air-rotary methods include:

- Rapid drilling of semiconsolidated and consolidated rock
- Good quality/reliable formation samples (particularly if small quantities of water and surfactant are used)
- Equipment generally available
- Allows easy and quick identification of lithologic changes
- Allows identification of most water-bearing zones
- Allows estimation of yields in strong water-producing zones with short “down time”

Limitations of this method include the following:

- Surface casing is frequently required to protect the top of the hole from washout and collapse
- Its use is restricted to semiconsolidated and consolidated formations
- Samples are reliable but due to small size are difficult to interpret
- Drying effect of the air may mask low yield water producing zones
- Air stream may require filtration to prevent introduction of contaminants from the air compressor
- The injected air may modify the chemical or biological conditions of the aquifer in the immediate vicinity of the borehole

3.6 Solid-Stem Continuous-Flight Augering Method

The solid-stem continuous-flight augering method operates in the same manner as the hollow-stem auger. Practical application of this method is restricted when compared with hollow-stem augers. Sampling is performed by completely removing the augers from the borehole, which may allow the hole to cave in. This method is effective in silty-clayey soils with hole depths limited to about 50 feet. Depth to water is difficult to determine while drilling. This method is ineffective for well installation in loose soils or when drilling below the water table. Applications and advantages include:

- Conducting shallow soils investigations and collecting disturbed soil samples
- Installing vadose zone monitoring wells (lysimeters)
- Identifying depth to bedrock
- Drill rigs are small and mobile, allowing access where larger rigs cannot operate

Disadvantages include:

- Soil sample data limited to areas and depths where borehole remains open during auger removal
- Unacceptable soil samples unless split-barrel or thin-wall samples are taken
- Monitoring wells cannot be installed in most unconsolidated aquifers because of borehole collapse following auger removal
- The depth capability decreases as the diameter of the auger increases
- Monitoring well diameter is limited by the auger diameter

3.7 Cable Tool

This method was one of the first mechanized methods to be widely used for drilling deep water wells. The drill hole is advanced using a heavy bit (a 500- to 2,500-pound tool) hung from a steel cable and suspended from a mast. The tool is placed into the hole and successively dropped from 2 to 3 feet above the bottom of the hole. This action pulverizes the rock or soil in the bottom of the hole. The drilling tool is pulled out and a large bailer is used to remove the cuttings; water may be added to aid in the removal of materials in unsaturated conditions. Casing is driven into the ground just behind the advance of the bit. Advantages include:

- Sampling can be conducted during drilling
- Well installation is easily accomplished, and development is generally minimal
- Large diameter installations can be completed, which may be valuable if telescoping required
- Advances through gravels and running sands
- Casing can be used as temporary casing for rock coring

Disadvantages include:

- Advancement is slowed in more cohesive materials
- May involve introduction of water into borehole that must be monitored/sampled

- Use is restricted to unconsolidated materials (*e.g*., no rock coring can be performed)
- Services are not always available through environmental drilling contractors

4.0 QUALITY ASSURANCE/QUALITY CONTROL

All field activities are to follow the guidelines enumerated in the project planning documents. Any changes required based on conditions encountered in the field are to be documented in the Field Logbook and receive approval of the Project Manager.

5.0 DOCUMENTATION AND RECORD KEEPING

Information to be collected during the completion of a subsurface drilling and monitoring well installation program will include:

- Soil types, thicknesses, and depths
- Bedrock types, depths, and thicknesses
- Identification of the presence and extent of subsurface contamination
- Depths to water-bearing zones, their respective yields, and presence of contamination
- Well construction details

Recording of the data should be completed in the field at the time of measurement or observation. The field book should be the primary repository for field data and observations (SOP # 106); however, field forms may provide a more suitable format for collecting and analyzing the data.

Soil boring and sampling information may be recorded entirely in the field notebook or on an appropriately designed boring log form and should include, at a minimum, the following information:

- Drill rig make/model, name of drilling subcontractor, and driller's name(s)
- Weather conditions
- Boring location identification, including physical description of location in reference to site features, and description of surface conditions at location
- Borehole advancement method (augering - include size, mud rotary, *etc.*)
- Sample number
- Sample depth
- Sample time
- Sample collection method (split-spoon, cuttings, *etc*.)
- Blow counts
- Recovery (length and percentage)
- Soil color (from Munsell Soil Color Chart)
- Soil texture and physical description (*SOP 33 – Subsurface Soil Sampling*)
- Observations of contamination (field screening results and visual observations)
- Occurrence and estimated yield of water-bearing zones
- Depth to water at completion of boring

- Any problems or significant events that occurred during drilling and sampling

Rock boring and coring data recording requirements are similar to those for soil borings. Information may be recorded in either a field notebook or an appropriately designed boring log form and should include, at a minimum, the following data:

- Drill rig make/model, name of drilling subcontractor, and driller's name(s)
- Weather conditions
- Boring location identification, including physical description of location in reference to site features, and description of surface conditions at location
- Borehole advancement method (augering - include size, mud rotary, *etc*.)
- Sample number
- Sample depth
- Sample time
- Sample collection method (cuttings, coring - indicate type)
- Recovery (for coring)
- Rock Quality Data (RQD) (for coring) (*SOP 11 – Rock Coring*)
- Rock color (from Munsell Rock Color Chart)
- Description of rock type, texture, fractures, *etc*.
- Rate of borehole/coring advancement (per foot)
- Observations of contamination (field screening results and visual observations)
- Occurrence of water-bearing zones and their respective yields
- Depth to water at completion of boring
- Any problems or significant events that occurred during drilling and sampling

6.0 REFERENCES

Aller, L., Bennett, T.W., Hackett, G., Petty, R.J., Lehr, J.H., Secoris, H., and Nielsen, D.H., 1989, Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells: Dublin, Ohio, National Water Well Association.

American Society for Testing and Materials, D2488, Standard Recommended Practice for Description of Soils - (Visual-Manual Method).

Driscoll F.G., 1986, Groundwater and Wells - Second Edition: St. Paul, Minnesota, Johnson Screens, 1089 p.

20 - VOLATILE ORGANIC SCREENING

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) presents Key Environmental Inc.'s standard methodology for performing field screening of samples for the presence of volatile organic compounds (VOCs). Field screening may be performed either directly by holding the instrument over the sample or via headspace screening by placing the sample in a sealed jar prior to screening. Additionally, headspace screening can be used when first opening a well prior to measuring water levels or purging/sampling.

Screening for the presence of VOCs may also be used to help determine whether site workers may need breathing protection during site activities, although this information alone is not adequate for making a final health and safety decision. Such screening may occur when personnel first arrive on site by screening ambient air. Screening may also be used to determine appropriate protection required to safely sample wells, soils, or other matrices. However, the most common use of VOC screening is to aid in a soil sampling program or determining where a well screen should be set.

Key generally uses two models of the HNu™: HW-101 and PI-l0l. The HNu™ is a portable, nonspecific, vapor/gas detector employing the principle of photo ionization to screen for a variety of volatile organic compounds in air. PIDs operate by photo ionizing molecules with an ultraviolet lamp and measuring the current generated by ions at a collection point in the ionization chamber.

Organic vapor monitoring using a PID generally serves two purposes:

- To monitor potential airborne chemical constituents and thereby assess the potential exposure of site workers, as specified in the site-specific Health and Safety Plan
- To evaluate organic vapor concentrations in various media to assist in site characterization

Field screening of subsurface soils is performed to qualitatively identify the presence of VOCs. This information may be subsequently used to:

- Aid in defining the lateral and vertical extent of VOCs in the subsurface (to the extent permitted by the data quality obtained *via* the screening instruments)
- Identify relative changes in VOC concentrations with depth or between boring locations
- Aid in the selection of samples for laboratory analysis based on criteria defined in the site work plan
- Aid in the selection of depths and locations for screen installation in ground water monitoring wells
- Aid in the determination of approximate volumes of solid materials (*e.g.*, soil, waste) for excavation or remediation

The screening equipment will be selected based on knowledge of potential VOCs expected to be present at the Site. Organic vapor meters (OVMs) (including flame ionization detectors [FIDs], see below) detect a wide variety of compounds, including methane, and can be used for general screening. An HNu™ (photoionization detector [PID], see below) will also be a good general screening device in most cases but will not detect methane; therefore, in landfill situations where methane is a by-product and VOCs are also present, both pieces of equipment can be used to determine the relative amount of methane versus VOCs. If the screening is being used to detect a known contaminant, the HNu™ can be calibrated to a standard and/or the appropriate lamp may be selected for screening a particular range of compounds.

PIDs may be susceptible to impacts of temperature and high humidity; therefore, alternative air monitoring devices (*e.g.,* Draeger tubes) which are less sensitive to the effects of high humidity may need to be maintained onsite

1.1 Referenced SOPs

None

1.2 Definitions

Organic Vapor Meter (OVM): A detector that uses a flame or ultraviolet (UV) light to ionize organic molecules and subsequently reports the concentration relative to a known standard.

Flame Ionization Detector: An OVM that uses a hydrogen flame to ionize organic molecules. The unit is calibrated to a methane standard and, in addition to methane, is most responsive for hydrocarbons but also detects oxygenated and nitrated compounds.

Photoionization Detector: An OVM that uses an UV light to ionize organic molecules. The unit is factory calibrated to benzene and can be field calibrated to one of several standards (commonly isobutylene or the compound of interest, if known). The use of different ionizing probes provides differing scales of detection. For use in landfills, the PID probes do not detect methane and are more applicable to volatile screening in these atmospheres.

Headspace Analysis: A field test to evaluate absence/presence of volatile organics in a soil/solid sample.

2.0 REQUIRED MATERIALS

Use of a PID does not require an extensive amount of equipment. The following items should be available at the work site:

- PID and operations manual, including charging mechanism
- Calibration sheets and pens/pencils
- Calibration gas
- UV lamps

- Field logbook and indelible ink pens
- Clean cloth and distilled water for decontamination
- Sample jars or zip-lock type bags

3.0 METHODOLOGIES

To ensure that the photo ionization detector operates properly, the equipment should be calibrated daily before use. Project-specific requirements may require additional, more frequent calibration. The instrument manual should be consulted for calibration standards. Calibration information should be recorded in the Field Logbook and on Instrument Calibration Log Sheets.

The HNu™ may need to have the battery recharged for approximately eight hours following a use of six to eight hours. The user should check the battery charge at the end of each work day to determine if recharging is necessary.

All screening equipment should be calibrated and warmed up prior to use. If field activities take place when ambient air temperatures are below 50 degrees Fahrenheit (°F), the screening equipment and samples should be placed in a heated/warm area if possible.

During operation, the background level should be set at 0 using the 1 to 20 scale. The needle may drift below 0 if the lamp is extinguished, when weather conditions are not favorable to operation, or there is an oxygen deficiency in the ambient air near the probe (particularly below 50 degrees Fahrenheit and if there is precipitation; during headspace analysis, condensate in the jar causes the needle to drift in this manner).

Gas vapor concentrations will vary due to mixing with ambient air during screening. Consequently, the range, not just the peak level, should be identified in the field notes and reports.

The following sections discuss the use of photo ionization detectors in various field activities.

3.1 Air Monitoring

Monitoring for volatile organic compounds will be conducted prior to and during all intrusive site activities, confined space entries, monitoring well inspection and/or sampling and any other field activities where inhalation may occur. Air monitoring for VOCs may also be conducted at the property perimeter to document background air conditions and to ensure that surrounding properties are not being adversely affected by site operations.

Periodic measurements should be taken in the breathing zone to monitor for organic vapors. If the organic vapor levels exceed the air monitoring action levels (for the constituents listed in the project specific health and safety plan) for a sustained period greater than five minutes, ventilate the immediate work area, employ vapor suppression techniques or work upwind of the contamination. If these methods are not feasible or do not reduce the potential exposure below the acceptable levels, then employees must upgrade to Level C protection if benzene is not

present. If benzene is present above the action level of 1 ppm, stop work, cover the area, and contact the Project Manager.

3.2 Soil Core and Split-Barrel Screening

Prior to opening the split barrel, determine and record background reading(s) (the work area should be placed in a location upwind of the drill rig and rig exhaust). When the split barrel is opened, scan the length of the sample with the probe within 1/8 inch of the surface. The screening should proceed slowly enough to permit appropriate equipment response (allow for a 2-second delay). Record the range of readings, if any, and the approximate depth of the maximum reading.

3.3 Small Test Pit Screening

Surface soil, newly exposed soil, soil stockpiles, and excavation surfaces can be screened for the presence of organic vapors using a PID or FID. Before screening newly exposed soil, soil stockpiles, and excavation surfaces, dig a small sample test pit at least 6 inches deep into the soil using a clean, decontaminated sampling tool such as a stainless-steel spoon and/or shovel. For surface soil or other soil directly exposed to the atmosphere for greater than 1 hour, dig a little deeper, approximately 12 inches before soil screening. When digging, minimize the diameter of the test pit, if possible, to reduce advection of soil vapors out of the test pit. Immediately insert the sample tip of the PID or FID into the test pit approximately 1 to 2 inches from the bottom of the hole, taking care not to foul the sample tip with soil particulates or water droplets. Record the maximum detector reading as the final sample concentration on the Soil Sampling Log Sheet or in the Field Logbook.

3.4 Headspace Screening

Headspace organic vapor screening involves the measurement of vapors emitted from solid or liquid samples into the headspace of a sealed container. The results generated from this measurement are semi-quantitative estimates of readily volatilized constituents.

Immediately following split-spoon sample collection, any borehole slough and/or the outer portion of the sample will be removed to prohibit potential cross contamination from overlying materials. The soil of interest should be placed directly into a clean and labeled 4-ounce sample jar using a decontaminated stainless steel knife or spatula. The jar should be filled approximately one half full, leaving sufficient room at the top (headspace) for buildup of VOCs. The jar should be tightly covered with aluminum foil to prohibit the emission of volatizing compounds; a lid can also be placed overtop the jar, but without the screwing on the lid. After the jars are sealed, they should be placed in an area of moderate temperature (50°F to 70°F) and permitted to stand for a period of time to allow equilibration. At the end of the predetermined time, each sample will be screened by penetrating the foil cover with the equipment probe (after determining and recording background conditions). The evaluation should be of sufficient duration to permit appropriate equipment response (a minimum of 5 seconds should be permitted).

Instead of using a glass sample jar and foil seal, zip-lock bags can be used to store soil samples for headspace screening. Procedures for this method require placing a volume of sample material (should be equivalent for all screened samples) into a quart-sized zip-lock bag. The sample should be crumbled to increase surface area to enhance volatilization. Seal the crumbled sample in the bag being sure to maintain an air pocket within the bag. The bag can be labeled with a marking pen to indicate sample location, depth, and time, and the bag can then be set aside to permit accumulation of volatile organic vapors. Following the predetermined equilibration interval, the sample may be screened by inserting the probe through the bag, or by inserting the prove tip into a small opening along the bag's re-usable seal. The maximum measurement should be recorded in the Field Logbook and/or on sample log sheets.

For more precise field screening measurements, the zip-lock bag method may be modified to include the installation of a stainless-steel air-valve to provide a Alead-free@ monitoring point. The air valve can also be used to administer a volume of hydrocarbon-free air using a volume pump and bottled air (or purified site air using carbon filters).

To avoid problems associated with high relative humidity, when the HNu™ device is used for headspace analysis, the instrument should be maintained at the same or higher temperature than the samples to be analyzed. If erratic instrument responses occur due to high VOC concentrations or elevated headspace moisture, the instrument behavior should be recorded in the field notes. Such a result may render the data unusable.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

Instrument calibration must occur on a daily basis, prior to each day's use. More frequent calibration may be specified in the site-specific planning documents. The Field Supervisor must ensure that calibration information is recorded as required.

5.0 DOCUMENTATION AND RECORD KEEPING

Readings should be recorded to indicate the calibration and, for the HNu™, the voltage of the UV lamp. For instance, if a reading of 17 parts per million by volume (ppmv) is reported by the HNu™, the notation should read "17 ppmv VOCs by HNu™ with a 10.2 electron volt lamp calibrated using isobutylene to a benzene standard."

Upon completion of the field activity, all data log sheets must be scanned for the permanent electronic project file. Hard copies of the log sheets also become part of the permanent job records.

6.0 REFERENCES

United States Environmental Protection Agency, May 1993, Subsurface Characterization and Monitoring Techniques: Washington, D.C.,EPA/625/R-93/003b.

United States Environmental Protection Agency, December 1987, A Compendium of Superfund Field Operations Methods: Washington, D.C., EPA/540/P-87/001.

22 - ENVIRONMENTAL SAMPLE PREPARATION

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) presents procedures for selecting appropriate sample containers and preservatives when collecting environmental samples for analysis at a selected laboratory. Procedures for packaging and shipping environmental samples are presented in KEY *SOP 23 – Sample Handling, Preservation, Packaging and Shipping*.

Environmental samples are those that are anticipated to be relatively low in analyte concentration. These samples consist of materials that may have been impacted by source area materials, but do not consist of source area materials such as sludge, material from drums, material from bulk storage tanks, *etc.* Examples of environmental samples include: soil samples collected adjacent to or underlying a source area, stream and sediment samples, and groundwater samples (which do not contain non-aqueous phase liquid).

1.1 Referenced SOPs

23 – Sample Handling, Preservation, Packaging and Shipping

1.2 Definitions

(Reserved)

2.0 REQUIRED MATERIALS

Required materials for sample containers and preservation may include:

- Laboratory-provided various sized glass containers (with Teflon®-lined lids or caps, clear or amber colored) as required for analysis
- Laboratory-provided various sized polyethylene containers (with Teflon®-lined lids or caps) as required for analysis
- Nitric acid
- Sulfuric acid
- Hydrochloric acid
- Sodium hydroxide
- Sodium thiosulfate
- Filtration equipment, if required

Project-specific, appropriate sample container size, sample volume, holding times, and preservatives should be presented in the Quality Assurance Project Plan (QAPP). The selected laboratory should be able to provide the most complete guidance on this topic, and will have been consulted during the preparation of the QAPP. This SOP is intended to provide general information to field and office personnel while preparing the project planning documents, ordering and shipping supplies, and performing sample collection activities.

3.0 METHODOLOGIES

3.1 Sample Containers

To limit potential chemical or physical changes in a sample during collection and transport, the sample container selection should be based on the following:

- Sample containers should be new and certified clean prior to sampling activities
- Sample containers should be constructed of non-reactive materials
- Sample containers should not chemically or physically alter the sample

The most widely used containers for aqueous samples are composed of glass or polyethylene.

3.2 Aqueous Samples

Glass Containers

Glass containers will be used when organic compounds are the analytes of interest. Sample volume will be sufficient to fill each sample container to allow the laboratory to attain the method-specific detection limits. Specific to volatile organic analysis, sample volume will be sufficient to fill each sample container so that no air bubbles are present. Once the sample container is full and preserved, if appropriate, it will be sealed with a Teflon®-lined screw cap. Specific container sizes for each analytical category are presented in the project-specific QAPP.

Polyethylene Containers

Polyethylene containers will be used for aqueous samples when metals and/or inorganic analytes are the parameters of interest. One-liter polyethylene bottles with solid polyethylene or polyethylene-lined caps will generally be used to collect groundwater samples for metals and inorganic analysis. Once the sample container is full and preserved, if appropriate, it will be sealed with the polyethylene screw cap. Specific container sizes for each analytical category are presented in the project-specific QAPP.

3.2 Solid Samples

Sample containers for the soil matrix are typically clear glass with a volume of 8 ounces. Larger sample containers may be necessary depending upon the number and type of analyses.

3.3 Sample Preservation

Sample preservation is important to retard physical and chemical alterations of unstable analytes within the sample matrix. Sample preservation methods are limited and are generally intended to:

- Retard biological action
- Retard hydrolysis of chemical compounds and complexes

- Limit photolysis
- Reduce volatility of constituents
- Reduce sorption effects

Preservation is usually limited to acidification, treatment with an alkaline chemical, reducing light exposure, filtration, and refrigeration.

Prior to any form of preservation, the following parameters, at a minimum, will be measured in the field on water samples and recorded in the field notebook:

- pH
- Specific conductance
- Temperature

These field measurements record baseline information on the water sample prior to external influences such as temperature, dissolved carbon dioxide, or oxygen affecting the sample.

Acidification

Acidification of samples is generally performed for two purposes. Acidifying a (water) sample serves to limit metal adsorption to the sample container and will maintain the metal in a dissolved state. Secondly, acidification will act to inhibit bacterial growth. Samples to be acidified for either purpose will require a minimum volume of 100 ml and will be acidified to a pH < 2. Acidification is performed immediately after taking field measurements or following sample filtration.

Alkaline Treatment

Samples are preserved with an alkaline chemical (*e.g.* NaOH) to form salts with volatile compounds such as cyanide. Samples undergoing this preservation require a minimum volume of 100 ml and will be treated to a pH >12.

Preservation of the sample will be performed by the addition of NaOH until the desired pH is achieved (pH > 12). Preservation of a water sample is performed immediately after the field measurements are collected and recorded.

Filtration

Filtration of samples will be used only for specific analytical parameters. It will be used when the dissolved metal content of water is of concern. Filtration will not be performed for samples to be analyzed for volatile organics, semi-volatile organics, or total recoverable metals.

When sample filtration is required, the sample will be drawn through a 0.45 micron filter. The filter material will either be paper or fiberglass dependent on the nature of the sampled water. Filtration is performed immediately following the field measurements and prior to any other

preservation methods. If the sample contains a significant level of suspended solids, a paper prefilter will be used prior to the 0.45 micron filter.

Temperature Control

All field samples that are to be analyzed by the laboratory will be sealed and then refrigerated during transfer to and storage at the laboratory. Refrigeration of samples is a bacterial inhibitor and slows the chemical and biological changes of a sample exposed to an oxidizing atmosphere. Transfer and storage of samples will be between $0^{o}C$ and $10^{o}C$, with a target temperature of $4^{o}C$. Solid samples are typically limited to this preservation method.

3.4 Laboratory Selection and Coordination

Choosing a qualified analytical laboratory is an integral part of sampling activities. Regulatory program requirements and certifications must be considered in selecting the laboratory to ensure that the laboratory is capable of meeting project-specific requirements. Also, the provisions of any Consent Orders or Unilateral Orders applicable to the project must be reviewed and communicated to the laboratory to ensure project-specific requirements are met.

Laboratory Selection

An analytical laboratory will be chosen based on the following criteria:

- Capabilities of the laboratory including performance history, certifications, and regulatory program experience
- The qualifications and experience of the laboratory staff
- Availability of a designated technical client representative who serves as a single point of contact for all KEY projects
- Quality and completeness of standard deliverables, including electronic data transfer availability
- The specified analyses and turnaround time
- The adequacy of the laboratory's quality assurance/quality control program

Coordination

After selecting a laboratory, the laboratory will be contacted and the following information requested pertaining to the sampling activities:

- Identification of a responsible party to act as sample custodian at the laboratory who is authorized to accept samples and verify the data entered from the accompanying chain-of-custody forms into the laboratory tracking system
- Provisions for a laboratory sample custody log consisting of serially numbered, standard laboratory tracking report sheets
- Specifications of laboratory sample custody procedures for sample handling, storage, and disbursement for analysis

The laboratory will be notified within 48 hours prior to receipt of samples. The samples will be packaged and shipped *via* express courier or hand delivered within 48 hours of collection to the laboratory. The laboratory will then be contacted to verify receipt of the samples and estimated turnaround time.

3.5 Sample Packaging and Shipping

Proper sample packaging and shipping accomplishes the following:

- Allows individual samples to be tracked through transport and analysis
- Limits the possibility of breaking or losing a sample bottle during transport
- Is part of formal chain-of-custody (COC) procedures (tracking of possession of the samples)

Samples will be packaged and shipped according to the procedures in *SOP 23 – Sample Handling, Preservation, Packaging and Shipping*.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

(Reserved)

5.0 DATA RECORDING OR MANAGEMENT

(Reserved)

6.0 REFERENCES

U.S. Environmental Protection Agency, 1986, RCRA Groundwater Monitoring Technical Enforcement Guidance Document: Washington, D.C., OSWER-9950.1.

U.S. Environmental Protection Agency, 1986, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods - SW-846 3rd Edition (with revisions): Washington, D.C.

U.S. Environmental Protection Agency, 1987, A Compendium of Superfund Field Operations Methods, Part 1: Washington, D.C.,EPA/540/P-87/001.

U.S. Environmental Protection Agency, 1991, Compendium of ERT Groundwater Sampling Procedures: Washington, D.C., EPA/540/P-91/007.

23 - SAMPLE HANDLING, PRESERVATION, PACKAGING AND SHIPPING

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) describes the procedures associated with the handling, preservation, packaging, and shipment of environmental samples for laboratory analysis or testing. Environmental samples may consist of air, groundwater, surface water, sediments or soil. The objective of sample preparation, handling, packaging, and shipping protocols is to develop standard procedures which will preserve the integrity of the samples and minimize the potential for sample tracking errors, sample spillage or leakage, and/or sample container breakage. The field team leader is responsible for the implementation of the sample handling, preservation, packaging, and shipping requirements outlined in the project-specific work plan.

1.1 Referenced SOPs

24 – Chain of Custody

1.2 Definitions

(Reserved)

2.0 REQUIRED MATERIALS

Required materials may include the following:

- Sample containers (preserved, as necessary, provided by the laboratory)
- Sample bottle labels
- Chain-of-Custody forms
- Sample cooler
- Bubble wrap or other suitable packing material
- "Blue Ice" (*i.e.*, reusable, freezable ice packs) or sealed bagged ice
- Shipping bills (Federal Express, UPS, etc.)
- Field Logbook
- Indelible ink pens
- Packaging tape
- Zip-lock type plastic bags

3.0 METHODOLOGIES

3.1 Sample Handling

Sample Containers

Sample containers and appropriate preservatives (where necessary) will be supplied by the analytical laboratory. After the respective sample containers have been filled with appropriate sample media and preserved as necessary, samples will be properly identified using sample container labels, and the samples will be stored at an appropriate temperature (usually <4°C) to preserve the integrity of the samples.

Sample Preservation

Preservatives will be supplied by the laboratory. When possible, preserved containers should be supplied by the lab. Common preservatives include hydrochloric acid (HCl), sulfuric acid (H_2SO_4), nitric acid (HNO_3), or sodium hydroxide (NaOH). Samples will be preserved in accordance with EPA protocol specified in SW-846 or the project specific protocols outlined in the quality assurance project plan (QAPP). Use of the preservatives will be noted on the COC for each particular sample and analytical parameter.

Sample Labels

Blank sample labels will be supplied by the analytical laboratory and affixed to the sample container. Sample labels will be completed using waterproof permanent markers or ink. The labels will be filled out at the time of sample collection by the field sampling personnel. The following identifying sample information will be included on the label:

- Client/Site
- Sample identification alpha-numeric code defined in the project planning documents
- Sample collector's initials
- Date and time (military) of sample collection
- Analytical method
- Laboratory analysis to be performed

Chain-of-Custody Forms

A chain-of-custody (COC) record will be established and maintained to document sample possession from the time of collection until receipt by the laboratory. A sample is considered to be in custody if it is in your physical possession, if it is in your view after being in possession, or if it is placed in a secure area with access controlled by you. Once samples are received by the laboratory, they will be handled under the laboratory internal COC procedures. Field sampling personnel will initiate a COC record by recording the following minimum data as the samples are collected:

- Client/Site
- Name(s) of sampler(s)
- Sample identification alpha-numeric code
- Date and time (military) of sample collection
- Type of sample (e.g., soil, groundwater)
- Number of containers per sample location
- Requested analyses
- Type of containers and preservatives used
- Name and address for the competed laboratory reports
- Name and address for the laboratory invoices
- Specific instructions/notes for the laboratory, as necessary

Sample COC forms will be placed in waterproof plastic bags and taped to the underside of the cooler lids. Sample COC forms will generally be supplied by the subcontracting analytical laboratory.

Subsequently, at each change of possession, the COC record will be signed by the person relinquishing the samples and by the person receiving the samples. The date and time of the transfer of possession of the sample will be recorded on the COC form; this occurs when the samples are transferred from the sampling personnel to the courier and when the samples are received at the analytical laboratory. Sample COC forms shall be completed in ink. Any transcription errors shall be corrected by striking the erroneous information with a single horizontal line. The correct information will be added immediately adjacent to the strikeout. The sampler should initial the correction. (Refer to *SOP 24 – Chain of Custody* for additional information).

3.2 Sample Packaging and Shipping

All samples will be transported to the analytical laboratory in durable, waterproof, secured metal or plastic coolers. Sample coolers will generally be supplied by the laboratory. All samples will be packaged very carefully to prevent sample breakage. Samples will be shipped *via* overnight carrier (*e.g.,* Federal Express or United Parcel Service) or hand delivered to the analytical laboratory, generally within 48 hours of collection. Airbills serve as custody documentation during shipping. However, project specific protocols will be checked to assure that specified sample holding times are not exceeded in the event that samples are not shipped on the same day that they were collected. Additionally, the sample security and preservation must be maintained if samples are not to be transported immediately to the laboratory. The following procedure should be followed for packaging samples for shipment to the laboratory for testing and/or analysis.

1. Place plastic bubble wrap matting or suitable material over the base and bottom corners of each cooler or shipping container.
2. Obtain a chain-of-custody record (similar to the example shown in Attachment 1of *SOP 24 – Chain of Custody*) and enter all the appropriate information as discussed above. Chain-of-custody records will include complete information for each sample. One or

more chain-of-custody records shall be completed for each cooler or shipping container as needed to manifest each sample.

3. Place bubble wrapping or other suitable material around glass bottles and place standing upright on the base of the cooler, taking care to leave room for packing material and ice or equivalent. Rubber bands or tape may be used to secure wrapping completely around each sample bottle.

4. Place additional bubble wrap and/or Styrofoam pellet packing or equivalent material throughout the voids between sample containers within each cooler.

5. Place cold packs or ice in heavy duty zip-lock type plastic bags, completely close the bags, and distribute such packages over the top of the samples. Add additional bubble wrap and/or Styrofoam pellets or other packing materials to fill the balance of the cooler or container.

6. If shipping the samples by express, courier, or delivery service, sign the chain-of-custody record thereby relinquishing custody of the samples. The date and time of custody transfer should be recorded on the chain-of-custody form. The custody transfer should be documented when directly transferring custody to a receiving party or when transmitting to a shipping service for subsequent receipt by the analytical laboratory. The shipping service should not be asked to sign chain-of-custody records.

7. Remove the last copy from the chain-of-custody record and retain with the field records. Place the original and remaining copies in a zip-lock type plastic bag and tape the bag to the underside of the lid of the cooler or shipping container.

8. Close the top or lid of the cooler or shipping container and with another person gently rotate the container to verify that the contents are packed so that they do not move. Improve the packaging if needed and reclose.

9. Packaging tape should be wrapped entirely around the sample shipping containers. A minimum of two full wraps of packaging tape will be placed in at least two places on the cooler or shipping container. Some project-specific QAPP may require custody seals be placed on the sample shipping containers. Sign and date the chain-of-custody tape.

10a. When transporting samples by automobile to the laboratory, and where periodic changes of ice are required, the cooler should only be temporarily closed so that reopening of the cooler can be easily performed. In these cases, chain-of-custody will be maintained by the person transporting the samples and chain-of-custody tape need not be used. If the cooler is to be left unattended, then chain-of-custody procedures should be implemented.

10b. If shipment is required, transport the cooler to an overnight express package terminal or arrange for pickup. Obtain copies of all shipment records as provided by the shipping service.

11. Upon receipt of the samples, the analytical laboratory will open the cooler or shipping container and will sign "received by laboratory" on each chain-of-custody form. The laboratory will verify that the chain-of-custody tape has not been broken previously and that the chain-of-custody tape number corresponds with the number on the chain-of-custody record. The analytical laboratory will then forward the back copy of the chain-of-custody record to the sample collector to indicate that sample transmittal is complete.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the samples leaving the site, each sample number and analyses, etc. are to be checked against the project planning documents, sample log sheets/field logbook, and chain of custody forms to ensure that all required samples have been collected and are labeled appropriately, and that bottles are filled for all required analyses.

Quality control samples such as rinsate blanks and duplicates will be specified by the project QAPP. A sample jar containing water should be sent as a temperature blank with each sample shipment requiring temperature preservation to ensure proper temperature is maintained. Also, a trip blank, provided by the laboratory will accompany shipments with samples intended for volatile organic chemical (VOC) analysis.

5.0 DOCUMENTATION AND RECORD KEEPING

The documentation for supporting the sample handling, preservation, packaging and shipping will consist of chain-of-custody records, shipping records and laboratory reports. In addition, a description of sample packaging procedures will be written in the Field Log Book. All documentation will be retained both physically and electronically in the project files.

6.0 REFERENCES

U.S. Environmental Protection Agency, 1986, RCRA Groundwater Monitoring Technical Enforcement Guidance Document: Washington, D.C., OSWER-9950.1.

U.S. Environmental Protection Agency, 1986, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods - SW-846 3rd Edition (with revisions): Washington, D.C.

U.S. Environmental Protection Agency, 1987, A Compendium of Superfund Field Operations Methods, Part 1: Washington, D.C., EPA/540/P-87/001.

U.S. Environmental Protection Agency, 1991, Compendium of ERT Groundwater Sampling Procedures: Washington, D.C., EPA/540/P-91/007.

24 - CHAIN OF CUSTODY

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) presents procedures for documenting possession/custody of environmental samples from the time of collection through delivery to the receiving analytical laboratory. At this point, internal laboratory records should document sample custody until final disposition. This SOP also discusses sample identification and the use of chain-of-custody (COC) forms.

Possession of a sample must be traceable from the time it is collected until analysis is completed. To document sample possession, chain-of-custody procedures are followed. Chain-of-custody evidence includes all documentation associated with the sample including the chain-of-custody form, sample label, custody seal, courier's receipt (if applicable), and field notebook.

A sample is under custody if one or more of the following criteria are met:

- It is in possession of the custodian or a designated member of the sampling team
- It is in plain view, after being in possession
- It was in possession and is secured against tampering
- It is placed in a designated secure area.

1.1 Referenced SOPs

23- Sample Handling, Preservation, Packaging and Shipping

1.2 Definitions

(Reserved)

2.0 REQUIRED MATERIALS

- Sample containers
- Sample container labels
- Chain-of-custody forms
- Zip-lock type plastic bags and tape
- Field logbook and permanent ink, waterproof pen
- Shipping airbills
- Shipping containers
- Locks or packaging tape
- Custody seals.

3.0 METHODOLOGIES

The Project Manager (or designee) is responsible for ensuring that sample labeling is completed in accordance with this SOP and that chain-of-custody forms are completed for sample shipments. All individuals relinquishing and receiving samples shall sign, date, and record the time on the chain-of-custody forms.

3.1 Sample Identification

Blank sample labels will be supplied by the analytical laboratory and affixed to the sample container. Sample labels will be completed using waterproof permanent markers or ink. The labels will be filled out at the time of sample collection by the field sampling personnel. The following identifying sample information will be included on the label:

- Client/Site
- Unique sample identification alpha-numeric code as specified in the Sampling and Analysis Plan
- Sample collector's initials
- Date and time (military) of sample collection
- Analytical method
- Laboratory analysis to be performed

3.2 Chain-of-Custody Forms

Once the sample containers have been filled with the sampled media and properly labeled, they will be prepared for shipment to the receiving analytical laboratory. Coolers containing samples will be accompanied by a chain-of-custody form (see example COC form in Attachment 1).

The field team leader (or designee) shall complete a chain-of-custody form for each lot of packaged samples (*e.g.,* each cooler). COC forms shall be completed in ink. Any transcription errors shall be corrected by striking the erroneous information with a single horizontal line. The corrected information shall be added immediately adjacent to the strikeout. The sampler should initial the correction.

The following information will be recorded on the COC form:

- Client/Site
- Name(s) of sampler(s)
- Sample identification alpha-numeric code
- Date and time (military) of sample collection
- Type of sample (*e.g.*, soil, groundwater)
- Number of containers per sample location
- Requested analyses
- Type of preservatives used

- Name and address for the completed laboratory reports
- Name and address for laboratory invoices
- Specific instructions/notes for the laboratory, as necessary

Any area of the COC, where sample information is not completed should have a diagonal line initialed by the sampler to show that this portion of the COC will not be completed.

Each COC will be placed in a waterproof zip lock plastic bag and affixed to the underside of the shipping container lid. Samples will be packaged properly for shipment as described in *SOP 23 – Sample Handling, Preservation, Packaging and Shipping*, and dispatched to the appropriate laboratory for analysis. Shipping containers will be padlocked or otherwise sealed for shipment to the laboratory, including the placement of custody seals that would indicate a container has been tampered with.

All shipments should be accompanied by the completed Chain-of-Custody Record. The original record will accompany the shipment to the laboratory, and a copy will be retained by the field team leader for the project file. Shipping bills and receipts must be retained as part of the chain-of-custody documentation. These documents should be scanned weekly and will become part of the permanent project files. Paper copies will be maintained in the project files in the office.

Upon receipt of the samples by the laboratory, the laboratory person assigned to log-in samples will confirm that the shipping container seals are in good condition and have not been disturbed. If a disturbance is noted, the laboratory shall notify the Key Project Manager at once. The original chain-of-custody form is to be signed and dated by the laboratory person logging in the samples. In addition, the receiving laboratory is to inspect each sample and indicate the condition of the sample on the COC. The receiving laboratory is to retain a copy of each chain-of-custody form along with the shipping bill. Internal laboratory chain-of-custody procedures will be followed once samples are logged in by the receiving laboratory.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to shipment, the Field Supervisor shall check to ensure that sample numbers are correct, sample paperwork is complete, field logbooks are maintained, and that the Sampling and Analysis Plan has been followed. If a particular sample location is inaccessible or if a sample could not be collected for any reason, the Project Manager is to be notified immediately. Such information must be included in the field logbook.

5.0 DATA RECORDING/MANAGEMENT

All sampling activities are to be documented in the field logbook. As discussed in Section 3.0, information related to tracking environmental samples will be recorded on the COC forms which will be retained in the project files.

All pages of the field logbooks relevant to sampling, as well as copies of all paperwork (COC forms, shipping labels, etc.) are to be scanned. Both paper copies and the digital copies become part of the permanent project file.

6.0 REFERENCES

U.S. Environmental Protection Agency, 1986, RCRA Ground-Water Monitoring Technical Enforcement Guidance Document: Office of Waste Programs Enforcement, Washington, D.C., EPA/530/Sw-86/055.

U.S. Environmental Protection Agency, 1986, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846 3rd Edition (with revisions): Washington, D.C.

U.S. Environmental Protection Agency, 1987, A Compendium of Superfund Field Operations Methods, Part 1: Washington, D.C., EPA/540/P-87/001.

U.S. Environmental Protection Agency, 1991, Compendium of ERT Groundwater Sampling Procedures: Washington, D.C., EPA/540/P-91/007.

Attachment 1
Example Chain-of-Custody Form

KEY ENVIRONMENTAL INCORPORATED

CHAIN OF CUSTODY

200 Third Avenue
Carnegie, PA 15106
Phone (412) 279-3363
Fax (412) 279-4332

Project No.: Project Name:

Samplers:
(signatures)

Sample I.D.	Date	Time	Comp	Grab	Sample Location Description	Number of Containers											Requested Analyses

Relinquish By: (signature)	Date	Time	Received By: (signature)	Date	Time	Notes:
Relinquish By: (signature)	Date	Time	Received By: (signature)	Date	Time	
Relinquish By: (signature)	Date	Time	Received By: (signature)	Date	Time	

Distribution: Original to Accompany samples; Copy Returned with Report

C:\Users\aal\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.Outlook\6B9XX3WL\COC.form
Revised 9/13/2012
Form # 3

25 - EQUIPMENT DECONTAMINATION

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) presents general guidelines and step-by-step methods for on-site decontamination of sampling equipment, heavy equipment, and personal protective equipment. Decontamination is performed as a quality assurance measure and a safety precaution. Decontamination prevents cross-contamination between samples, minimizes contaminant transport, and also helps to maintain a clean working environment for the safety of the field personnel.

Although this SOP defines on-site decontamination procedures, it is highly recommended that (1) dedicated disposable sampling implements are used whenever possible, and (2) sufficient dedicated sampling implements are taken to the field so that the need for field decontamination is eliminated or reduced. For example, in collecting groundwater samples, dedicated, disposable bailers should be used, where practicable.

Decontamination is mainly achieved by washing and rinsing with liquids which include; soap and/or detergent solutions, tap water, distilled water, acetone, hexane, and nitric acid. The actual procedure will vary depending on project-specific requirements as listed in the Quality Assurance Project Plan (QAPjP), the type of equipment to be used, and the analytical parameters of interest.

1.1 Referenced SOPs

05 – Management of Investigation-Derived Wastes

1.2 Definitions

(Reserved)

2.0 REQUIRED MATERIALS

This section contains a general list of materials that may be required to conduct field decontamination of sampling equipment. A particular project may have slightly different requirements; the QAPjP should be consulted prior to gathering and shipping equipment to the site.

- Concrete or lined decontamination pad (as required by project planning documents)
- Plastic sheeting
- Garden-type water sprayers
- Pressure washer, if required
- Portable steam cleaner, if required
- Cleaning brushes
- Distilled water
- Phosphate-free detergent (e.g., Liquinox® or Alconox®)

- Potable water supply
- Hexane
- Acetone
- Isopropanol
- 10% Nitric acid
- Chemical-free paper towels or shop cloths
- Cleaning brushes and scrapers
- Aluminum foil
- Drop cloth or plastic sheeting
- Gloves; safety glasses, protective clothing as specified in the Health and Safety Plan
- Cleaning containers (e.g., buckets, basins, pans)
- Chemically-compatible dedicated squirt or spray bottles for each solvent above and/or distilled water

Additional supplies such as those listed below could be required for waste disposal:

- Trash bags
- Trash containers
- 55-Gallon drums
- Metal or plastic buckets with lids for storage and disposal of decontamination liquids

3.0 METHODOLOGIES

Where feasible, all sampling equipment should be cleaned prior to use and dedicated to one sampling location for each sampling event, to minimize the need for cleaning equipment in the field. In some instances, the use of dedicated sampling equipment may not be a practical option, depending on the scope of the project.

In general, decontamination is accomplished by manually scrubbing, washing, or spraying equipment with one or more of the following: detergent solutions, tap water, distilled/deionized water, steam, acids, or solvents. Equipment can be allowed to air dry after being decontaminated or may be wiped dry with chemical-free paper towels, if immediate use is necessary.

The field decontamination methods and agents are to be determined on a project-specific basis and should be stated in the project planning documents. Decontamination plans should be based on a conservative, worst-case scenario, using all available information about a work area. An initial assumption is usually made that all protective clothing and equipment that leave the actual work location are contaminated. Based on this assumption, all nondisposable equipment is washed and rinsed, and disposable equipment and clothing are handled appropriately.

It is the primary responsibility of the field team leader to assure that the proper decontamination procedures are followed. Project-specific decontamination procedures are to be included in the field SAP. It is the responsibility of the project safety officer (or designee) to develop and implement safety measures which provide protection for all persons involved directly with decontamination.

A decontamination plan will be developed in the Health and Safety Plan. A decontamination line should be set up before any personnel or equipment enters areas of potential exposure. The decontamination plan should include

- The layout of decontamination stations and methods
- Disposal methods for contaminated clothing, equipment and solutions
- Procedures to minimize the potential for contamination, including work practices, the use of remote sampling techniques, the use of disposable or dedicated equipment; and avoiding laying down equipment in areas of obvious contamination

The contaminants encountered and type of equipment used will dictate the type of field decontamination procedures required.

At a minimum, the following procedures will be used:

1. Remove adhered material from the sampling equipment by brushing and/or rinsing with tap water.

2. Wash with non-phosphate detergent and tap water.

3. Rinse with distilled tap water.

4. Repeat the first three steps as necessary until all residue is removed.

5. Rinse with appropriate solvent specified in the Sampling and Analysis Plan, if organic constituents are of interest.

6. Rinse with distilled tap water to remove solvent.

7. Rinse with 10% nitric acid, if metals are a constituent of interest.

8. Rinse with distilled tap water.

9. Air dry or dry with clean, chemical free paper towels or shop cloths.

If metals are not a constituent of interest, the nitric acid rinse and the subsequent distilled water rinse steps can be eliminated.

3.1 Decontamination Area

During the project planning activities, a localized decontamination area will be identified for large equipment such as drill rigs and earthmoving equipment. This decontamination area should be located such that fluids and solids wastes can be managed in a controlled area with minimal risk to the surrounding environment.

In some cases, an existing concrete pad can be used. In other cases, one may need to be constructed. This determination will be made following an initial site visit. Decontamination areas may be lined with heavy-gauge plastic sheeting and include a collection system to capture decontamination Investigation Derived Waste (IDW).

Smaller decontamination tasks, such as the cleaning of soil or water sampling equipment, may take place at the sampling location. In this case, all required decontamination supplies and equipment must be mobilized to the site. These small decontamination areas may include basins or tubs to capture the decontamination IDW, which can be transferred to larger containers as needed.

3.2 Health and Safety Precautions

Decontamination procedures may involve:

- Potential exposure to constituents within the medium being investigated or solvents employed
- Physical hazards associated with the operation of the decontamination equipment

When decontamination is performed on equipment which has been in contact with the constituents of interest or when the quality assurance objectives of the project require decontamination with chemical solvents, the measures necessary to protect personnel should be addressed in the Health and Safety Plan. The Health and Safety Plan must be approved by the project Health and Safety Officer before work commences, must be distributed to all personnel performing equipment decontamination and must be adhered to as field activities are performed. Material Safety Data Sheets for any solvents stored or used on-Site should be should be available at the Site.

At a minimum, eye protection, safety shoes, and gloves are to be worn. There are several types of gloves that may be worn, depending on equipment being cleaned, type and extent of equipment contamination, and cleaning solutions or solvents being used.

Polyvinyl gloves may be worn when the equipment to be decontaminated is not heavily coated with constituents such as tars/oils. In cases where heavy accumulations of tars/oils are present on the equipment, neoprene or similar chemically compatible gloves are recommended. If a potential for skin contact exists, protective clothing should be worn.

3.3 Equipment Decontamination Planning Considerations

Decontamination methods, solutions, and frequencies must be considered and addressed during the formulation of a decontamination strategy, and should be outlined in the project plans. Each are dependent on site logistics, site-specific parameters of interest, the nature of the sample media, and the objectives of the study.

There are several factors which should be considered when deciding upon a decontamination solution or solvent:

- The solution or solvent should not contain any of the analytes of interest
- The solvent or solution must be effective at removing the constituents of interest
- The solvent must be relatively stable so that it can be handled and stored in the field without special handling requirements
- All sampling equipment must be resistant to the solvent or solution

Regulatory agencies may have specific requirements regarding decontamination solvents.

Methanol, acetone, and hexane are typical solvents of choice for equipment decontamination for general organic analyses. A 10% nitric acid and deionized water solution is the typical solvent of choice for sampling equipment decontamination for general metals analyses. If used on metal equipment, nitric acid may corrode the metal and lead to the introduction of metals to the collected samples. If it is necessary to use metal sampling equipment to collect samples for metals analysis, consideration of the aforementioned should be included during the evaluation of field and laboratory QA/QC samples.

Decontamination should be performed far enough away from the source of contamination so as not to be affected by the source, but close enough to the sampling site to keep decontaminated equipment handling to a minimum.

If heavy equipment, such as drill rigs or backhoes, is to be decontaminated, then a central decontamination station should be considered. Power may be required to run steam generators or high pressure water pumps. A potable water source may also be necessary. The construction of a suitable temporary structure to contain sprays and splashes may be necessary. Rinse and wash solutions should be collected and contained until the materials are characterized to identify appropriate management options, or, if available and appropriate, conveyed directly to an on-Site treatment facility for management.

Depending on the nature of the sample media or the solvents utilized, it may be necessary to collect, contain, and manage all particulate matter and wash solutions. If containment is necessary, it may be achieved by performing the decontamination in large galvanized tubs or over plastic sheeting.

3.4 General Equipment Decontamination Procedures

All sampling equipment must be decontaminated before use to ensure that contaminants have not been introduced to the sample during the sampling process through contact with the sampling device. Heavy equipment such as trucks, drilling rigs and backhoes should be decontaminated upon arrival at the site to prevent the introduction of road chemicals or constituents from a previous site. Monitoring well riser pipes, screens and drilling augers must also be decontaminated, as appropriate, to prevent the introduction of constituents.

Unless the decontaminated sampling devices are to be used immediately, they should be wrapped in aluminum foil, shiny side out, and stored in a designated “clean” area. Field equipment can also be stored in plastic bags to eliminate the potential for contamination. Larger size

equipment, such drill rods, augers, backhoe buckets, etc. need not be wrapped or covered. This equipment should be stored on horses or otherwise, kept from storage directly on the ground surface. Field equipment should be inspected and decontaminated prior to use if the equipment has been stored for long periods of time.

If specific procedures are not stated in the project plans, the standard procedures specified herein should be followed.

1. Determine from the project plans the method of containment for the particulate and wash solution generated during decontamination.

2. Typically, smaller equipment will be decontaminated in a plastic or galvanized tub.

3. The brush and container used for the decontamination process should be new or decontaminated prior to use.

4. Remove all solid particles from the equipment or material by brushing and then rinsing with available tap water. This initial step is performed to remove gross materials. Depending on the size of the equipment being decontaminated, this step may be preceded and/or followed by a steam or high pressure water rinse to remove solids and/or residual oil or grease.

3.5 Personnel and Personal Protective Equipment (PPE)

Decontamination of personnel and PPE prevents undesired human-health exposure to contaminants via ingestion, absorption, and inhalation. All personnel and PPE will be decontaminated as outlined in the Health and Safety Plan (HASP). Any further concerns regarding personnel and PPE decontamination procedures may be addressed directly with the Health and Safety Officer and/or Project Manager.

3.6 Decontamination of Sampling Equipment

Conduct consistent decontamination of sampling equipment to ensure the quality of the samples collected. Decontaminate all equipment that comes into contact with potentially contaminated samples. Disposable equipment intended for one-time use that is factory-wrapped generally does not need to be decontaminated before use, unless evidence of contamination is present.

Disposable equipment, such as disposable bailers, spoons, TerraCore® or Encore® VOC samplers, is preferred over reusable equipment; use wherever appropriate. Decontaminate sampling equipment, including split-barrel samplers, hand augers, reusable bailers, spoons, trowels, shovels, and pumps used to collect samples for chemical analyses before each use and before sampling at a new sampling location. Decontamination personnel will wear the appropriate PPE as required by the HASP.

Take the following steps to decontaminate non-dedicated sampling equipment:

1. Remove as much gross contamination (such as pieces of soil) as possible off equipment at the sampling site.

2. If heavy petroleum residuals are encountered during sampling, an appropriate solvent such as methanol will be used to remove any petroleum residues from sampling equipment. If a solvent is used, it must be properly used, collected, stored, and disposed of according to the HASP and the project-specific planning documents. If heavy petroleum residuals are not encountered, this step should be omitted.

3. Wash water-resistant equipment thoroughly and vigorously with potable water containing non-phosphate laboratory-grade detergent such as Liquinox®, Alconox®, or equivalent, and using a bristle brush or similar utensil to remove any remaining residual contamination.

4. Rinse equipment thoroughly with potable water (1st rinse).

5. Rinse equipment thoroughly with distilled or deionized water (2nd rinse).

6. For sensitive field instruments, rinse equipment with distilled, deionized, or American Society for Testing and Materials (ASTM) reagent grade water (3rd rinse).

7. Air dry at a location where dust or other fugitive contaminants may not contact the sample equipment. Alternatively, wet equipment maybe dried with a clean, disposable paper towel to assist the drying process. All equipment should be dry before reuse.

8. If the equipment is not used soon after decontamination, it should be covered or wrapped in new, oil-free aluminum foil or new, unused plastic bags to protect the decontaminated equipment from fugitive contaminants before reuse.

9. Store decontaminated equipment at a secure, unexposed location out of the weather and any potential contaminant exposure.

3.7 Decontamination of Groundwater Sampling Equipment

(Note: This procedure does not apply to dedicated submersible pumps which have been permanently installed in groundwater extraction wells.)

Proper decontamination between wells is essential to avoid introduction contaminants from the sampling equipment to another well. If peristaltic pumps are being used, it is necessary only to replace the pump head tubing after sampling each well. If sampling with submersible pumps or reusable bailers that come into direct contact with groundwater, the equipment must be decontaminated. The following procedure will be used to decontaminate submersible pumps before and between groundwater sample collection points, as well as the end of each day of use.

1. During decontamination, the submersible pump will be placed on a clean surface, such as a new plastic sheet.

2. When removing the submersible pump from each well, the power cord and discharge line will be wiped dry using chemical-free disposable towels. Should the pump be fitted with a disposable discharge line, disconnect the line for proper disposal.

3. Clean an upright plastic-nalgene cylinder first with a methanol, 10% nitric acid, or other specified solvent and then a distilled/deionized water rinse, wiping the free liquids after each.

4. For reversible pumps, reverse the pump to backwash all removable residual water present in the pump tubing. The pump should be shut off as soon as intermittent flow is observed from the reverse discharge.

5. Rinse the stainless steel submersible down hole pump section with a detergent solution followed by a water rinse and the specified solvent.

6. Place the submersible pump section upright in the cylinder and fill the cylinder with tap water, adding 50-100 ml of specified solvent for every one liter of water.

7. Activate the pump in the forward mode, withdrawing water from the cylinder.

8. Continue pumping until the water in the cylinder is pumped down and air is drawn through the pump. At this time air pockets will be observed in the discharge line. Shut off the pump immediately.

9. Remove the pump from the cylinder and place the pump in the reverse mode to discharge all removable water into a disposal container.

10. Using the water remaining in the cylinder, rinse the sealed portion of the power cord and discharge tube by pouring the water carefully over the coiled lines.

11. On reaching the next monitoring well, place the pump in the well casing and wipe dry both the power and discharge lines with a chemical-free paper towel as the pump is lowered.

3.8 Decontamination of Measurement Devices and Monitoring Equipment

For water quality instruments, oil-water interface indicators, water level indicators, continuous water level dataloggers, and other field instruments that have the potential to come into contact with site media, at a minimum, wash with dilute laboratory-grade detergent (Liquinox® or similar) and double rinse with potable and distilled/deionized water before and after each use using a similar procedure as discussed in Section 3.6. If heavy petroleum residuals are

encountered during sampling, use an appropriate solvent such as methanol to remove petroleum residues per the manufacturer's maintenance guidelines.

3.9 Decontamination of Drilling and Subsurface Soil Sampling Equipment

Drilling equipment and associated materials will be decontaminated by the drilling contractor prior to any drilling operations and between borings. Decontaminate tools used for soil sampling (for example, split spoon samplers) before and between collecting any analytical samples, as outlined in Section 3.6. Thoroughly clean external and internal surfaces of drilling equipment (that is, drill bits, auger, drilling stem, and hand tools) before beginning any drilling operations and between borings using the following basic sequence:

1. Remove as much gross contamination as possible off equipment at the sampling site.

2. Wash equipment thoroughly and vigorously with high-temperature potable water using a high-pressure washer and/or steam cleaner. A bristle brush is also suggested to remove any persistent gross contamination.

3. Rinse equipment twice thoroughly with potable water (1st and 2nd rinse).

4. Air dry at a location where dust or other fugitive contaminants may not contact the sample equipment. All equipment should be dry before reuse.

5. Store decontaminated equipment at a location away from any potential exposure from fugitive contamination.

3.10 Decontamination of Heavy Equipment

Wash earthwork equipment (such as excavators, back-hoes, and trucks) with high-pressure potable water, if possible, before leaving a contaminated area, using similar steps as outlined in Section 3.9. Portable steam-cleaners and hand washing with a brush and detergent, followed by a potable water rinse, can also be used. In some instances, tires and tracks of equipment maybe only need to be thoroughly brushed with a dry brush. Take particular care with the components in direct contact with contaminants, such as tires and backhoe buckets. Any part of earthwork equipment that may come in direct contact with analytical samples (that is, sampling from the excavator bucket) must be thoroughly decontaminated before excavation activities and between sample locations.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

To ensure that sampling equipment is cleaned properly and sample cross-contamination does not occur, field rinsate blanks will be collected as required by the Sampling and Analysis Plan. A rinsate blank will consist of pouring deionized organic-free water over the specific sampling device or pouring it through the device after it has been cleaned. The rinsate sample is collected in the field under the same conditions as occurred for the sampling activity, and is handled exactly like any other samples collected that day.

Generally, one rinsate blank is collected each day of sampling or at a rate of 1 per 20 for each parameter, whichever is less, for each matrix being sampled or for each type of sampling instrument decontaminated and reused per day. The rinsate samples are analyzed for the specific parameters of concern (for each matrix). Rinsate blanks should be labeled like a routine environmental sample, and laboratory analysis instructions should be included on the chain-of-custody form.

Rinsate blanks are not required if dedicated sampling equipment is used. Additional quality assurance samples may be collected if deemed necessary by project specific requirements. All project specific quality assurance sampling will be defined in the sampling and analysis plan (SAP) or QAPjP prior to initiation of the field work.

5.0 DOCUMENTATION AND RECORD KEEPING

The field team leader will maintain a record of the decontamination procedures. Notations shall be made in the field logbook concerning the decontamination procedures and which equipment was decontaminated. An Equipment Decontamination Record form shall be completed for all rental equipment (see Attachment 1).

The following information should be recorded in the Field Logbook:

- Decontamination personnel
- Decontamination solutions used
- Start and finish date and time
- Location of decontamination activities
- General methods used, tools used, and observations, including any deviations from this SOP
- Equipment identification numbers
- Manufacturer names and lot numbers of decontamination solutions
- Location and amount of decontamination IDW collected, stored, and/or disposed, including the sources (e.g., well or boring numbers) of the IDW (see SOP *05 – Management of Investigation-Derived Wastes*)
- Any spills or releases, and associated corrective actions taken

6.0 REFERENCES

United States Environmental Protection Agency, January 1991, Compendium of ERT Groundwater Sampling Procedures: Washington, D.C., EPA 540/P-91/007.

United States Environmental Protection Agency, December 1987, A Compendium of Superfund Field Operations Methods: Washington, D.C., EPA 540/P-87/001.

ATTACHMENT 1
SOP 25 – EQUIPMENT DECONTAMINATION
EQUIPMENT DECONTAMINATION RECORD

EQUIPMENT DECONTAMINATION RECORD

HS-15

This form must be completed for all rental equipment.
A copy of this form should accompany all returned equipment.

EQUIPMENT IDENTIFICATION

Type of equipment: _____

Model: _____

Serial Number: _____

Rented From (Name & Address): _____

_____

_____

_____

DECONTAMINATION

Decontamination Method: _____
Date of Decontamination: _____
Site Name: _____
Project Number: _____

DECONTAMINATION CERTIFICATION

To be signed by the Site Supervisor or Site Health and Safety Officer.

Name: _____
Title: _____
Signature: _____
Date:

32 – SURFACE SOIL SAMPLING

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) presents Key Environmental, Inc.'s (KEY) standard procedures for collection of representative samples of surface soil or similar materials. Surface soil typically consists of material at the surface of a site from a depth of 0-6 inches below ground surface but the definition of surface soil may vary based on site-specific conditions or regulatory considerations.

Based on site-specific conditions and data quality objectives, surface soil samples may consist of material from alternate depth intervals. For example, in the event that surface cover materials such as gravel, asphalt, or clean soil cover are present in the area to be characterized, a baseline surface soil sample may be material from beneath the cover material. Samples from the surface of excavated soil stockpiles may also be treated as surface soil for the purposes of this SOP.

Site-specific regulatory requirements should also be considered with respect to the definition of surface soil. For example, contingent upon specific State or EPA regulations (or regulator input) or whether human or ecological receptors are of interest, surface soil may actually consist of the top two centimeters of soil or the top two or even three feet of soil.

The site- or project-specific planning documents (Work Plan, Quality Assurance Project Plan, Sampling and Analysis Plan, Field Sampling Plan, Scoping Document, Scope of Work or other similar project planning documents) shall be consulted to identify the specific depth intervals of interest for the purposes of surface soil sampling pursuant to this SOP.

Data derived from surface soil sampling and analysis can be used to address various objectives, including, but not limited to, the following:

1. To support determination of whether a release of constituent(s) of interest has occurred in a specific area.

2. To delineate the nature and lateral extent of a release to support ecological or human health risk assessments via direct contact pathways.

3. To provide information to support modeling exercises such as erosion and runoff estimation or atmospheric transport of dust for risk assessment purposes.

4. To establish background concentrations of naturally-occurring constituents (i.e., metals) in surficial soils.

5. To provide information for establishing site- and task-specific health and safety requirements and for preparation of a Health and Safety Plan.

6. To accommodate area and volume estimation to support cost analysis for viable remedial options.

7. To support remedial design of excavation, in-situ treatment, or engineering control options.

8. To provide an initial data set for the purposes of determining if additional data collection is necessary to identify subsurface soil and groundwater impacts.

1.1 Referenced SOPs

03 – Field Logbook
22 – Sample Preparation
23 – Sample Handling, Preservation, Packaging and Shipping
24 – Chain of Custody
25 – Equipment Decontamination

2.0 REQUIRED MATERIALS

As previously discussed, project planning documents shall be reviewed to identify any site- or project-specific requirements regarding sampling equipment. The types of equipment to be used may vary based on the location of the site and State- and/or EPA Region-specific requirements or based on the method of recording sample locations. Examples of relevant equipment for surface soil sampling are as follows:

Health and Safety Plan
Work Plan
Hard Hat
Safety Glasses
Steel-Toed Work Boots
Hearing Protection
Safety Vests
Daily Mobile Equipment Check List
Tailgate Safety Meeting Sheets
Direct Push Drilling Equipment
Hand Augers
AMS Soil Probes
Wildco Hand Corer Sampler
Acetate Sample Sleeves
Soil Cone Catches
Trowels
Shovels
Scoops
Spoons
Post-Hole Diggers
Bulb Planters
Spatulas
Bowls
EnCore® Samplers
TerraCore® Sample Kits
Plastic Sheeting
Sample Bottles
Photoionization Detector
Buckets
Scrub Brushes
Detergents (Non-phosphate)
Potable Water
Deionized Water
Nitric Acid
Hexane
Spray Bottles (for Decontamination)
Clipboard
Chain-of-Custody Forms
Sample Collection Forms
Field Logbook
Sample Labels
Air Bills

Shipping Labels
Custody Seals
Indelible Ink Pens
Zip-Lock Bags
Trash Bags
Bubble Wrap
Vermiculite
Cooler(s)
Ice/Freezer Packs
Duct Tape
Strapping Tape
Nitrile Gloves
Paper Towels / Shop Cloths
55-Gal DOT-Approved Steel Drums
Drum Labels
Digital Camera
Stakes
Pin Flags
Pedometer
Flagging Tape
Marking Paint
Hand-Held GPS Unit
Metal Detector or Utility Locator
Tape Measure (100' – 300' reel)
Compass

A direct push technology (i.e., Geoprobe) rig may be appropriate for sampling hard cohesive surface soils if depth intervals in excess of one foot are to be sampled. Should a direct push drill rig be used for shallow soil sampling, a one-call utility clearance may be required prior to mobilizing to the field to conduct drilling efforts. Additionally, oversight personnel coordinating field efforts should consult the KEY Project Manager, or appointed representative, to ensure all access agreements are in place and current before mobilizing to the field.

Hand augers of various types and bulb planters are suitable for sampling all types of cohesive soils. Trowels, shovels, scoops, and spoons are suitable for all types of shallow surface soil sampling including cohesive and non-cohesive materials. The sampling equipment should be manufactured of a material that is suitable for the types of analyses to be conducted. Stainless steel, glass, and hard plastics are typically suitable materials.

Spatulas may be suitable for cohesive soils to assist in the removal of material from augers if hand augering is completed. Stainless steel bowls are suitable for compositing samples from multiple locations or for the homogenization of soils from a discrete vertical interval at a single location. Note that samples for Volatile Organic Compound (VOC) analysis are typically collected using an EnCore® Sampler or a TerraCore® Sampling Kit. VOC samples shall ALWAYS be collected directly from the sampling location and should never be collected after homogenization or compositing.

Additional equipment identified above is used for sample handling, packing and shipping, and for Investigation-Derived Waste management for subsequent off-site disposal and documentation purposes. Sample handling, packaging and shipping, chain-of-custody, and sample preparation are discussed in detail in other relevant KEY *SOPs 23, 24, and 22*, respectively.

3.0 METHODOLOGIES

The sample location should be identified in the field based on inspection of site sample location maps (and associated coordinates) from the project planning documents and/or based on visual inspection of the area to identify areas of staining or stressed vegetation. If locations are pre-specified in the project planning documents, the sample location should be determined via use of

a hand-held GPS unit or via measurement using a tape measure (and compass as necessary) relative to fixed site features (e.g., building corners, monitoring wells, survey benchmarks, hydrants, poles, etc.). If VOCs are of interest for the sampling and analysis program, a photoionization detector (PID) measurement should be obtained within 3 inches of the ground surface at the planned sample location prior to sampling.

The ground surface at the sample location should be cleared of debris (e.g., rocks, twigs, leaves) or other materials that may prohibit/inhibit sampling (e.g., gravel or grass). If ornamental vegetation must be disturbed (e.g., grass removal) a shovel should be used to remove a layer of the turf to accommodate sampling of the underlying soil matrix. The turf should be replaced upon completion of sampling.

A hierarchical approach shall be followed during surface soil sampling activities. Samples for the analyses specified in the project planning documents should be collected such that those that are most likely to be subject to losses via mass-transfer mechanisms (e.g., volatilization) are collected and bottled first and the most stable samples are collected last. The preferred collection order for common analytical parameters is as follows:

1. Volatile Organic Compounds;
2. Semi-Volatile Organic Compounds;
3. Total Petroleum Hydrocarbons;
4. Total Organic Carbon;
5. Metals and Cyanide; and
6. Radionuclides

If direct push technology sampling is completed, a decontaminated macrocore sampler with disposable acetate sleeves shall be used to collect the surface soil sample. Once the core barrel is recovered and the acetate sleeve is removed from the core barrel, the acetate should be cut open via two parallel incisions along the length of the core. Drillers typically have a cutting tool suited for this purpose. Alternately, a utility knife equipped with a hook blade for safety, may be used to cut the acetate sleeves.

Samples for VOC analysis (if any) should be obtained from the exposed core immediately after opening of the acetate sleeve. These samples should be obtained from the exposed core at a location corresponding to the appropriate sample depth as specified in the project planning documents or at a depth corresponding to the highest PID reading along the length of the core.

The sample shall be obtained directly from the core using the specified VOC sampling tool (i.e., TerraCore® kits or EnCore® samplers). Sampling for VOC analysis using TerraCore® kits or EnCore® samplers shall be conducted to minimize entrainment of any air in the samplers and shall be completed in accordance with the manufacturer's instructions.

The remaining sample interval (e.g., 0-2 feet) should be homogenized in a dedicated or decontaminated stainless steel or glass mixing bowl. Homogenization should be completed via thorough hand mixing of the sample with a trowel, spoon, or scoop. Contingent upon the nature

of the matrix, coning and quartering may be an appropriate means of homogenization and generation of the desired sample aliquot(s).

To complete coning and quartering, the sample shall be placed in the mixing bowl in a cone shape, shall be flattened into a cake, and shall be segregated into four quarters. Two quarters are then discarded (i.e., returned to the sample location). The remaining quarters are blended, coned, flattened, and quartered and segregated again. This process continues until only a quantity of sample sufficient to fill the sample bottles remains. Note that coning and quartering may be difficult for cohesive soils such as wet sticky clay. Such soils should be homogenized to the greatest extent practicable prior to collection of sample aliquots.

Decontaminated (or dedicated) trowels, spoons, hand augers, etc. may be used in lieu of a drilling rig. If a sample portion is to be submitted for analysis of VOCs, the soil for VOC analysis should be collected directly from the sample location at a depth as specified in the project planning documents. Sampling for VOC analysis using TerraCore® kits or EnCore® samplers shall be conducted to minimize entrainment of any air in the samplers and shall be completed in accordance with the manufacturer's instructions.

If a composite (or multi-increment) sample of several surface locations is desired, or if homogenization of a vertical sample from a single location is necessary to generate a representative sample, then mixing must be performed using a decontaminated or dedicated glass or stainless steel bowl. Compositing and mixing will be performed only after any samples to be submitted for analysis of VOC have been taken. Most soil matrices are suitable for homogenization via the coning and quartering procedure previously discussed. Multi-increment sampling, if conducted, will be completed via collection of field composite samples to be subsequently processed and sub-sampled by the contracted laboratory.

Upon completion of sampling at any given location (whether a subsample for a composite, or a stand-alone grab sample), the location should be clearly marked with a stake and flagging tape or a pin flag. The sample location number shall be marked on the stake (or flag) using indelible ink. The sample location should be photographed for documentation purposes. Hand-held GPS units are typically suitable for documenting sample locations to the desired degree of accuracy and, routinely, coordinates should be obtained and recorded at the time of sampling if so specified in the project planning documents. If very accurate survey information is required, the sample location shall be surveyed at a later time unless sample locations were laid out in advance via surveying.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance and quality control for surface soil sampling activities will consist of several distinct elements. Double checking of planned sample numbers versus numbers recorded on the field log sheets, on the sample label, and on the chain-of-custody form shall be completed to ensure that no mix up of samples versus locations occurs. Collection of field quality control samples will be completed as specified in the project planning documents and will typically consist of field duplicate samples, matrix-spike/matrix spike duplicates, and possibly rinsate

blanks. Trip blanks and field blanks are typically not required for the soil matrix but may be required on a project-specific basis.

Decontamination of sampling equipment between sample locations is to be performed as outlined in *SOP 25 - Equipment Decontamination*. Sample preparation will follow *SOP 22 – Environmental Sample Preparation*. Sampling handling, preservation, packaging and shipping will follow *SOP 23 – Sample Handling, Preservation, Packaging and Shipping*. Chain of custody will be maintained at all times, following *SOP 24 – Chain of Custody*.

5.0 DOCUMENTATION AND RECORD-KEEPING

All relevant observations and information about the sample location and sample collection effort shall be recorded in the field logbook in accordance with the relevant KEY field logbook SOP (*SOP 03 – Field Logbook*). Detailed information regarding the sample and required analyses shall be recorded on a surface soil sample form, including, but not limited to, sample number; collection date, time, and location; soil texture and color; and relevant observations for the sample location (staining, odors, stressed vegetation). Attachment 1 is a sample collection form which shall be used for surface soil sample collection efforts.

6.0 REFERENCES

ASTM International (formerly American Society for Testing and Materials). *ASTM D-5633 (2008) - Standard Practice for Sampling with a Scoop.*

NJDEP (New Jersey Department of Environmental Protection), August 2005, Field Sampling Procedures Manual, §5.3, §6.1, and §6.2: Trenton, New Jersey.

USEPA (United States Environmental Protection Agency), December 1987, A Compendium of Superfund Field Operations Methods: Washington, D.C., EPA/540/P-87/001, pp. 8.1-4 through 8.1-18.

ATTACHMENT 1
SOP 32 – SURFACE SOIL SAMPLING
SOIL SAMPLE LOG SHEET

Sample No. _____

KEY ENVIRONMENTAL INCORPORATED

SURFACE SOIL SAMPLE LOG

Project Number: _____ **Date:** _____

Project Location: _____ **Time:** _____

Client: _____ **Weather Conditions:** _____

Collected By: _____

Sample Point Description: _____

_____

(Include nearby landmarks, designation from a map layout of the site, measurements, or any other locating information.)

SAMPLE COLLECTION:

Equipment Used: _____

_____

Required Analyses: _____

_____

No. of Sample Containers and Sizes: _____

_____

Figure 1: Sample Point

Collection Depths	Soil Description

Comments: _____

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33 - SUBSURFACE SOIL SAMPLING

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) presents procedures for the collection and identification of representative subsurface soil samples from borings. Soil samples are used to evaluate the physical and/or chemical characteristics of the subsurface. Physical information can be used to define site geologic, hydrogeologic, and geotechnical properties. Chemical data generated from these samples can be used to define the lateral and vertical extent of contaminants in the subsurface.

Samples may be collected *via* a number of techniques, depending upon site conditions and project objectives. These techniques include split-barrel sampling or thin-walled sampling through hollow-stem augers, direct-push sampling *via* Geoprobe or cone-penetration technology, hand auger, test pit excavation, or other methods.

Project planning documents such as the Work Plan and the Sampling and Analysis Plan should be consulted to identify the specific depth intervals of interest. Data derived from subsurface soil sampling can be used to

- Determine whether a release of constituent(s) of interest has occurred
- Delineate the nature and extent (both lateral and vertical) of a release
- Provide information to support an assessment of potential groundwater impacts
- Establish background concentrations of naturally occurring constituents (i.e., metals)
- Support remedial design activities

1.1 Referenced SOPs

03 – Field Logbook
22 – Sample Preparation
23 – Sample Handling, Preservation, Packaging and Shipping
24 – Chain of Custody
25 – Equipment Decontamination

1.2 Definitions

(Reserved)

2.0 REQUIRED MATERIALS

The following equipment may be required when conducting subsurface soil sampling. However, not all equipment may be needed for any single sampling event.

- Split-barrel sampler
- Thin-walled sampler
- Direct-push sampler

Sampling devices are often provided by subcontractors.

Project planning documents should be reviewed by field personnel and Field Team Leader to determine the types of sampling equipment required for completion of the designated tasks. The types of equipment to be used may vary based on the location of the site, and State- or EPA Region-specific requirements. Examples of other relevant equipment for subsurface soil sampling may include:

Health and Safety Plan
Work Plan
Hard Hat
Safety Glasses
Steel Toed Work Boots
Hearing Protection
Safety Vests
Daily Mobile Equipment Check List
Tailgate Safety Meeting Sheets
Direct Push Drilling Equipment
Hand Augers
AMS Soil Probes
Wildco Hand Corer Sampler
Acetate Sample Sleeves
Soil Cone Catches
Spoons
Spatulas
Bowls
Plastic Sheeting
Sample Bottles
Photoionization Detector
Buckets
Scrub Brushes
Detergents (Non-phosphate)
Potable Water
Deionized Water
Nitric Acid
Hexane
Spray Bottles (for Decon)
Clipboard
Chain-of-Custody Forms
Sample Collection Forms
Field Logbook
Sample Labels
Air Bills
Shipping Labels
Custody Seals
Indelible Ink Pens
Zip-Lock Type Bags
Trash Bags
Bubble Wrap
Vermiculite
Cooler(s)
Ice/Freezer Packs
Duct Tape
Strapping Tape
Nitrile Gloves
Paper Towels / Shop Cloths
55-Gal DOT-Approved Steel Drums
Drum Labels
Digital Camera
Stakes
Pin Flags
Pedometer
Flagging Tape
Marking Paint
Hand-Held GPS Unit
Metal Detector or Utility Locator
Tape Measure (100’ – 300’ reel)
Compass

3.0 METHODOLOGIES

3.1 Sample Collection

Subsurface soil samples can be collected using a variety of methods that are generally dependent upon project requirements, intended analyses (*i.e.*, volume of soil required for testing) and site geologic conditions. Common sample collection methods are discussed below.

Split-Barrel Sampling

The procedures for this sampling method are presented in the American Society for Testing and Materials (ASTM) Method D1586 (Attachment 1). The samples collected with this method usually provide a sufficient volume to test some physical parameters, such as grain size distribution, and commonly performed chemical analyses (*e.g.*, VOCs, SVOCs, and metals).

Following each use, the sampler should be washed thoroughly to remove residual soils. If samples are to be submitted for chemical analysis, the sampler should be decontaminated between samples using a soapy (nonphosphatic) water wash and clean water rinse followed by solvent rinses and/or acid rinses and distilled water rinses as required for the analytes of interest. Split-barrel samples are used to collect soil samples 18 to 24 inches in length from a selected depth interval. Depth intervals will be specified in the project-specific work plan. The sampling depth and the blow counts for each 6-inch interval will be recorded in the field notebook. After removing the sampler from the borehole, these procedures should be followed:

- Note and record the amount of recovery
- Describe the sample as per ASTM Method D2488 (Attachment 2)

Select representative portion(s) for retention and place in a labeled clean storage jar(s) for subsequent evaluation of physical characteristics or in a laboratory supplied, labeled jar for laboratory chemical analysis.

If samples are to be field screened for volatile organics: (1) the soil core should be screened immediately after the spoon is opened; and/or, (2) a sample should be placed with adequate headspace in a clean glass jar to be screened later for volatile organic chemicals in the headspace, if necessary. If a sample is to be submitted for volatile organic chemical analysis, it is important that exposure time of the soils to the air be kept to a minimum. In addition, samples collected for chemical analysis should be placed on ice in a sample cooler immediately after sampling.

As necessary, the following information should be included in the field logbook, as described in *SOP 03 – Field Logbook*:

- Sample depth interval
- Standard blow counts required for each six-inch penetration
- Sample recovery
- Sample description
- Field screening data

When samples are collected for laboratory analysis, include the unique sample identification number, the type of analyses requested, and the laboratory where the sample is to be sent.

Excess sample material can be containerized or placed on the land surface as specified in the project-specific work plan. Management requirements for wash water and decontamination water should also be identified in the project-specific work plan.

Undisturbed (Thin-Walled) Soil Sampling

These samples are commonly referred to as "Shelby tube" samples. The method is used to collect samples in conjunction with auger or wet rotary drilling methods, generally for geotechnical testing, but they may be used for chemical analysis as well. These samples are generally collected only from cohesive materials.

Typically, the soil is not removed from the Shelby tube in the field, unless analytical testing is required; the tube ends are sealed with plastic caps and/or wax and the tube sent intact to the testing laboratory. Prior to sending the samples to the laboratory, all residual soil should be removed from the outside of the sampling tube.

The tube should then be prepared for shipment as indicated in ASTM Method D1587 (Attachment 3). The tube should be labeled as shown in Figure 1, including the following information:

- Job name and number
- Sample location (soil or well boring number)
- Sample identification
- Sample interval and the percent recovery
- Date of sample
- Top and bottom of sample - lines should be drawn around the circumference of the tube, indicating the top and the bottom of the sample with an arrow pointing toward the top

This information and any descriptive data on sample characteristics should be recorded in the field notebook.

Direct-Push Soil Sampling

The Geoprobe® direct-push soil sampling methodology is described herein, and is considered to be representative of most direct-push soil sampling procedures. Direct-push soil borings are completed by hydraulically pushing a sampling device to the top of the desired depth interval for soil sample collection. The soil sampling device typically consists of a stainless steel sampling tube through which a stainless steel drive point is inserted and attached to a piston stop pin. The steel drive point and piston stop pin prevent soil from entering the sampling device until the desired depth interval is encountered. A dedicated acetate liner for soil containment may be inserted into the sampling device. When the top of the desired sampling interval is encountered, the piston stop pin and stainless steel drive point are removed in order to permit soil to enter the sampling device with the next push of the rods. The rods are then extracted and the sampling

device is opened to expose the sampled core of soil, which can then be described and/or containerized.

3.2 Sample Identification

A unique sample identification will be given to each soil sample collected. A precise method for sample identification, based on this generic scheme, should be presented in the project work plan and sampling and analysis plan. One example of a sample identification scheme follows:

The identifier will be composed of three groups of alpha-numeric characters, which will identify (1) the project and/or site; (2) the sample location; and, (3) the sample interval. The three groups should be separated by dashes as in the following example:

AL-MW10-SS5

- Project Site (AL): The first two characters of the sample identifier should be a two-character alphabetical code identifying the client and the site. For example, a project for the Allied Gas Company in Lewistown may be identified with the code "AL." A unique project site identifier should be selected by the project manager and be specified the project-specific work plan and the project-specific sampling and analysis plan.

- Sample Location (MW10): The second set of digits should be a combined alphabetical and numerical code that identifies the sample location and location type. The example identifies a soil sample collected during the construction of Monitoring Well 10. Commonly used sample location identifiers include:

    - SB - soil boring
    - SF - surface soil
    - TP - test pit
    - MW - monitoring well (if soil samples are collected from a monitoring well pilot borehole)

- Sample Type and Interval (SS5): The third group of characters should be both alphabetical and numerical characters that identify the sample interval. The example given identifies a soil sample collected from split-barrel sample 5. The boring log and field notes should reference the specific sampling interval (indicated numerically), but typically the number indicates the depth in feet below land surface where sampling began. Commonly used sample type identifiers include:

    - SS - split-barrel sample
    - ST - Shelby tube sample
    - CB - core barrel sample
    - CO - composite sample
    - AC - auger cuttings

"Blind" duplicate samples will be identified in the same way as any other sample, such that it is not identified as a duplicate; however, the source of the duplicate sample should be identified in

the field book as such. Data quality samples (matrix spike or matrix spike duplicate samples) should be identified as such with an "MS" or "MSD" code, as appropriate [*e.g.*, AL-MW10-SS5(MS)].

If trip blanks or field blanks are required (these are typically deionized water samples or rinsate water samples collected from soil sampling tools), the sample identification scheme will include TB or FB and a number in the second group. The number should identify the source of the blank and be described in the field notes. A sample type and interval code for blank samples is not required.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance and quality control for subsurface soil sampling activities will consist of several distinct elements. Double-checking of planned sample numbers versus numbers recorded on the field log sheets, on the sample labels and on the chain-of-custody forms shall be completed to ensure that no mix-up of samples versus locations occurs. Collection of field quality control samples will be completed as specified in the project planning documents and will typical consist of field duplicate samples, matrix spike/matrix spike duplicate samples, and possible rinsate blanks. Trip blanks (unless a rinsate sample is submitted for VOC analysis) and field blanks may not be required.

Decontamination of sampling equipment between sample locations is to be performed as outlined in *SOP 25 - Equipment Decontamination*. Sample preparation will follow *SOP 22 – Environmental Sample Preparation*. Sampling handling, preservation, packaging and shipping will follow *SOP 23 – Sample Handling, Preservation, Packaging and Shipping*. Chain of custody will be maintained at all times, following *SOP 24 – Chain of Custody*.

5.0 DOCUMENTATION AND RECORD-KEEPING

All relevant observations and information about the sample location and sample collection effort shall be recorded in the field logbook in accordance with the KEY field logbook SOP. Detailed information regarding the sample and require analyses shall he recorded on a soil sample collection form, including, but not limited to, sample number, collection date/time, sample location, soil texture/color, relevant observations such as staining, odors, and PID readings. Attachment 4 is a form to be used for subsurface soil sample collection record keeping.

6.0 REFERENCES

American Society of Testing and Materials, 1996, *1996* - ASTM Standard D1586: Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.

American Society of Testing and Materials, 1996, *1996* Annual Book of ASTM Standards - ASTM Standard D1587: Standard Test Method for Thin-Walled Tube Sampling of Soils.

American Society of Testing and Materials, 1996, 1996 Annual Book of ASTM Standards - ASTM Standard D2488: Practice for Description and Identification of Soils (Visual-Manual Procedure).

Figure 1. Shelby Tube Marking Requirements

ATTACHMENT 1
SOP 33 – SUBSURFACE SOIL SAMPLING
ASTM D1586

Designation: D1586 – 11

Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils[1]

This standard is issued under the fixed designation D1586; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This test method describes the procedure, generally known as the Standard Penetration Test (SPT), for driving a split-barrel sampler to obtain a representative disturbed soil sample for identification purposes, and measure the resistance of the soil to penetration of the sampler. Another method (Test Method D3550) to drive a split-barrel sampler to obtain a representative soil sample is available but the hammer energy is not standardized.

1.2 Practice D6066 gives a guide to determining the normalized penetration resistance of sands for energy adjustments of N-value to a constant energy level for evaluating liquefaction potential.

1.3 Test results and identification information are used to estimate subsurface conditions for foundation design.

1.4 Penetration resistance testing is typically performed at 5-ft depth intervals or when a significant change of materials is observed during drilling, unless otherwise specified.

1.5 This test method is limited to use in nonlithified soils and soils whose maximum particle size is approximately less than one-half of the sampler diameter.

1.6 This test method involves use of rotary drilling equipment (Guide D5783, Practice D6151). Other drilling and sampling procedures (Guide D6286, Guide D6169) are available and may be more appropriate. Considerations for hand driving or shallow sampling without boreholes are not addressed. Subsurface investigations should be recorded in accordance with Practice D5434. Samples should be preserved and transported in accordance with Practice D4220 using Group B. Soil samples should be identified by group name and symbol in accordance with Practice D2488.

1.7 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026, unless superseded by this test method.

1.8 The values stated in inch-pound units are to be regarded as standard, except as noted below. The values given in parentheses are mathematical conversions to SI units, which are provided for information only and are not considered standard.

1.8.1 The gravitational system of inch-pound units is used when dealing with inch-pound units. In this system, the pound (lbf) represents a unit of force (weight), while the unit for mass is slugs.

1.9 Penetration resistance measurements often will involve safety planning, administration, and documentation. This test method does not purport to address all aspects of exploration and site safety. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* Performance of the test usually involves use of a drill rig; therefore, safety requirements as outlined in applicable safety standards (for example, OSHA regulations,[2] NDA Drilling Safety Guide,[3] drilling safety manuals, and other applicable state and local regulations) must be observed.

2. Referenced Documents

2.1 *ASTM Standards:*[4]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D854 Test Methods for Specific Gravity of Soil Solids by Water Pycnometer

[1] This method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.02 on Sampling and Related Field Testing for Soil Evaluations.

Current edition approved Nov. 1, 2011. Published December 2011. Originally approved in 1958. Last previous edition approved in 2008 as D1586–08a. DOI: 10.1520/D1586-11.

[2] Available from Occupational Safety and Health Administration (OSHA), 200 Constitution Ave., NW, Washington, DC 20210, http://www.osha.gov.

[3] Available from the National Drilling Association, 3511 Center Rd., Suite 8, Brunswick, OH 44212, http://www.nda4u.com.

[4] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

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D1587 Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
D2216 Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
D2487 Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
D2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)
D3550 Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils
D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
D4220 Practices for Preserving and Transporting Soil Samples
D4633 Test Method for Energy Measurement for Dynamic Penetrometers
D5434 Guide for Field Logging of Subsurface Explorations of Soil and Rock
D5783 Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices
D6026 Practice for Using Significant Digits in Geotechnical Data
D6066 Practice for Determining the Normalized Penetration Resistance of Sands for Evaluation of Liquefaction Potential
D6151 Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling
D6169 Guide for Selection of Soil and Rock Sampling Devices Used With Drill Rigs for Environmental Investigations
D6286 Guide for Selection of Drilling Methods for Environmental Site Characterization
D6913 Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

3. Terminology

3.1 *Definitions:*

3.1.1 Definitions of terms included in Terminology D653 specific to this practice are:

3.1.2 *cathead, n*—the rotating drum or windlass in the rope-cathead lift system around which the operator wraps a rope to lift and drop the hammer by successively tightening and loosening the rope turns around the drum.

3.1.3 *drill rods, n*—rods used to transmit downward force and torque to the drill bit while drilling a borehole.

3.1.4 *N-value, n*—the blow count representation of the penetration resistance of the soil. The *N*-value, reported in blows per foot, equals the sum of the number of blows (*N*) required to drive the sampler over the depth interval of 6 to 18 in. (150 to 450 mm) (see 7.3).

3.1.5 *Standard Penetration Test (SPT), n*—a test process in the bottom of the borehole where a split-barrel sampler having an inside diameter of either 1-1/2-in. (38.1 mm) or 1-3/8-in. (34.9 mm) (see Note 2) is driven a given distance of 1.0 ft (0.30 m) after a seating interval of 0.5 ft (0.15 m) using a hammer weighing approximately 140-lbf (623-N) falling 30 ± 1.0 in. (0.76 m ± 0.030 m) for each hammer blow.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *anvil, n*—that portion of the drive-weight assembly which the hammer strikes and through which the hammer energy passes into the drill rods.

3.2.2 *drive weight assembly, n*—an assembly that consists of the hammer, anvil, hammer fall guide system, drill rod attachment system, and any hammer drop system hoisting attachments.

3.2.3 *hammer, n*—that portion of the drive-weight assembly consisting of the 140 ± 2 lbf (623 ± 9 N) impact weight which is successively lifted and dropped to provide the energy that accomplishes the sampling and penetration.

3.2.4 *hammer drop system, n*—that portion of the drive-weight assembly by which the operator or automatic system accomplishes the lifting and dropping of the hammer to produce the blow.

3.2.5 *hammer fall guide, n*—that part of the drive-weight assembly used to guide the fall of the hammer.

3.2.6 *number of rope turns, n*—the total contact angle between the rope and the cathead at the beginning of the operator's rope slackening to drop the hammer, divided by 360° (see Fig. 1).

3.2.7 *sampling rods, n*—rods that connect the drive-weight assembly to the sampler. Drill rods are often used for this purpose.

4. Significance and Use

4.1 This test method provides a disturbed soil sample for moisture content determination, for identification and classification (Practices D2487 and D2488) purposes, and for laboratory tests appropriate for soil obtained from a sampler that will produce large shear strain disturbance in the sample such as Test Methods D854, D2216, and D6913. Soil deposits containing gravels, cobbles, or boulders typically result in penetration refusal and damage to the equipment.

4.2 This test method provides a disturbed soil sample for moisture content determination and laboratory identification. Sample quality is generally not suitable for advanced laboratory testing for engineering properties. The process of driving the sampler will cause disturbance of the soil and change the engineering properties. Use of the thin wall tube sampler (Practice D1587) may result in less disturbance in soft soils. Coring techniques may result in less disturbance than SPT sampling for harder soils, but it is not always the case, that is, some cemented soils may become loosened by water action during coring; see Practice D6151, and Guide D6169.

4.3 This test method is used extensively in a great variety of geotechnical exploration projects. Many local correlations and widely published correlations which relate blow count, or *N*-value, and the engineering behavior of earthworks and foundations are available. For evaluating the liquefaction potential of sands during an earthquake event, the *N*-value should be normalized to a standard overburden stress level. Practice D6066 provides methods to obtain a record of

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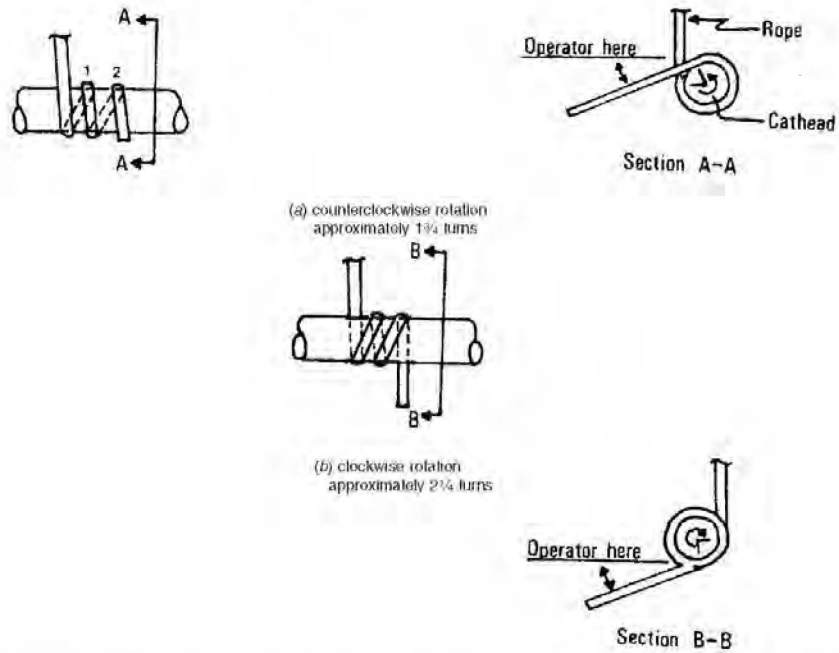

FIG. 1 Definitions of the Number of Rope Turns and the Angle for (*a*) Counterclockwise Rotation and (*b*) Clockwise Rotation of the Cathead

normalized resistance of sands to the penetration of a standard sampler driven by a standard energy. The penetration resistance is adjusted to drill rod energy ratio of 60 % by using a hammer system with either an estimated energy delivery or directly measuring drill rod stress wave energy using Test Method D4633.

NOTE 1—The reliability of data and interpretations generated by this practice is dependent on the competence of the personnel performing it and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D3740 generally are considered capable of competent testing. Users of this practice are cautioned that compliance with Practice D3740 does not assure reliable testing. Reliable testing depends on several factors and Practice D3740 provides a means of evaluating some of these factors. Practice D3740 was developed for agencies engaged in the testing, inspection, or both, of soils and rock. As such, it is not totally applicable to agencies performing this practice. Users of this test method should recognize that the framework of Practice D3740 is appropriate for evaluating the quality of an agency performing this test method. Currently, there is no known qualifying national authority that inspects agencies that perform this test method.

5. Apparatus

5.1 *Drilling Equipment*—Any drilling equipment that provides at the time of sampling a suitable borehole before insertion of the sampler and ensures that the penetration test is performed on intact soil shall be acceptable. The following pieces of equipment have proven to be suitable for advancing a borehole in some subsurface conditions:

5.1.1 *Drag, Chopping, and Fishtail Bits,* less than 6½ in. (165 mm) and greater than 2¼ in. (57 mm) in diameter may be used in conjunction with open-hole rotary drilling or casing-advancement drilling methods. To avoid disturbance of the underlying soil, bottom discharge bits are not permitted; only side discharge bits are permitted.

5.1.2 *Roller-Cone Bits,* less than 6½ in. (165 mm) and greater than 2¼ in. (57 mm) in diameter may be used in conjunction with open-hole rotary drilling or casing-advancement drilling methods if the drilling fluid discharge is deflected.

5.1.3 *Hollow-Stem Continuous Flight Augers,* with or without a center bit assembly, may be used to drill the borehole. The inside diameter of the hollow-stem augers shall be less than 6½ in. (165 mm) and not less than 2¼ in. (57 mm).

5.1.4 *Solid, Continuous Flight, Bucket and Hand Augers,* less than 6½ in. (165 mm) and not less than 2¼ in. (57 mm) in diameter may be used if the soil on the side of the borehole does not cave onto the sampler or sampling rods during sampling.

5.2 *Sampling Rods*—Flush-joint steel drill rods shall be used to connect the split-barrel sampler to the drive-weight assembly. The sampling rod shall have a stiffness (moment of inertia) equal to or greater than that of parallel wall "A" rod (a steel rod that has an outside diameter of 1-5/8 in. (41.3 mm) and an inside diameter of 1-1/8 in. (28.5 mm).

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5.3 *Split-Barrel Sampler*—The standard sampler dimensions are shown in Fig. 2. The sampler has an outside diameter of 2.00 in. (50.8 mm). The inside diameter of the of the split-barrel (dimension D in Fig. 2) can be either 1½-in. (38.1 mm) or 1⅜-in. (34.9 mm) (see Note 2). A 16-gauge liner can be used inside the 1½-in. (38.1 mm) split barrel sampler. The driving shoe shall be of hardened steel and shall be replaced or repaired when it becomes dented or distorted. The penetrating end of the drive shoe may be slightly rounded. The split-barrel sampler must be equipped with a ball check and vent. Metal or plastic baskets may be used to retain soil samples.

NOTE 2—Both theory and available test data suggest that *N*-values may differ as much as 10 to 30 % between a constant inside diameter sampler and upset wall sampler. If it is necessary to correct for the upset wall sampler refer to Practice D6066. In North America, it is now common practice to use an upset wall sampler with an inside diameter of 1½ in. At one time, liners were used but practice evolved to use the upset wall sampler without liners. Use of an upset wall sampler allows for use of retainers if needed, reduces inside friction, and improves recovery. Many other countries still use a constant ID split-barrel sampler, which was the original standard and still acceptable within this standard.

5.4 *Drive-Weight Assembly:*

5.4.1 *Hammer and Anvil*—The hammer shall weigh 140 ± 2 lbf (623 ± 9 N) and shall be a rigid metallic mass. The hammer shall strike the anvil and make steel on steel contact when it is dropped. A hammer fall guide permitting an unimpeded fall shall be used. Fig. 3 shows a schematic of such hammers. Hammers used with the cathead and rope method shall have an unimpeded over lift capacity of at least 4 in. (100 mm). For safety reasons, the use of a hammer assembly with an internal anvil is encouraged as shown in Fig. 3. The total mass of the hammer assembly bearing on the drill rods should not be more than 250 ± 10 lbm (113 ± 5 kg).

NOTE 3—It is suggested that the hammer fall guide be permanently marked to enable the operator or inspector to judge the hammer drop height.

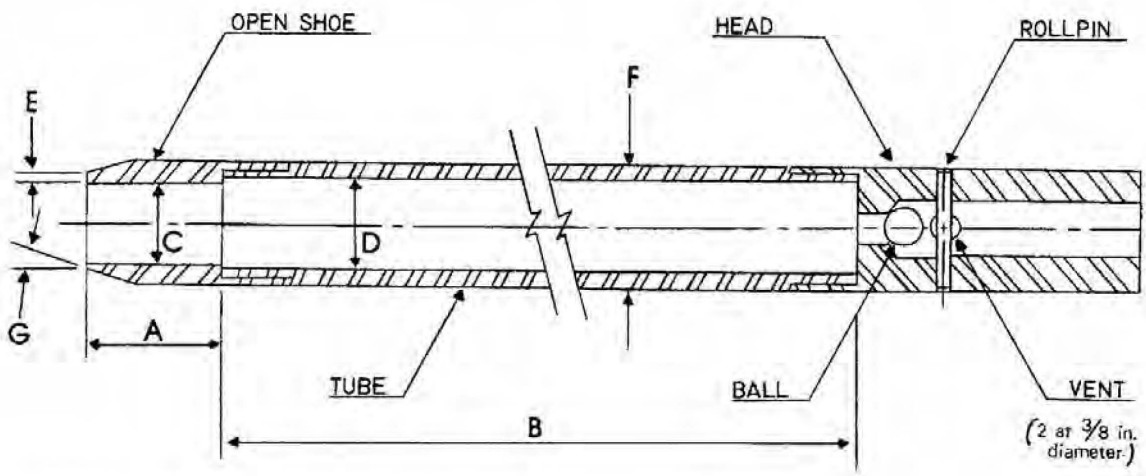
5.4.2 *Hammer Drop System*—Rope-cathead, trip, semi-automatic or automatic hammer drop systems may be used, providing the lifting apparatus will not cause penetration of the sampler while re-engaging and lifting the hammer.

5.5 *Accessory Equipment*—Accessories such as labels, sample containers, data sheets, and groundwater level measuring devices shall be provided in accordance with the requirements of the project and other ASTM standards.

6. Drilling Procedure

6.1 The borehole shall be advanced incrementally to permit intermittent or continuous sampling. Test intervals and locations are normally stipulated by the project engineer or geologist. Typically, the intervals selected are 5 ft (1.5 m) or less in homogeneous strata with test and sampling locations at every change of strata. Record the depth of drilling to the nearest 0.1 ft (0.030 m).

6.2 Any drilling procedure that provides a suitably clean and stable borehole before insertion of the sampler and assures that the penetration test is performed on essentially intact soil shall be acceptable. Each of the following procedures has proven to be acceptable for some subsurface conditions. The subsurface conditions anticipated should be considered when selecting the drilling method to be used.



A = 1.0 to 2.0 in. (25 to 50 mm)
B = 18.0 to 30.0 in. (0.457 to 0.762 m)
C = 1.375 ± 0.005 in. (34.93 ± 0.13 mm)
D = 1.50 ± 0.05 – 0.00 in. (38.1 ± 1.3 – 0.0 mm)
E = 0.10 ± 0.02 in. (2.54 ± 0.25 mm)
F = 2.00 ± 0.05 – 0.00 in. (50.8 ± 1.3 – 0.0 mm)
G = 16.0° to 23.0°

FIG. 2 Split-Barrel Sampler

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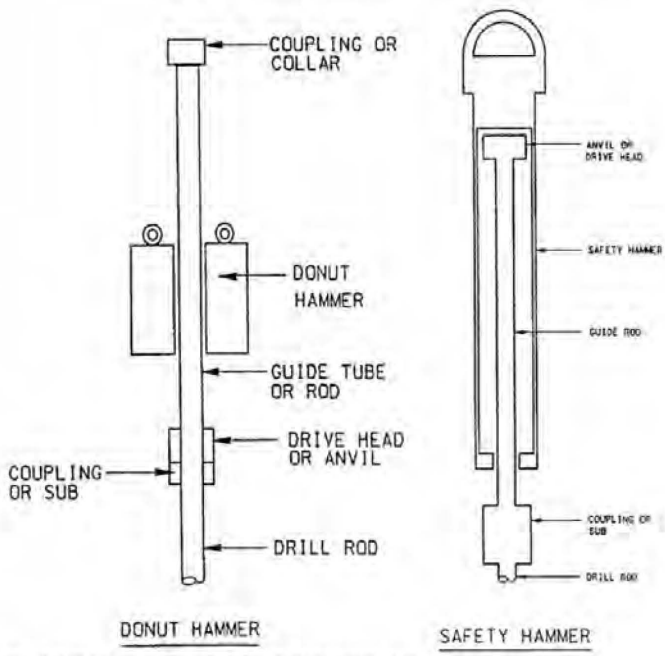

FIG. 3 Schematic Drawing of the Donut Hammer and Safety Hammer

6.2.1 Open-hole rotary drilling method.

6.2.2 Continuous flight hollow-stem auger method.

6.2.3 Wash boring method.

6.2.4 Continuous flight solid auger method.

6.3 Several drilling methods produce unacceptable boreholes. The process of jetting through an open tube sampler and then sampling when the desired depth is reached shall not be permitted. The continuous flight solid auger method shall not be used for advancing the borehole below a water table or below the upper confining bed of a confined non-cohesive stratum that is under artesian pressure. Casing may not be advanced below the sampling elevation prior to sampling. Advancing a borehole with bottom discharge bits is not permissible. It is not permissible to advance the borehole for subsequent insertion of the sampler solely by means of previous sampling with the SPT sampler.

6.4 The drilling fluid level within the borehole or hollow-stem augers shall be maintained at or above the in situ groundwater level at all times during drilling, removal of drill rods, and sampling.

7. Sampling and Testing Procedure

7.1 After the borehole has been advanced to the desired sampling elevation and excessive cuttings have been removed, record the cleanout depth to the nearest 0.1 ft (0.030 m), and prepare for the test with the following sequence of operations:

7.1.1 Attach either split-barrel sampler Type A or B to the sampling rods and lower into the borehole. Do not allow the sampler to drop onto the soil to be sampled.

7.1.2 Position the hammer above and attach the anvil to the top of the sampling rods. This may be done before the sampling rods and sampler are lowered into the borehole.

7.1.3 Rest the dead weight of the sampler, rods, anvil, and drive weight on the bottom of the borehole. Record the sampling start depth to the nearest 0.1 ft (0.030 m). Compare the sampling start depth to the cleanout depth in 7.1. If excessive cuttings are encountered at the bottom of the borehole, remove the sampler and sampling rods from the borehole and remove the cuttings.

7.1.4 Mark the drill rods in three successive 0.5-ft (0.15 m) increments so that the advance of the sampler under the impact of the hammer can be easily observed for each 0.5-ft (0.15 m) increment.

7.2 Drive the sampler with blows from the 140-lbf (623-N) hammer and count the number of blows applied in each 0.5-ft (0.15-m) increment until one of the following occurs:

7.2.1 A total of 50 blows have been applied during any one of the three 0.5-ft (0.15-m) increments described in 7.1.4.

7.2.2 A total of 100 blows have been applied.

7.2.3 There is no observed advance of the sampler during the application of 10 successive blows of the hammer.

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7.2.4 The sampler is advanced the complete 1.5 ft. (0.45 m) without the limiting blow counts occurring as described in 7.2.1, 7.2.2, or 7.2.3.

7.2.5 If the sampler sinks under the weight of the hammer, weight of rods, or both, record the length of travel to the nearest 0.1 ft (0.030 m), and drive the sampler through the remainder of the test interval. If the sampler sinks the complete interval, stop the penetration, remove the sampler and sampling rods from the borehole, and advance the borehole through the very soft or very loose materials to the next desired sampling elevation. Record the *N*-value as either weight of hammer, weight of rods, or both.

7.3 Record the number of blows (*N*) required to advance the sampler each 0.5-ft (0.15 m) of penetration or fraction thereof. The first 0.5-ft (0.15 m) is considered to be a seating drive. The sum of the number of blows required for the second and third 0.5-ft (0.15 m) of penetration is termed the "standard penetration resistance," or the "*N*-value." If the sampler is driven less than 1.5 ft (0.45 m), as permitted in 7.2.1, 7.2.2, or 7.2.3, the number of blows per each complete 0.5-ft (0.15 m) increment and per each partial increment shall be recorded on the boring log. For partial increments, the depth of penetration shall be reported to the nearest 0.1 ft (0.030 m) in addition to the number of blows. If the sampler advances below the bottom of the borehole under the static weight of the drill rods or the weight of the drill rods plus the static weight of the hammer, this information should be noted on the boring log.

7.4 The raising and dropping of the 140-lbf (623-N) hammer shall be accomplished using either of the following two methods. Energy delivered to the drill rod by either method can be measured according to procedures in Test Method D4633.

7.4.1 *Method A*—By using a trip, automatic, or semi-automatic hammer drop system that lifts the 140-lbf (623-N) hammer and allows it to drop 30 ± 1.0 in. (0.76 m ± 0.030 m) with limited unimpedence. Drop heights adjustments for automatic and trip hammers should be checked daily and at first indication of variations in performance. Operation of automatic hammers shall be in strict accordance with operations manuals.

7.4.2 *Method B*—By using a cathead to pull a rope attached to the hammer. When the cathead and rope method is used the system and operation shall conform to the following:

7.4.2.1 The cathead shall be essentially free of rust, oil, or grease and have a diameter in the range of 6 to 10 in. (150 to 250 mm).

7.4.2.2 The cathead should be operated at a minimum speed of rotation of 100 RPM.

7.4.2.3 The operator should generally use either 1-3/4 or 2-1/4 rope turns on the cathead, depending upon whether or not the rope comes off the top (1-3/4 turns for counterclockwise rotation) or the bottom (2-1/4 turns for clockwise rotation) of the cathead during the performance of the penetration test, as shown in Fig. 1. It is generally known and accepted that 2-3/4 or more rope turns considerably impedes the fall of the hammer and should not be used to perform the test. The cathead rope should be stiff, relatively dry, clean, and should be replaced when it becomes excessively frayed, oily, limp, or burned.

7.4.2.4 For each hammer blow, a 30 ± 1.0 in. (0.76 m ± 0.030 m) lift and drop shall be employed by the operator. The operation of pulling and throwing the rope shall be performed rhythmically without holding the rope at the top of the stroke.

NOTE 4—If the hammer drop height is something other than 30 ± 1.0 in. (0.76 m ± 0.030 m), then record the new drop height. For soils other than sands, there is no known data or research that relates to adjusting the *N*-value obtained from different drop heights. Test method D4633 provides information on making energy measurement for variable drop heights and Practice D6066 provides information on adjustment of *N*-value to a constant energy level (60 % of theoretical, N60). Practice D6066 allows the hammer drop height to be adjusted to provide 60 % energy.

7.5 Bring the sampler to the surface and open. Record the percent recovery to the nearest 1 % or the length of sample recovered to the nearest 0.1 ft (30 mm). Classify the soil samples recovered as to, in accordance with Practice D2488, then place one or more representative portions of the sample into sealable moisture-proof containers (jars) without ramming or distorting any apparent stratification. Seal each container to prevent evaporation of soil moisture. Affix labels to the containers bearing job designation, boring number, sample depth, and the blow count per 0.5-ft (150-mm) increment. Protect the samples against extreme temperature changes. If there is a soil change within the sampler, make a jar for each stratum and note its location in the sampler barrel. Samples should be preserved and transported in accordance with Practice D4220 using Group B.

8. Data Sheet(s)/Form(s)

8.1 Data obtained in each borehole shall be recorded in accordance with the Subsurface Logging Guide D5434 as required by the exploration program. An example of a sample data sheet is included in Appendix X1.

8.2 Drilling information shall be recorded in the field and shall include the following:

8.2.1 Name and location of job,

8.2.2 Names of crew,

8.2.3 Type and make of drilling machine,

8.2.4 Weather conditions,

8.2.5 Date and time of start and finish of borehole,

8.2.6 Boring number and location (station and coordinates, if available and applicable),

8.2.7 Surface elevation, if available,

8.2.8 Method of advancing and cleaning the borehole,

8.2.9 Method of keeping borehole open,

8.2.10 Depth of water surface to the nearest 0.1 ft (30 mm) and drilling depth to the nearest 0.1 ft (30 mm) at the time of a noted loss of drilling fluid, and time and date when reading or notation was made,

8.2.11 Location of strata changes, to the nearest 0.5 ft (150 mm),

8.2.12 Size of casing, depth of cased portion of borehole to the nearest 0.1 ft (30 mm),

8.2.13 Equipment and Method A or B of driving sampler,

8.2.14 Sampler length and inside diameter of barrel, and if a sample basket retainer is used,

8.2.15 Size, type, and section length of the sampling rods, and

8.2.16 Remarks.

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8.3 Data obtained for each sample shall be recorded in the field and shall include the following:

8.3.1 Top of sample depth to the nearest 0.1 ft (30 mm) and, if utilized, the sample number,

8.3.2 Description of soil,

8.3.3 Strata changes within sample,

8.3.4 Sampler penetration and recovery lengths to the nearest 0.1 ft (30 mm), and

8.3.5 Number of blows per 0.5 ft (150 mm) or partial increment.

9. Precision and Bias

9.1 *Precision*—Test data on precision is not presented due to the nature of this test method. It is either not feasible or too costly at this time to have ten or more agencies participate in an in situ testing program at a given site.

9.1.1 The Subcommittee 18.02 is seeking additional data from the users of this test method that might be used to make a limited statement on precision. Present knowledge indicates the following:

9.1.1.1 Variations in *N*-values of 100 % or more have been observed when using different standard penetration test apparatus and drillers for adjacent boreholes in the same soil formation. Current opinion, based on field experience, indicates that when using the same apparatus and driller, *N*-values in the same soil can be reproduced with a coefficient of variation of about 10 %.

9.1.1.2 The use of faulty equipment, such as an extremely massive or damaged anvil, a rusty cathead, a low speed cathead, an old, oily rope, or massive or poorly lubricated rope sheaves can significantly contribute to differences in *N*-values obtained between operator-drill rig systems.

9.2 *Bias*—There is no accepted reference value for this test method, therefore, bias cannot be determined.

10. Keywords

10.1 blow count; in-situ test; penetration resistance; soil; split-barrel sampling; standard penetration test

APPENDIX

(Nonmandatory Information)

X1. Example Data Sheet

X1.1 See Fig. X1.1

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DRILLERS BORING LOG

Project: _____ Project No: _____ Boring No: _____
Location: _____ Sheet _____ of _____

Date Started: _____ Date Completed: _____

Drill Crew:

Boring Location
Station _____ Offset _____

Elevation

Strata Depth		Soil Description and Remarks	Sample Type	No.	Depth		Recovery	N-Values		
From	To				From	To		6"	6"	6"

Drill Rig Type: _____

Method Of Drilling:
Auger _____ Size _____
Wash _____ Water _____ Mud _____

Hammer Type
Auto _____ Manual _____

Split-Spoon Type
Length _____ Liner Used _____

Boring Size _____ Bit Used _____
Casing Size _____ Length _____

Weather _____

Non-Drilling Time (Hrs.)
Boring Layout _____ Moving _____
Hauling Water _____ Standby _____

Water Level @ _____ Date _____ Time _____
@ _____ Date _____ Time _____
@ _____ Date _____ Time _____

Cave-in Depth
@ _____ Date _____ Time _____

FIG. X1.1 Example Data Sheet

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SUMMARY OF CHANGES

Committee D18 has identified the location of selected changes to this test method since the last issue, D1586–08a, that may impact the use of this test method. (Approved November 1, 2011)

(*1*) Corrected misuse of significant digits.

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ATTACHMENT 2
SOP 33 – SUBSURFACE SOIL SAMPLING
ASTM D2488

Designation: D2488 – 09a

Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)[1]

This standard is issued under the fixed designation D2488; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This practice covers procedures for the description of soils for engineering purposes.

1.2 This practice also describes a procedure for identifying soils, at the option of the user, based on the classification system described in Test Method D2487. The identification is based on visual examination and manual tests. It must be clearly stated in reporting an identification that it is based on visual-manual procedures.

1.2.1 When precise classification of soils for engineering purposes is required, the procedures prescribed in Test Method D2487 shall be used.

1.2.2 In this practice, the identification portion assigning a group symbol and name is limited to soil particles smaller than 3 in. (75 mm).

1.2.3 The identification portion of this practice is limited to naturally occurring soils (either intact or disturbed).

NOTE 1—This practice may be used as a descriptive system applied to such materials as shale, claystone, shells, crushed rock, etc. (see Appendix X2).

1.3 The descriptive information in this practice may be used with other soil classification systems or for materials other than naturally occurring soils.

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 *This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For specific precautionary statements see Section 8.

1.6 *This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D653 Terminology Relating to Soil, Rock, and Contained Fluids
D1452 Practice for Soil Exploration and Sampling by Auger Borings
D1586 Test Method for Penetration Test (SPT) and Split-Barrel Sampling of Soils
D1587 Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
D2113 Practice for Rock Core Drilling and Sampling of Rock for Site Investigation
D2487 Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
D4083 Practice for Description of Frozen Soils (Visual-Manual Procedure)

3. Terminology

3.1 *Definitions:*

3.1.1 Except as listed below, all definitions are in accordance with Terminology D653.

[1] This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.07 on Identification and Classification of Soils.

Current edition approved June 15, 2009. Published July 2009. Originally approved in 1966. Last previous edition approved in 2009 as D2488 – 09. DOI: 10.1520/D2488-09A.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

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NOTE 2—For particles retained on a 3-in. (75-mm) US standard sieve, the following definitions are suggested:
Cobbles—particles of rock that will pass a 12-in. (300-mm) square opening and be retained on a 3-in. (75-mm) sieve, and
Boulders—particles of rock that will not pass a 12-in. (300-mm) square opening.

3.1.2 *clay*—soil passing a No. 200 (75-µm) sieve that can be made to exhibit plasticity (putty-like properties) within a range of water contents, and that exhibits considerable strength when air-dry. For classification, a clay is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index equal to or greater than 4, and the plot of plasticity index versus liquid limit falls on or above the "A" line (see Fig. 3 of Test Method D2487).

3.1.3 *gravel*—particles of rock that will pass a 3-in. (75-mm) sieve and be retained on a No. 4 (4.75-mm) sieve with the following subdivisions:

coarse—passes a 3-in. (75-mm) sieve and is retained on a ¾-in. (19-mm) sieve.

fine—passes a ¾-in. (19-mm) sieve and is retained on a No. 4 (4.75-mm) sieve.

3.1.4 *organic clay*—a clay with sufficient organic content to influence the soil properties. For classification, an organic clay is a soil that would be classified as a clay, except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

3.1.5 *organic silt*—a silt with sufficient organic content to influence the soil properties. For classification, an organic silt is a soil that would be classified as a silt except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

3.1.6 *peat*—a soil composed primarily of vegetable tissue in various stages of decomposition usually with an organic odor, a dark brown to black color, a spongy consistency, and a texture ranging from fibrous to amorphous.

3.1.7 *sand*—particles of rock that will pass a No. 4 (4.75-mm) sieve and be retained on a No. 200 (75-µm) sieve with the following subdivisions:

coarse—passes a No. 4 (4.75-mm) sieve and is retained on a No. 10 (2.00-mm) sieve.

medium—passes a No. 10 (2.00-mm) sieve and is retained on a No. 40 (425-µm) sieve.

fine—passes a No. 40 (425-µm) sieve and is retained on a No. 200 (75-µm) sieve.

3.1.8 *silt*—soil passing a No. 200 (75-µm) sieve that is nonplastic or very slightly plastic and that exhibits little or no strength when air dry. For classification, a silt is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index less than 4, or the plot of plasticity index versus liquid limit falls below the "A" line (see Fig. 3 of Test Method D2487).

4. Summary of Practice

4.1 Using visual examination and simple manual tests, this practice gives standardized criteria and procedures for describing and identifying soils.

4.2 The soil can be given an identification by assigning a group symbol(s) and name. The flow charts, Fig. 1a and Fig. 1b for fine-grained soils, and Fig. 2, for coarse-grained soils, can be used to assign the appropriate group symbol(s) and name. If the soil has properties which do not distinctly place it into a specific group, borderline symbols may be used, see Appendix X3.

NOTE 3—It is suggested that a distinction be made between *dual symbols* and *borderline symbols*.
Dual Symbol—A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC, CL-ML used to indicate that the soil has been identified as having the properties of a classification in accordance with Test Method D2487 where two symbols are required. Two symbols are required when the soil has between 5 and 12 % fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart.
Borderline Symbol—A borderline symbol is two symbols separated by a slash, for example, CL/CH, GM/SM, CL/ML. A borderline symbol should be used to indicate that the soil has been identified as having properties that do not distinctly place the soil into a specific group (see Appendix X3).

5. Significance and Use

5.1 The descriptive information required in this practice can be used to describe a soil to aid in the evaluation of its significant properties for engineering use.

5.2 The descriptive information required in this practice should be used to supplement the classification of a soil as determined by Test Method D2487.

5.3 This practice may be used in identifying soils using the classification group symbols and names as prescribed in Test Method D2487. Since the names and symbols used in this practice to identify the soils are the same as those used in Test Method D2487, it shall be clearly stated in reports and all other appropriate documents, that the classification symbol and name are based on visual-manual procedures.

5.4 This practice is to be used not only for identification of soils in the field, but also in the office, laboratory, or wherever soil samples are inspected and described.

5.5 This practice has particular value in grouping similar soil samples so that only a minimum number of laboratory tests need be run for positive soil classification.

NOTE 4—The ability to describe and identify soils correctly is learned more readily under the guidance of experienced personnel, but it may also be acquired systematically by comparing numerical laboratory test results for typical soils of each type with their visual and manual characteristics.

5.6 When describing and identifying soil samples from a given boring, test pit, or group of borings or pits, it is not necessary to follow all of the procedures in this practice for every sample. Soils which appear to be similar can be grouped together; one sample completely described and identified with the others referred to as similar based on performing only a few of the descriptive and identification procedures described in this practice.

5.7 This practice may be used in combination with Practice D4083 when working with frozen soils.

NOTE 5—Notwithstanding the statements on precision and bias contained in this standard: The precision of this test method is dependent on the competence of the personnel performing it and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D3740 are generally considered capable of competent and objective testing. Users of this test method are cautioned that compliance with Practice D3740 does not in itself assure reliable testing. Reliable testing

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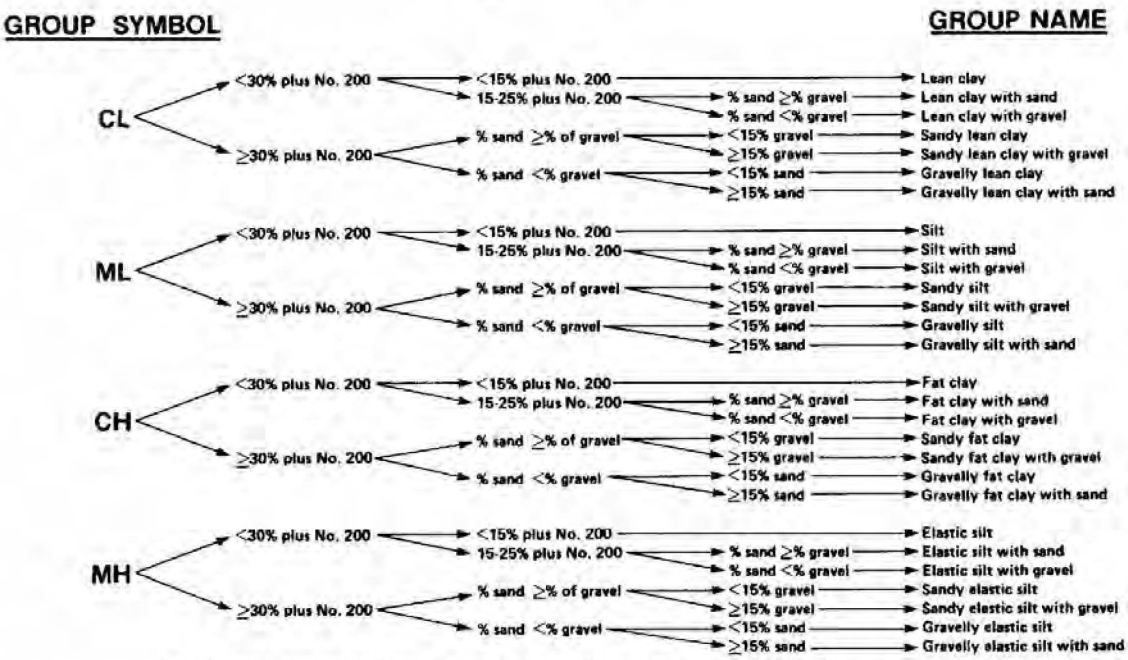
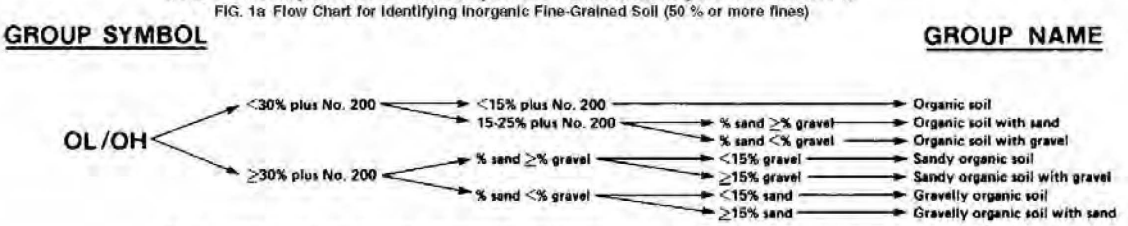


NOTE 1—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 1a Flow Chart for Identifying Inorganic Fine-Grained Soil (50 % or more fines)



NOTE 1—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 1 b Flow Chart for Identifying Organic Fine-Grained Soil (50 % or more fines)

depends on several factors; Practice D3740 provides a means for evaluating some of those factors.

6. Apparatus

6.1 *Required Apparatus:*

6.1.1 *Pocket Knife or Small Spatula.*

6.2 *Useful Auxiliary Apparatus:*

6.2.1 *Test Tube and Stopper* (or jar with a lid).

6.2.2 *Hand Lens.*

7. Reagents

7.1 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean water from a city water supply or natural source, including non-potable water.

7.2 *Hydrochloric Acid*—A small bottle of dilute hydrochloric acid, HCl, one part HCl (10 *N*) to three parts water (This reagent is optional for use with this practice). See Section 8.

8. Safety Precautions

8.1 When preparing the dilute HCl solution of one part concentrated hydrochloric acid (10 *N*) to three parts of distilled water, slowly add acid into water following necessary safety precautions. Handle with caution and store safely. If solution comes into contact with the skin, rinse thoroughly with water.

8.2 **Caution**—Do not add water to acid.

9. Sampling

9.1 The sample shall be considered to be representative of the stratum from which it was obtained by an appropriate, accepted, or standard procedure.

NOTE 6—Preferably, the sampling procedure should be identified as having been conducted in accordance with Practices D1452, D1587, or D2113, or Test Method D1586.

9.2 The sample shall be carefully identified as to origin.

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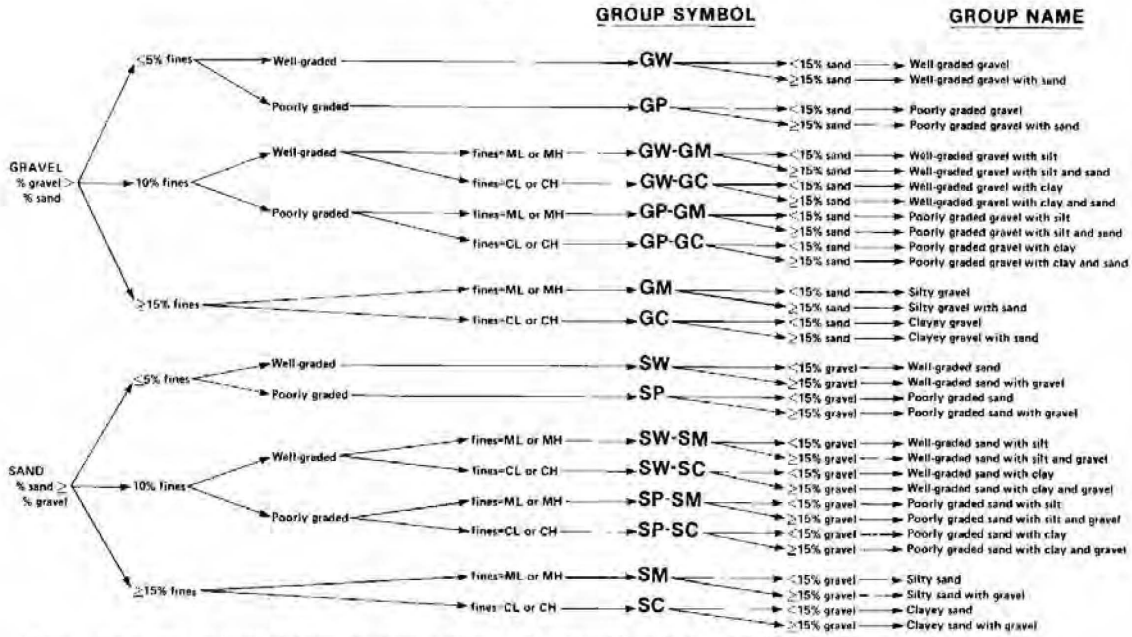

NOTE 1—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 2 Flow Chart for Identifying Coarse-Grained Soils (less than 50 % fines)

NOTE 7—Remarks as to the origin may take the form of a boring number and sample number in conjunction with a job number, a geologic stratum, a pedologic horizon or a location description with respect to a permanent monument, a grid system or a station number and offset with respect to a stated centerline and a depth or elevation.

9.3 For accurate description and identification, the minimum amount of the specimen to be examined shall be in accordance with the following schedule:

Maximum Particle Size, Sieve Opening	Minimum Specimen Size, Dry Weight
4.75 mm (No. 4)	100 g (0.25 lb)
9.5 mm (⅜ in.)	200 g (0.5 lb)
19.0 mm (¾ in.)	1.0 kg (2.2 lb)
38.1 mm (1½ in.)	8.0 kg (18 lb)
75.0 mm (3 in.)	60.0 kg (132 lb)

NOTE 8—If random isolated particles are encountered that are significantly larger than the particles in the soil matrix, the soil matrix can be accurately described and identified in accordance with the preceeding schedule.

9.4 If the field sample or specimen being examined is smaller than the minimum recommended amount, the report shall include an appropriate remark.

10. Descriptive Information for Soils

10.1 *Angularity*—Describe the angularity of the sand (coarse sizes only), gravel, cobbles, and boulders, as angular, subangular, subrounded, or rounded in accordance with the criteria in Table 1 and Fig. 3. A range of angularity may be stated, such as: subrounded to rounded.

TABLE 1 Criteria for Describing Angularity of Coarse-Grained Particles (see Fig. 3)

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

10.2 *Shape*—Describe the shape of the gravel, cobbles, and boulders as flat, elongated, or flat and elongated if they meet the criteria in Table 2 and Fig. 4. Otherwise, do not mention the shape. Indicate the fraction of the particles that have the shape, such as: one-third of the gravel particles are flat.

10.3 *Color*—Describe the color. Color is an important property in identifying organic soils, and within a given locality it may also be useful in identifying materials of similar geologic origin. If the sample contains layers or patches of varying colors, this shall be noted and all representative colors shall be described. The color shall be described for moist samples. If the color represents a dry condition, this shall be stated in the report.

10.4 *Odor*—Describe the odor if organic or unusual. Soils containing a significant amount of organic material usually have a distinctive odor of decaying vegetation. This is especially apparent in fresh samples, but if the samples are dried, the odor may often be revived by heating a moistened sample.

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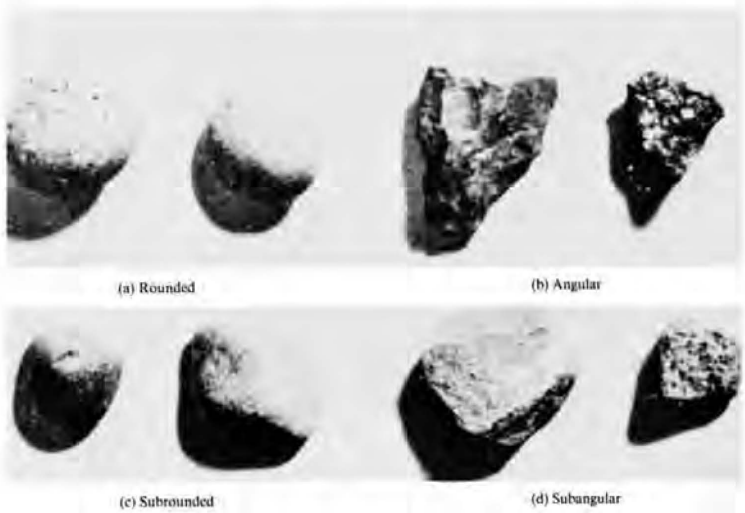

FIG. 3 Typical Angularity of Bulky Grains

TABLE 2 Criteria for Describing Particle Shape (see Fig. 4)

The particle shape shall be described as follows where length, width, and thickness refer to the greatest, intermediate, and least dimensions of a particle, respectively.

Flat	Particles with width/thickness > 3
Elongated	Particles with length/width > 3
Flat and elongated	Particles meet criteria for both flat and elongated

If the odor is unusual (petroleum product, chemical, and the like), it shall be described.

10.5 *Moisture Condition*—Describe the moisture condition as dry, moist, or wet, in accordance with the criteria in Table 3.

10.6 *HCl Reaction*—Describe the reaction with HCl as none, weak, or strong, in accordance with the critera in Table 4. Since calcium carbonate is a common cementing agent, a report of its presence on the basis of the reaction with dilute hydrochloric acid is important.

10.7 *Consistency*—For intact fine-grained soil, describe the consistency as very soft, soft, firm, hard, or very hard, in accordance with the criteria in Table 5. This observation is inappropriate for soils with significant amounts of gravel.

10.8 *Cementation*—Describe the cementation of intact coarse-grained soils as weak, moderate, or strong, in accordance with the criteria in Table 6.

10.9 *Structure*—Describe the structure of intact soils in accordance with the criteria in Table 7.

10.10 *Range of Particle Sizes*—For gravel and sand components, describe the range of particle sizes within each component as defined in 3.1.2 and 3.1.6. For example, about 20 % fine to coarse gravel, about 40 % fine to coarse sand.

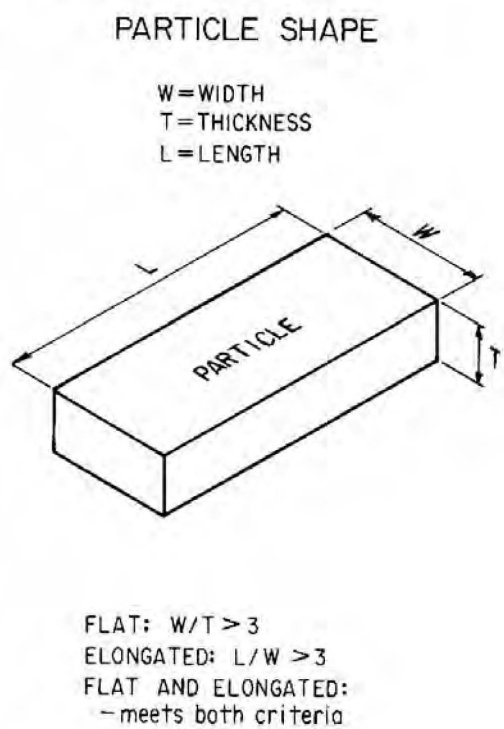

FIG. 4 Criteria for Particle Shape

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TABLE 3 Criteria for Describing Moisture Condition

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

TABLE 4 Criteria for Describing the Reaction With HCl

Description	Criteria
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

TABLE 5 Criteria for Describing Consistency

Description	Criteria
Very soft	Thumb will penetrate soil more than 1 in. (25 mm)
Soft	Thumb will penetrate soil about 1 in. (25 mm)
Firm	Thumb will indent soil about ¼ in. (6 mm)
Hard	Thumb will not indent soil but readily indented with thumbnail
Very hard	Thumbnail will not indent soil

TABLE 6 Criteria for Describing Cementation

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

TABLE 7 Criteria for Describing Structure

Description	Criteria
Stratified	Alternating layers of varying material or color with layers at least 6 mm thick; note thickness
Laminated	Alternating layers of varying material or color with the layers less than 6 mm thick; note thickness
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided	Fracture planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness
Homogeneous	Same color and appearance throughout

10.11 *Maximum Particle Size*—Describe the maximum particle size found in the sample in accordance with the following information:

10.11.1 *Sand Size*—If the maximum particle size is a sand size, describe as fine, medium, or coarse as defined in 3.1.6. For example: maximum particle size, medium sand.

10.11.2 *Gravel Size*—If the maximum particle size is a gravel size, describe the maximum particle size as the smallest sieve opening that the particle will pass. For example, maximum particle size, 1½ in. (will pass a 1½-in. square opening but not a ¾-in. square opening).

10.11.3 *Cobble or Boulder Size*—If the maximum particle size is a cobble or boulder size, describe the maximum dimension of the largest particle. For example: maximum dimension, 18 in. (450 mm).

10.12 *Hardness*—Describe the hardness of coarse sand and larger particles as hard, or state what happens when the particles are hit by a hammer, for example, gravel-size particles fracture with considerable hammer blow, some gravel-size particles crumble with hammer blow. "Hard" means particles do not crack, fracture, or crumble under a hammer blow.

10.13 Additional comments shall be noted, such as the presence of roots or root holes, difficulty in drilling or augering hole, caving of trench or hole, or the presence of mica.

10.14 A local or commercial name or a geologic interpretation of the soil, or both, may be added if identified as such.

10.15 A classification or identification of the soil in accordance with other classification systems may be added if identified as such.

11. Identification of Peat

11.1 A sample composed primarily of vegetable tissue in various stages of decomposition that has a fibrous to amorphous texture, usually a dark brown to black color, and an organic odor, shall be designated as a highly organic soil and shall be identified as peat, PT, and not subjected to the identification procedures described hereafter.

12. Preparation for Identification

12.1 The soil identification portion of this practice is based on the portion of the soil sample that will pass a 3-in. (75-mm) sieve. The larger than 3-in. (75-mm) particles must be removed, manually, for a loose sample, or mentally, for an intact sample before classifying the soil.

12.2 Estimate and note the percentage of cobbles and the percentage of boulders. Performed visually, these estimates will be on the basis of volume percentage.

NOTE 9—Since the percentages of the particle-size distribution in Test Method D2487 are by dry weight, and the estimates of percentages for gravel, sand, and fines in this practice are by dry weight, it is recommended that the report state that the percentages of cobbles and boulders are by volume.

12.3 Of the fraction of the soil smaller than 3 in. (75 mm), estimate and note the percentage, by dry weight, of the gravel, sand, and fines (see Appendix X4 for suggested procedures).

NOTE 10—Since the particle-size components appear visually on the basis of volume, considerable experience is required to estimate the percentages on the basis of dry weight. Frequent comparisons with laboratory particle-size analyses should be made.

12.3.1 The percentages shall be estimated to the closest 5 %. The percentages of gravel, sand, and fines must add up to 100 %.

12.3.2 If one of the components is present but not in sufficient quantity to be considered 5 % of the smaller than 3-in. (75-mm) portion, indicate its presence by the term *trace*, for example, trace of fines. A trace is not to be considered in the total of 100 % for the components.

13. Preliminary Identification

13.1 The soil is *fine grained* if it contains 50 % or more fines. Follow the procedures for identifying fine-grained soils of Section 14.

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13.2 The soil is *coarse grained* if it contains less than 50 % fines. Follow the procedures for identifying coarse-grained soils of Section 15.

14. Procedure for Identifying Fine-Grained Soils

14.1 Select a representative sample of the material for examination. Remove particles larger than the No. 40 sieve (medium sand and larger) until a specimen equivalent to about a handful of material is available. Use this specimen for performing the dry strength, dilatancy, and toughness tests.

14.2 *Dry Strength:*

14.2.1 From the specimen, select enough material to mold into a ball about 1 in. (25 mm) in diameter. Mold the material until it has the consistency of putty, adding water if necessary.

14.2.2 From the molded material, make at least three test specimens. A test specimen shall be a ball of material about ½ in. (12 mm) in diameter. Allow the test specimens to dry in air, or sun, or by artificial means, as long as the temperature does not exceed 60°C.

14.2.3 If the test specimen contains natural dry lumps, those that are about ½ in. (12 mm) in diameter may be used in place of the molded balls.

NOTE 11—The process of molding and drying usually produces higher strengths than are found in natural dry lumps of soil.

14.2.4 Test the strength of the dry balls or lumps by crushing between the fingers. Note the strength as none, low, medium, high, or very high in accorance with the criteria in Table 8. If natural dry lumps are used, do not use the results of any of the lumps that are found to contain particles of coarse sand.

14.2.5 The presence of high-strength water-soluble cementing materials, such as calcium carbonate, may cause exceptionally high dry strengths. The presence of calcium carbonate can usually be detected from the intensity of the reaction with dilute hydrochloric acid (see 10.6).

14.3 *Dilatancy:*

14.3.1 From the specimen, select enough material to mold into a ball about ½ in. (12 mm) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.

14.3.2 Smooth the soil ball in the palm of one hand with the blade of a knife or small spatula. Shake horizontally, striking the side of the hand vigorously against the other hand several times. Note the reaction of water appearing on the surface of the soil. Squeeze the sample by closing the hand or pinching the soil between the fingers, and note the reaction as none, slow, or rapid in accordance with the criteria in Table 9. The reaction is the speed with which water appears while shaking, and disappears while squeezing.

14.4 *Toughness:*

14.4.1 Following the completion of the dilatancy test, the test specimen is shaped into an elongated pat and rolled by hand on a smooth surface or between the palms into a thread about ⅛ in. (3 mm) in diameter. (If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation.) Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about ⅛ in. The thread will crumble at a diameter of ⅛ in. when the soil is near the plastic limit. Note the pressure required to roll the thread near the plastic limit. Also, note the strength of the thread. After the thread crumbles, the pieces should be lumped together and kneaded until the lump crumbles. Note the toughness of the material during kneading.

14.4.2 Describe the toughness of the thread and lump as low, medium, or high in accordance with the criteria in Table 10.

14.5 *Plasticity*—On the basis of observations made during the toughness test, describe the plasticity of the material in accordance with the criteria given in Table 11.

14.6 Decide whether the soil is an *inorganic* or an *organic* fine-grained soil (see 14.8). If inorganic, follow the steps given in 14.7.

14.7 *Identification of Inorganic Fine-Grained Soils:*

14.7.1 Identify the soil as a *lean clay*, CL, if the soil has medium to high dry strength, no or slow dilatancy, and medium toughness and plasticity (see Table 12).

14.7.2 Identify the soil as a *fat clay*, CH, if the soil has high to very high dry strength, no dilatancy, and high toughness and plasticity (see Table 12).

14.7.3 Identify the soil as a *silt*, ML, if the soil has no to low dry strength, slow to rapid dilatancy, and low toughness and plasticity, or is nonplastic (see Table 12).

14.7.4 Identify the soil as an *elastic silt*, MH, if the soil has low to medium dry strength, no to slow dilatancy, and low to medium toughness and plasticity (see Table 12).

NOTE 12—These properties are similar to those for a lean clay. However, the silt will dry quickly on the hand and have a smooth, silky feel when dry. Some soils that would classify as MH in accordance with the criteria in Test Method D2487 are visually difficult to distinguish from lean clays, CL. It may be necessary to perform laboratory testing for proper identification.

14.8 *Identification of Organic Fine-Grained Soils:*

TABLE 8 Criteria for Describing Dry Strength

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling
Low	The dry specimen crumbles into powder with some finger pressure
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface
Very high	The dry specimen cannot be broken between the thumb and a hard surface

TABLE 9 Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing

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TABLE 10 Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness

TABLE 11 Criteria for Describing Plasticity

Description	Criteria
Nonplastic	A 1/8-in. (3-mm) thread cannot be rolled at any water content
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

TABLE 12 Identification of Inorganic Fine-Grained Soils from Manual Tests

Soil Symbol	Dry Strength	Dilatancy	Toughness and Plasticity
ML	None to low	Slow to rapid	Low or thread cannot be formed
CL	Medium to high	None to slow	Medium
MH	Low to medium	None to slow	Low to medium
CH	High to very high	None	High

14.8.1 Identify the soil as an *organic soil*, OL/OH, if the soil contains enough organic particles to influence the soil properties. Organic soils usually have a dark brown to black color and may have an organic odor. Often, organic soils will change color, for example, black to brown, when exposed to the air. Some organic soils will lighten in color significantly when air dried. Organic soils normally will not have a high toughness or plasticity. The thread for the toughness test will be spongy.

NOTE 13—In some cases, through practice and experience, it may be possible to further identify the organic soils as organic silts or organic clays, OL or OH. Correlations between the dilatancy, dry strength, toughness tests, and laboratory tests can be made to identify organic soils in certain deposits of similar materials of known geologic origin.

14.9 If the soil is estimated to have 15 to 25 % sand or gravel, or both, the words "with sand" or "with gravel" (whichever is more predominant) shall be added to the group name. For example: "lean clay with sand, CL" or "silt with gravel, ML" (see Fig. 1a and Fig. 1b). If the percentage of sand is equal to the percentage of gravel, use "with sand."

14.10 If the soil is estimated to have 30 % or more sand or gravel, or both, the words "sandy" or "gravelly" shall be added to the group name. Add the word "sandy" if there appears to be more sand than gravel. Add the word "gravelly" if there appears to be more gravel than sand. For example: "sandy lean clay, CL", "gravelly fat clay, CH", or "sandy silt, ML" (see Fig. 1a and Fig. 1b). If the percentage of sand is equal to the percent of gravel, use "sandy."

15. Procedure for Identifying Coarse-Grained Soils

(Contains less than 50 % fines)

15.1 The soil is a *gravel* if the percentage of gravel is estimated to be more than the percentage of sand.

15.2 The soil is a *sand* if the percentage of gravel is estimated to be equal to or less than the percentage of sand.

15.3 The soil is a *clean gravel* or *clean sand* if the percentage of fines is estimated to be 5 % or less.

15.3.1 Identify the soil as a *well-graded gravel*, GW, or as a *well-graded sand*, SW, if it has a wide range of particle sizes and substantial amounts of the intermediate particle sizes.

15.3.2 Identify the soil as a *poorly graded gravel*, GP, or as a *poorly graded sand*, SP, if it consists predominantly of one size (uniformly graded), or it has a wide range of sizes with some intermediate sizes obviously missing (gap or skip graded).

15.4 The soil is either a *gravel with fines* or a *sand with fines* if the percentage of fines is estimated to be 15 % or more.

15.4.1 Identify the soil as a *clayey gravel*, GC, or a *clayey sand*, SC, if the fines are clayey as determined by the procedures in Section 14.

15.4.2 Identify the soil as a *silty gravel*, GM, or a *silty sand*, SM, if the fines are silty as determined by the procedures in Section 14.

15.5 If the soil is estimated to contain 10 % fines, give the soil a dual identification using two group symbols.

15.5.1 The first group symbol shall correspond to a clean gravel or sand (GW, GP, SW, SP) and the second symbol shall correspond to a gravel or sand with fines (GC, GM, SC, SM).

15.5.2 The group name shall correspond to the first group symbol plus the words "with clay" or "with silt" to indicate the plasticity characteristics of the fines. For example: "well-graded gravel with clay, GW-GC" or "poorly graded sand with silt, SP-SM" (see Fig. 2).

15.6 If the specimen is predominantly sand or gravel but contains an estimated 15 % or more of the other coarse-grained constituent, the words "with gravel" or "with sand" shall be added to the group name. For example: "poorly graded gravel with sand, GP" or "clayey sand with gravel, SC" (see Fig. 2).

15.7 If the field sample contains any cobbles or boulders, or both, the words "with cobbles" or "with cobbles and boulders" shall be added to the group name. For example: "silty gravel with cobbles, GM."

16. Report

16.1 The report shall include the information as to origin, and the items indicated in Table 13.

NOTE 14—*Example: Clayey Gravel with Sand and Cobbles, GC*—About 50 % fine to coarse, subrounded to subangular gravel; about 30 % fine to coarse, subrounded sand; about 20 % fines with medium plasticity, high dry strength, no dilatancy, medium toughness; weak reaction with HCl; original field sample had about 5 % (by volume) subrounded cobbles, maximum dimension, 150 mm.

In-Place Conditions—Firm, homogeneous, dry, brown

Geologic Interpretation—Alluvial fan

NOTE 15—Other examples of soil descriptions and identification are given in Appendix X1 and Appendix X2.

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TABLE 13 Checklist for Description of Soils

1. Group name
2. Group symbol
3. Percent of cobbles or boulders, or both (by volume)
4. Percent of gravel, sand, or fines, or all three (by dry weight)
5. Particle-size range:
   Gravel—fine, coarse
   Sand—fine, medium, coarse
6. Particle angularity: angular, subangular, subrounded, rounded
7. Particle shape: (if appropriate) flat, elongated, flat and elongated
8. Maximum particle size or dimension
9. Hardness of coarse sand and larger particles
10. Plasticity of fines: nonplastic, low, medium, high
11. Dry strength: none, low, medium, high, very high
12. Dilatancy: none, slow, rapid
13. Toughness: low, medium, high
14. Color (in moist condition)
15. Odor (mention only if organic or unusual)
16. Moisture: dry, moist, wet
17. Reaction with HCl: none, weak, strong

For intact samples:

18. Consistency (fine-grained soils only): very soft, soft, firm, hard, very hard
19. Structure: stratified, laminated, fissured, slickensided, lensed, homogeneous
20. Cementation: weak, moderate, strong
21. Local name
22. Geologic interpretation
23. Additional comments: presence of roots or root holes, presence of mica, gypsum, etc., surface coatings on coarse-grained particles, caving or sloughing of auger hole or trench sides, difficulty in augering or excavating, etc.

NOTE 16—If desired, the percentages of gravel, sand, and fines may be stated in terms indicating a range of percentages, as follows:
Trace—Particles are present but estimated to be less than 5 %
Few—5 to 10 %
Little—15 to 25 %
Some—30 to 45 %
Mostly—50 to 100 %

16.2 If, in the soil description, the soil is identified using a classification group symbol and name as described in Test Method D2487, it must be distinctly and clearly stated in log forms, summary tables, reports, and the like, that the symbol and name are based on visual-manual procedures.

17. Precision and Bias

17.1 This practice provides qualitative information only, therefore, a precision and bias statement is not applicable.

18. Keywords

18.1 classification; clay; gravel; organic soils; sand; silt; soil classification; soil description; visual classification

APPENDIXES

(Nonmandatory Information)

X1. EXAMPLES OF VISUAL SOIL DESCRIPTIONS

X1.1 The following examples show how the information required in 16.1 can be reported. The information that is included in descriptions should be based on individual circumstances and need.

X1.1.1 *Well-Graded Gravel with Sand (GW)*—About 75 % fine to coarse, hard, subangular gravel; about 25 % fine to coarse, hard, subangular sand; trace of fines; maximum size, 75 mm, brown, dry; no reaction with HCl.

X1.1.2 *Silty Sand with Gravel (SM)*—About 60 % predominantly fine sand; about 25 % silty fines with low plasticity, low dry strength, rapid dilatancy, and low toughness; about 15 % fine, hard, subrounded gravel, a few gravel-size particles fractured with hammer blow; maximum size, 25 mm; no reaction with HCl (Note—Field sample size smaller than recommended).

In-Place Conditions—Firm, stratified and contains lenses of silt 1 to 2 in. (25 to 50 mm) thick, moist, brown to gray; in-place density 106 lb/ft^3; in-place moisture 9 %.

X1.1.3 *Organic Soil (OL/OH)*—About 100 % fines with low plasticity, slow dilatancy, low dry strength, and low toughness; wet, dark brown, organic odor; weak reaction with HCl.

X1.1.4 *Silty Sand with Organic Fines (SM)*—About 75 % fine to coarse, hard, subangular reddish sand; about 25 % organic and silty dark brown nonplastic fines with no dry strength and slow dilatancy; wet; maximum size, coarse sand; weak reaction with HCl.

X1.1.5 *Poorly Graded Gravel with Silt, Sand, Cobbles and Boulders (GP-GM)*—About 75 % fine to coarse, hard, subrounded to subangular gravel; about 15 % fine, hard, subrounded to subangular sand; about 10 % silty nonplastic fines; moist, brown; no reaction with HCl; original field sample had about 5 % (by volume) hard, subrounded cobbles and a trace of hard, subrounded boulders, with a maximum dimension of 18 in. (450 mm).

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X2. USING THE IDENTIFICATION PROCEDURE AS A DESCRIPTIVE SYSTEM FOR SHALE, CLAYSTONE, SHELLS, SLAG, CRUSHED ROCK, AND THE LIKE

X2.1 The identification procedure may be used as a descriptive system applied to materials that exist in-situ as shale, claystone, sandstone, siltstone, mudstone, etc., but convert to soils after field or laboratory processing (crushing, slaking, and the like).

X2.2 Materials such as shells, crushed rock, slag, and the like, should be identified as such. However, the procedures used in this practice for describing the particle size and plasticity characteristics may be used in the description of the material. If desired, an identification using a group name and symbol according to this practice may be assigned to aid in describing the material.

X2.3 The group symbol(s) and group names should be placed in quotation marks or noted with some type of distinguishing symbol. See examples.

X2.4 Examples of how group names and symbols can be incororated into a descriptive system for materials that are not naturally occurring soils are as follows:

X2.4.1 *Shale Chunks*—Retrieved as 2 to 4-in. (50 to 100-mm) pieces of shale from power auger hole, dry, brown, no reaction with HCl. After slaking in water for 24 h, material identified as "Sandy Lean Clay (CL)"; about 60 % fines with medium plasticity, high dry strength, no dilatancy, and medium toughness; about 35 % fine to medium, hard sand; about 5 % gravel-size pieces of shale.

X2.4.2 *Crushed Sandstone*—Product of commercial crushing operation; "Poorly Graded Sand with Silt (SP-SM)"; about 90 % fine to medium sand; about 10 % nonplastic fines; dry, reddish-brown.

X2.4.3 *Broken Shells*—About 60 % uniformly graded gravel-size broken shells; about 30 % sand and sand-size shell pieces; about 10 % nonplastic fines; "Poorly Graded Gravel with Silt and Sand (GP-GM)."

X2.4.4 *Crushed Rock*—Processed from gravel and cobbles in Pit No. 7; "Poorly Graded Gravel (GP)"; about 90 % fine, hard, angular gravel-size particles; about 10 % coarse, hard, angular sand-size particles; dry, tan; no reaction with HCl.

X3. SUGGESTED PROCEDURE FOR USING A BORDERLINE SYMBOL FOR SOILS WITH TWO POSSIBLE IDENTIFICATIONS.

X3.1 Since this practice is based on estimates of particle size distribution and plasticity characteristics, it may be difficult to clearly identify the soil as belonging to one category. To indicate that the soil may fall into one of two possible basic groups, a borderline symbol may be used with the two symbols separated by a slash. For example: SC/CL or CL/CH.

X3.1.1 A borderline symbol may be used when the percentage of fines is estimated to be between 45 and 55 %. One symbol should be for a coarse-grained soil with fines and the other for a fine-grained soil. For example: GM/ML or CL/SC.

X3.1.2 A borderline symbol may be used when the percentage of sand and the percentage of gravel are estimated to be about the same. For example: GP/SP, SC/GC, GM/SM. It is practically impossible to have a soil that would have a borderline symbol of GW/SW.

X3.1.3 A borderline symbol may be used when the soil could be either well graded or poorly graded. For example: GW/GP, SW/SP.

X3.1.4 A borderline symbol may be used when the soil could either be a silt or a clay. For example: CL/ML, CH/MH, SC/SM.

X3.1.5 A borderline symbol may be used when a fine-grained soil has properties that indicate that it is at the boundary between a soil of low compressibility and a soil of high compressibility. For example: CL/CH, MH/ML.

X3.2 The order of the borderline symbols should reflect similarity to surrounding or adjacent soils. For example: soils in a borrow area have been identified as CH. One sample is considered to have a borderline symbol of CL and CH. To show similarity, the borderline symbol should be CH/CL.

X3.3 The group name for a soil with a borderline symbol should be the group name for the first symbol, except for:

CL/CH lean to fat clay
ML/CL clayey silt
CL/ML silty clay

X3.4 The use of a borderline symbol should not be used indiscriminately. Every effort shall be made to first place the soil into a single group.

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X4. SUGGESTED PROCEDURES FOR ESTIMATING THE PERCENTAGES OF GRAVEL, SAND, AND FINES IN A SOIL SAMPLE

X4.1 *Jar Method*—The relative percentage of coarse- and fine-grained material may be estimated by thoroughly shaking a mixture of soil and water in a test tube or jar, and then allowing the mixture to settle. The coarse particles will fall to the bottom and successively finer particles will be deposited with increasing time; the sand sizes will fall out of suspension in 20 to 30 s. The relative proportions can be estimated from the relative volume of each size separate. This method should be correlated to particle-size laboratory determinations.

X4.2 *Visual Method*—Mentally visualize the gravel size particles placed in a sack (or other container) or sacks. Then, do the same with the sand size particles and the fines. Then, mentally compare the number of sacks to estimate the percentage of plus No. 4 sieve size and minus No. 4 sieve size present. The percentages of sand and fines in the minus sieve size No. 4 material can then be estimated from the wash test (X4.3).

X4.3 *Wash Test (for relative percentages of sand and fines)*—Select and moisten enough minus No. 4 sieve size material to form a 1-in (25-mm) cube of soil. Cut the cube in half, set one-half to the side, and place the other half in a small dish. Wash and decant the fines out of the material in the dish until the wash water is clear and then compare the two samples and estimate the percentage of sand and fines. Remember that the percentage is based on weight, not volume. However, the volume comparison will provide a reasonable indication of grain size percentages.

X4.3.1 While washing, it may be necessary to break down lumps of fines with the finger to get the correct percentages.

X5. ABBREVIATED SOIL CLASSIFICATION SYMBOLS

X5.1 In some cases, because of lack of space, an abbreviated system may be useful to indicate the soil classification symbol and name. Examples of such cases would be graphical logs, databases, tables, etc.

X5.2 This abbreviated system is not a substitute for the full name and descriptive information but can be used in supplementary presentations when the complete description is referenced.

X5.3 The abbreviated system should consist of the soil classification symbol based on this standard with appropriate lower case letter prefixes and suffixes as:

Prefix:	Suffix:
s = sandy	s = with sand
g = gravelly	g = with gravel
	c = with cobbles
	b = with boulders

X5.4 The soil classification symbol is to be enclosed in parenthesis. Some examples would be:

Group Symbol and Full Name	Abbreviated
CL, Sandy lean clay	s(CL)
SP-SM, Poorly graded sand with silt and gravel	(SP-SM)g
GP, poorly graded gravel with sand, cobbles, and boulders	(GP)scb
ML, gravelly silt with sand and cobbles	g(ML)sc

SUMMARY OF CHANGES

Committee D18 has identified the location of selected changes to this standard since the last issue (D2488 – 09) that may impact the use of this standard. (Approved June 15, 2009.)

(1) Revised Section 1.2.3.

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D2488 – 09a

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ATTACHMENT 3
SOP 33 – SUBSURFACE SOIL SAMPLING
ASTM D1587

Designation: D1587 – 08 (Reapproved 2012)$^{\varepsilon 1}$

Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes[1]

This standard is issued under the fixed designation D1587; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

ε^1 NOTE—Editorial changes were made throughout in May 2012.

1. Scope

1.1 This practice covers a procedure for using a thin-walled metal tube to recover relatively intact soil samples suitable for laboratory tests of engineering properties, such as strength, compressibility, permeability, and density. Thin-walled tubes used in piston, plug, or rotary-type samplers should comply with Section 6.3 of this practice which describes the thin-walled tubes.

NOTE 1—This practice does not apply to liners used within the samplers.

1.2 This practice is limited to soils that can be penetrated by the thin-walled tube. This sampling method is not recommended for sampling soils containing gravel or larger size soil particles, cemented, or very hard soils. Other soil samplers may be used for sampling these soil types. Such samplers include driven split barrel samplers and soil coring devices (D1586, D3550, and D6151). For information on appropriate use of other soil samplers refer to D6169.

1.3 This practice is often used in conjunction with fluid rotary drilling (D1452, D5783) or hollow-stem augers (D6151). Subsurface geotechnical explorations should be reported in accordance with practice (D5434). This practice discusses some aspects of sample preservation after the sampling event. For information on preservation and transportation process of soil samples, consult Practice D4220. This practice does not address environmental sampling; consult D6169 and D6232 for information on sampling for environmental investigations.

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4.1 The tubing tolerances presented in Table 1 are from sources available in North America. Use of metric equivalent is acceptable as long as thickness and proportions are similar to those required in this standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.6 This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D1452 Practice for Soil Exploration and Sampling by Auger Borings

D1586 Test Method for Penetration Test (SPT) and Split-Barrel Sampling of Soils

D2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)

D3550 Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils

D3740 Practice for Minimum Requirements for Agencies

[1] This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.02 on Sampling and Related Field Testing for Soil Evaluations.

Current edition approved May 15, 2012. Published November 2012. Originally approved in 1958. Last previous edition approved in 2008 as D1587 – 08. DOI: 10.1520/D1587-08R12E1.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

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TABLE 1 Dimensional Tolerances for Thin-Walled Tubes

Nominal Tube Diameters from Table 2[A] Tolerances						
Size Outside Diameter	2 in	50.8 mm	3 in	76.2 mm	5 in	127 mm
Outside diameter, D_o	+0.007 -0.000	+0.179 -0.000	+0.010 -0.000	+0.254 -0.000	+0.015 -0.000	0.381 -0.000
Inside diameter, D_i	+0.000 -0.007	+0.000 -0.179	+0.000 -0.010	+0.000 -0.254	+0.000 -0.015	+0.000 -0.381
Wall thickness	±0.007	±0.179	±0.010	±0.254	±0.015	±0.381
Ovality	0.015	0.381	0.020	0.508	0.030	0.762
Straightness	0.030/ft	2.50/m	0.030/ft	2.50/m	0.030/ft	2.50/m

[A] Intermediate or larger diameters should be proportional. Specify only two of the first three tolerances; that is, D_o and D_i, or D_o and Wall thickness, or D_i and Wall thickness.

Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

D4220 Practices for Preserving and Transporting Soil Samples

D5434 Guide for Field Logging of Subsurface Explorations of Soil and Rock

D5783 Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices

D6151 Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling

D6169 Guide for Selection of Soil and Rock Sampling Devices Used With Drill Rigs for Environmental Investigations

D6232 Guide for Selection of Sampling Equipment for Waste and Contaminated Media Data Collection Activities

3. Terminology

3.1 *Definitions:*

3.1.1 For common definitions of terms in this standard, refer to Terminology D653.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *inside clearance ratio, %, n*—the ratio of the difference in the inside diameter of the tube, D_i, minus the inside diameter of the cutting edge, D_e, to the inside diameter of the tube, D_i expressed as a percentage (see Fig. 1).

3.2.2 *ovality, n*—the cross section of the tube that deviates from a perfect circle.

4. Summary of Practice

4.1 A relatively intact sample is obtained by pressing a thin-walled metal tube into the in-situ soil at the bottom of a boring, removing the soil-filled tube, and applying seals to the soil surfaces to prevent soil movement and moisture gain or loss.

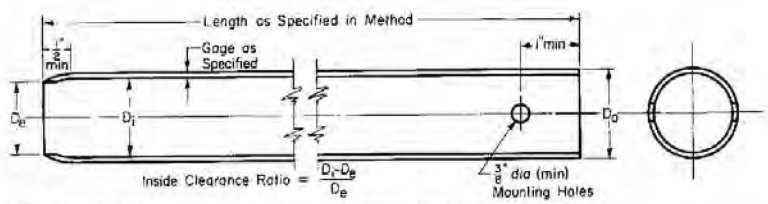
5. Significance and Use

5.1 This practice, or Practice D3550 with thin wall shoe, is used when it is necessary to obtain a relatively intact specimen suitable for laboratory tests of engineering properties or other tests that might be influenced by soil disturbance.

NOTE 2—The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D3740 are generally considered capable of competent and objective sampling. Users of this practice, are cautioned that compliance with Practice D3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D3740 provides a means of evaluating some of those factors.

6. Apparatus

6.1 *Drilling Equipment*—When sampling in a boring, any drilling equipment may be used that provides a reasonably



NOTE 1—Minimum of two mounting holes on opposite sides for D_o smaller than 4 in. (101.6 mm).

NOTE 2—Minimum of four mounting holes equally spaced for D_o 4 in. (101.6 mm) and larger.

NOTE 3—Tube held with hardened screws or other suitable means.

NOTE 4—2-in (50.8 mm) outside-diameter tubes are specified with an 18-gauge wall thickness to comply with area ratio criteria accepted for "intact samples." Users are advised that such tubing is difficult to locate and can be extremely expensive in small quantities. Sixteen-gauge tubes are generally readily available.

Metric Equivalent Conversions

in	mm
3/8	9.53
1/2	12.7
1	25.4
2	50.8
3	76.2
4	101.6
5	127

FIG. 1 Thin-Walled Tube for Sampling

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TABLE 2 Suitable Thin-Walled Steel Sample Tubes[A]

Outside diameter (D_o):			
in.	2	3	5
mm	50.8	76.2	127
Wall thickness:			
Bwg	18	16	11
in.	0.049	0.065	0.120
mm	1.24	1.65	3.05
Tube length			
in.	36	36	54
m	0.91	0.91	1.45
Inside clearance ratio, %	<1	<1	<1

[A] The three diameters recommended in Table 2 are indicated for purposes of standardization, and are not intended to indicate that sampling tubes of intermediate or larger diameters are not acceptable. Lengths of tubes shown are illustrative. Proper lengths to be determined as suited to field conditions.

clean hole; that minimizes disturbance of the soil to be sampled; and that does not hinder the penetration of the thin-walled sampler. Open borehole diameter and the inside diameter of driven casing or hollow stem auger shall not exceed 3.5 times the outside diameter of the thin-walled tube.

6.2 *Sampler Insertion Equipment* , shall be adequate to provide a relatively rapid continuous penetration force. For hard formations it may be necessary, although not recommended, to drive the thin-walled tube sampler.

6.3 *Thin-Walled Tubes,* should be manufactured to the dimensions as shown in Fig. 1. They should have an outside diameter of 2 to 5 in. (50 to 130 mm) and be made of metal having adequate strength for the type of soil to be sampled. Tubes shall be clean and free of all surface irregularities including projecting weld seams. Other diameters may be used but the tube dimensions should be proportional to the tube designs presented here.

6.3.1 *Length of Tubes*—See Table 2 and 7.4.1.

6.3.2 *Tolerances,* shall be within the limits shown in Table 1.

6.3.3 *Inside Clearance Ratio,* should be not greater than 1 % unless specified otherwise for the type of soil to be sampled. Generally, the inside clearance ratio used should increase with the increase in plasticity of the soil being sampled, except for sensitive soils or where local experience indicates otherwise. See 3.2.1 and Fig. 1 for definition of inside clearance ratio.

6.3.4 *Corrosion Protection*—Corrosion, whether from galvanic or chemical reaction, can damage or destroy both the thin-walled tube and the sample. Severity of damage is a function of time as well as interaction between the sample and the tube. Thin-walled tubes should have some form of protective coating, unless the soil is to be extruded less than 3 days. The type of coating to be used may vary depending upon the material to be sampled. Plating of the tubes or alternate base metals may be specified. Galvanized tubes are often used when long term storage is required. Coatings may include a light coat of lubricating oil, lacquer, epoxy, zinc oxide, and others.

NOTE 3—Most coating materials are not resistant to scratching by soils that contain sands. Consideration should be given for prompt testing of the sample because chemical reactions between the metal and the soil sample can occur with time.

6.4 *Sampler Head,* serves to couple the thin-walled tube to the insertion equipment and, together with the thin-walled tube, comprises the thin-walled tube sampler. The sampler head shall contain a venting area and suitable check valve with the venting area to the outside equal to or greater than the area through the check valve. In some special cases, a check valve may not be required but venting is required to avoid sample compression. Attachment of the head to the tube shall be concentric and coaxial to assure uniform application of force to the tube by the sampler insertion equipment.

7. Procedure

7.1 Remove loose material from the center of a casing or hollow stem auger as carefully as possible to avoid disturbance of the material to be sampled. If groundwater is encountered, maintain the liquid level in the borehole at or above groundwater level during the drilling and sampling operation.

7.2 Bottom discharge bits are not permitted. Side discharge bits may be used, with caution. Jetting through an open-tube sampler to clean out the borehole to sampling elevation is not permitted.

NOTE 4—Roller bits are available in downward-jetting and diffused-jet configurations. Downward-jetting configuration rock bits are not acceptable. Diffuse-jet configurations are generally acceptable.

7.3 Lower the sampling apparatus so that the sample tube's bottom rests on the bottom of the hole and record depth to the bottom of the sample tube to the nearest 0.1-ft (0.03 m).

7.3.1 Keep the sampling apparatus plumb during lowering, thereby preventing the cutting edge of the tube from scraping the wall of the borehole.

7.4 Advance the sampler without rotation by a continuous relatively rapid downward motion and record length of advancement to the nearest 1 in. (25 mm).

7.4.1 Determine the length of advance by the resistance and condition of the soil formation, but the length shall never exceed 5 to 10 diameters of the tube in sands and 10 to 15 diameters of the tube in clays. In no case shall a length of advance be greater than the sample-tube length minus an allowance for the sampler head and a minimum of 3 in. (76 mm) for sludge and end cuttings.

NOTE 5—The mass of sample, laboratory handling capabilities, transportation problems, and commercial availability of tubes will generally limit maximum practical lengths to those shown in Table 2.

7.5 When the soil formation is too hard for push-type insertion, the tube may be driven or Practice D3550 may be used. If driving methods are used, the data regarding weight and fall of the hammer and penetration achieved must be shown in the report. Additionally, that tube must be prominently labeled a "driven sample."

7.6 Withdraw the sampler from the soil formation as carefully as possible in order to minimize disturbance of the sample. The tube can be slowly rotated to shear the material at the end of the tube, and to relieve water or suction pressures (or both) and improve recovery. Where the soil formation is soft, a delay before withdraw of the sampler (typically 5 to 30 minutes) may improve sample recovery.

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8. Sample Measurement, Sealing and Labeling

8.1 Upon removal of the tube, remove the drill cuttings in the upper end of the tube and measure the length of the soil sample recovered to the nearest 0.25 in. (6 mm) in the tube. Seal the upper end of the tube. Remove at least 1 in. (25 mm) of material from the lower end of the tube. Use this material for soil description in accordance with Practice D2488. Measure the overall sample length. Seal the lower end of the tube. Alternatively, after measurement, the tube may be sealed without removal of soil from the ends of the tube.

8.1.1 Tubes sealed over the ends, as opposed to those sealed with expanding packers, should be provided with spacers or appropriate packing materials, or both prior to sealing the tube ends to provide proper confinement. Packing materials must be nonabsorbent and must maintain their properties to provide the same degree of sample support with time.

8.1.2 Depending on the requirements of the investigation, field extrusion and packaging of extruded soil samples can be performed. This allows for physical examination and classification of the sample. Samples are extruded in special device equipped which includes hydraulic jacks with properly sized platens to extrude the core in a smooth continuous speed. In some cases, further extrusion may cause sample disturbance reducing suitability for testing of engineering properties. In other cases, if damage is not significant, cores can be extruded and preserved for testing (Practice D4220). Bent or damaged tubes should be cut off before extruding.

8.2 Prepare and immediately affix labels or apply markings as necessary to identify the sample (see Section 9). Assure that the markings or labels are adequate to survive transportation and storage.

NOTE 6—Top end of the tube should be labeled "top."

9. Field Log

9.1 Record the information that may be required for preparing field logs in general accordance to Guide D5434. This guide is used for logging explorations by drilling and sampling. Some examples of the information required include;

9.1.1 Name and location of the project,

9.1.2 Boring number,

9.1.3 Log of the soil conditions,

9.1.4 Surface elevation or reference to a datum to the nearest foot (0.5 m) or better,

9.1.5 Location of the boring,

9.1.6 Method of making the borehole,

9.1.7 Name of the drilling foreman and company, and

9.1.8 Name of the drilling inspector(s).

9.1.9 Date and time of boring-start and finish,

9.1.10 Depth to groundwater level: date and time measured,

9.2 Recording the appropriate sampling information is required as follows:

9.2.1 Depth to top of sample to the nearest 0.1 ft. (.03 m) and number of sample,

9.2.2 Description of thin-walled tube sampler: size, type of metal, type of coating,

9.2.3 Method of sampler insertion: push or drive,

9.2.4 Method of drilling, size of hole, casing, and drilling fluid used,

9.2.5 Soil description in accordance with Practice D2488,

9.2.6 Length of sampler advance (push), and

9.2.7 Recovery: length of sample obtained.

10. Keywords

10.1 geologic investigations; intact; sampling; soil exploration; soil investigations; subsurface investigations

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ATTACHMENT 4
SOP 33 – SUBSURFACE SOIL SAMPLING
SOIL SAMPLE LOG SHEET

Sample No. _____

KEY ENVIRONMENTAL INCORPORATED

SOIL SAMPLE LOG SHEET

Project Number: _____ **Date:** _____

Project Location: _____ **Time:** _____

Client: _____ **Weather Conditions:** _____

Collected By: _____

Sample Point Description: _____

(Include nearby landmarks, designation from a map layout of the site, measurements, or any other locating information.)

SAMPLE COLLECTION:

Equipment Used: _____

Required Analyses: _____

No. of Sample Containers and Sizes: _____

Figure 1: Sample Point

Collection Depths	Soil Description

Comments: _____

APPENDIX C

QUALITY ASSURANCE PROJECT PLAN

REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY WORK PLAN
QUALITY ASSURANCE PROJECT PLAN

STANDARD CHLORINE CHEMICAL COMPANY SITE
KEARNY, NEW JERSEY

Prepared for:

Performing Parties Group
(Beazer East, Inc., Cooper Industries, LLC, Tierra Solutions, Inc. on
behalf of Occidental Chemical Corporation, and Apogent Transition Corporation)

Prepared by:

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September 2013

REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY WORK PLAN
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LIST OF ATTACHMENTS

A KEY STANDARD OPERATING PROCEDURE #05
GIS/Key Electronic Data Deliverables

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LIST OF ABBREVIATIONS/ACRONYMS

%R	Percent recovery
ACOE	Army Corps of Engineers
AOC	Area of Concern
Apogent	Apogent Transition Corporation
ASTM	American Society for Testing and Materials
Beazer	Beazer East, Inc.
C	Completeness
CLP	Contract Laboratory Program
COI	Constituents of Interest
Cooper	Cooper Industries, LLC
DQO	Data Quality Objective
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved oxygen
EDD	Electronic Data Deliverable
FID	Flame ionization detector
FSP	Field Sampling Plan
FSPM	Field Sampling Procedures Manual
GDMVS	Graphical Data Management and Visualization System
GIS	Geographic Information System
Group	The Performing Parties Group consisting of Tierra Solutions, Inc., Beazer East, Inc., Cooper Industries, LLC, and Apogent Transition Corporation
IRA	Interim Response Action
KEY	Key Environmental, Inc.
LQM	Laboratory Quality Manual
NJAC	New Jersey Administrative Code
NJ	New Jersey
NJDEP	New Jersey Department of Environmental Protection
ORP	Oxidation/Reduction Potential
OVA	Organic Vapor Analyzer
PCBs	Polychlorinated biphenyls
PCDD	Polychlorinated Dibenzo-p-dioxin
PCDF	Polychlorinated Dibenzo-p-furan
PID	Photo-ionization Detector
ppm	Parts per million
PVC	Polyvinyl chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative Percent Difference
USDA	United States Department of Agriculture
SAS	Special Analytical Services
SCCC	Standard Chlorine Chemical Co., Inc.
Site	SCCC Site

SOP	Standard Operating Procedure
SPLP	Synthetic Precipitation Leaching Procedure
SVOC	Semi-Volatile organic compounds
Tierra	Tierra Solutions, Inc.
UCSC	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

1.0 PROJECT MANAGEMENT

On behalf of the Performing Parties Group (Group), Key Environmental, Inc. (KEY) has prepared this Quality Assurance Project Plan (QAPP) to supplement the Remedial Investigation/Focused Feasibility Study (RI/FFS) Work Plan for the Standard Chlorine Chemical Company (SCCC) Site, located in Kearny, New Jersey.

This RI/FFS Work Plan has been prepared to address a specific requirement of a RI/FFS Statement of Work (SOW) prepared by the United States Environmental Protection Agency (USEPA). The referenced SOW is provided as Appendix A of an Administrative Settlement Agreement and Order on Consent for Remedial Investigation/Focused Feasibility Study (AOC) for the SCCC Site effective May 3, 2013. Specifically, this plan has been prepared to address the requirements listed in Section III of the USEPA RI/FFS SOW dated March 28, 2013 (Task 2 - RI/FFS Work Plan). The RI/FFS Work Plan constitutes the primary component of this deliverable. The RI/FFS Work Plan describes the investigation activities proposed by the Group for the SCCC Site which consist of the following components:

- Surface soil characterization
- DNAPL delineation
- Varved clay sampling and analysis

The RI/FFS Work Plan provides relevant background information for the Site and defines the field activities required to support the implementation of the RI/FFS. This QAPP presents the quality assurance and quality control procedures necessary for execution of the RI/FFS Work Plan including both field and laboratory analytical methods

The QAPP is complimented by other documents that outline RI/FFS Work Plan implementation procedures including the Health and Safety Plan (HASP) included as Appendix A of this RI/FFS Work Plan and the Field Sampling Plan (FSP) included as Appendix B of this RI/FFS Work Plan. Applicable KEY Standard Operating Procedures (SOPs) are included in Attachment A of this QAPP or in the attendant FSP and are referenced herein where appropriate. If a discrepancy exists between an SOP and specific protocol included in this QAPP, the procedure specified in the main body of the QAPP takes precedence.

This QAPP provides an overview of the analytical methods, data analysis processes, and other procedures to be followed to ensure confidence and to document the validity of the results of the sampling activities described in the RI/FFS Work Plan. This QAPP satisfies the United States Environmental Protection Agency's (USEPA) and the New Jersey Department of Environmental Protection's (NJDEP) requirements for a QAPP as outlined in the following guidance:

1. U.S. EPA, "Guidance on Systematic Planning Using the Data Quality Objectives Process," EPA QA/G-4, February 2006;
2. U.S. EPA "EPA Requirements for Quality Assurance Project Plans," EPA QA/R-5, March 2001; and,
3. N.J.A.C. 7:26E-2.2, May 2012.

This QAPP has been prepared to serve as the guidance document for quality assurance/quality control (QA/QC) requirements for Site-wide data acquisition.

1.1 PROJECT ORGANIZATION

The Group will oversee and coordinate the project. KEY will be responsible for ensuring that project-specific sampling activities related to the data acquisition activities are implemented in conformance with the requirements of the RI/FFS Work Plan, FSP, and QAPP. Those tasks not performed by KEY will be completed by subcontractors subject to oversight by KEY. KEY will also provide QA/QC for field activities and deliverables. KEY will issue deliverables to the Group for submittal to the USEPA and NJDEP, as appropriate.

The management, technical, and QA/QC responsibilities of the project personnel for implementation of the future sampling activities are summarized as follows:

- Performing Parties Group Project Management and Technical Committee [Messrs. Mitchell Brourman (Beazer), Enrique Castro (Tierra), Nelson Olavarria (Cooper), and John McTigue (The Isosceles Group on behalf of Apogent)]
  - Coordinate project technical activities
  - Conduct project planning activities
  - Attend review and planning meetings between the Group and USEPA, as necessary
  - Review all project deliverables
  - Oversee the project budget, and schedule

- KEY Project Manager (James Zubrow, P.G.)
  - Coordinate project technical activities
  - Assist the Group Project Management and Technical Committee in project planning
  - Attend review and planning meetings between the Group and USEPA and NJDEP, as necessary
  - Provide technical guidance to field personnel
  - Establish project files
  - Review project deliverables
  - Manage the project budget, schedule, and staffing

- KEY Field Investigation Task Leader (Vamsee Veera, P.E.):
  - Ensure that appropriate field documentation is incorporated into the project files
  - Supervise field investigation activities and ensure that the RI/FFS and QAPP are followed
  - Provide Health and Safety field support
  - Participate in project meetings with the Group and USEPA and NJDEP, as necessary
  - Prepare project technical reports

- KEY QA/QC Officer (Robert Hubbard, P.E.)
  - Initiate corrective action, as necessary, for quality assurance (QA) compliance
  - Review laboratory data corrective action, as necessary, for QA compliance
  - Coordinate analytical data validation, as required, and review
  - Review laboratory QA/QC
  - Review documentation

Primary responsibility for data quality rests with KEY's QA/QC Officer. Quality assurance will be provided by the analytical laboratory's Project Manager and QA/QC Officer prior to release of data and/or reports to KEY. A data validation specialist, independent of the laboratory, may complete additional data validation review on behalf of the Group contingent upon project-specific Data Quality Objectives (DQOs).

1.2 PROJECT BACKGROUND

A detailed description of the Site background information is provided in the RI/FFS Work Plan that constitutes the primary portion of this deliverable. Site history information, physical settings, a summary of previous measures, and a summary of Site characterization data are provided in Section 2.0 of the RI/FFS Work Plan.

1.3 PROJECT DESCRIPTION

Section 5.0 of the RI/FFS Work Plan provides a description of the data acquisitions activities. The data acquisition activities, identifying the sample collection locations, descriptions, sample matrix, boring depth, sample depth, required analytical suites, analytical methods, bottle requirements, quality control samples, preservation, and holding times are summarized in Table 1. The data acquisition activities will focus on collection of data to support the following three components:

- Surface Soil Characterization, Sampling, and Analysis;
- DNAPL Delineation;
- Varved Clay Sampling and Analysis.

1.4 DATA QUALITY OBJECTIVES

DQOs specify the appropriate amount and type of data required and tolerable levels of uncertainty for the environmental decisions to be made. The USEPA has developed a systematic process for developing DQOs that includes consideration of several critical elements considered during preparation of this QAPP. The process requires definition of the problem and statement of the decisions that will be made based on study results. The users of the data and key personnel and their roles in the program are identified, as are any regulatory criteria or agencies that will be involved. Information needed to support these decisions can then be determined, including what the contaminants of concern are and physical boundaries of the study area, the quantity of data that will be needed, the means to collect these data and the level of uncertainty that will be acceptable. Program design can then be optimized to collect defensible data in the most efficient manner.

For the purposes of the design data acquisition activities, data will be used to support specific decisions, as follows:

Surface Soil Sampling and Analysis – Collection of surface soil samples on the SCCC Site will be used to complete the analytical data requirements for soils beneath the IRM on Lots 48, 50 and 51. These data will supplement the 2008 surface soil characterization activities conducted as part of the pre-Interim Response Action investigation.

DNAPL Delineation Investigation - The primary objectives of this investigation are to identify the extent of DNAPL impacts in areas heretofore subjected to limited or indirect (i.e., Laser-Induced Fluorescence [LIF]) investigation. Areas subject to additional investigation focus primarily on the western portion of the SCCC Site and the western portion of the adjacent Seaboard site.

Varved Clay Sampling and Analysis –These data are needed to fulfill assessment requirements for the vertical migration of DNAPL. The RI/FFS Work Plan approach addresses these particular needs and will provide detailed characterization of the vertical extent of DNAPL for the Site.

1.4.1 Project Quality Objectives

This QAPP serves as a controlling mechanism during the RI/FFS to provide procedures which, when followed properly, will assure that all decisions based on laboratory and field data generated during this investigation are technically sound, statistically valid, and properly documented. Specific procedures for sampling, laboratory analyses, data reporting, and data validation, are presented in other sections of this QAPP.

1.4.2 Measurement Performance Criteria

The overall QA objective for the RI/FFS is to provide procedures which, when followed properly, will assure that all decisions based on laboratory and field data generated during this

investigation are technically sound, statistically valid, and properly documented. Specific procedures for sample collection, laboratory analyses, data reporting, and data validation, are presented in other sections of this QAPP. The primary purpose of this section is to define statistical acceptance criteria for chemical data generated by the analytical laboratory.

As a result of the varying nature of the data required, there are several applicable levels of data quality for the RI/FFS. A primary component of data quality is selection of the appropriate analytical level for the intended data use. Analytical levels, as described in "Data Quality Objectives for Remedial Response Activities" (USEPA, March 1987), are as follows:

- Level I - Field screening or analysis using portable instruments. Results are often not compound-specific and not quantitative, but are available in real-time. Level I data is appropriate for initial field screening and for health and safety monitoring. They are frequently used to determine sample collection locations for laboratory analyses.
- Level II - Field analysis using more sophisticated portable analytical instruments; in some cases, the instruments may be set up in a mobile laboratory on location. There is a wide range in the quality of data that can be generated that is dependent on the use of suitable calibration standards, reference materials and sample preparation equipment. Results are available in real-time or within several hours.
- Level III - All analyses are performed in an off-Site analytical laboratory. Level III provides quantitative data. Documented sampling and analysis procedures must be used. Level III analyses may or may not use Contract Laboratory Program (CLP) procedures, but at a minimum, abbreviated CLP-type deliverables are required. Level III may require data validation and QA/QC procedures conducted in accordance with EPA guidelines. The laboratory may or may not be a CLP laboratory.
- Level IV – CLP-equivalent routine analytical services. All analyses are performed in an off-site analytical laboratory following CLP protocols. Level IV is characterized by rigorous QA/QC protocols and documentation with full validation of all data.
- Level V - Analysis by nonstandard methods. All analyses are performed in an off-site laboratory that may or may not be a CLP laboratory. Method development or method modification may be required for specific constituents or detection limits. CLP Special Analytical Services (SAS) are Level V.

Level I will be used for the field screening activities identified in the RI/FFS, specifically this includes screening data collected using field instruments such as a photo-ionization detector (PID), flame ionization detector (FID) organic vapor analyzer (OVA), and multi-meter. For the purposes of the Remedial Investigation, the following Analytical Levels were anticipated to be employed:

- Level I – Field Instrumentation Measurements
- Level IV – Contract Laboratory Program Equivalent Data
- Level V – Analysis via Nonstandard Analytical Methods

Level I - Level I analytical data will consist of information generated using portable field instrumentation, specifically, a Photoionization Detector (PID). The PID will be used as a screening tool to support selection of appropriate samples to be submitted for laboratory analysis. Sonic borings will be completed, and given the semi-volatile and volatile nature of the constituents of interest (i.e., chlorinated aromatic hydrocarbons) the PID is an appropriate screening tool for selection of such samples. The PID is also an appropriate tool to assess the potential presence of constituents of interest on a semi-quantitative basis.

Level IV – Level IV analytical data will consist of information generated via analysis of solid phase samples by off-site fixed-base laboratories. SW-846 analytical methods (e.g., SW-846 8260B, SW-846 8270C, SW-846 8082A, SW-846 8290A, and SW-846 6000 and 7000 series methods) will be employed for all offsite sample analyses with the exception of hexavalent chromium. Contract Laboratory Program level deliverables will be required such that validation of analytical data in accordance with the National Function Guidelines for organic and inorganic data review can be completed if necessary.

Level V – Level V analytical data will consist of information generated via analysis of solid phase samples by off-site fixed-based laboratories. Level V data will consist of data developed via nonstandard procedures used for hexavalent chromium analysis. The NJDEP has developed specific procedures to be followed for solid phase hexavalent chromium analysis. While the methods are based on the corresponding SW-846 method for digestion and analysis of solid samples (i.e., SW-846 Methods 3060A and 7199), additional quality assurance and quality control requirements apply such that the potential impacts of reducing conditions can be gauged as a result of the analytical program (i.e., measurement of Eh and pH are required for all samples and additional spiking requirements apply). The NJDEP-modified methods will be employed for hexavalent chromium analysis to satisfy specific state requirements.

Each of these levels is characterized by statistically based criteria expressed in terms of:

- Precision;
- Accuracy;
- Representativeness;
- Completeness;
- Comparability; and,
- Sensitivity.

These parameters are discussed in the following five sections.

1.4.2.1 Precision

Precision is defined as the degree of agreement between repeated measurements of the same parameter under prescribed, similar conditions. Field and laboratory precision will be monitored using results from duplicate sample analyses. Precision can then be expressed as the relative percent difference (RPD) of one result with another. The RPD is calculated as follows:

$$RPD = \frac{D1 - D2}{\frac{(D1 + D2)}{2}} x\,100$$

Where: RPD = relative percent difference
D1 = first duplicate value
D2 = second duplicate value.

The overall DQO for precision of analytical measurements is expressed as a percent of the duplicates having RPDs within established control limits.

The precision of Level I data will be confirmed through repetitive and/or consecutive measurements. The precision of Level III data can be measured through the analysis of field duplicates, laboratory duplicates, and matrix spike duplicates. The frequency of field duplicate collection is specified in Section 2.4.1.1. The frequencies of laboratory duplicate analyses (required for inorganic analyses) and matrix spike/matrix spike duplicate set analyses (required for organic analyses); will be at a minimum of 1 per 20 field samples.

Given anticipated difficulties as a result of matrix interference effects in soils, it is tentatively planned that matrix spike/matrix spike duplicate samples will be spiked at both high and low spike concentrations. This will be conducted to ensure that discernible concentrations of the spiked compounds are measured.

Reproducibility is expressed as a relative percent difference, which is the absolute value of the range between the duplicate results divided by the mean. Acceptable RPDs for each analyte from laboratory and matrix spike duplicates are specified in descriptions of their respective methods. Field duplicate precision criteria for soils and waters are included in data validation guidelines.

1.4.2.2 Accuracy

Accuracy is the measure of the degree of agreement between an analyzed value and the true or accepted value where it is known. Accuracy will be monitored using known concentrations of analytes and surrogates spiked into blanks and selected samples. Accuracy can then be expressed as a percent recovery (%R), which is calculated as follows:

$$\%R = \frac{Qd}{Qa}\,x\,100$$

Where: %R = percent recovery
Qd = spiked sample result minus the sample result
Qa = spiked amount.

The overall DQO for accuracy is thus the percent of samples that have %R within prescribed control limits.

Accuracy of Level III data can be measured by the analysis of equipment blanks, trip blanks, method blanks, matrix spikes, and surrogate standards. Blanks provide a way of detecting biases introduced in the sampling, sample handling, and analysis. Matrix spikes are samples to which known amounts of target constituents are added.

The frequency of equipment blank and trip blank collection and analysis is specified in Section 2.4.1.1. The frequencies of analyses of method blanks, laboratory control spikes, and matrix spikes, and surrogate standards are specified in the respective methods. The methods also present the acceptable percent recovery limits for each analyte.

1.4.2.3 Representativeness

Representativeness expresses the extent to which the analytical data reflect the actual media at the Site and are representative of Site conditions and characteristics. Representativeness is a function of the sampling program design and execution and the analytical program. Representativeness from field activities is addressed by collecting an adequate number of samples from optimal locations using standard procedures. The number and location of samples and methodologies of sampling is specified in the attendant Field Sampling Plan (Appendix B). Representativeness as a function of analytical-method issues may be compromised by method deviations, the presence of potential laboratory or field artifacts, indications of sample non-homogeneity, and recovery anomalies from surrogates or spikes into field samples.

1.4.2.4 Completeness

Completeness (C) is a measure of the amount of valid data obtained from an analytical measurement system. It is expressed as a percent of the overall data that were generated and is calculated as follows:

$$\%C = \frac{V}{T}\ x\,100$$

Where: %C = percent completeness
V = number of measurements judged valid
T = total number of measurements.

An acceptable percentage of data determined to be valid should be established as target goals for each particular objective. Anything below these goals would require re-sampling and re-analysis or a modification to the goal with justification. As a general rule, the sampling programs will be designed so that program needs will be met if 90% completeness is achieved.

1.4.2.5 Comparability

Comparability is an expression of the confidence with which one data set can be compared against another. Comparability is a qualitative function of the sampling and analysis methods. To assure that one data set can be compared to another, the sampling and analysis methods will follow well-documented standard procedures and typical reporting units will be used.

1.4.2.6 Sensitivity

Sensitivity is the ability of the method to detect the contaminant of concern at the concentration of interest (regulatory clean up standard). QC measures which aid in evaluating sensitivity are field rinsate blanks, trip blanks, and laboratory method blanks. These QC samples are used to ensure that field or laboratory practices do not introduce contaminants, which may positively bias laboratory results. Method reporting limits are set at a level equal to that of the low level standard of the instrument calibration curve.

Sensitivity requirements for this program will depend on the media of concern. Soil and water analyses will be designed, where possible, to meet the nominal practical quantitation limits for each analyte presented in the USEPA/NJDEP guidance documents, cleanup criteria, and screening criteria. To the degree possible, analyses will be conducted to provide adequate sensitivity to demonstrate Site conditions with respect to the applicable USEPA regional screening levels defined in the identified technical guidelines.

1.5 DOCUMENTATION AND RECORDS

All records generated during this project will be kept on file by KEY on behalf of the Group. These records may include: field log books, field sampling forms, chain of custody forms, laboratory data deliverables, photographs, and other relevant records.

Revisions and updates to this QAPP will be prepared as the Group and/or KEY deem necessary, and/or based upon conditions observed in the field. A full review of the QAPP will be performed if work has not been completed within five years and updates will be incorporated as necessary. This will ensure that laboratory changes or method improvements are addressed, and that changes to program objectives, or scope that may be made as a result of the information gathered in the initial program stages, are incorporated into the overall QA/QC program. Changes to the QAPP will be fully documented and signed by the KEY Project Manager and QA Officer.

2.0 MEASUREMENT DATA ACQUISITION

2.1 SAMPLING METHODS

Sampling methods, decontamination procedures, and management of investigation-derived waste are discussed in the attendant Field Sampling Plan (Appendix C).

2.2 SAMPLING HANDLING AND CUSTODY

Sample handling and custody are discussed in detail in Section 8.0 of the attendant Field Sampling Plan (Appendix C).

2.3 ANALYTICAL METHODS

The analytical procedures to be used for the data acquisition activities include a combination of EPA and ASTM methods, as well as specific methods to be completed in accordance with laboratory SOPs. The specific analytical methods to be used for the RI/FFS Work Plan are as follows:

- TCL Volatile Organic Compounds (SW-846 Methods 5035A and 8260B)
- TCL Semi-Volatile Organic Compounds (SW-846 Method 8270C)
- TCL Polychlorinated Biphenyls (SW-846 Method 8082)
- Hexavalent Chromium (SW-846 Method 7199)
- TAL Metals (SW-846 6000 and 7000 Series Methods)
- Dioxins/furans (SW-846 Method 8290)
- pH (SW-846 Method 9040C), and
- Oxidation-Reduction Potential (ASTM D1498)

Detailed information and quality control requirements will be provided in the subcontract laboratory's Laboratory Quality Manual (LQM). As per notification previously provided to USEPA, Test America and Eurofins Lancaster have been selected as the analytical chemistry subcontract laboratories for the project. Copies of the subcontract laboratories' LQMs will be provided upon request.

2.4 QUALITY CONTROL

This section discusses field and laboratory quality control requirements. Laboratory quality control requirements are dictated, in large part, by the analytical methods. Additional aspects of laboratory quality control are addressed in the subcontract laboratories' LQMs.

2.4.1 Field Quality Control Requirements

Quality control in the field will be maintained through equipment calibration (discussed in Section 2.6.1 of this QAPP), measurement reproducibility, and the collection of QC samples.

2.4.1.1 Field Quality Control Samples

Quality control for field sampling efforts will primarily be measured via the collection of field QC samples, which consist of the following:

- Field duplicates;
- Equipment blanks;
- Trip blanks.

The data application and sample requirements for each are discussed in the following paragraphs.

Field Duplicates

Field duplicates are used to evaluate the sample collection and analyses effects on the reproducibility of data. Field duplicates are collected by splitting a sample evenly between the primary sample and QA/QC sample containers. Field duplicates of soil samples for all analyses except volatile organics will be taken by homogenizing the soil in a stainless steel bowl and then placing replicate portions into the sample containers. Field duplicates for volatile analyses will be collected as separate discrete grab samples from the same location and boring depth.

Preservation will be performed as necessary for the appropriate analysis. One field duplicate for each chemical analysis for each sampling event or one per every 20 samples will be collected, whichever is greater.

Equipment Blanks

Equipment blank data are used to evaluate field decontamination procedures. Equipment blanks will be collected by pouring analyte-free water, supplied by the analytical laboratory, through a decontaminated sample bailer or low flow purging and sampling device or over decontaminated soil sampling utensils into the sample bottles. Preservation and filtration will be performed as necessary for the appropriate analyses. For equipment that is decontaminated and re-used, one equipment blank will be collected per day for each type of equipment used or one per every 10 samples will be collected, whichever is greater.

If disposable equipment is used, the equipment blank will be taken from a rinse of the equipment prior to sampling use. One field blank per sampling event will be sufficient for each type of disposable instrument used. Equipment blanks will be analyzed for the same chemical parameters as the primary soil samples as follows:

- Surface soil samples: TCL VOCs (including all 3 tricholorobenzene isomers) and SVOCs; TCL PCBs, PCDD/PCDF, TAL Metals (including total chromium), hexavalent chromium, pH, and ORP.
- Subsurface DNAPL delineation soil samples: TCL VOCs and SVOCs;
- Subsurface varved clay soil samples: TCL VOCs and SVOCs; TAL Metals (including total chromium), hexavalent chromium, pH, and ORP.
- If DNAPL is observed, up to 10 subsurface DNAPL impacted material samples will also be analyzed for TCL PCBs and PCDD/PCDF.

Trip Blanks

Trip blank data will be used to evaluate exposure to volatile organic constituents during sampling, shipping and storage at the laboratory. Trip blanks will be prepared by the analytical laboratory and will be shipped with the VOC vials. Trip blanks for soil samples consist of methanol. Trip blanks for a particular date of sample collection will be transported to the laboratory in the sample shipment container with all other VOC samples for that date. One set of trip blanks will be included in each cooler containing VOC sample vials and will be analyzed for the same list of VOCs as the primary samples.

2.4.2 Laboratory Quality Control Requirements

Quality control data are necessary to determine precision and accuracy of the analyses, and to demonstrate the absence of interferences and contamination of glassware and reagents. Laboratory-generated QC will consist of blanks, replicates, standards, matrix spikes, surrogate spikes and blanks. These will be prepared and analyzed at the method-required frequencies. Method-recommended matrix spiking solutions will be used to determine matrix effects. Surrogates will be added to all samples requiring gas chromatography analyses (or as specified in the method). At a minimum, one method blank will be processed for every batch (up to 20 samples) analyzed. Blank samples will be analyzed in order to assess possible contamination and determine which corrective measures may be taken, if necessary.

Laboratory Duplicates

Replicate samples are aliquots of a single sample that are split upon arrival at the laboratory or prior to analysis. Laboratory duplicates are required by methods for inorganic analyses. Since it is anticipated that the concentrations of most organic parameters will be below the laboratory detection limits, precision data on replicate analyses will largely be derived from matrix spike duplicate data. Significant differences between two replicates that are split in a controlled laboratory environment will result in flagging of the affected analytical results.

Surrogate Analysis

Surrogate spike analysis is used to determine the recovery efficiency of analytes in the sample preparation and analysis. Calculated percentage recovery of the spike is used as a measure of the

accuracy of the total analytical method. A surrogate spike is prepared by adding to a sample (before extraction) a known amount of pure compound similar to that for which the sample is being analyzed. Surrogate compounds will be added to all samples that are to be analyzed for volatiles and semi-volatiles, including method blanks, duplicate samples, and matrix spikes using the compounds recommended in the respective methods. If a recovery does not fall within these limits, the corrective actions described in the method will be implemented.

Matrix Spike/Matrix Spike Duplicate Analysis

This technique is used to determine the effect of matrix interference on analytical results. Aliquots of the same sample are prepared in the laboratory and each aliquot receives consistent treatment throughout the analytical method. Spikes are added at concentrations specified in the methods. Spike duplicates are prepared for organic analyses. The percent difference between the values of the spike duplicates is taken as a measure of the precision of the analytical method.

Method Blanks

Method blanks will be run for all appropriate chemical analyses to verify that the procedures used do not introduce contaminants that affect the analytical results. The method blank will be prepared by addition of all reagents to a substance of similar matrix as the sample. This blank will then undergo all of the procedures required for sample preparation. The resultant solution will be analyzed with the field samples prepared under identical conditions.

Deviations from the established QC criteria will be noted and reanalysis, or other corrective action, will be instituted as appropriate for the situation.

2.5 EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

Equipment condition and maintenance activities will be noted in the field notebooks and may include:

- Cleansing of the ionization chamber, lamp window, and any filters on a PID, FID, or multimeter; and,
- Daily inspections of drilling equipment for proper and safe function.

Spare and replacement parts stored in the field to minimize downtime may include:

- Appropriately sized batteries;
- Decontamination supplies;
- Extra sample containers;
- Stainless steel bowls and spatulas/spoons;
- Calibration kit(s), battery charger, and support equipment;
- Health and safety supplies; and,
- Tool kit.

If damaged equipment is identified, it will be replaced by the same or equivalent model as soon as is practicable. Field QA issues will be reported to the KEY Project Manager and QA Officer. Problems encountered during the program affecting quality will be reported. The Project Manager/QA Officer will be responsible for initiating the corrective actions and for ensuring that the actions are taken in a timely manner and that the desired results are produced.

During the course of the corrective actions, the field personnel will be responsible for seeing that field instruments are functioning properly and that work progresses satisfactorily. Additionally, field personnel are responsible for the performance of routine preventative maintenance and QC procedures, thereby ensuring collection of valid field data.

2.6 INSTRUMENT CALIBRATION AND FREQUENCY

This section discusses instrument calibration procedures and frequency of calibration. Field instrument calibration is discussed in Section 2.6.1. Laboratory instrument calibration is discussed in Section 2.6.2.

2.6.1 Field Instrument Calibration

Precision and accuracy of field measurements will be maintained in two ways:

- Through daily calibration of each instrument or in accordance with the manufacturer's recommended procedures, if such procedures exist; and,
- By checking the reproducibility of the measurement by obtaining and recording multiple readings.

2.6.1.1 Equipment Requirements

The following field equipment is anticipated for use during the RI, for various screening, monitoring, and measurement tasks:

- Electronic water depth measuring devices (E-tapes) and oil-water interface probes; and,
- PID or FID.

2.6.1.2 Calibration Requirements

All equipment will be calibrated daily for each day of use, more frequently if necessary, and/or per manufacturer's recommendations. Calibration information is to be recorded in the field notebook. If calibration difficulties are experienced for a given piece of equipment, KEY or subcontractor responsible for equipment upkeep will replace the equipment with a similar, or equivalent model, as soon as is practicable.

2.6.2 Laboratory Instrument Calibration

Calibration of laboratory equipment will be accomplished according to published procedures associated with specific methods of analysis, if any, and U.S. EPA guidance. Records of calibration, repairs, or replacement will be filed and maintained by the designated laboratory personnel performing quality control activities. These records will be filed at the location where the work is performed and will be subject to a QA audit. For all instruments, the laboratory will maintain a factory-trained repair staff with in-house spare parts, or maintain service contracts with vendors.

2.7 DATA ACQUISITION

Data will be transferred electronically or by computer diskette directly from the laboratory to KEY. Once received by KEY, data will be reduced and formatted in easily interpreted tables in Excel format for incorporation into a Graphical Data Management and Visualization System (GDMVS). From this format, data will also be electronically transferred into KEY's GDMVS and in NJ HazSite electronic data deliverable (EDD) format. The data format required by KEY for production of the USEPA Region 2 EDD Format is provided at www.epa.gov/region02/Superfund/medd.htm and includes a site basemap and sampling data with locational data in decimal latitude and longitude. The data format required by KEY for production of the NJ HazSite EDD is presented in SOP #05 (included in Attachment A).

2.8 DATA MANAGEMENT

The analytical, survey, and geological data (electronic and hardcopy) will be managed and maintained by KEY. Any requests for these data by third parties must be first approved by the Group. Data management for the project has the following objectives:

- Establish a controlled, functional, and efficiently operated data management system and accompanying procedures to manage, analyze, document, and transfer the environmental data that are collected and generated.
- Maintain a usable and accurate database throughout the life of the project.
- Support processing of specific data requests from project and Group personnel.
- Support transfer specific data components to other parties, as appropriate.
- To allow archiving of the data and related documentation upon closure of the project.

2.8.1 Data Transmittal, Transformation, and Analysis

Upon receipt of data from the analytical laboratory, KEY personnel will ensure that all data packages are complete. If data packages are determined to be incomplete, the laboratory will be contacted and will be required to promptly provide the missing information. KEY personnel will be responsible for transcribing all data, including electronically transferred data (i.e., EDDs), into tables suitable for data review. After review and any necessary validation, field and laboratory data will be entered into the database with appropriate qualifiers.

KEY personnel will review Level III data to ascertain that the laboratory has provided the following information:

- Results for all samples submitted;
- Correct reporting units;
- Documentation of acceptable matrix spike duplicate and surrogate recoveries;
- Acceptable standard and preparation blank results; and,
- Appropriate qualifiers of data for which results are reported below the applicable detection limit or for analytes that are also detected in method or preparation blanks.

Any difficulties originating from the EDD format shall be resolved with the laboratory before the data are imported. Upon importing analytical data, a random sampling will be verified against the associated hard copy data and a copy of the reviewed electronic data printout will be annotated, signed, and retained in the project file.

Tables containing analytical data will be generated through queries from the database and results will be compared to appropriate regulatory criteria. Geographic Information System (GIS) data may be used to generate boring logs, groundwater flow maps, and vertical and lateral iso-concentration plots. Geologic data obtained from boring logs, well construction information, and survey coordinates and elevations will also be entered. The data will be reviewed for accuracy and completeness.

2.8.2 Data Storage and Retrieval

All electronic data will be maintained in the KEY database and will be accessed and managed by KEY. All records will be maintained by KEY following project completion and closeout until directed otherwise by the Group.

3.0 ASSESSMENT/OVERSIGHT

3.1 ASSESSMENT AND RESPONSE ACTIONS

The oversight of the project activities may include a process of review and evaluation through systems audits, field audits, internal peer review, and laboratory oversight. This process will ensure that the QAPP is adhered to, the quality of the data is adequate, and corrective actions, when needed, are implemented effectively and in a timely manner.

3.1.1 Technical Systems Audits

Systems audits performed by the Quality Assurance Officer or designee may encompass evaluation of QA components to ascertain their appropriate selection and application. In addition, field and laboratory quality control procedures and associated documentation may be system audited. These audits will be conducted if conditions that may compromise quality are detected, and/or if the Group requests an unscheduled audit. The Systems Audit will consist of an inspection of the following procedures:

- Sampling
- Sample custody
- Sample storage and preservation
- Sample preparation
- Analytical methodology
- Data management
- Preventive maintenance
- Recordkeeping

3.1.2 Technical Performance Audits

Performance audits may be conducted periodically through the duration of the project to determine the accuracy and implementation of the QA/QC Plan. As in system audits, unplanned audits may be implemented if requested. Performance audits will be performed after sampling activities commence and the project begins to generate data. These audits document that sampling, custody, and record-keeping in the field are in compliance with applicable requirements of the QAPP. In addition to in-house performance audits, the laboratory will also participate in inter-laboratory performance evaluation studies.

3.1.2.1 Field Performance Audits

A QA audit may be conducted at the discretion of the Project Manager to ensure that field personnel comply with the RI/FFS Work Plan and applicable SOPs. Each audit shall cover the

items necessary to verify proper control of the activities within the defined scope of work. Concerns such as equipment inspections and calibration, personnel training, decontamination, field screening, sample collection, sample shipping and chain-of-custody procedures, and document control are included in a field audit.

The mobilization stage may be audited before work begins to assure that all procedures, training, and materials are in place to support the QA Plan. Field activities may be audited during the initial stage to assure compliance with the QA Plan. Additional audits may be required depending on the results of these audits. All audits and corrective actions will be reported in writing to the Project Manager.

3.1.2.2 Laboratory Audits

New Jersey certified laboratories will be used for analysis of all Site-related constituents of interest (COIs) in this program. If conditions are noted that indicate potential quality issues with analytical results, an audit may be conducted at the recommendation of the Quality Assurance Manager. This audit shall consist of a general audit and a specific procedure audit. A general audit will be an overview of the whole laboratory from sample receipt to sample disposal. A specific technical audit will be a detailed in-depth review of an actual method or procedure.

The findings from any audit conducted will be documented on a laboratory audit record form. Any issues, observations, and findings shall be discussed with the Laboratory Manager. The results of the audit shall be kept on file along with any corrective action taken. If, as a result of the audit, there is uncertainty as to the validity or correctness of a test result, immediate corrective action should be taken and the client notified in writing.

3.2 CORRECTIVE ACTION PROTOCOLS

Project management and staff, including field investigation teams, quality assurance auditors, document, sample control personnel, and laboratory groups, will monitor ongoing work performance in the normal course of daily responsibilities. When a significant condition adverse to quality is noted at the project location or laboratory, the cause of the condition will be determined and corrective action taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned and taken will be documented and reported to the Project Manager. Implementation of correction action will be verified by documented follow-up action. All project personnel have the responsibility, as part of their normal work duties, to promptly identify and report conditions adverse to quality, and solicit correction. Corrective actions may be initiated under the following (for example):

- When predetermined acceptance standards are not attained (objectives for precision, accuracy, and completeness);
- When procedures or data compiled are determined to be incorrect or incomplete;
- When equipment or instrumentation is found to be malfunctioning;
- When samples and test results cannot be traced with certainty;

- When quality assurance requirements have been violated;
- When designated approvals have been circumvented;
- As a result of system and performance audits; or,
- As a result of a management assessment.

Corrective actions shall be documented using appropriate field and laboratory forms. All corrective action forms shall be entered into the project files.

3.3 REPORTS TO MANAGEMENT

As needed, reports will be prepared by KEY and submitted to the Group. Quality assurance reports to management will consist of reports on audits, reports on correction of deficiencies found in audits, a final QA report on field sampling activities, and a final analytical laboratory QA/QC report.

4.0 DATA VALIDATION AND USABILITY

4.1 DATA REVIEW, VALIDATION, AND VERIFICATION

This section discusses data review, validation, and verification. Field data are discussed in Section 4.1.1. Laboratory data are discussed in Section 4.1.2.

4.1.1 Field Data

Field data will be reviewed using four different procedures:

- Routine checks will be made during the processing of data, e.g., looking for potential transcription errors;
- Internal consistency of a data set will be evaluated. This step will involve plotting the data and testing for outliers;
- Checks for consistency of the data set over time will be performed. This can be accomplished by visually comparing data sets against gross upper limits obtained from historical data sets, or by testing for historical consistency; and,
- Checks will be made for consistency with parallel data sets; i.e., data sets obtained from the same population (for example, from the same region of the aquifer).

The purpose of these validation checks and tests is to identify outliers; i.e., an observation that does not conform to the pattern established by other observations. Outliers may be the result of transcription errors or instrumentation breakdowns. Outliers may also be manifestations of a greater degree of spatial or temporal variability than expected.

After an outlier has been identified, a decision concerning its factual basis must be made. Obvious mistakes in data will be corrected when possible, and the correct values inserted. If the correct values cannot be obtained, the data may be excluded. An attempt will be made to explain the existence of the outlier. If no plausible explanation can be found for the outlier, it may be excluded, but a note to that effect will be included in the report. Also, an attempt will be made to determine the effect of the outlier with both inclusion and exclusion from the data set.

4.1.2 Laboratory Data

Prior to submitting analytical data to KEY, the laboratory must verify compliance to the method requirements. The laboratory will follow their QA/QC manual, SOPs, and this QAPP for all sample analyses. The laboratory will also be responsible for the oversight of the data quality for all analyses. Any sample integrity issues, discrepancies with the chain-of-custody, or concerns with the analysis will be addressed and resolved through the laboratory QA Officer.

All analytical data and calculations shall be reviewed by the laboratory and shall include a minimum of three levels of documented review, including analyst review, peer review, and

supervisory review. For each level, the review process shall be documented, signed and dated by the reviewer. Each step of this review process shall include the evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review. All electronic deliverables must be checked against the hard-copy reports to ensure that the two versions match.

Laboratory data deliverables as specified in N.J.A.C. 7:26E - Appendix A, shall be followed, specifically:

a) New Jersey reduced laboratory data deliverables shall be submitted for all chemical analyses; and,

b) Analytical results without all QC and raw data, as required in full and reduced laboratory data deliverables, may be provided for all delineation samples which necessitate additional delineation sampling and for all long-term groundwater monitoring samples; data deliverables will contain, at a minimum:

- A cover page, including facility name and address, laboratory name and address, laboratory certification number, if applicable, date of analytical report preparation and signature of laboratory director;
- A listing of all field sample identification numbers and corresponding laboratory sample identification numbers;
- A listing of all analytical methods used;
- The method detection limit and practical quantitation level for each analyte for each sample analysis;
- All sample results including date of analysis;
- All method blank results; and,
- All chain of custody documentation.

4.2 VALIDATION AND VERIFICATION METHODS

Third party data validation is not considered necessary for the purposes of the RI/FFS Work Plan which will not include any crucial risk assessment associated decisions. Nonetheless, in the event that validation is deemed necessary, it will be completed in accordance with and the USEPA Region 2 Quality Assurance SOPs for data validation (Region 2 SOPs are available at: http://www.epa.gov/region02/qa/documents.htm).
As required, these guidance documents will be used in conjunction with the laboratory SOPs for the respective analytical methods. Professional judgment will be exercised throughout the validation effort, particularly for situations that are not addressed or clearly specified in the SOPs or in the guidance documents.

4.3 RECONCILIATION WITH DATA QUALITY OBJECTIVES

Results from review/validation of field activities and analytical data will be integrated to allow a final reconciliation of achieved data quality with the stated DQOs.

Accuracy, precision, and completeness will be evaluated in accordance with the formulas provided in this document. Representativeness will be evaluated based on the implementation of the field sampling program and analytical program with attention paid to evidence of non-homogeneity of samples. Reporting limits will be compared to applicable criteria to evaluate whether adequate sensitivity was achieved. Sampling and analysis methods and results will be reviewed against historical data or data from other related locations to determine comparability.

4.3.1 Data Quality Assessment

The KEY QA Officer will identify any areas of concern where objectives were not met and evaluate the impact of these upon the intended uses of the data. Specific samples or analytes for which the uncertainty exceeds program or project-specific objectives will be identified so that the Group may make informed decisions on the potential impact to the overall program.

5.0 REFERENCES

NJDEP (New Jersey Department of Environmental Protection), *Field Sampling Procedures Manual*, August 1995.

N.J.A.C. Chapter 26E, *Technical Requirements for Site Remediation*, including most recent supplements.

American Public Health Association, *Standard Methods for Examination of Water and Wastes*, 16th edition.

U.S. EPA, *Methods for Chemical Analysis of Water and Wastes*, EPA 600/4-70-020, 1983.

U.S. EPA, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW846, third edition, as updated and revised, 1986.

U.S. EPA, *Contract Laboratory Program, National Functional Guidelines for Organic Data Review.*

U.S. EPA, *Contract Laboratory Program, National Functional Guidelines for Inorganic Data Review.*

U.S. EPA, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, February 2006.

U.S. EPA, *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations*, EPA QA/R-5, March 2001.

U.S. EPA, *Data Quality Objectives for Remedial Response Activities*, OSWER Directive 9355.0-7B, March 1987.

TABLE

TABLE 1

ANALYTICAL METHODS AND DETAILS
SCCC SITE REMEDIAL INVESTIGATION
KEARNY, NEW JERSEY

Matrix Sample Summary			QA Sample Frequency[1]				Analytical Requirements Summary				
Sample Location	Analytical Parameter[2]	No. of Samples	Field Duplicates	Rinsate Blanks	MS	MSD	Method Reference[3]	Bottle Type	Required Sample Volume[4]	Preservation	Holding Time
SURFACE SOIL SAMPLES											
D-14 through D-22 VC-1 through VC-5	TCL VOCs	14[5]	1	2	1	1	SW846 5035A SW846 8260B	Glass	Encore™ (3) or TerraCor Kits	1 x 5 ml methanol; 2 x 5 ml sodium bisulfate; 1 x 5 ml	14 days from collection if field preserved. Preservation within 48 hours if lab preserved.
D-14 through D-22 VC-1 through VC-5	TCL SVOCs	14[5]	1	2	1	1	SW846 8270C	Glass	100 grams	4°C	7 days to extraction/40 days to analysis.
D-14 through D-22 VC-1 through VC-5	TCL PCBs	14[5]	1	2	1	1	SW846 8082	Glass	4 ounces	4°C	7 days to extraction/40 days to analysis.
D-14 through D-22 VC-1 through VC-5	PCDD/PCDF	14[5]	1	2	1	1	SW846 8290	4-oz glass	25 mg	4°C	1 year
D-14 through D-22 VC-1 through VC-5	TAL Metals (includes total Cr)	14[5]	1	2	1	1	SW846 6000 and 7000 series	Glass	100 grams	4°C	28 days for Hg; 6 months for other metals
D-14 through D-22 VC-1 through VC-5	Hexavalent Chromium	14[5]	1	2	1	1	SW846 7199[11]	Plastic or glass	100 grams	4°C	28 days for soil matrix; 24 hours for aqueous matrix
D-14 through D-22 VC-1 through VC-5	Hydronium Ion (pH)	14[5]	1	2	1	1	SW846 9045C	Glass	4 ounces	4°C	As soon as possible after sample receipt
D-14 through D-22 VC-1 through VC-5	Oxidation-Reduction Potential	14[5]	1	2	1	1	ASTM D1498	Glass	4 ounces	4°C	As soon as possible after sample receipt
FILL/MEADOW MAT SUBSURFACE SOIL SAMPLES											
D-14 through D-27 VC-1 through VC-5	TCL VOCs	TBD[6] [max = 19]	1[7]	1[7]	1[7]	1[7]	SW846 5035A SW846 8260B	Glass	Encore™ (3) or TerraCor Kits	1 x 5 ml methanol; 2 x 5 ml sodium bisulfate; 1 x 5 ml	14 days from collection if field preserved. Preservation within 48 hours if lab preserved.
D-14 through D-27 VC-1 through VC-5	TCL SVOCs	TBD[6] [max = 19]	1[7]	1[7]	1[7]	1[7]	SW846 8270C	Glass	100 grams	4°C	7 days to extraction/40 days to analysis.
D-14 through D-27 VC-1 through VC-5	TCL PCBs	TBD[8] [max = 10]	--	--	--	--	SW846 8082	Glass	4 ounces	4°C	7 days to extraction/40 days to analysis.
D-14 through D-27 VC-1 through VC-5	PCDD/PCDF	TBD[8] [max = 10]	--	--	--	--	SW846 8290	4-oz glass	25 mg	4°C	1 year
DEEP SAND SUBSURFACE SOIL SAMPLES											
D-14 through D-27 VC-1 through VC-5	TCL VOCs	19[9]	1	1	1	1	SW846 5035A SW846 8260B	Glass	Encore™ (3) or TerraCor Kits	1 x 5 ml methanol; 2 x 5 ml sodium bisulfate; 1 x 5 ml	14 days from collection if field preserved. Preservation within 48 hours if lab preserved.
D-14 through D-27 VC-1 through VC-5	TCL SVOCs	19[9]	1	1	1	1	SW846 8270C	Glass	100 grams	4°C	7 days to extraction/40 days to analysis.
D-14 through D-27 VC-1 through VC-5	TCL PCBs	TBD[8] [max = 10]	--	--	--	--	SW846 8082	Glass	4 ounces	4°C	7 days to extraction/40 days to analysis.
D-14 through D-27 VC-1 through VC-5	PCDD/PCDF	TBD[8] [max = 10]	--	--	--	--	SW846 8290	4-oz glass	25 mg	4°C	1 year
VARVED CLAY SUBSURFACE SOIL SAMPLES											
D-14 through D-27 VC-1 through VC-5	TCL VOCs	19+19[10]	1	1	1	1	SW846 5035A SW846 8260B	Glass	Encore™ (3) or TerraCor Kits	1 x 5 ml methanol; 2 x 5 ml sodium bisulfate; 1 x 5 ml	14 days from collection if field preserved. Preservation within 48 hours if lab preserved.
D-14 through D-27 VC-1 through VC-5	TCL SVOCs	19+19[10]	1	1	1	1	SW846 8270C	Glass	100 grams	4°C	7 days to extraction/40 days to analysis.
VC-1 through VC-5	TAL Metals (includes total Cr)	5+5[10]	1	1	1	1	SW846 6000 and 7000 series	Glass	100 grams	4°C	28 days for Hg; 6 months for other metals
VC-1 through VC-5	Hexavalent Chromium	5+5[10]	1	1	1	1	SW846 7199[11]	Plastic or glass	100 grams	4°C	28 days for soil matrix; 24 hours for aqueous matrix
VC-1 through VC-5	Hydronium Ion (pH)	5+5[10]	1	1	1	1	SW846 9045C	Glass	4 ounces	4°C	As soon as possible after sample receipt
VC-1 through VC-5	Oxidation-Reduction Potential	5+5[10]	1	1	1	1	ASTM D1498	Glass	4 ounces	4°C	As soon as possible after sample receipt

1. Quality assurance samples to be obtained at a frequency of 1 per 20 samples with the exception of equipment blanks (rinsate samples). Rinsate samples to be collected at a frequency of 1 per 10 samples.
2. Abbreviations for analyses are as follows: TCL - Target Compound List; TAL - Target Analyte List; VOCs - Volatile Organic Compounds (including all 3 trichlorobenzene isomers); SVOCs - Semivolatile Organic Compounds; PCBs - Polychlorinated Biphenyls as Aroclors; PCDD/PCDF - Polychlorinated-dibenzo-p-dioxins and Polychlorinated-dibenzo-p-furans
3. Abbreviations for analytical methods are as follow: SW846 - Environmental Protection Agency methods per Test Methods for Evaluating Solid Waste - Physical/Chemical Methods - SW846 (3rd Ed) (as revised and updated); ASTM - American Society for Testing and Materials.
4. Precleaned and preveserved sample bottles to be provided by the laboratory. Sample volumes to be minimized as possible based on minimum laboratory volume requirements.
5. Surface soil samples will not be obtained on the adjacent Seaboard site given that processed dredge material has been placed. Surface soil samples will be obtained from all DNAPL (D) and Varved Clay (VC) borings on the SCCC Site.
6. The number of samples to be collected from the fill or meadow mat is to be determined based on field observations. One such sample will be obtained from each of the 19 borings if field observations indicate that either residual or free-phase DNAPL is present. The DNAPL Ranking System as defined in the Field Sampling Plan will be the basis to determine if a fill/meadow mat sample is to be obtained. If the sample is assigned a DNAPL ranking of 2 (residual DNAPL) or 3 (free phase DNAPL) a sample will be obtained for analysis. The most highly impacted material encountered in the fill or meadow mat will be sampled from each boring where residual or free phase DNAPL is encountered. Samples will be obtained as discrete grab samples of sufficient volume to satistfy aliquot requirements for analytical purposes.
7. In the event that no fill or meadow mat samples are obtained as the result of the absence of any residual or free phase DNAPL in the horizons of interest, the associated QA/QC samples will be unnecessary.
8. Selected subsurface soil samples from DNAPL impacted material will be analyzed for PCBs and PCDD/PCDF in addition to VOC and SVOC analysis. A maximum of 10 such samples will be obtained from the fill/meadow mat and the deep sand across both the DNAPL (D) and Varved Clay (VC) borings. The first 10 such samples encountered will be subjected to the PCB and PCDD/PCDF analysis.
9. One subsurface soil sample will be obtained from the deep sand for each of the DNAPL (D) and Varved Clay (VC) borings. The sample will be obtained from the most highly DNAPL-impacted zone if DNAPL is present, or from the base of the deep sand if DNAPL is not present. If a DNAPL-impacted zone is present, a discrete grab sample of sufficient volume to satisfy aliquot requirements for analytical purposes will be obtained.
10. Organic analysis samples for varved clay investigation consist of a sample from the upper horizon (1 foot) of the varved clay (19 samples total) and, if DNAPL is present in the deep sand, up to 19 additional samples obtained approximately 5 feet below the initial samples (to be held in the laboratory for analysis if needed). Inorganic analysis samples for varved clay investigation consist of a sample from the upper horizon (1 foot) of the varved clay (5 samples total) and 5 additional samples obtained approximately 5 feet below the initial samples (to be held in the laboratory for analysis if needed).
11. Hexavalent chromium analysis to be completed pursuant to SW-846 Method 7199 subject to the additional pH/ORP measurement requirements for determination of oxidizing or reducing conditions and hexavalent chromium spiking requirements stipulated by the NJDEP.

ATTACHMENT A

KEY STANDARD OPERATING PROCEDURE #05

GIS ELECTRONIC DATA DELIVERABLES

05 - GIS ELECTRONIC DATA DELIVERABLES

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) specifies the formatting requirements for the submission of electronic laboratory analytical data.

Attachment 1 presents the file layout structure for the "Labdata.dbf" file as utilized by GIS/Key's™ Winbuild module. The file may be submitted as a dBase (.dbf), text (.txt), or Excel (.xls) file.

Files should be submitted initially via e-mail, with a CD of the deliverable mailed to Key Environmental, Inc.'s Pittsburgh office.

If laboratory personnel have any questions regarding this format, they should direct their inquiries to Key Environmental, Inc.'s GIS coordinator. A template of the labdata.dbf format is available upon request from Key Environmental, Inc.

1.1 Referenced SOPs

None

1.2 Definitions

(Reserved)

2.0 REQUIRED MATERIALS

All work is to be conducted using KEY's network.

3.0 METHODOLOGIES

(Reserved)

4.0 QUALITY ASSURANCE/QUALITY CONTROL

When the data are received, the complete files are reviewed, including the results of the quality control samples and field duplicates. This step ensures that the data meet the project specifications with respect to accuracy and completeness.

5.0 DOCUMENTATION AND RECORD KEEPING

All data are retained in electronic format and in hard copy. Original data CDs are kept in the file to support any regulatory questions about the original data. Data are formatted into tables per the project manager's specific requirements, e.g., organized by chemical, medium, date, or other criteria to support discussion of the nature and extent of impacts or the development of risk assessments, remedial actions, etc. Comparison to remedial action or regulatory requirements can also be performed by the data manager or project personnel.

6.0 REFERENCES

(Reserved)

ATTACHMENT 1
SOP 05 – GIS ELECTRONIC DATA DELIVERABLES
FILE LAYOUT

Remark	Required	Justify	Field Name 10 Character	Type	Len	Dec	Notes (Default parameters)
user	X *	L	SITE_ID	C	15		Well or sampling location as labeled on the GIS\Key Map. An entry in SITE_ID is required for all Primary results, duplicates, and splits. Spike results may be associated with samples from another location, and therefore SITE_ID is not required although recommended if appropriate. The import routine requires all sites to be in the project database.
user	X *	L	SP_ID	C	7		Sample Period (EVENT_ID) is used to group QA/QC data to within the data range of the sample period. An entry in the EVENT_ID field is required for Blanks, Control Samples and Spikes. The import routine requires the EVENT_ID to be defined in the project database.
lab	X		SAMP_TYPE	C	1		Sample types are <W>ater, <S>oil, Sediment, Solid. Others sample types can be added, but these are not supported by GIS\Key. The import routine requires < W, S> entry.
lab	X	L	RES_CODE	C	4		Preliminary code used to determine the type of chemical result. See notes at end of table for details of valid entries. RES_CODE is used by the GIS/Build routine to derive the GIS\Key RES_TYPE and RES_CLASS fields. Initially assigned by the lab and modified as required by the user to reflect sample status not known by the lab.
GIS	internal		RES_CLASS	C	1		Assigned by GIS/Build from the RES_CODE field, this code refers to the type of result received from the lab. Allowable RES_CLASS entries are <P>rimary/duplicate/split|<C>ontrol sample|<B>lank sample| and <S>pike sample.
GIS	internal	L	RES_TYPE	C	3		Assigned by GIS/Build from the RES_CODE field, this code works in conjunction with RES_CLASS to describe the type of result. It consists of a one character code, a test sequence number, and a result occurrence.
lab			RES_COLUMN	C	1		The column number of a multiple column test. RES_COLUMN should = 0 for the result set of record of a record. This corresponds to a RES_CODE result set occurrence = 0 for the result set of record. For other result sets, the column number of the test should be given. Used primarily for IRPIMS reporting.
lab	X*	L	RES_ORIG	C	3		Points to the originating result of a result set of record in a multiple column or dilution test. A result set of the record may be a combination of one or more column/dilution tests. The RES_ORIG points to the result in the test run from which the result of the record came and should equal the last 3 characters of the RES_CODE for that result. Used primarily for IRPIMS reporting.
lab	X*		SURROG_FLG	L	1		The field is set to AT@ for a surrogate result and AF@ for all other result types.
user	X	L	SAMP_ID	C	15		SAMP_ID is the unique identifier provided to the laboratory on the sample bottle.

Remark	Required	Justify	Field Name 10 Character	Type	Len	Dec	Notes (Default parameters)
user		L	SAMP_ID2	C	15		SAMP_ID2 is used ONLY for Field Spike Duplicates or for Blind Control Sample Duplicates.
user	X *		SAMP_DATE	D	8		Date sample was collected (mm/dd/yy format). Required for all results except blanks, spikes and control samples.
lab/user	X *		SAMP_TIME	C	5		Time sample was collected (##:## 24hr format). Required for all primary, duplicate, split and surrogate results but not required for blank, spike, and control sample results. If not required and not specified, the import routine enters a default of 00:00.
user	X *		SAMP_DEPTH	N	8		Depth below ground surface in meters (metric) or feet (American) at which sample was collected. Required for SAMP_TYPE = <S>, Recommended for SAMP_TYPE = <W>. Depths above ground surface are assigned a negative number. Note that primary key in American version is based on depth measurements to a hundredth of a foot only.
user			S_DEPTH	N	8	3	Depth below ground surface in feet to the top of the sample interval range.
user			E_DEPTH	N	8	3	Depth below ground surface in feet to the bottom of the sample interval range.
user	X *	L	CASE_ID	C	5		Case and blank Ids or case and QA/QC IDs are used to associate primary results with quality control results. CASE_ID is a required entry for quality control data and should be entered for primary results if quality control data is being entered. For small projects, many GIS\Key users use sampling event as CASE_ID. IRPIMS projects should enter the IRPIMS site in the CASE_ID.
lab/user	X*	L	SDG_ID	C	25		SDG or sample delivery group ID. This field (in combination with CASE_ID) is used to associate rinsate blank results with primary results. Required for rinsate blanks.
lab	X*	L	QAQC_ID	C	25		QA/QC Batch ID's are normally assigned only by labs. This field is used to associate laboratory quality control results (i.e. method blanks, lab blanks, matrix spikes, control samples) with primary results. QAQC_ID entries must uniquely identify each batch of samples analyzed by the laboratory and may not be repeated. Required for method blanks.
lab/ user	X*	L	BLANK_ID	C	25		Field Blank identifier. BLANK_ID is used in combination with CASE_ID to associate field blank results with primary results. Required for field blanks.
user	X	L	TCL_ID	C	10		TCL ID, or Template Constituent List is required for all results. A TCL is a data entry template which groups sample results into logical sets. The user defines a TCL to include a lab code (LAB_ID) and optionally a test method (METHOD_ID) and a list of chemicals with reporting limits. GIS/Build can automatically assign a TCL, if METHOD_ID and LAB_ID are provided.
GIS/ user	X		TCL_TYPE	C	1		TCL Type. Used to differentiate lists of chemicals having the same test method and lab. GIS/Build assigns the GIS/Key default value to this field if it is left blank.

Remark	Required	Justify	Field Name 10 Character	Type	Len	Dec	Notes (Default parameters)
lab/user		L	METHOD_ID	C	10		Test Method identification. The import routine will generate error messages if the METHOD_ID is not in the GIS\Key database.
lab	X*	L	EXTRACTION	C	6		Extraction method code. The import routine requires definition of entries in the GIS/Key database.
user		L	LAB_ID	C	5		Lab ID code. The Import routine requires codes to be defined in GIS\Key database. Lab ID codes must be incorporated into the definition of a TCL_ID.
GIS	internal	R	SEQ_NUM	C	3		Used to order the compounds in a TCL (SEQ_NUM=1 for the first compound on a TCL). When editing results after data import, the sequence number controls the order in which the results are viewed. GIS/Build assigns a SEQ_NUM based on the SEQ_NUM of the chemicals defined in the TCL. If a TCL definition is not found in the project, the SEQ_NUM assignment is based on the order within the TCL in LABDATA.dbf.
user	X *	L	SPLIT_ID	C	10		SPLIT_ID records the TCL_ID of the first split sample of the primary sample. This field is left blank unless the record is for a primary result and a split sample was analyzed. A split sample result entered as a separate record will be orphaned unless this field is filled in for the primary result record.
user	X *	L	SPLIT_ID2	C	10		SPLIT_ID2 records the TCL_ID of the second split sample of the primary sample. This field is left blank unless the record is for a primary result and a second split sample was analyzed. The second split result, entered as a separate record, will be orphaned unless this field is filled in for the primary result record.
lab	X*	L	LSAMP_ID	C	15		Lab sample ID.
lab		L	LSAMP_ID2	C	15		ab sample ID of duplicates, entered by the lab for known-control sample duplicates and lab spike duplicates.
lab	X *	R	LAB_CAS_ID	C	11		CAS Registry number assigned by the Lab for the constituent. Either a LAB_CAS_ID or a LAB_CHEM must be included with each record. The import routine requires any LAB_CAS_ID to match a CAS_NUM in GIS\Key COMPOUND.DBF.
GIS	internal	R	CAS_NUM	C	11		CAS number from the GIS\Key compound.dbf. This is internally assigned based on a match with LAB_CHEM or LAB_CAS_ID, with preference given to LAB_CAS_ID
lab	X *	L	LAB_CHEM	C	40		Constituent name from lab. Either a LAB_CAS_ID or a LAB_CHEM must be included with each result. If LAB_CHEM is used, then it must match a GIS\Key COMPOUND.DBF alias.
GIS	internal	L	NAME	C	40		Constituent name assigned by comparing LAB_CHEM to COMPOUND.DBF. If LAB_CAS_ID is used without a matching LAB_CHEM, NAME is assigned based on alias 0 in GIS\Key Database.
GIS	internal	R	ALIAS_NUM	C	2		Alias numbers are internally assigned by comparing LAB_CAS_ID and LAB_CHEM to COMPOUND.DBF.

Remark	Required	Justify	Field Name 10 Character	Type	Len	Dec	Notes (Default parameters)
lab	X *	L	CONC	C	11		Utilized to store constituent concentrations for primary results, duplicates, splits & blanks and concentrations added to spikes and control samples. The field is left blank for surrogates. Warning code generated when CONC and LIMIT1 are both left blank for primary results, duplicates, splits and blanks. Stored as a character string to preserve significant figures. May be expressed in scientific notation (e.g. 1.3E03). All entries must be numeric with the exception of AE@ (i.e. scientific notation), A+@, or a A+/-@. A A+@ after concentration amount means greater than while a concentration followed by A+/-@ and a number expresses an uncertainty factor.
lab	X *	L	LIMIT1	C	10		Detection Limit 1 for a sample result. Stored as a character string to preserve the significant figures. May be expressed in scientific notation (e.g. 1.3E03). Required for primary results, duplicates, splits & blanks if CONC is blank. Left blank for control samples, matrix spikes and surrogates. All entries must be numeric with the exception of AE@ (i.e. scientific notation) or A?@. A A?@ means that the detection limit is unknown. The entered detection limit should reflect dilution. Generally, LIMIT1 refers to the method detection limit. However, GIS\Key places no restrictions on the use of this field.
lab	X *	L	DL_FLAG	C	2		Place a {<} in this field if the result is non-detect, otherwise leave it blank. Required for primary results, duplicates, splits and blanks. The field is left blank for control samples, matrix spikes and surrogates. For IRPIMS files, DL_FLAG corresponds to the PARVQ field. DL_FLAG corresponds to RF_FLAG on the data entry screen.
lab	X *	L	UNITS	C	5		Reported units of concentration. GIS\Key can automatically convert concentrations in mg/l, mg/kg, ug/l, ug/kg, ppm, ppb, and %. Other units are allowed but will generate warning codes.
lab		L	LIMIT2	C	10		Practical quantitation limit for a blank or primary sample result. Format limitations for LIMIT2 are the same as described for LIMIT1. The entered quantitation limit should reflect dilution. GIS\Key places no restrictions on the use of this field.
lab		L	INSTRUMENT	C	20		Identifying number or name of laboratory equipment used to perform the analysis. Used primarily for Air Force reporting.
lab		L	CALIBRATE	C	20		Calibration reference number for the test. Used primarily for Air Force reporting.
GIS	internal		SPIKE_DUP	L	1		Flag indicating a spike control sample duplicate record. Information is combined in the same record as the spike or control sample.
lab/ user		L	TEST_ORIG	C	3		Used for spikes to identify the res_code of the sample that was spiked.
lab			S_CONC	C	11		Spike Concentration
lab	X *		RECOVER	N	3		Constituent Recovery in %. Required for spike, surrogate, and control sample results. The field is left blank for primary samples, duplicates, splits and blanks. Supplied by the Lab for surrogates, lab matrix spikes and known control samples.

Remark	Required	Justify	Field Name 10 Character	Type	Len	Dec	Notes (Default parameters)
lab	X *		D_RECOVER	N	3		Duplicate constituent recovery in %. Required for spike and control sample duplicates results. The field is left blank for primary sample, duplicates, splits, blanks, and surrogates. Supplied by the Lab for lab matrix spikes and known control samples.
lab/user		L	T_CONC	C	11		Target concentration for spikes (i.e. calculated total of concentration in sample plus concentration spiked).
lab		L	R_CONC	C	11		Measured concentration in control samples and spiked samples. Supplied by the Lab for lab matrix spikes, field matrix spikes, blind control samples and known control samples.
lab		L	D_CONC	C	11		Measured concentration in duplicate control samples and spiked samples. Supplied by the Lab for lab matrix spikes, field matrix spikes, blind control samples, and known control samples.
lab			RPD	N	3		Relative Percent Difference (RPD). Supplied by the Lab for matrix spike and control samples that are run in duplicate. When RES_CODEs DL#/DF#/DB#/DK# are used, the RPD is entered with these records.
lab			B_RECOVER	N	3		Lower percent recovery goal for surrogates, spikes, and control samples and spikes reported by the Laboratory.
lab			E_RECOVER	N	3		Upper percent recovery goal for surrogates, spikes, and control samples reported by the Laboratory.
lab			MAX_RPD	N	3		Maximum relative percent difference goal for control samples and spikes reported by the Laboratory.
lab/user	X		PF_CODE	C	1		Preparation Fraction Code: The import routine requires the preparation fraction to be specified and to match a user-defined code in GIS\Key database, standard codes include AT@ (total), AD@ (dissolved fraction), AA@: Acid Rain Extraction, AC@ TCLP Extraction, AE@ EPTOX Extraction, AS@: California Wet Extraction, AW@: Deionized Water Extraction.
lab			CR_C	C	1		CLP data concentration AC@ column. The import routine requires entry to match a code defined in GIS\Key Database.
lab		L	CR_M	C	2		CLP data method AM@ column. The import routine requires entry to match a code defined in GIS\Key Database.
lab		L	CR_Q	C	3		CLP data qualifier AQ@ column. The import routine requires entry(s) to match 1 character code(s) defined in the GIS\Key Database.
user		L	ER_Q	C	3		Expert review data qualifier. The import routine requires entry(s) to match 1 character code(s) defined in the GIS\Key Database.
user		L	ER_R1	C	2		Expert review reason 1 AR1@ code. The import routine requires entry to match a defined code in GIS\Key Database.
user		L	ER_R2	C	2		Expert review reason 2 AR2@ code. The import routine requires entry to match a defined code in GIS\Key Database.
user		L	ER_R3	C	2		Expert review reason 3 AR3@ code. The suggested use of this field is to track updates. The import routine requires entry to match a defined code in GIS\Key Database.

Remark	Required	Justify	Field Name 10 Character	Type	Len	Dec	Notes (Default parameters)
user			FILTERED	C	1		Was sample field filtered, <Y>es or <N>o. It is the user's responsibility to ensure that preparation fraction codes reflect field filtering status.
user			PRESERVED	C	1		Sample preservation code, AH@ = HCI, AN@ = HNO3, AS@ = H2S04, AU@ = unknown, A@ = none, and AO@ = other sample preservation
user			ICED	C	1		Field preservation Code, AY@ = stored/shipped on ice, AN@ = stored/shipped at ambient temperature.
lab	*	L	CUSTODY	C	25		Chain of custody ID. Used to associate travel blanks with primary samples. Required for travel blanks.
lab	*		DILUTION	N	7	2	Dilution factor for sample run ranging from 0.01 to 9999. A required field for all primary results, duplicates, splits and blank results. The field is left blank for all other results.
GIS/user	X*		PROG_TYPE	C	1		Program codes are required for all results. The import routine requires codes to be defined in GIS\Key Database. Program codes must be identical for all chemical results for a particular TCL. GIS/Build assigns the GIS/Key default value to this field if it is left blank.
lab			RECEIVED	D	8		Date sample was received by the Lab (mm/dd/yy format).
lab			REC_TIME	C	5		Time sample was received by the Lab (##:## 24hr format).
lab			PREPARED	D	8		Date sample was prepared or extracted by the Lab (mm/dd/yy format).
lab			PREP_TIME	C	5		Time sample was prepared or extracted by the Lab (##:## 24hr format).
lab			TESTED	D	8		Date sample was analyzed by the Lab (mm/dd/yy format for American Version).
lab			TEST_TIME	C	5		Time sample was analyzed by the Lab (##:## 24hr format).
lab			REPORTED	D	8		Date sample was reported by the Lab (mm/dd/yy format for American Version).
lab			APPROVED	D	8		Date sample was result approved by the Lab (mm/dd/yy format for American Version).
lab/ user		L	LOT_NUMBER	C	4		IRPIMS lot control number (LOTCTLNUM) used to associate primary samples with QC.
lab/ user		L	SA_CODE	C	3		IRPIMS sample type code (SA_CODE) used to identify the type of sample collected.
lab/ user		L	MATRIX	C	2		IRPIMS sampling matrix code.
lab/ user			BASIS	C	1		Used to indicate whether results are reported on a (W)et or (D)ry basis. Required for soil results.
lab/ user			MOISTURE	N	4	1	Percent moisture of a soil sample.
GIS	internal	L	EXC_CODE	C	30		Exception codes are generated by the import routine to alert the user to problems in the LABDATA.DBF file which must be addressed before the data can be appended to the project database.
GIS	internal	L	WARN_CODE	C	20		Warning codes are generated by the import routine to alert the user to possible problems in LABDATA.DBF file. Warning codes do not prevent user from appending LABDATA.DBF file to the project database.

Remark	Required	Justify	Field Name 10 Character	Type	Len	Dec	Notes (Default parameters)
GIS	internal		BUILD_FLAG	C	1		Internal flag used during the GIS\Build process.
lab/ user		L	NOTE	C	20		Lab/user notes for samples (i.e. placed in CSAMPLE.DBF). May be expanded to 50 characters.
lab/user		L	TEST_NOTE	C	20		Lab/user notes for tests (i.e. placed in CTEST.DBF). May be expanded to 50 characters.

Notes:

RES CODES:

PP0<1-9>	Primary Results
PD[1-9]<1-9>	Duplicate
PS[1-2]<1-9>	Split
BF[1-9]<1-9>	Field Blanks
BL[1-9]<1-9>	Lab Blanks
BM[1-9]<1-9>	Method Blanks
BR[1-9]<1-9>	Rinsate Blanks
BT[1-9]<1-9>	Travel Blanks
CB[1-9]<1-9>	Blind Control Sample
CK[1-9]<1-9>	Known Control Sample
SL[1-9]<1-9>	Lab Spike
SF[1-9]<1-9>	Field Spike
DL[1-9]<1-9>	Duplicate Lab Spike
DF[1-9]<1-9>	Duplicate Field Spike
DB[1-9]<1-9>	Duplicate Blind Control Sample
DK[1-9]<1-9>	Duplicate Known Control Sample

Numbers in [] denote test sequence numbers

Numbers in <> denote result set occurrence

* = Conditionally Required

EXCEPTION CODES: (an exc_code indicates bad or missing data)

AN =	No entry in ALIAS_NUM
BI=	No entry in BLANK_ID (for a field blank)
CI=	No entry in CASE_ID
CN=	Cas Number is not found in COMPOUND.DBF
CU=	No entry in CUSTODY (for a trip blank)
DI=	DILUTION < = 0
DP=	Sample depth precision > 2 (not allowed for American or unspecified project)
DR=	Duplicate record
HT=	Holding times out of sequence (SAMP_DATE, RECEIVED, PREPARED, TESTED and REPORTED)
LB=	No entry in LAB_ID
PF=	Invalid in PF_CODE
PS=	No primary sample for duplicate or split
PT =	Invalid in PROG_TYPE
QC =	No entry in QAQC_ID (for a lab blank, method blank, spike or control sample)
RC=	Invalid RES_CODE
SD=	No entry in SAMP_DATE
SG=	No entry in SDG_ID (for a rinsate blank)
SI=	No entry in SITE_ID
SP=	No entry in SP_ID(event) or 3rd character of id is not a =-=
SK=	No spike duplicate match or invalid spike dup fields
ST=	Invalid SAMP_TYPE
TC=	No entry in TCL_ID
TM=	SAMP_TIME format invalid

WARNING CODES:

BA	=	BASIS should be =W=et or =D=ry for soil results
CI	=	No entry in case id for a primary sample
DL	=	No detection limit and no conc
DP	=	Sample Depth = 0 or not within range of S_DEPTH & E_DEPTH
PF	=	PF_CODE not defined in project
PS	=	No primary sample for duplicate or split
PT	=	PROG_TYPE not defined in project
SD	=	No entry in sample date for a rinsate or field blank
RE	=	B_RECOVER > E_RECOVER
TM	=	Invalid TEST_TIME for rinsate or lab blank
TT	=	TCL_TYPE not defined in project
U	=	No entry in UNITS

Notes (continued):

DUPLICATE RECORD KEY FOR PRIMARIES, DUPLICATES AND SPLITS (RES_CODE = PP0#, PD##, PS##):

SAMP_TYPE + SITE_ID + SAMP_DATE + SAMP_TIME(water) or SAMP_DEPTH(soil) + RES_CODE + TCL_ID + PF_CODE + CAS_NUM

Index file = EXPRI.IDX TO use in FOXPRO enter: USE EXCDATA INDEX EXCPRI

DUPLICATE RECORD KEY FOR BLANKS (RES_CODE = BR##, BM##, BT##, BF##):

SAMP_TYPE + CASE_ID + BLANK_ID + RES_CODE + TCL_ID + PF_CODE + CAS_NUM

Index file = EXCQC.IDX TO use in FOXPRO enter: USE EXCDATA INDEX EXCQC

DUPLICATE RECORD KEY FOR SPIKES AND CONTROL SAMPLES (RES_CODE = SF##, SL##, CB##, CK##):

SAMP_TYPE + CASE_ID + QAQC_ID + RES_CODE + TCL_ID + PF_CODE + CAS_NUM

Index file = EXCQC.IDX

ASSIGNING RES_CODE SEQUENCE NUMBERS [1-9]:

The test sequence number refers to a sample sequence used to differentiate test results that otherwise have the same primary key. For example, a test sequence number of 2 for a duplicate sample would mean that the result set is for the second of 2 duplicate samples originating from the same primary sample. A test sequence number of 2 for a method blank would mean that 2 method blanks were run for the same batch (QAQC_ID). Note that matrix spikes and control samples and their duplicates should always have matching test sequence numbers.

ASSIGNING RES_CODE RESULT SET OCCURRENCES <1-9>:

The result set occurrence is used to differentiate multiple column or dilution runs of the same sample and test method that otherwise have the same primary key. Occurrence = 1 is the set of record and the set used for reporting and graphics.

ASSIGNING RES_ORIG CODES

RES_ORIG codes are equal to the last three characters of RES_CODES for all results except when multiple column/dilution runs are being reported and the result being reported is for the combined Abest estimate@ result. In this case, the RES_ORIG code equals the last three characters of the RES_CODE of the originating column/dilution run.

ADDITIONAL GUIDANCE FOR FIELD/LAB MATRIX SPIKE DUPLICATES AND BLIND/KNOWN CONTROL SAMPLE DUPLICATES:

Field/lab matrix spike duplicate and blind/known control sample duplicate concentrations are always entered in the D_CONC field, with recoveries in the D_RECOVER field. Spike and control sample duplicates may be entered as individual records using RES_CODEs DL##, DF##, DB##, DK##, or can be combined with the record storing the original spike or control sample when using RES_CODEs SL##, SF##, CB##, CK##.

APPENDIX D

OPERATION AND MAINTENANCE PLAN

OPERATION, MAINTENANCE, AND MONITORING PLAN

STANDARD CHLORINE CHEMICAL COMPANY SITE
KEARNY, NEW JERSEY

Prepared for:

Cooperating Parties Group
(Beazer East, Inc., Cooper Industries, LLC, and Tierra Solutions, Inc.
On behalf of Occidental Chemical Corporation)

Prepared by:

Key Environmental, Inc.
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ABBREVIATIONS/ACRONYMS

CA	Consolidation Area
DNAPL	Dense Non-Aqueous Phase Liquid
E&S	Erosion and Sediment
FFS	Focused Feasibility Study
Group	Cooperating Parties Group
HASP	Health and Safety Plan
HC	Hydraulic Control
HCTS	Hydraulic Control Treatment System
IRM	Interim Remedial Measure
KEY	Key Environmental, Inc.
NACE	National Association of Corrosion Engineers
NJPDES	New Jersey Pollution Discharge Elimination System
O&M	Operation and Maintenance
OM&M	Operation, Maintenance, and Monitoring
RI	Remedial Investigation
SCCC	Standard Chlorine Chemical Co., Inc.
SOP	Standard Operating Procedure
SSP	Steel Sheet Pile
TOC	Total Organic Carbon
TSS	Total Suspended Solids
USEPA	United State Environmental Protection Agency

1.0 INTRODUCTION

Key Environmental, Inc. (KEY) has prepared this Operation, Maintenance and Monitoring (OM&M) Plan on behalf of the Cooperating Parties Group ("Group") for the Standard Chlorine Chemical Co., Inc. (SCCC) Site located in Kearny, New Jersey (Figure 1). This OM&M Plan was prepared at the request of the United States Environmental Protection Agency (USEPA) as part of the January 8, 2013 meeting with representatives from the Group and KEY. This OM&M Plan is a supplement to the Remedial Investigation/Focused Feasibility Study (RI/FFS) Work Plan required by the Administrative Settlement Agreement and Order on Consent (AOC) between the USEPA and the Group. OM&M activities included with this Plan consist of the following tasks.

Site inspections and monitoring activities include the following:

- Steel sheet pile (SSP) wall inspections;
- SSP wall cathodic protection system inspections;
- Consolidation Area (CA) cover system inspections;
- Interim Remedial Measure (IRM) cover systems inspections;
- Groundwater potentiometric surface elevation monitoring;
- Dense non-aqueous phase liquid (DNAPL) thickness gauging;
- Hydraulic Control Treatment System (HCTS) influent and effluent monitoring;
- Stormwater management, erosion and sediment (E&S) control, and permanent vegetation inspections;
- Slurry wall working platform inspections; and,
- Site security and access inspections.

Potential Site maintenance (as needed based on the results of the inspections) could include the repairs for the following components:

- SSP wall;
- CA cover;
- IRM cover systems;
- Monitoring wells and piezometers;
- Stormwater/E&S control features and vegetation;
- Slurry wall platform; and,
- Site security/access features.

Operation and maintenance (O&M) activities associated with this OM&M Plan include:

- Hydraulic control wells;
- DNAPL recovery wells; and,
- The SSP wall cathodic protection system.

Details related to the routine HCTS system operation and equipment information are included in an HCTS O&M Plan that is maintained at the facility by the System Operations Contractor. The HCTS O&M Plan was provided to EPA and NJDEP in January 2011. Additionally, for the freshwater wetlands restoration area, maintenance activities refer to the applicable freshwater wetlands information provided in the Shoreline Restoration and Tidal Emergent Wetland Mitigation Plan, dated April 28, 2010. The Interim Response Action Work Plan Post-Construction Site O&M Plan includes additional monitoring requirements. The list of supplemental OM&M-related documents is provided in Section 6.0.

This OM&M Plan will be revised/updated periodically (if needed) based on future Site conditions. The health and safety protocol for OM&M field activities is provided in the Health and Safety Plan (HASP) provided as Appendix A to the RI/FFS Work Plan. The HASP will be updated as needed to reflect potential Site activities. If Contractors are retained for Site construction, then activity-specific HASPs will be prepared by the Contractor.

2.0 INSPECTIONS AND MONITORING

A summary of routine inspection and monitoring activities are included in this section.

Information regarding the inspection and monitoring frequencies is provided in Section 2.11.1.

2.1 SSP WALL INSPECTIONS

The SSP wall (as shown on Figure 2) integrity and associated appurtenance inspections include the following items:

- Alignment;
- Corrosion;
- Settlement;
- Backfill condition;
- Sheet interlock;
- Holes/dents/cracks; and,
- Condition of welds.

2.2 SSP WALL CATHODIC PROTECTION SYSTEM INSPECTIONS

The cathodic protection system inspections include:

- Rectifiers performance and condition; and,
- Anode well performance and integrity.

2.3 CA COVER INSPECTIONS

The SCCC Site CA cover system and SCCC Site Former Process Area cover system inspections (at the locations shown on Figure 2) include:

- Cover vegetation adequacy;
- Cover soil erosion;
- Cover system settlement; and,
- Berm conditions.

2.4 IRM COVER INSPECTIONS

Existing IRM cover systems as shown on Figure 2 are comprised of one of the following cover system types:

- PVC geomembrane underlain and overlain by a geotextile fabric, and additionally overlain by either a four inch +/- (Cover System "A");
- Four inch+/- thick layer of asphaltic concrete underlain by aggregate (Cover System B);
- Two inch thick layer of asphalt above existing pavement (Cover System C);
- PVC geomembrane underlain and overlain by a geotextile fabric, and additionally overlain by a six inch+/-thick layer of aggregate (Cover System D);
- Six to 18-inch+/- thick soil (vegetative) cover (Cover System S);

The details pertaining to each cover system are shown on Figure 3.

The SCCC IRM cover systems A, B, C, D, and S inspections (at the locations shown on Figure 2) to evaluate the following:

- Stone cover adequacy;
- Soil cover/vegetation adequacy;
- Geomaterial adequacy; and,
- Asphalt adequacy.

2.5 GROUNDWATER POTENTIOMETRIC SURFACE ELEVATION MONITORING

Monitoring well and piezometer gauging is a component of the remedial system monitoring activities. Figure 2 shows the locations of the piezometers and monitoring wells. Physical integrity inspections are also included as part of each monitoring event.

The groundwater potentiometric surface elevation measurements are documented and the results are utilized to evaluate the following:

- Groundwater elevations inside and outside the slurry wall to monitor slurry wall performance;
- Overall Site groundwater flow trends; and,
- The performance of the hydraulic control system operation.

2.6 HYDRAULIC CONTROL AND DNAPL RECOVERY WELL THICKNESS GAUGING

Hydraulic control well monitoring consists of monthly water level measurements at each hydraulic control monitoring well using an electronic water level meter. These measurements are used to determine groundwater pump level control probe set points, as well as evaluate performance of the hydraulic control recovery well network.

DNAPL thickness gauging is a component of the monitoring activities. DNAPL thickness gauging results are documented, and the results are utilized to evaluate the following:

- Determine if DNAPL removal is required for a well; and,
- Establish the DNAPL accumulation rates and thickness trends.

The locations of the hydraulic control and DNAPL recovery wells are shown on Figure 2. Hydraulic control and DNAPL recovery well integrity inspections are also included as part of each monitoring event.

2.7 HCTS INFLUENT AND EFFLUENT MONITORING

Two separate permits are applicable to the HCTS influent and effluent monitoring. The HCTS Preconstruction Permit to Operate - air permit (PCP100002, dated 11/01/2011) includes a description of the influent monitoring requirements; and, the New Jersey Pollution Discharge Elimination System (NJPDES) permit (DSN001A attached to NJPDES Permit No. NJG0175102) includes a description of the effluent monitoring requirements. Treated effluent discharges to the Hackensack River via Outfall DSN001A. This section includes a summary of the HCTS influent and effluent monitoring requirements.

Influent and effluent monitoring activities consist of monthly monitoring for volatile organic compounds and semi-volatile organic compounds. In addition, the instantaneous influent flow rate and effluent totalizing flow rates (for reporting purposes) are monitored via flow meters. The permit limits are, as follows:

Table 2-1
HCTS Discharge Limits
Permit NJG0175102 – Outfall DSN001A

Monitored Parameter	Permit Limit	Monitored Parameter	Permit Limit
1,2,4-Trichlorobenzene	68/140	Arsenic	50/100
1,2-Dichlorobenzene	77/163	Chromium	50/100
1,3-Dichlorobenzene	31/44	Lead	50/100
1,4-Dichlorobenzene	Rpt/28	Magnesium	Rpt/Rpt
2,4-Dimethylphenol	18/36	Manganese	Rpt/Rpt
Acenaphthene	Rpt/Rpt	Mercury	Rpt/1
Benzene	37/136	Nickel	50/100
Chlorobenzene	15/28	Zinc	100/200
Ethylbenzene	32/108		
Methylene chloride	40/89		
Phenol	15/26		
Tetrachloroethylene	22/56	Total Organic Carbon (TOC)	Rpt/20
Trichloroethylene	21/54		
Toluene	26/80	Total Suspended Solids (TSS)	Rpt/40
		pH	6.0/9.0

Whole Effluent Toxicity chronic limit of 61% applies 3 years after effective date of permit (05-28-2010).
Permit Limits presented are monthly averages/daily maxima except for pH (monthly min/monthly max).
Sampling frequency, reporting limits and requirements are specified in Table III-A-1 of the permit.
Rpt – Report result. All limits are in ug/L with the exception of TOC and TSS (mg/L) and pH (SU)

The air permit addresses the monitoring requirements of the NJDEP Air Quality Permitting Program. The air permit includes a requirement that the influent flow rate be maintained at or below 50 gallons per minute at all times and also requires that ambient air concentrations within 6 inches of the top of the chromium reduction tank, flocculation tank and filter press be maintained below 10 parts per million total VOCs. The air permit also requires monthly analysis of the influent and effluent for VOCs.

2.8 STORMWATER MANAGEMENT, EROSION AND SEDIMENT (E&S) CONTROL, AND PERMANENT VEGETATION INSPECTIONS

The stormwater management, E&S control features, and permanent vegetation inspections include evaluations of the following:

- Stormwater diversion channels condition;
- Catch basins and culverts condition;
- Outlets 001 and 003 condition; and,
- Re-vegetated areas.

Specific stormwater diversion channel inspection items include:

- Abnormal settlement;
- Erosion of channel bases/sideslopes;
- Areas with unsatisfactory vegetative growth;
- Unusual or inadequate operational behavior; and,
- Debris and accumulated sediment.

Specific catch basins, piping and outlet works inspection items include:

- Abnormal settlement;
- Cracking or spalling of concrete;
- Groundwater entering catch basin at pipe penetrations;
- Possible undermining of structure and pipe foundations;
- Unusual or inadequate operational function;
- Debris and accumulated sediment in catch basin grates/clogging;
- Connection of check valves with outlet pipes;
- Rusting of metalwork; and,
- Erosion or displacement of riprap aprons.

Inspections of re-vegetated areas will include an evaluation of the following:

- The approximate percent vegetative coverage;
- The condition of the vegetation; and,
- Significant invasive species impacts.

2.9 SLURRY WALL WORKING PLATFORM INSPECTIONS

The slurry wall working platform inspections include evaluation of the following:

- Signs of erosion or other soil disturbances;
- Platform/slurry wall settlement;
- Standing water; and,
- The condition of the vegetation.

2.10 SITE SECURITY AND ACCESS INSPECTIONS

Site Security and access inspections include evaluation of the following:

- Fences/signs integrity;
- Gates integrity/locks in place; and,
- Access roads condition.

2.11 INSPECTIONS AND MONITORING FREQUENCY AND FIELD FORMS

This section includes a summary of the inspections and monitoring frequencies and a listing of the inspection and monitoring Field Forms.

2.11.1 Frequency

The table provided in Attachment 1 includes a listing of the inspection and monitoring items, the frequencies for conducting the inspections and monitoring, and the associated reference section/table for each item.

2.11.2 Field Forms

The General Site Inspection Form (Attachment 2) includes a checklist for inspections of the SSP wall; the CA cover system; IRM cover systems; the general stormwater and E&S control features; the slurry wall working platform; and Site security and access features.

Attachment 3 includes the Rectifier and Anode Well Integrity Inspection Form.

Attachment 4 includes the detailed Stormwater Management, E&S Control Features and Permanent Vegetation Inspection Form.

The Piezometer Gauging Form associated with the groundwater potentiometric surface elevation measurements is included with Attachment 5 [Standard Operating Procedures (SOP) – Piezometer Well Monitoring and Maintenance].

The HCTS Well Network Gauging Form includes the information necessary to document DNAPL thicknesses (where encountered), and is provided in the SOP - Hydraulic Control and Recovery Well O&M (Attachment 6).

The HCTS influent and effluent monitoring requirements and discharge limits are included as part of the Monthly Inspection Form (HCTS O&M Plan) and included herein as Attachment 7.

3.0 MAINTENANCE ACTIVITIES

This section includes a description of the maintenance activities based on anticipated conditions and the issues identified during the inspection and monitoring events. Maintenance activities are summarized in Attachment 1.

3.1 SSP WALL MAINTENANCE

SSP wall maintenance includes the construction activities needed to prevent potential structural or functional issues that could compromise the performance of the wall. Potential maintenance conditions could include component repair or replacement due to wall misalignment, corrosion, settlement, adjacent backfill soil settlement, interlock separation, holes, waler conditions, dents, cracks, and integrity of the welds.

3.2 CA COVER SYSTEM MAINTENANCE

Potential SCCC CA cover systems maintenance activities include repair or replacement of settled areas, eroded areas, or otherwise damaged areas. Repair or replacement could apply to the following:

- Damaged geomaterials;
- Inadequate vegetation; and,
- Soil materials that have been eroded or displaced.

Vegetative maintenance of exposed topsoil will consist of reseeding/fertilization/ liming/mulching. The cover system vegetation will be mowed, as required. Maintenance also includes controlling the establishment of deep-rooted vegetation such as bushes and trees in order to prevent root penetration into the geomaterials. Maintenance of the structural integrity of the SCCC CA berms is also a Site Maintenance task. Inadequate berm areas will be repaired as necessary.

3.3 IRM COVER SYSTEM MAINTENANCE

Previous remedial actions completed included the installation of five (5) separate SCCC IRM cover systems. The plan locations of IRM Covers “A,” “B,” “C,”, “D” and “S” are shown on Figure 3. The IRM cover details are shown on Figure 3.

Potential SCCC IRM cover systems maintenance activities include repair or replacement of settled areas, eroded areas, or otherwise damaged areas. Repair or replacement could apply to the following:

- Damaged geomaterials;
- Eroded or displaced soil materials;

- Eroded or displaced stone cover; and
- Damaged or cracked asphalt.

SCCC IRM cover system maintenance also includes controlling the establishment of deep-rooted vegetation such as bushes and trees in order to prevent root penetration into the cover soils and geomaterials.

3.4 PIEZOMETERS, GROUNDWATER MONITORING WELLS, HYDRAULIC CONTROL WELLS, AND DNAPL RECOVERY WELLS MAINTENANCE

This section includes the potential maintenance activities for the well networks at the Site. The Well Logs associated with the piezometers, monitoring wells, hydraulic control wells, and DNAPL recovery wells are shown in Attachment 8.

Attachment 5 (SOP – Piezometer Monitoring and Maintenance) includes descriptions of the maintenance activities for the piezometer network installed along the inland reaches of the slurry wall. Twenty-eight (28) piezometers are present (in nested groups) along the slurry wall. Generally, the potential maintenance task for the piezometers includes aboveground well cover casing repairs.

Potential monitoring well and piezometer maintenance activities could include the repair of damaged wellheads and replacement of locks, clearing obstructions, and well redevelopment.

Attachment 6 (SOP – Hydraulic Control Well O&M) includes descriptions of the maintenance activities for the hydraulic control wells. Twenty-six (26) hydraulic control wells are located within the interior of the slurry wall. Generally, the maintenance items for the hydraulic control wells include:

- Well vaults;
- Groundwater pumps and level control adjustments;
- Fittings, piping connections and valve assemblies; and,
- Individual hydraulic control well panel electrical components.

Repair of hydraulic control well component and replacement of equipment/parts will be completed routinely as needed.

Attachment 9 (SOP – DNAPL Recovery Operation) includes descriptions of the maintenance activities for the DNAPL recovery wells. Sixteen (16) DNAPL recovery wells are located within the limits of the slurry wall. Generally, the potential maintenance items for the DNAPL recovery wells include:

- Well vaults;
- Groundwater pumps and level control inspection and adjustments;

- Fittings, piping connections and valve assemblies; and,
- Individual recovery well control panel electrical components.

DNAPL Recovery Well repairs and equipment/parts replacement will be completed as needed.

3.5 SLURRY WALL MAINTENANCE

Any damage, erosion, or settlement observed along the slurry wall working platform will be repaired, as needed. The working platform vegetation will be mowed as required. Slurry wall maintenance also includes controlling the establishment of deep-rooted vegetation such as bushes and trees in order to prevent root penetration into the slurry wall.

3.6 SITE SECURITY AND ACCESS MAINTENANCE

Site security maintenance includes repair or replacement of fencing, gates, locks, and signage. Access maintenance includes upkeep of the access roads and related appurtenances (e.g., culverts and the concrete slurry wall crossings). Any necessary repairs and replacement will be completed for the stone-lined and asphalt road surfaces, road crossings at culverts, and concrete slurry wall crossings, as needed.

4.0 OPERATION AND MAINTENANCE ACTIVITIES

The O&M activities are summarized in Attachment 1. This section includes a description of the O&M activities for the following:

- The hydraulic control system;
- The DNAPL recovery system; and,
- The SSP wall cathodic protection system.

The extraction system for the HCTS consists of shallow hydraulic control wells and shallow and deep DNAPL Recovery wells. These well designations are HCWU (hydraulic control well upper) and DRWU (DNAPL recovery wells upper) and DRWL (DNAPL recovery wells lower). The DNAPL recovery wells include sumps to promote the in-well physical separation of DNAPL and groundwater. The DNAPL is then recovered at the wellhead via pumping. The sumps are 10 feet in length and serve to provide for accumulation of recovered DNAPL to maximize the efficiency of the recovery operations. The groundwater produced from the hydraulic control wells and the DNAPL recovery wells is pumped using multi-stage Grundfos pumps and is conveyed to the HCTS via below grade one-inch diameter SDR-11 high-density polyethylene piping.

The purpose of the cathodic protection system includes minimizing the corrosion of the SSP wall. The cathodic protection system wells and rectifier are in place, and the installation of the remaining cathodic protection system appurtenances is ongoing. The remaining tasks that are required to test and start the system include installation of negative return cables, welding of the sheet pile wall joints to provide continuity across the sheet pile wall. Continuity testing will be performed to verify that proper polarization of the entire SSP wall has been achieved, and verify that the system to operating as designed. These tasks should be completed the later part of 2013, and the system will be activated. O&M of the cathodic protection system will be initiated once the system is activated.

4.1 HYDRAULIC CONTROL WELL O&M

The details related to the operation of the hydraulic control wells are included in Attachment 6 (SOP - Hydraulic Control Well O&M). Individual Hydraulic Control (HC) well operation and performance will be evaluated monthly (at a minimum). The start / stop well pump water level conductivity probes will be adjusted based on gauging data and flow readings acquired during routine HC well gauging. Preventative maintenance of the groundwater recovery pumps, associated conveyance lines, and electrical control systems will be completed as needed based upon observed performance during routine operations.

4.2 DNAPL RECOVERY WELL OPERATION AND DNAPL MANAGEMENT

The details related to the operation of the DNAPL recovery wells and management of the collected DNAPL are included in Attachment 9 (SOP - DNAPL Recovery Operation). The base of the well DNAPL recovery threshold is set at a thickness of 5.0' of DNAPL (half the length of the sump at the base of the well). The DNAPL accumulations are monitored monthly (at a minimum) with subsequent DNAPL recovery implemented as required based on rate of DNAPL accumulation. The operator will document the pre- and post-recovery volumes of DNAPL present in each recovery well per event. The total DNAPL volume recovered will also be calculated and documented for each event.

4.3 SSP WALL CATHODIC PROTECTION SYSTEM O&M

Cathodic protection O&M activities will be completed based on the overall performance of the cathodic protection system.

Routine cathodic protection operation activities are described below:

- Read and record the rectifier direct current voltage and current output. Notify the Manufacturer of current and voltage changes of +/- 20% (relative to the previous readings);
- Read and record the reference electrode polarized "on" potential;
- Turn the rectifier off by opening the alternating current disconnect adjacent to the rectifier unit, or on the rectifier panel face;
- Check the rectifier for excessive heat;
- Check all connections for tightness and evidence of arcing;
- Turn rectifier on; and,
- Recheck rectifier outputs.

Routine maintenance includes the repair and/or replacement of cathodic protection system components. In addition, general routine maintenance tasks include cleaning the interior and exterior of the rectifier.

Routine maintenance of damaged anode wells include the repair or replacement of well features, as needed.

A National Association of Corrosion Engineers (NACE) International Certified Cathodic Protection Specialist or Corrosion Specialist will complete non-routine maintenance activities including:

- Measure protected polarized structure-to-reference electrode potentials. Perform testing to verify structure polarization in accordance with NACE SP0169-96;

- Measure network parameters including anode-to-structure resistance, structure-to-electrolyte resistance and anode-to-electrolyte resistance;
- Verify the accuracy of the rectifier panel meters; and,
- Adjust rectifier as required.

The NACE Specialist will repair and/or replace the rectifier and anode well components as needed, as described in the pending Cathodic Protection System Operations Manual. The Anode Well Logs are provided in Attachment 10.

5.0 DOCUMENTATION AND REPORTING

This section describes the content and format of OM&M documentation pertaining to inspection and monitoring results, maintenance activities, operation results, and potential follow-up actions for component repair or replacement activities. At the conclusion of each inspection, an Inspection Log will be prepared that summarizes the current operations and condition of specific remedial components, and identifies modifications that were implemented or required/necessary repairs. The inspection Log Sheets are maintained electronically for performance monitoring, maintenance tracking and reporting purposes.

If specific issues require component maintenance, repair, or replacement, the situation will be evaluated and maintenance/repair/replacement activities will be implemented, and subsequently documented.

Quarterly Progress Reports related to OM&M efforts completed will be prepared. The Quarterly Progress Reports will be submitted to the EPA in the month following each quarterly reporting period. Submittals will be uploaded to the File Transfer Protocol webpage established for the SCCC Site.

6.0 OM&M PLAN SUPPORTING DOCUMENTS

The purpose of this section is to provide the supporting documents (above and beyond the documents attached) associated with this Site OM&M Plan. The supporting documents are listed below.

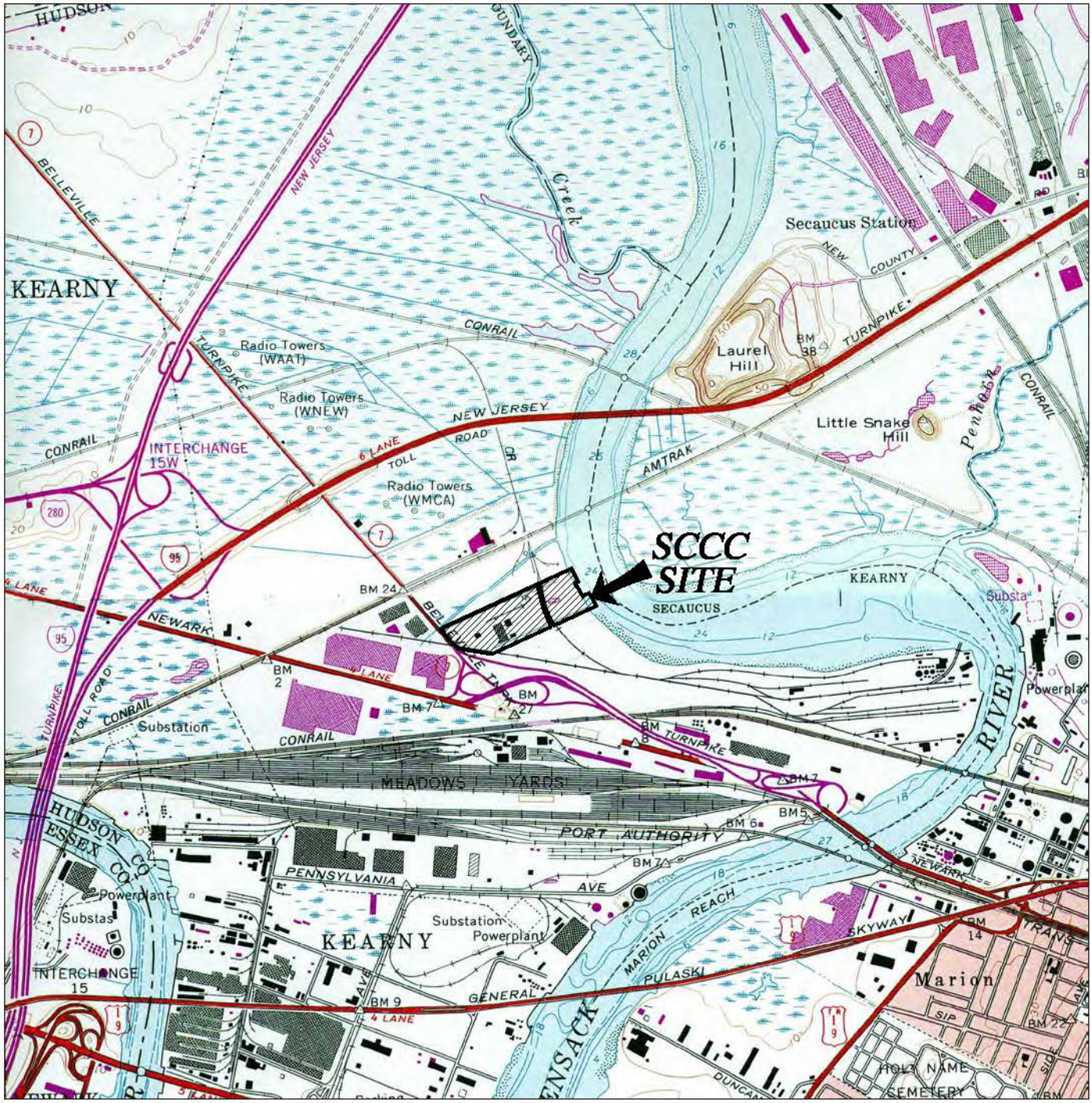
1. The HCTS OM&M Plan, prepared by KEY, dated January 2011 submitted to the USEPA and NJDEP.

2. Shoreline Restoration and Tidal Emergent Wetland Mitigation Plan, prepared by KEY, dated April 28, 2010 submitted to the NJDEP, USEPA, and New Jersey Meadowlands Commission.

3. The Interim Response Action Report and associated As-Built Drawings and Post-Construction Site O&M Plan, prepared by KEY, dated December 2011 submitted to the USEPA and NJDEP.

These documents are maintained on-Site in the HCTS building.

FIGURES



COOPERATING PARTIES GROUP

DRWN: SCC	DATE: 03/25/13	KEY ENVIRONMENTAL INCORPORATED
CHKD: RJH	DATE: 03/25/13	
APPD: JSZ	DATE: 03/25/13	
SCALE: 1"= 2000'		

REMEDIAL INVESTIGATION/
FOCUSED FEASIBILITY STUDY WORK PLAN
STANDARD CHLORINE CHEMICAL CO., INC. SITE
KEARNY, HUDSON COUNTY, NEW JERSEY

REFERENCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLES OF JERSEY CITY, AND WEEHAWKEN, NEW JERSEY.
THE QUADRANGLES HAS BEEN EDITED BY KEY TO REFLECT THE DEMOLITION OF THE MAJORITY OF THE ONSITE STRUCTURES AND TO DEPICT THE SITE LOCATION.

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

SITE LOCATION MAP

PROJECT NO: 2012-14

FIGURE 1

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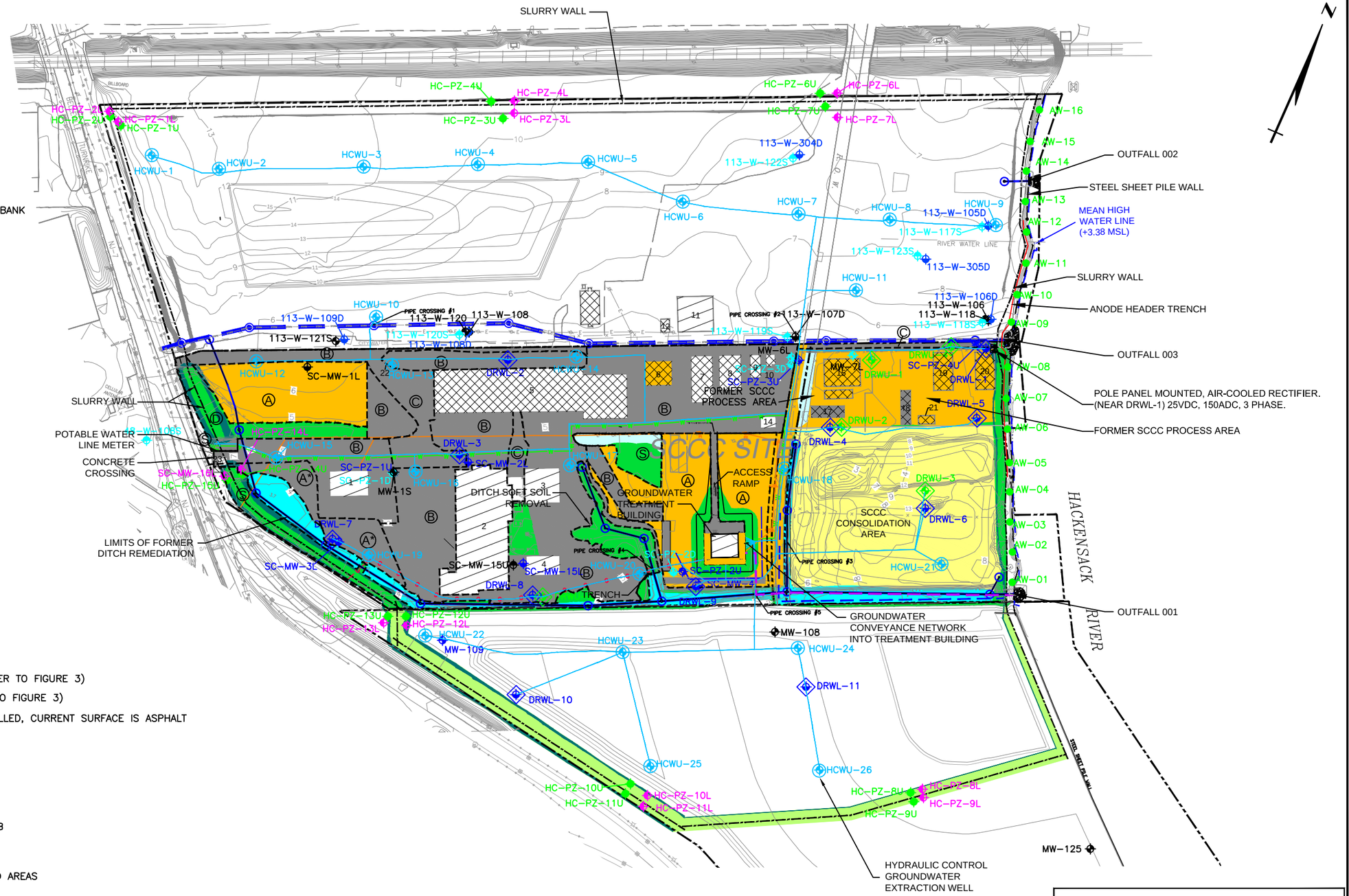
LEGEND

- EXISTING ACCESS ROAD
- EXISTING NEW JERSEY TRANSIT RAILROAD (ACTIVE)
- EXISTING FENCE
- EXISTING UTILITY POLES
- EXISTING LIGHT STANDARD
- EXISTING WATER LINE
- EXISTING STORM DRAIN
- EXISTING STORM SEWER
- EXISTING GAS LINE
- EXISTING OVERHEAD POWER LINE
- PROPERTY BOUNDARY
- EXISTING GROUND SURFACE ELEVATION CONTOURS
- EXISTING STREAM, POND AND RIVER BANK
- EXISTING ELEVATION (FEET–MSL)
- SLURRY WALL LOCATION
- STEEL SHEET PILE WALL LOCATION
- GROUNDWATER CONVEYANCE PIPING TRENCH ALIGNMENT
- FILL UNIT GROUNDWATER EXTRACTION (HYDRAULIC CONTROL) WELL LOCATION
- FILL UNIT DNAPL RECOVERY WELL LOCATION
- SAND UNIT DNAPL RECOVERY WELL LOCATION
- TREATED WATER PERMITTED DISCHARGE PIPE
- EXISTING STORM DRAIN (48" PIPE)
- CULVERT(S)
- DROP INLET
- RIPRAP OUTFALL
- POWER AND PHONE LINES (OVERHEAD)
- WATER LINE TO TREATMENT BUILDING
- MONITORING WELL LOCATION
- HC–PZ–9U HYDRAULIC CONTROL PIEZOMETER UPPER ZONE (APPROX.)
- HC–PZ–9L HYDRAULIC CONTROL PIEZOMETER LOWER ZONE (APPROX.)
- Ⓐ Ⓑ Ⓒ Ⓓ EXISTING IRM COVER SYSTEMS (REFER TO FIGURE 3)
- Ⓢ EXISTING IRM SOIL COVER (REFER TO FIGURE 3)
- (A*) FORMER GRAVEL COVER AREA INSTALLED, CURRENT SURFACE IS ASPHALT
- SEMI–DEEP ANODE WELL LOCATION
- POWER (UNDERGROUND)(APPROX.)
- RECTIFIER LOCATION
- EXISTING BUILDING
- FORMER BUILDING FOUNDATION/SLAB
- WETLANDS
- NON–PERMITTED PRE–IRAW WETLAND AREAS
- CONSOLIDATION AREA COVER SYSTEM (REFER TO FIGURE 3)
- VEGETATIVE COVER
- NON–PLANTED PARTIALLY VEGETATIVE AREA OF WORKING PLATFORM
- GENERAL STONE COVER 6" LAYER OF NJDOT #4 STONE, UNDERLAIN BY 10 OZ./S.Y. NON–WOVEN GEOTEXTILE
- ASPHALT



0 120 240 FEET

REV #	DATE	DESCRIPTION	APPD
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REFERENCE: EXISTING GROUND SURFACE CONTOURS PER AIR SURVEY, DULLES, VIRGINIA, APRIL 14, 2001. HORIZONTAL REFERENCE: NEW JERSEY STATE PLANE COORDINATES (NAD 1927). VERTICAL REFERENCE: NATIONAL GEODETIC VERTICAL DATUM (NGVD 1929).

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

COOPERATING PARTIES GROUP

DRWN: SCC	DATE: 07/01/13	KEY ENVIRONMENTAL INCORPORATED
CHKD: MV	DATE: 07/01/13	
APPD: JSZ	DATE: 07/01/13	
SCALE: AS SHOWN		

REMEDIAL INVESTIGATION/
FOCUSED FEASIBILITY STUDY WORK PLAN
STANDARD CHLORINE CHEMICAL CO., INC. SITE
KEARNY, HUDSON COUNTY, NEW JERSEY

OM&M ACTIVITIES SITE PLAN

PROJECT NO: 2013–02

FIGURE 2

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CONSTRUCTION NOTES AND TECHNICAL SPECIFICATIONS

GENERAL

1. Reference specification are to New Jersey Department of Transportation Standard Specification fro Road and Bridge Construction, 1989 edition.

2. This drawing contains technical specifications for materials and methods to be used for implementation of Interim Remedial Measures.

MATERIAL SPECIFICATIONS

1. Contractors shall verify that all materials delivered to the site are to be free of contaminants. Dense Graded Aggregate shall be delivered directly from quarry. No off-site borrow material shall be permitted. Recycled pavement shall not be used.

2. Geotextile Fabric

The geotextile fabric used for dust control and light stabilization shall be a non-woven polyester or polypropylene geotextile drainage fabric with the following properties:

Apparent Opening Size (ASTM D-4751): 70 sieve max.

Permeability (ASTM D-4491): 0.02 to 0.7 sec

Puncture (ASTM D-3787): 60 lbs. min.

Mullenburst (ASTM D-3786): 200 lbs. min.

Trapezoid Tear (ASTM D-4533): 40lbs. min.

Grab Tensile/Elongation (ASTM D-4632): 90 lbs. min. /50% max.

Ultraviolet Resistance (ASTM D-4355): 70 pct. min.

Drainage fabrics such as Amoco 4545, Mirafi 140N, Exxon GTF 150 D and others conform to the above properties.

3. Geomembrane

The geomembrane used for dust control and light stabilization shall be a polyolefin or polyvinyl chloride with the following properties.

Gauge	30 Mil	Test Methods
Specific Gravity	1.24-1.30	ASTM D 792
TENSILE MD	2200	ASTM D 882
TD		ASTM D 882
ELONGATION MD	300	ASTM D 882
% Min. TD		ASTM D 882
Graves Tear LIN	270	ASTM 689
100% Modulus MD	1000	ASTM D 882 B
PSI TD		ASTM D 822 B
Water Extraction %	.35	LP-375b Par 4.3
Volatility %	.7	ASTM D 1203-55
Cold Crack F.	-20	CS 192-53 Sect.
Shore Durometer	70	
Pin Holes per 10 sq. yd.	1 max	
Alkali Resistance	Passed Corps of Engineers CRD 572-61	
Seam Strength	75%	ASTM D-822
Thickness	±10%	

Geomembrane manufacturers such as Nerva-tite, Environmental Protection Gundle Lining System, Inc., and Seaman Corp or others conform to the above properties. Geotextile manufacturers such as Mirafi, Amoco, and Exxon or others conform to the above properties.

4. Dense Graded Aggregate

Dense graded aggregate shall consist of fresh broken stone aggregate from the quarry conforming to the provisions of NJDOT Specifications Section 901.08.

CONSTRUCTION NOTES AND TECHNICAL SPECIFICATIONS (CONT)

5. Bituminous Paving Materials

a. Prime coat shall be cut back Asphalt Grades MC-30 or MC-70.

b. Tack coat shall be emulsified asphalt SS-1, SS-1h, CSS-1, or CSS-1h conforming to AASHTO M140 or AASHTO M208 diluted 1 part water to 1 part emulsified asphalt.

c. Bituminous concrete base and surface course shall be plant mix bituminous concrete conforming to Section 903 of the N.J. D.O.T. Specification. Basic details are listed below and on the drawings.

	Base Layer	Surface Course	Overlay Course (if req'd.)
Thickness	2.5 inches	1.5 inches	varies .3 - 2.0 inch
Mix Designation Table 903-1 of Specification	I-3	I-5	I-5
Maximum Aggregate Size	1 inch	3/8 inch	3/8 inch
Asphalt Content	4-8.5 %	5-10 %	5-10 %

EARTHWORK

1. Stripping

Stripping in IRM areas shall be performed to the approximate elevations shown on the plan or to the elevations established by the engineer in the field. all stripped materials shall remain on-site, and be placed in designated fill areas onsite immediately, and shall not be stockpiled.

2. Proofrolling

a. Proofrolling of existing subgrades in fill areas and stripped subgrades shall be performed using a heavy vibratory roller with minimum 5 ton static weight. A minimum of 5 passes shall be performed.

b. All proofrolled areas shall be evaluated by the engineer. Soft areas observed to be yielding shall be stiffened by addition of coarse stone. The engineer may elect to thicken the aggregate base course in areas found to be yielding.

1. Compaction

Materials derived from stripping shall be spread in maximum 8-inch think thick loose lifts and shall be compacted with at least 5 passes of the vibratory roller.

2. Geotextile & Geomembrane

Spread Geotextile over subgrade as dust protection temporarily when required and is installed permanently when grading and compaction is complete. provide a minimum 12" overlap for the geotextile and geomembrane. If the field seams are heat welded, or heat sealed for the geomembrane the overlap shall be 2 to 4 inches.

PAVEMENT CONSTRUCTION

1. Dense Graded Aggregate Base Course

Dense graded aggregate base course shall be spreadover the geotextile fabrics soon as possible. Fine grading shall be performed to provide uniform thickness specified on project drawings. The aggregate shall be compacted with minimum of 4 passes of the smooth drum pavement roller.

2. Preparation of Unpaved Subgrade

Area to be paved shall be graded true to the line and grade The aggregate surface shall be treated with Asphalt primer shere required by the engineer. Tack Coat shall be applied to edges of walks, pavements, etc. to be joined.

PAVEMENT CONSTRUCTION (CONT)

3. Preparation for Existing Pavement for Overlay

All weak areas should be matched where required by the engineer. Potholes shall be filled with compacted bituminous concrete. Pavement surface to be overlaid shall be cleaned and a tack coat applied. Apply an emulsion slurry seal or areas of wide cracks.

4. Preparation and Transportation of the Mixture

Plan mix shall be prepared using NJDOT approved procedures at a qualified asphalt plant conforming to NJDOT specification Section 404 for Bituminous Concrete Batch Plants and Vehicles.

5. Placement of Base Course and Surface Course

The base course mixture shall be placed in one or more lifts with and asphalt paver or spreader to provide a nominal compacted thickness as indicated on the plans. The mix shall be compacted immediately after placing. Initial compaction with a steel-wheel tandem roller, three wheeled roller of a pneumatic roller shall follow the paver as close as possible. If needed, intermediate rolling shall be done immediately behind the initial rolling. Final rolling shall eliminate the marks from previous rolling.

6. Slope Areas and Swales

Pavement on slope areas and swales shall be placed and spreeded by hand where inaccessible to mechanical paving equipment. Vibrating plate compactors shall be used to compact slope and swale areas.

7. Acceptance Criteria

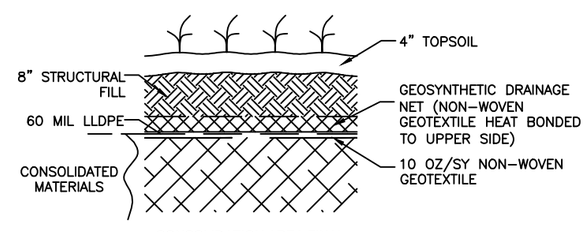
a. Relative Density

Laboratory compacted densities from the supplier's certified laboratory shall be provided to the engineer. Compaction of base and surface will be accepted when the average of 5 nuclear gage density determinations indicates an average relative density of 96 percent of the laboratory compacted density determined in accordance with ASTM Test D 1559 and the minimum relative density is 94 percent.

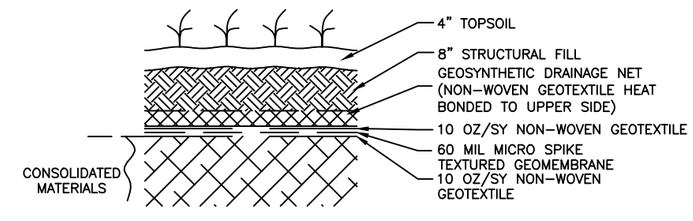
b. Thickness
Probes will be made by the engineer to check compacted thickness.

c. Smoothness

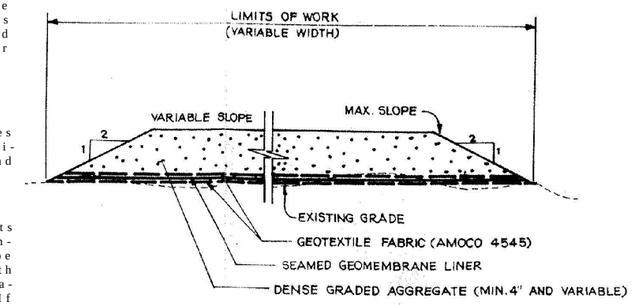
Smoothness shall be checked using a 10 foot straight edge. The surface shall not vary more than 1/8 inch along the contour and 1/4 inch along slope.



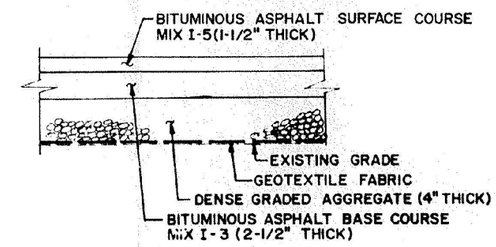
CONSOLIDATION AREA FINAL COVER DETAIL
N.T.S



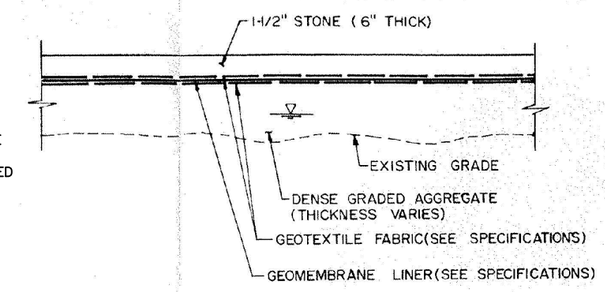
CONSOLIDATION AREA TEXTURED LINER FINAL COVER DETAIL
N.T.S



IRM COVER "A"
(SEE REFERENCE 1)
N.T.S



IRM COVER "B"
(SEE REFERENCE 1)
N.T.S



IRM COVER "D"
(SEE REFERENCE 1)
N.T.S

NOTES:
1. COVER "C" CONSISTS OF A TWO INCH LAYER OF ASPHALT ABOVE EXISTING PAVEMENT, AND A DETAIL HAS NOT BEEN PROVIDED.
2. THE IRM SOIL COVER "S" CONSISTS OF A 6 TO 18 INCH LAYER OF GENERAL EARTHFILL. ANY POTENTIAL IRM SOIL COVER AREA REPAIRS/REPLACEMENT WILL CONSIST OF STRUCTURAL FILL AS DEFINED IN THE TECHNICAL SPECIFICATIONS.

REV #	DATE	DESCRIPTION	APPD
3			
2			
1			

REFERENCE:
1. IRM COVER DETAILS AND NOTES PER FRENCH & PARRELLO ASSOCIATES, P.A. "DWG. NO. 3 OF 3" ENTITLED "DETAILS AND NOTES", DATED 1/9/91.

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

COOPERATING PARTIES GROUP

DRWN: SCC	DATE: 07/01/13	KEY ENVIRONMENTAL INCORPORATED
CHKD: MJV	DATE: 07/01/13	
APPD: JSZ	DATE: 07/01/13	
SCALE: AS SHOWN		

REMEDIAL INVESTIGATION/
FOCUSED FEASIBILITY STUDY WORK PLAN
STANDARD CHLORINE CHEMICAL CO., INC. SITE
KEARNY, HUDSON COUNTY, NEW JERSEY

IRM COVER DETAILS AND SCCC CA COVER DETAILS

PROJECT NO: 2013-02
FIGURE 3

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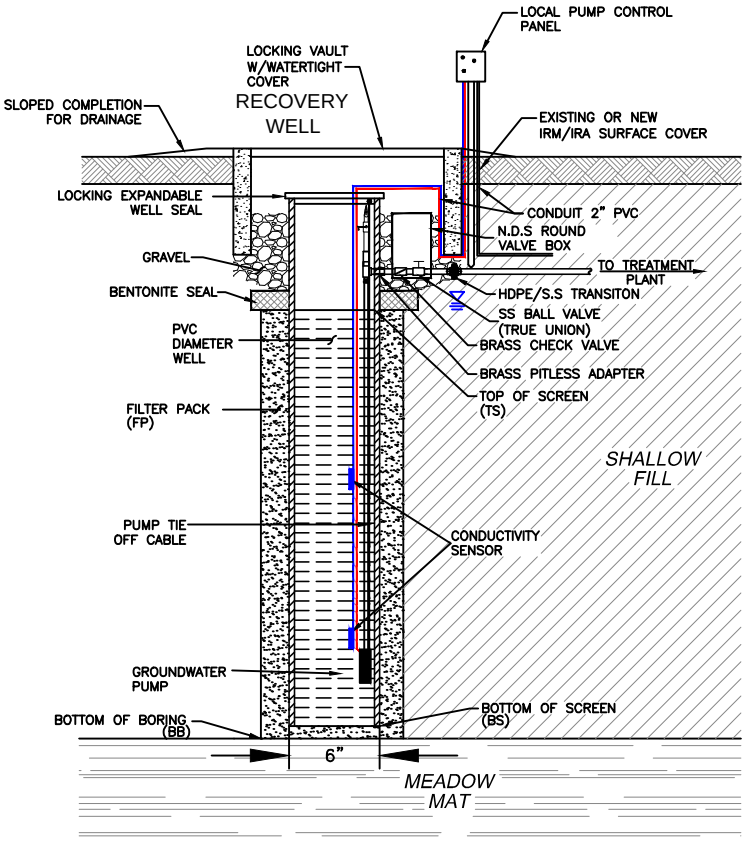


TYPICAL SHALLOW
GROUNDWATER RECOVERY WELL
NOT TO SCALE

COOPERATING PARTIES GROUP

DRWN: SCC	DATE: 03/25/13	KEY ENVIRONMENTAL INCORPORATED
CHKD: RJH	DATE: 03/25/13	
APPD: JSZ	DATE: 03/25/13	
SCALE: 1"= 2000'		

REMEDIAL INVESTIGATION/
FOCUSED FEASIBILITY STUDY WORK PLAN
STANDARD CHLORINE CHEMICAL CO., INC. SITE
KEARNY, HUDSON COUNTY, NEW JERSEY

REFERENCE:

ISSUE DATE:

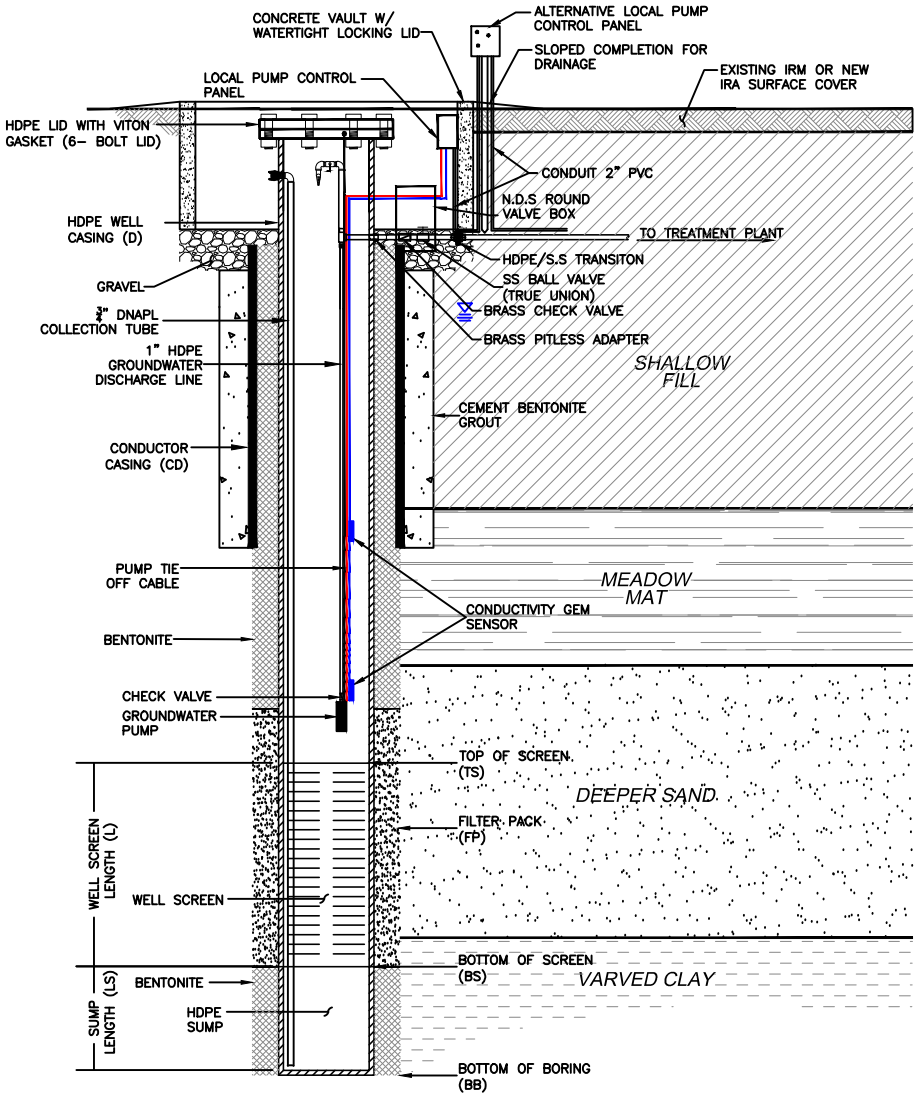
KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

HYDRAULIC CONTROL WELL DETAIL (TYPICAL)

PROJECT NO: 2012-14

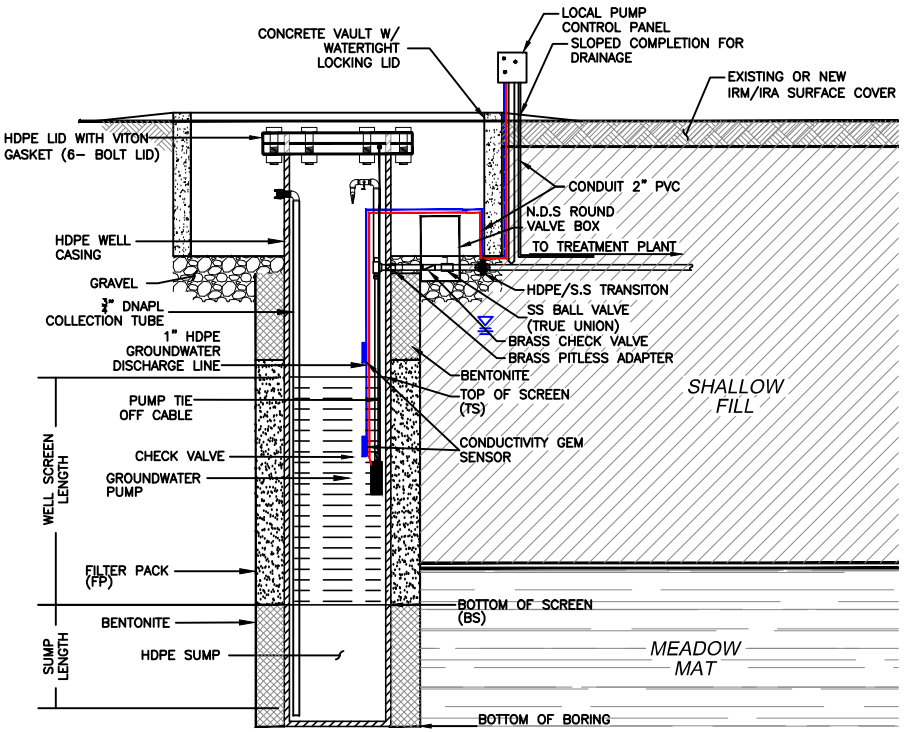
FIGURE 4

y:\00civil\kearny\ri-ffs work plan\appendix a\figure 4.dwg Last Saved By: Scomer 7/11/2013 4:19 PM Plotted By: Shelly Comer 7/25/2013 6:22 AM Scale: 1:1.016827



TYPICAL DEEPER SAND UNIT
DNAPL RECOVERY WELL

NOT TO SCALE



TYPICAL SHALLOW FILL UNIT
DNAPL RECOVERY WELL

NOT TO SCALE

COOPERATING PARTIES GROUP

DRWN: SCC	DATE: 03/25/13	KEY ENVIRONMENTAL INCORPORATED
CHKD: RJH	DATE: 03/25/13	
APPD: JSZ	DATE: 03/25/13	
SCALE: 1"= 2000'		

REMEDIAL INVESTIGATION/
FOCUSED FEASIBILITY STUDY WORK PLAN
STANDARD CHLORINE CHEMICAL CO., INC. SITE
KEARNY, HUDSON COUNTY, NEW JERSEY

REFERENCE:	ISSUE DATE:	
	KEY ENVIRONMENTAL, INC. 200 THIRD AVENUE CARNEGIE, PA 15106	DNAPL RECOVERY WELL DETAIL (TYPICAL)
		PROJECT NO: 2012-14 FIGURE 5

ATTACHMENT 1
INSPECTION, MONITORING, AND O&M SUMMARY

Inspections, Monitoring, and Operation and Maintenance Summary
SCCC Site
Kearny, NJ

Zoning Certification / Occupancy Cert O&M Manual Interim Response Action			Reference Section / Table	Reporting Requirement	Record Keeping and/or Reporting Trigger Events, General Notes
Permanent Vegetation					
Inspections				Manual to be Reviewed/Revised Annually with proposed revisions submitted to the NJMC for review and approval. Logs of Preventative and Corrective maintenance must be maintained and submitted to the Chief Engineer of NJMC - no specification of reporting frequency in the NJMC O&M Manual. Recommend submittal of report annually with a proposed reduction in inspection frequency submitted at that time.	**"Monitoring of the vegetative cover should commence immediately after the permanent seeding and mulching is completed Per section 2.0 of the Zone Cert / Occupancy cert application. Final seeding and erosion repairs efforts are expected to be completed in late May / early June pursuant to the KEY's proposal for such services, dated May 10, 2012.**
SCCC Consolidation Area, Slurry Wall Working Platform, Catch Basins, Piping System Associated with South Ditch, Other Disturbed Areas	Seed/mulched areas until 80% vegetation is established - Inspect for erosion, cracks depressions, slips/slumps, borrowing animals, woody vegetation	Every 7 days and within 24 hrs of 1'' rain event/ Quarterly thereafter			
	Seed/mulched areas after 80% Vegetation is established - Inspect for erosion, cracks depressions, slips/slumps, borrowing animals, woody vegetation	Quarterly			
	Vegetative cover after establishment when 50% damage has occurred	Quarterly			
	Drainage Channels, Catch Basins, Piping, Tide Flex Checks, Outlet Protection	Biweekly for 1st Growing Season, W/I 24hrs of 1'' rain, Quarterly, Annually			
Vegetative Cover Maintenance and Erosion Repairs					
Maintenance Activity					
SCCC Consolidation Area, Slurry Wall Working Platform, Catch Basins, Piping System Associated with South Ditch, Other Disturbed Areas					
Mowing	Select areas - Wells/Inspection Areas	As needed			
Fertilization / Lime Application	Based on agronomic analyses - Soil Testing and Fert/Lime application after 1st growing season then every 2-3 years thereafter	Annual - 1st year then every 2-3 years thereafter			
Stormwater Management System					
Inspections					
Drainage Channels	Alignment, debris, mulch blanket, erosion / scour, unwanted vegetative growth, vegetative lining, Other	Weekly, Annually and following a rain event >1''			
Catch Basins	Alignment, Debris, Grates, Concrete Issues, Structural Issues, Signs of Inflow Joints, Other	Weekly, Quarterly, and following a rain event >1''			
Piping	Alignment, Debris, Outlet Blockage, Signs of Inflow at Joints	Weekly, Quarterly, and following a rain event >1''			
Check Valves	Valve Attached, Clogged with Debris, Valve material in good condition	After Significant Rain Event			
Riprap Apron	Debris and Sediment Accumulation, Riprap lining Intact	After Significant Rain Event			
General - Hackensack Water Level, Construction Activity, Other.	General Observation	Every Inspection			
Stormwater Management System					
Maintenance Activity					
Drainage Channels, Catch Basins, Piping, Tide Flex Check Valves and Outlet Protection (Outlets 001 and 003)	Removed Accumulated Debris and Sediment	Quarterly and following Rain events >1''			
	Erosion & Scour Repair	Annually			
	Removal of unwanted vegetative growth	Annually			
	Remove blockage of pipes and conveyance lines	After Significant Rain Event			
	Reseed and mulch damaged areas >50% and inspect restored vegetation	As needed			
	Repair to structural components	As needed			
	Mowing	Minimum of monthly during growing season			
	Fertilizer / Treatment application	As needed			

Inspections, Monitoring, and Operation and Maintenance Summary
SCCC Site
Kearny, NJ

Post-Construction Site Operations and Maintenance Plan IRAR					
Inspections	**Item**	**Frequency**	**Reference Section / Table**	Inspection Logs to be prepared summarizing conditions observed and required modifications, repairs and replacements. Inspection and maintenance forms will be included with the Inspection Log, along with any supplemental narrative or supporting information.	**Pursuant to the Post-Construction Site O&M Plan IRA, "The Post-construction Site activities will commence following NJDEP approval of the IRAR. This Site O&M Plan will be implemented until final remedies are completed at the respective Sites".**
SCCC - CA Cover System	Vegetative cover until 80% establishment, soil erosion, cover system settlement, Berm conditions	Every 7 days and within 24 hrs of 1'' rain event, then Quarterly thereafter	Section 3.1 - General Site Inspection Form - Post Construction Site O&M Plan		
SCCC - IRM Cover System	Vegetative cover until 80% establishment, soil cover adequacy, Geomaterial Adequacy, Asphalt Adequacy	Every 7 days and within of 1'' rain event, then Quarterly thereafter	Section 3.2 - General Site Inspection Form - Post Construction Site O&M Plan		
Stormwater Management /Erosion & Sediment (E&S) Control Maintenance and Permanent Vegetation	Stormwater - Drainage Channels, Catch Basins and Culvert condition, Outlet 001 and 003 Piping, Re-vegetated areas, Mowing as needed.	Quarterly	Section 3.3 - General Site Inspection Form - Post Construction Site O&M Plan		
Slurry Wall	Working Platform erosion, Working Platform Settlement, Working Platform Vegetative Cover mowing (as needed)	Quarterly	Section 3.4 - General Site Inspection Form - Post Construction Site O&M Plan		
Sheet Pile Wall (SSP)	Alignment, Sheet interlock, Corrosion, dents, cracks, weld integrity, Settlement, Adjacent soil / backfill conditions	Quarterly	Section 3.5 - General Site Inspection Form - Post Construction Site O&M Plan		
Site Security and Access	Fences/Signs, Gates/Locks, Access Roads	Quarterly	Section 3.6 - General Site Inspection Form - Post Construction Site O&M Plan		
Cathodic Protection **SCCC** (AW-01 through AW-08) - 8 CP Wells (SCCC portion of SSP = 606.97 linear feet)	Routine - Rectifier Performance and Condition, Anode Well Performance and Integrity Non-Routine - Measure protected polarized structure-to-reference electrode potential, test to verify structural polarization in accordance with NACE SP0169-96, Measure anode-structure resistance, structure-to-electrolyte resistance and anode-to-electrolyte, verify accuracy of rectifier panel meters, adjust rectifiers needed - **To be conducted by an NACE certified inspector**	Pending Cathodic Protection O&M Plan	Section 3.7 - Rectifier and Anode Well Integrity Inspection Form		
Maintenance Activity	**Item**	**Frequency**	**Reference Section / Table**		
SCCC - CA Cover System	Repair of Settled and Eroded Areas, Repair of damaged geomaterials, Soil and Riprap cover Repair, Vegetative maintenance, Structural Integrity of the CA berm	As needed for repairs, mowing as needed to prohibit woody vegetation - Mowing estimated annually	**Section 3.0**		**Note that additional access roads are required to safely conduct DNAPL recovery at DRWL-11 and DRWL-10 (should it produce) estimated 250' of underlined crushed/compacted stone to reach DRWL-11.**
SCCC - IRM Cover System	Maintenance of IRM covers A through D and S, Repair of eroded areas, damaged geomaterial, stone /soil/asphalt cover repair	As needed for repairs, mowing as needed to prohibit woody vegetation - Mowing estimated annually	**Section 3.0**		
Stormwater Management /Erosion & Sediment (E&S) Control Maintenance and Permanent Vegetation	Removal of Debris and Sediment. Channel lining (grass, erosion control matting, riprap) repair/replace, Repairs to outlet structures	Repairs and Debris and Sediment clearing as needed. Channel Mowing to prohibit deep rooting woody vegetation - Mowing estimated Annually	**Section 3.3 -**		
Slurry Wall	Damage, erosion, settlement, mowing to prohibit deep rooting vegetation	Repairs as necessary based on Quarterly inspections. Mowing anticipated to be Annually	**Section 3.4**		
Sheet Pile Wall (SSP)	Repair to wall alignment, corrosion, settlement, adjacent backfill settling, interlock separation, holes, dents, cracks, and weld repairs	Repairs as necessary based on Quarterly inspections.	**Section 3.5**		
Site Security and Access	Repair/Replace Fencing, gates, locks, signage, culvert crossings, access road maintenance	Repairs as necessary based on Quarterly inspections.	**Section 3.6**		
Cathodic Protection **SCCC** (AW-01 through AW-08) - 8 CP Wells (SCCC portion of SSP = 606.97 linear feet)	Routine - Cathodic Protection O&M Plan Pending - General Maintenance to include - cleaning of the interior / exterior of the rectifier Non-Routine - NACE Specialist to repair/replace rectifier and anode well components	As Needed, as described in Pending Cathodic Protection Systems Operations Manual As Needed, as described in Pending Cathodic Protection Systems Operations Manual	**Section 3.7**		

Inspections, Monitoring, and Operation and Maintenance Summary
SCCC Site
Kearny, NJ

Operations, Maintenance & Monitoring Manual HCTS - SCCC & Diamond Sites (Jan 2012)					
Inspections	**Item**	**Frequency**	**Reference Section / Table**		
HCTS					
Daily	Daily Inspection Form - Plant Flow Rate, Inst Plant pH, Flash and Mix tank pH and ORP, PID readings Piping, Tanks, Filter Press Hardware	Daily	HCTS O&M Manual	Logs Maintained for System Operation Evaluation and Preventative Maintenance Purposes	
Weekly	Weekly Inspection Form - General Piping and Pump Inspection	Weekly	HCTS O&M Manual	Logs Maintained for System Operation Evaluation and Preventative Maintenance Purposes	
Monthly	Monthly Inspection Form - HCTS and DRW Well Pumps (at Manifold)	Monthly	HCTS O&M Manual	Logs Maintained for System Operation Evaluation and Preventative Maintenance Purposes	
Quarterly	Quarterly Inspection Form - Relief Valve Setting, Throttle & Solenoid Valve Exercise, Jib Crane System (Anchor Bolts, Boom Hardware, Endstop/Tagline Assemblies	Quarterly	HCTS O&M Manual	Logs Maintained for System Operation Evaluation and Preventative Maintenance Purposes	
Semiannually	Semiannual Inspection Form - Jib Crane Rollers, Level of Boom, Gorbel Crane - general visual inspection	Semiannual	HCTS O&M Manual	Logs Maintained for System Operation Evaluation and Preventative Maintenance Purposes	
Annually	System Tankage, Mixers and Gauges	Annual	HCTS O&M Manual	Logs Maintained for System Operation Evaluation and Preventative Maintenance Purposes	
HC & DRW Well Gauging	Gauging of DTW, DTP and TD at 26 HCW's and 16 DRW's	Monthly	HCTS O&M Manual	Logs Maintained for System Operation Evaluation and Preventative Maintenance Purposes	
	Inspection of Structural Integrity at 26 HCW's and 16 DRW's	Monthly	HCTS O&M Manual	Logs Maintained for System Operation Evaluation and Preventative Maintenance Purposes	
PZ Gauging	Gauging of DTW at 28 PZ's	Monthly	HCTS O&M Manual	Logs Maintained for System Operation Evaluation and Preventative Maintenance Purposes	
	Gauging of DTW, DTP and TD at 26 HCW's and 16 DRW's	Monthly	HCTS O&M Manual	Logs Maintained for System Operation Evaluation and Preventative Maintenance Purposes	
HCTS Monitoring & Reporting Activity	**Item**	**Frequency**	**Reference Section / Table**		
NJPDES (Outfall DSN001A) - monitored location 001A	Effluent Treatment Stream Monitoring - Flow, pH, TSS, TOC, Metals (Total), VOC's, SVOC's	Monthly	NJPDES Permit No. NJ0155438	Monthly DMR no later than the 25th day of the following month	
	Ceriodaphnia	Quarterly	NJPDES Permit No. NJ0155438	Quarterly DMR in concert w/ monthly submittal	
Waste (Sludge / Filter Cake)	Residual Composite Sample of Filter Cake for NJPDES Permit Monitoring List plus Total Solids	Annual	NJPDES Permit No. NJ0155438	Annual DMR 60 days from year end	
Air Permit	Visual Observation to Avoid Fugitive emissions	Daily - 1X/shift during operations	NJDEP Permit activity No. PCP100002	Manual Log or Computer Database	
	Visual observation of all equipment kept covered as much as possible	1X/shift	NJDEP Permit activity No. PCP100002	None	
	PID Screening for total VOC's ≤10ppm at chrome reduction tank, flocculation tank, filter press (<6'' from tank opening)	1X/shift	NJDEP Permit activity No. PCP100002	Manual Log or Computer Database	
	Waste water analysis for Total VOC's (Influent to HCTS monitored for VOC's/SVOC's per NJPDES Permit parameter list	Monthly	NJDEP Permit activity No. PCP100002	Manual Log or Computer Database	
	Total VOC's ≤ 0.05 lbs/hr at building exhaust fan	Within 120 days upon request of Department	NJDEP Permit activity No. PCP100002	Stack Test Report	
Maintenance Activity	**Item**	**Frequency**	**Reference Section / Table**		
Stormwater Monitoring and Analysis Plan					
Monitoring & Reporting	**Item**	**Frequency**	**Reference Section / Table**		
	Stormwater sampling at Outlet 1 (OL1-SW) and Outlet 3 (OL3-SW) and Upstream Off-site (BG-SW) following a significant precipitation event (≥0.5''). Analyzed for site-specific analytes.	Sampling to be completed for two (2) events	Sections 1, 2 and 3	The results of the study will be submitted to Prospective Plaintiff's and Agencies within two (2) weeks of conclusion of the data validation process	

ATTACHMENT 2
GENERAL SITE INSPECTION FORM

General Site Inspection Form
Operation, Maintenance, and Monitoring Plan
SCCC Site
Kearny, NJ

POST-CONSTRUCTION INSPECTION COMPONENTS	SATISFACTORY	ACTION REQUIRED	NOTES *
Ia. SCCC Site Consolidation Area Cover System			
1. Vegetation condition			
2. Soil erosion			
3. Settlement			
4. Exposed and/or damaged geomaterials			
5. Berm condition			
II. Interim Remedial Measure Cover Systems			
1. Stone coverage			
2. Soil Coverage			
3. Asphalt coverage			
4. Settlement			
5. Exposed and/or damaged geomaterials			
III. Stormwater Management and Erosion and Sediment Control Maintenance			
1. Stormwater diversion channels			
2. Catch basins			
3. Culverts			
4. Outlets 001 and 003			
5. Rip rap aprons			
IV. Slurry Wall			
1. Working platform erosion			
2. Working platform settlement/standing water			
3. Working platform vegetation condition			
V. Steel Sheet Pile Wall			
1. Alignment			
2. Sheet interlock			
3. Corrosion/dents/cracks/weld integrity			
4. Settlement			
5. Waler Condition			
6. Adjacent Soil backfill conditions			
VI. Site Security and Access			
1. Fences/signs			
2. Gates/locks			
3. Access roads and road crossings			

* Include additional pages, as needed.

ATTACHMENT 3
RECTIFIER AND ANODE WELL INTEGRITY INSPECTION FORM

Rectifier and Anode Well Inspection Form
Operation, Maintenance, and Monitoring Plan
SCCC Site
Kearny, NJ

RECTIFIER NO. _____

OWNER/OPERATOR: The Cooperating Parties Group
RECTIFIER LOCATION: Kearny, NJ
MANUFACTURER: Universal Rectifiers, Inc.
SERIAL NUMBER :
DATE INSTALLED:
TYPE OF UNIT:
MAXIMUM DC OUTPUT: 25 VOLTS; 175 AMPS
AC INPUT: VOLTS; 3 PHASE
AC INPUT: AMPS
NUMBER OF ANODES:
TYPE OF GROUNDBED:
GROUNDBED INSTALL DATE:

OPERATING INSTRUCTION DO NOT EXCEED
_____ VOLTS.

DATE	MAX AMPS	MIN AMPS	BY

DATE	CHECKED BY	AMPS	VOLTS	REFERENCE	AW-01 THROUGH AW-16 INTEGRITY	NOTES/OBSERVATIONS

ATTACHMENT 4
STORMWATER MANAGEMENT, E&S CONTROL FEATURES, AND PERMANENT VEGETATION INSPECTION FORM

Stormwater Management, E&S Control, and Permanent Vegetation Inspection Form
Operation, Maintenance, and Monitoring Plan
SCCC Site
Kearny, NJ

Date/Time:

NJMC File No. 10-041

County:

Site Name: Standard Chlorine Chemical Company **Owner:** Town of Kearny

Purpose of Inspection: NJMC & O,M &M Plan **Weather Conditions:**

Inspector(s): **Contact(s):**

Photographs: ( ) Yes or ( ) No

	Frequency	Yes	No	Not Applicable	Not Observed	Comments
STORMWATER FACILITY/APPURTENANCE						
A. Drainage Channels (C-1, C-2, C-3A, C-3B):						
1. Alignment problems?	Weekly / Storm*					
2. Excessive debris or sediment accumulation?	Weekly / Storm*					
3. Mulch blanket intact?	Weekly / Storm*					
4. Erosion or scour?	Annually					
5. Unwanted growth?	Annually					
6. Vegetative lining intact?	Annually					
7. Other? (specify)						
B. Catch Basins (CB2 through CB15, and CB17):						
1. Alignment problems?	Weekly / Storm*					
2. Excessive debris or sediment accumulation?	Weekly / Storm*					
3. Grates intact?	Weekly / Storm*					
4. Concrete problems?	Quarterly					
5. Structural problems?	Quarterly					
6. Signs of inflow at joints?	Quarterly					
7. Other? (specify)						
C. Piping (Pipes 2 through 15, and Pipe 17):						
1. Alignment problems?	Weekly / Storm*					
2. Excessive debris or sediment accumulation?	Weekly / Storm*					
3. Outlet blocked?	Weekly / Storm*					
4. Signs of inflow at joints?	Quarterly					
D. Check Valves (Pipes 9 and 17)						
1. Valve attached to pipe?	After Significant Storm					
2. Valve clogged with debris?	After Significant Storm					
3. Valve material in good condition?	After Significant Storm					
E. Riprap Aprons						
1. Excessive debris or sediment accumulation?	After Significant Storm					
2. Riprap lining intact?	After Significant Storm					
PERMANENT VEGETATION						
B. SCCC Consolidation Area:						
1. Has 80% vegetation been established?	Weekly / Storm*					
2. Signs of sheet or rill erosion?	Quarterly					
3. Cracks, depressions, slips or slumps? (specify)	Quarterly					
4. Areas with >50% damage to vegetation?	Quarterly					
5. Trees or brush on surface?	Quarterly					
6. Animal burrows?	Quarterly					
7. Other? (specify)						
C. Working Platform:						
1. Has 80% vegetation been established?	Weekly / Storm*					
2. Signs of sheet or rill erosion?	Quarterly					
3. Cracks, depressions, slips or slumps? (specify)	Quarterly					
4. Areas with >50% damage to vegetation?	Quarterly					
5. Trees or brush on surface?	Quarterly					
6. Animal burrows?	Quarterly					
7. Other? (specify)						
D. Remaining Areas Disturbed During Implementation of IRAW Construction (not including wetland mitigation)						
1. Has 80% vegetation been established?	Weekly / Storm*					
2. Signs of sheet or rill erosion?	Quarterly					
3. Cracks, depressions, slips or slumps? (specify)	Quarterly					
4. Areas with >50% damage to vegetation?	Quarterly					
5. Trees or brush on surface?	Quarterly					
6. Animal burrows?	Quarterly					
7. Other? (specify)						
GENERAL		**High**	**Normal**	**Low**		
1. Hackensack River water level?	Every Inspection					
2. Construction activity?	Every Inspection					
3. Other? (specify)	Every Inspection					

Notes:

* 1" precipitation or greater storm event

ATTACHMENT 5
STANDARD OPERATING PROCEDURE:
PIEZOMETER MONITORING AND MAINTENANCE

SOP – PIEZOMETER WELL MONITORING AND MAINTENANCE

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) describes procedures to be followed for routine piezometer well Monitoring and Maintenance (M&M) at the Cooperating Party Group's Standard Chlorine Chemical Co., (SCCC) site located in Kearny, NJ. Routine piezometer M&M will be completed in accordance with the Health and Safety Plan (HASP) and as described herein.

2.0 REQUIRED MATERIALS

The following list identifies the preferred types of equipment and materials to be used while completing piezometer monitoring and maintenance tasks:

- Items listed in the HASP;
- Field Note Book and/or field log forms;
- Water Level Meter;
- Appropriate Standard Level D PPE for including: nitrile or latex gloves, steel toed work boots, hardhat and safety glasses;
- Decontamination solutions (Liquinox®); and,
- Paper towels.

3.0 METHODOLOGY

3.1 This section describes routine M&M of the Piezometer Well Network.

- Use the Piezometer Well Network Gauging Form (Attachment A) to record depth to water, and total depth measurements with an electronic water level meter. The operator will measure and record the depth to water from Top of Casing at each piezometer. This form is to be completed monthly.
    - Piezometers will be visually inspected during each gauging event to assure structural integrity of the protective outer casing, well pad and inner riser are maintained and each piezometer is secured (i.e. locked with a "2006" master lock) and properly labeled.

- Water levels are measured three (3) times over the course of a minimum of five (5) minutes to assure there is not fluctuation in water levels and confirm measurements are accurate
- Depth to Water (DTW) measurements are taken from the surveyed piezometer top of inner casing and these measurements recorded to the nearest hundredth of a foot (0.01').
- The water level meter (probe and tape) is to be deconed using an Alconox wash and potable water rinse.
- Following gauging of each piezometer the technician will re-secure the inner casing with a slip cap or J-plug and the outer protective casing will be secured with a "2006" keyed-alike padlock.
- All PPE and decon materials generated during these efforts will be containerized in the onsite PPE accumulation drum for subsequent off-site disposal at an approved facility.

4.0 QC PROCEDURES

Quality control procedures include the following:

- Piezometers are opened and groundwater elevations allowed to equilibrate to atmospheric pressure for a minimum of five (5) minutes prior to gauging water level measurements.
- All DTW and TD measurements are compared to the previous months' measurements in the field at the time of gauging to identify potential measurement errors or anomalous data which may require additional evaluation in the field and potential follow-up action.
- Total depth evaluations will completed at a minimum annually to assure excessive occlusion of the screened interval is not occurring. Redevelopment of piezometers to remove accumulated fines will be conducted when occlusion reaches $\geq$ 20% of the screened interval length at any given piezometer.
- General non-intrusive well maintenance tasks such as lock replacement, rising painting, relabeling and well pad repair will be performed as needed and any repair/maintenance efforts completed documented in the operators field notebook. Repairs and maintenance performed will be summarized and provided in the Quarterly Progress Report.

5.0 DATA RECORDING OR MANAGEMENT

Proper field data collection and management is important. Field notes and observations are to be recorded in a bound field log book. Data collected during O&M efforts are to be recorded the attached field forms herein and submitted to the project manager for review upon completion.
Water level elevations are evaluated and graphed monthly to assess the effectiveness of the slurry wall and associated hydraulic control well groundwater recovery system network.

ATTACHMENT A
PIEZOMETER WELL NETWORK GAUGING FORM

ATTACHMENT A
PIEZOMETER WELL NETWORK GAUGING FORM

Piezometer Gauging Form
Operation, Maintenance, and Monitoring Plan
SCCC Site
Kearny, NJ

Date:

Well ID	Depth to Water	Total Depth
HC-PZ-1U		
HC-PZ-2U		
HC-PZ-3U		
HC-PZ-4U		
HC-PZ-6U		
HC-PZ-7U		
HC-PZ-8U		
HC-PZ-9U		
HC-PZ-10U		
HC-PZ-11U		
HC-PZ-12U		
HC-PZ-13U		
HC-PZ-14U		
HC-PZ-15U		
HC-PZ-1L		
HC-PZ-2L		
HC-PZ-3L		
HC-PZ-4L		
HC-PZ-6L		
HC-PZ-7L		
HC-PZ-8L		
HC-PZ-9L		
HC-PZ-10L		
HC-PZ-11L		
HC-PZ-12L		
HC-PZ-13L		
HZ-PZ-14L		
SC-MW-16L		

ATTACHMENT 6
STANDARD OPERATING PROCEDURE:
HYDRAULIC CONTROL WELL O&M

SOP – HYDRAULIC CONTROL AND RECOVERY WELL O&M

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) describes procedures to be followed for routine hydraulic control and recovery well Operations and Maintenance (O&M) at the Cooperating Party Group's Standard Chlorine Chemical Co., (SCCC) site located in Kearny, NJ. Routine well O&M will be completed in accordance with the Health and Safety Plan (HASP) and as described herein.

2.0 REQUIRED MATERIALS

The following list identifies the preferred types of equipment and materials to be used while completing well maintenance tasks:

- Items listed in the HASP;
- Field Note Book and/or field log forms;
- Interface meter;
- Plastic sheeting;
- Absorbent pads;
- Spill kit, including: oil dry, absorbent booms, shovel, trash bags;
- Appropriate Standard Level D PPE for including: nitrile or latex gloves, steel toed work boots, hardhat, safety glasses and Tyvek;
- Decontamination solutions (acetone, Liquinox®); and,
- Paper towels.

3.0 METHODOLOGY

3.1 This section describes routine O&M of the Hydraulic Control Treatment System (HCTS) and DNAPL Recovery Well Network.

- Use the HCTS Well Network Gauging Form (Attachment A) to record depth to water, depth to product, and total depth measurements with an electronic interface meter. This form is to be completed monthly.

- Use the HCTS Pump Operational Hours field form (Attachment B) to record the pump run time. This form is to be completed monthly and compared to previous data to ensure adequate pump operation.

  - If pump hours indicate abnormal run time, adjust on/off conductivity probes to maximize optimization. Confirm that probes are set above the depth of the pump and record new position on the HCTS Well Network Gauging Form (Attachment A).

- Record the pressure and flow rates of the wells using the form titled Individual Well Flow and Pressure Evaluation (Attachment D). This form is to be completed as needed during troubleshooting activities and compared to previous data to ensure adequate pump operation.

  - If pressure/flow readings are abnormal based on the readings at the plant, check the flow rate of the pump using a 5-gallon bucket and a stopwatch. Compare the flow rate from the "bucket test" to the flow rate from the plant. If the pump is working properly, but the pressure is abnormal, the conveyance line may be occluded and require cleaning.
  - If the pump is not working correctly check the amperage draw (full load is 1.2) with a multi-meter. If the amperage draw is high, this may indicate a pump or line restriction. If the amperage draw is low, this may indicate motor failure or wiring issues and a replacement motor may be required.
  - If there appears to be a clog in the pump, disassemble the pump and soak the parts in 10% sulfuric acid solution for several hours. Once the parts have been soaked and cleaned, reassemble and check the amperage draw again.
  - Prior to putting the pump back on line, determine the thickness of DNAPL in the well and set the flow rate to no more than 0.25 gallons per minute (only in wells containing DNAPL). The well will be gauged a minimum of two times per day for one week after pump replacement/repair.
  - Discontinue water extraction in wells immediately if DNAPL or sheen is observed in the sample port near the plant well header or if rates in the sump indicate the potential of extracting DNAPL into the recovery stream. Shut down individual pumps at the Human Machine Interface (HMI).

4.0 QC PROCEDURES

Quality control procedures include the following:

- Levels are measured to the nearest hundredth of a foot.

5.0 DATA RECORDING OR MANAGEMENT

Proper field data collection and management is important. Field notes and observations are to be recorded in a bound field log book. Data collected during O&M efforts are to be recorded on the attached field forms herein and submitted to the project manager for review upon completion.

ATTACHMENT A
HCTS WELL NETWORK GAUGING FORM

HCTS Well Network Gauging Form

Recovery Well ID	New Total Well	Pump Length* (ft TOC)	Start Probe Set Depth	Stop Probe Set Depth	DTW (ft TOC)	Depth to Product (ft TOC)	Total Depth (ft TOC)	NOTES
HCWU-1	14.26	11.15	10.00	11.00				
HCWU-2	14.88	11.79	9.00	10.00				
HCWU-3	14.21	11.02	7.00	8.00				
HCWU-4	13.30	10.28	5.50	6.50				
HCWU-5	12.58	9.31	5.00	6.00				
HCWU-6	10.36	7.21	3.10	4.10				
HCWU-7	8.65	5.53	4.50	5.50				
HCWU-8	11.94	8.83	3.00	4.00				
HCWU-9	7.00	3.85	3.55	4.55				
HCWU-10	7.62	4.34	1.91	2.91				
HCWU-11	8.34	5.03	3.50	4.50				
HCWU-12	8.94	5.83	4.00	5.00				
HCWU-13	8.29	5.10	3.40	4.40				
HCWU-14	6.04	3.39	2.00	3.00				
HCWU-15	8.73	5.36	3.00	4.00				
HCWU-16	8.45	5.26	3.10	4.10				
HCWU-17	7.45	4.23	2.00	3.00				
HCWU-18	6.45	3.46	2.00	3.00				
HCWU-19	8.25	5.01	2.00	3.00				
HCWU-20	7.71	4.42	1.55	2.25				
HCWU-21	17.41	14.08	11.60	12.60				
HCWU-22	9.66	6.03	4.00	5.00				
HCWU-23	16.30	12.67	11.40	12.40				
HCWU-24	13.25	9.73	7.00	8.00				
HCWU-25	16.29	12.70	12.00	13.00				
HCWU-26	14.41	10.88	7.62	8.62				

HCTS Well Network Gauging Form

Recovery Well ID	New Total Well	Pump Length* (ft TOC)	Start Probe Set Depth	Stop Probe Set Depth	DTW (ft TOC)	Depth to Product (ft TOC)	Total Depth (ft TOC)	NOTES
DRWU-1	10.51	3.21	X	X				
DRWU-2	10.73	7.66	3.41	4.41				
DRWU-3	22.55	14.13	13.47	14.47				
DRWU-4	12.04	4.40	2.47	3.47				
DRWU-5	8.84	4.45	2.00	3.00				
DRWL-1	31.89	18.22	4.75	5.75				
DRWL-2	26.94	13.32	2.00	3.00				
DRWL-3	28.85	15.19	2.00	3.00				
DRWL-4	30.44	16.72	3.39	4.39				
DRWL-5	29.80	16.14	2.81	3.81				
DRWL-6	40.75	25.97	15.07	16.07				
DRWL-7	27.15	13.50	2.00	3.00				
DRWL-8	28.84	14.80	2.00	3.00				
DRWL-9	28.45	15.07	2.67	3.67				
DRWL-10	30.55	16.62	4.68	5.68				
DRWL-11	33.16	19.08	7.34	8.34				
113-W-106*	X	X	X	X				
113-W-106D*	X	X	X	X				
113-W-108*	X	X	X	X				
113-W-108D*	X	X	X	X				
113-W-118*	X	X	X	X				
113-W-118S*	X	X	X	X				
113-W-120*	X	X	X	X				
113-W-120S*	X	X	X	X				
48-W-108S*	X	X	X	X				
MW-1S*	X	X	X	X				

NOTE: Hydraulic well lengths are from bottom of pitless to bottom of pump.
DNAPL wells are from bottom of pitless to intake (near middle of pump)
***Wells to be gauged for supplemental interior potentiometric evaluation**

ATTACHMENT B
HCTS PUMP OPERATIONAL HOURS FIELD FORM

HCTS Pump Operational Hours

	Operation Hour Meter Reading Date:	
Well ID	**Time**	**Hours of Operation**
HCWU-1		
HCWU-2		
HCWU-3		
HCWU-4		
HCWU-5		
HCWU-6		
HCWU-7		
HCWU-8		
HCWU-9		
HCWU-10		
HCWU-11		
HCWU-12		
HCWU-13		
HCWU-14		
HCWU-15		
HCWU-16		
HCWU-17		
HCWU-18		
HCWU-19		
HCWU-20		
HCWU-21		
HCWU-22		
HCWU-23		
HCWU-24		
HCWU-25		
HCWU-26		
DRWU-1		
DRWU-2		
DRWU-3		
DRWU-4		
DRWU-5		
DRWL-1		
DRWL-2		
DRWL-3		
DRWL-4		
DRWL-5		
DRWL-6		
DRWL-7		
DRWL-8		
DRWL-9		
DRWL-10		
DRWL-11		

ATTACHMENT C
HCTS PUMP OPERATIONAL STATUS LOG

HCTS Pump Operational Status Log

	DATE:		
Well ID	**Status**	**Troubleshooting/Repairs**	**HCTS HC well Flow Status**
HCWU-1			
HCWU-2			
HCWU-3			
HCWU-4			
HCWU-5			
HCWU-6			
HCWU-7			
HCWU-8			
HCWU-9			
HCWU-10			
HCWU-11			
HCWU-12			
HCWU-13			
HCWU-14			
HCWU-15			
HCWU-16			
HCWU-17			
HCWU-18			
HCWU-19			
HCWU-20			
HCWU-21			
HCWU-22			
HCWU-23			
HCWU-24			
HCWU-25			
HCWU-26			
DRWU-1			
DRWU-2			
DRWU-3			
DRWU-4			
DRWU-5			
DRWL-1			
DRWL-2			
DRWL-3			
DRWL-4			
DRWL-5			
DRWL-6			
DRWL-7			
DRWL-8			
DRWL-9			
DRWL-10			
DRWL-11			

ATTACHMENT D
INDIVIDUAL WELL FLOW AND PRESSURE EVALUATION FORM

Individual Well Flow and Pressure Evaluation

Well	Date:		
	Flow (gpm)	**Pressure (psi)**	**Notes**
HCWU-1			
HCWU-2			
HCWU-3			
HCWU-4			
HCWU-5			
HCWU-6			
HCWU-7			
HCWU-8			
HCWU-9			
HCWU-10			
HCWU-11			
HCWU-12			
HCWU-13			
HCWU-14			
HCWU-15			
HCWU-16			
HCWU-17			
HCWU-18			
HCWU-19			
HCWU-20			
HCWU-21			
HCWU-22			
HCWU-23			
HCWU-24			
HCWU-25			
HCWU-26			
Average Pressure			
Total Inf Flow			

OOS: *Out of Service*
Br: *Brownish- High TSS*
Bl: *Blackish- Contains sulfides*
C: *Clear- Low Turbidity*
F: *Foamy- likely pH related*
Y: *Yellow tint- likely high in* Cr^{+6}

ATTACHMENT 7
HCTS LIMITS AND MONITORING REQUIREMENTS

PART III
LIMITS AND MONITORING REQUIREMENTS

MONITORED LOCATION:	RECEIVING STREAM:	STREAM CLASSIFICATION:	DISCHARGE CATEGORY(IES):
001A Treated Groundwater	Hackensack River	SE2(C2)	BGR - General Remediation Clean-up (GP)

Location Description

Effluent sampling shall be performed after all treatment steps but prior to discharge at latitude 40d 44m 58.75s. and 74d 05m 43.4s.

Contributing Waste Types

Groundwater Remediation

Surface Water DMR Reporting Requirements:

Submit a Monthly DMR: within twenty-five days after the end of every month beginning from the effective date of the permit (EDP).

Comments:

Outfall DSN001A is for the long term cleanup project. DSN002A and DSN003A are for the temporary construction treatment system. A Chronic WET limit of 61% shall become effective on EDP+3 years.

Table III - A - 1: Surface Water DMR Limits and Monitoring Requirements

PHASE: 1 Interim **PHASE Start Date:** 07/01/2010 **PHASE End Date:** 06/30/2013

Parameter	Sample Point	Limit	Limit	Units	Limit	Limit	Limit	Units	Frequency	Sample Type
Flow, In Conduit or Thru Treatment Plant	Effluent Gross Value	REPORT Monthly Average	REPORT Daily Maximum	GPD	*****	*****	*****	*****	1/Month	Metered
January thru December	QL	***	***		***	***	***			
pH	Effluent Gross Value	*****	*****	*****	6.0 Monthly Minimum	*****	9.0 Monthly Maximum	SU	1/Month	Grab
January thru December	QL	***	***		***	***	***			
Solids, Total Suspended	Effluent Gross Value	*****	*****	*****	*****	REPORT Monthly Average	40 Daily Maximum	MG/L	1/Month	Grab
January thru December	QL	***	***		***	***	***			
IC25 Statre 7day Chr Ceriodaphnia	Effluent Gross Value	*****	*****	*****	REPORT Report Per Minimum	*****	*****	%EFFL	1/Quarter	Composite
January thru December	QL	***	***		***	***	***			
Carbon, Tot Organic (TOC)	Effluent Gross Value	*****	*****	*****	*****	REPORT Monthly Average	20 Daily Maximum	MG/L	1/Month	Grab
January thru December	QL	***	***		***	***	***			

Surface Water DMR Reporting Requirements:

Submit a Monthly DMR: within twenty-five days after the end of every month beginning from the effective date of the permit (EDP).

Comments:

Outfall DSN001A is for the long term cleanup project. DSN002A and DSN003A are for the temporary construction treatment system. A Chronic WET limit of 61% shall become effective on EDP+3 years.

Table III - A - 1: Surface Water DMR Limits and Monitoring Requirements

PHASE: 1 Interim **PHASE Start Date:** 07/01/2010 **PHASE End Date:** 06/30/2013

Parameter	Sample Point	Limit	Limit	Units	Limit	Limit	Limit	Units	Frequency	Sample Type
Magnesium, Total (as Mg)	Effluent Gross Value	*****	*****	*****	*****	REPORT Monthly Average	REPORT Daily Maximum	UG/L	1/Month	Grab
January thru December	QL	***	***		***	***	***			
Manganese, Total Recoverable	Effluent Gross Value	*****	*****	*****	*****	REPORT Monthly Average	REPORT Daily Maximum	UG/L	1/Month	Grab
January thru December	QL	***	***		***	***	***			
Nickel, Total Recoverable	Effluent Gross Value	*****	*****	*****	*****	50 Monthly Average	100 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	10	10			
Zinc, Total Recoverable	Effluent Gross Value	*****	*****	*****	*****	100 Monthly Average	200 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	30	30			
Lead, Total Recoverable	Effluent Gross Value	*****	*****	*****	*****	50 Monthly Average	100 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	10	10			
Chromium, Total Recoverable	Effluent Gross Value	*****	*****	*****	*****	50 Monthly Average	100 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	10	10			
Arsenic	Effluent Gross Value	*****	*****	*****	*****	50 Monthly Average	100 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	8	8			

Surface Water DMR Reporting Requirements:
Submit a Monthly DMR: within twenty-five days after the end of every month beginning from the effective date of the permit (EDP).

Comments:
Outfall DSN001A is for the long term cleanup project. DSN002A and DSN003A are for the temporary construction treatment system. A Chronic WET limit of 61% shall become effective on EDP+3 years.

Table III - A - 1: Surface Water DMR Limits and Monitoring Requirements

PHASE: 1 Interim **PHASE Start Date:** 07/01/2010 **PHASE End Date:** 06/30/2013

Parameter	Sample Point	Limit	Limit	Units	Limit	Limit	Limit	Units	Frequency	Sample Type
Mercury, Total (as Hg)	Effluent Gross Value	*****	*****	*****	*****	REPORT Daily Avg Minimum	1 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	1	1			
Acenaphthene	Effluent Gross Value	*****	*****	*****	*****	REPORT Monthly Average	REPORT Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	9.5	9.5			
1,2-Dichlorobenzene	Effluent Gross Value	*****	*****	*****	*****	77 Monthly Average	163 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	9	9			
1,2,4-Trichloro-benzene	Effluent Gross Value	*****	*****	*****	*****	68 Monthly Average	140 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	10	10			
1,3-Dichlorobenzene	Effluent Gross Value	*****	*****	*****	*****	31 Monthly Average	44 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	9	9			
1,4-Dichlorobenzene	Effluent Gross Value	*****	*****	*****	*****	REPORT Monthly Average	28 Daily Maximum	UG/L	1/Month	Grab
January thru December	QL	***	***		***	***	***			
Toluene	Effluent Gross Value	*****	*****	*****	*****	26 Monthly Average	80 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	20	20			

Surface Water DMR Reporting Requirements:

Submit a Monthly DMR: within twenty-five days after the end of every month beginning from the effective date of the permit (EDP).

Comments:

Outfall DSN001A is for the long term cleanup project. DSN002A and DSN003A are for the temporary construction treatment system. A Chronic WET limit of 61% shall become effective on EDP+3 years.

Table III - A - 1: Surface Water DMR Limits and Monitoring Requirements

PHASE: 1 Interim **PHASE Start Date:** 07/01/2010 **PHASE End Date:** 06/30/2013

Parameter	Sample Point	Limit	Limit	Units	Limit	Limit	Limit	Units	Frequency	Sample Type
Benzene	Effluent Gross Value	*****	*****	*****	*****	37 Monthly Average	136 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	7	7			
Chlorobenzene	Effluent Gross Value	*****	*****	*****	*****	15 Monthly Average	28 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	6	6			
Ethylbenzene	Effluent Gross Value	*****	*****	*****	*****	32 Monthly Average	108 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	6	6			
Methylene Chloride	Effluent Gross Value	*****	*****	*****	*****	40 Monthly Average	89 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	10	10			
Tetrachloroethylene	Effluent Gross Value	*****	*****	*****	*****	22 Monthly Average	56 Daily Maximum	UG/L	1/Quarter	Grab
January thru December	RQL	***	***		***	9	9			
Trichloroethylene	Effluent Gross Value	*****	*****	*****	*****	21 Monthly Average	54 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	5	5			
2,4-Dimethylphenol	Effluent Gross Value	*****	*****	*****	*****	18 Monthly Average	36 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	13.5	13.5			

Surface Water DMR Reporting Requirements:
Submit a Monthly DMR: within twenty-five days after the end of every month beginning from the effective date of the permit (EDP).

Comments:
Outfall DSN001A is for the long term cleanup project. DSN002A and DSN003A are for the temporary construction treatment system. A Chronic WET limit of 61% shall become effective on EDP+3 years.

Table III - A - 1: Surface Water DMR Limits and Monitoring Requirements

PHASE: 1 Interim **PHASE Start Date:** 07/01/2010 **PHASE End Date:** 06/30/2013

Parameter	Sample Point	Limit	Limit	Units	Limit	Limit	Limit	Units	Frequency	Sample Type
Phenol Single Compound	Effluent Gross Value	*****	*****	*****	*****	15 Monthly Average	26 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	10	10			

Table III - A - 2: Surface Water DMR Limits and Monitoring Requirements

PHASE: 2 Final **PHASE Start Date:** 07/01/2013 **PHASE End Date:**

Parameter	Sample Point	Limit	Limit	Units	Limit	Limit	Limit	Units	Frequency	Sample Type
Flow, In Conduit or Thru Treatment Plant	Effluent Gross Value	REPORT Monthly Average	REPORT Daily Maximum	GPD	*****	*****	*****	*****	1/Month	Metered
January thru December	QL	***	***		***	***	***			
pH	Effluent Gross Value	*****	*****	*****	6.0 Monthly Minimum	*****	9.0 Monthly Maximum	SU	1/Month	Grab
January thru December	QL	***	***		***	***	***			
Solids, Total Suspended	Effluent Gross Value	*****	*****	*****	*****	REPORT Monthly Average	40 Daily Maximum	MG/L	1/Month	Grab
January thru December	QL	***	***		***	***	***			
IC25 Statre 7day Chr Ceriodaphnia	Effluent Gross Value	*****	*****	*****	61 Report Per Minimum	*****	*****	%EFFL	1/Quarter	Composite
January thru December	QL	***	***		***	***	***			

Surface Water DMR Reporting Requirements:

Submit a Monthly DMR: within twenty-five days after the end of every month beginning from the effective date of the permit (EDP).

Comments:

Outfall DSN001A is for the long term cleanup project. DSN002A and DSN003A are for the temporary construction treatment system. A Chronic WET limit of 61% shall become effective on EDP+3 years.

Table III - A - 2: Surface Water DMR Limits and Monitoring Requirements

PHASE: 2 Final **PHASE Start Date:** 07/01/2013 **PHASE End Date:**

Parameter	Sample Point	Limit	Limit	Units	Limit	Limit	Limit	Units	Frequency	Sample Type
Carbon, Tot Organic (TOC)	Effluent Gross Value	*****	*****	*****	*****	REPORT Monthly Average	20 Daily Maximum	MG/L	1/Month	Grab
January thru December	QL	***	***		***	***	***			
Magnesium, Total (as Mg)	Effluent Gross Value	*****	*****	*****	*****	REPORT Monthly Average	REPORT Daily Maximum	UG/L	1/Month	Grab
January thru December	QL	***	***		***	***	***			
Manganese, Total Recoverable	Effluent Gross Value	*****	*****	*****	*****	REPORT Monthly Average	REPORT Daily Maximum	UG/L	1/Month	Grab
January thru December	QL	***	***		***	***	***			
Nickel, Total Recoverable	Effluent Gross Value	*****	*****	*****	*****	50 Monthly Average	100 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	10	10			
Zinc, Total Recoverable	Effluent Gross Value	*****	*****	*****	*****	100 Monthly Average	200 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	30	30			
Lead, Total Recoverable	Effluent Gross Value	*****	*****	*****	*****	50 Monthly Average	100 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	10	10			
Chromium, Total Recoverable	Effluent Gross Value	*****	*****	*****	*****	50 Monthly Average	100 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	10	10			

Surface Water DMR Reporting Requirements:

Submit a Monthly DMR: within twenty-five days after the end of every month beginning from the effective date of the permit (EDP).

Comments:

Outfall DSN001A is for the long term cleanup project. DSN002A and DSN003A are for the temporary construction treatment system. A Chronic WET limit of 61% shall become effective on EDP+3 years.

Table III - A - 2: Surface Water DMR Limits and Monitoring Requirements

PHASE: 2 Final **PHASE Start Date:** 07/01/2013 **PHASE End Date:**

Parameter	Sample Point	Limit	Limit	Units	Limit	Limit	Limit	Units	Frequency	Sample Type
Arsenic	Effluent Gross Value	*****	*****	*****	*****	50 Monthly Average	100 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	8	8			
Mercury, Total (as Hg)	Effluent Gross Value	*****	*****	*****	*****	REPORT Daily Avg Minimum	1 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	1	1			
Acenaphthene	Effluent Gross Value	*****	*****	*****	*****	REPORT Monthly Average	REPORT Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	9.5	9.5			
1,2-Dichlorobenzene	Effluent Gross Value	*****	*****	*****	*****	77 Monthly Average	163 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	9	9			
1,2,4-Trichloro-benzene	Effluent Gross Value	*****	*****	*****	*****	68 Monthly Average	140 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	10	10			
1,3-Dichlorobenzene	Effluent Gross Value	*****	*****	*****	*****	31 Monthly Average	44 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	9	9			
1,4-Dichlorobenzene	Effluent Gross Value	*****	*****	*****	*****	REPORT Monthly Average	28 Daily Maximum	UG/L	1/Month	Grab
January thru December	QL	***	***		***	***	***			

Surface Water DMR Reporting Requirements:

Submit a Monthly DMR: within twenty-five days after the end of every month beginning from the effective date of the permit (EDP).

Comments:

Outfall DSN001A is for the long term cleanup project. DSN002A and DSN003A are for the temporary construction treatment system. A Chronic WET limit of 61% shall become effective on EDP+3 years.

Table III - A - 2: Surface Water DMR Limits and Monitoring Requirements

PHASE: 2 Final **PHASE Start Date:** 07/01/2013 **PHASE End Date:**

Parameter	Sample Point	Limit	Limit	Units	Limit	Limit	Limit	Units	Frequency	Sample Type
Toluene	Effluent Gross Value	*****	*****	*****	*****	26 Monthly Average	80 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	20	20			
Benzene	Effluent Gross Value	*****	*****	*****	*****	37 Monthly Average	136 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	7	7			
Chlorobenzene	Effluent Gross Value	*****	*****	*****	*****	15 Monthly Average	28 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	6	6			
Ethylbenzene	Effluent Gross Value	*****	*****	*****	*****	32 Monthly Average	108 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	6	6			
Methylene Chloride	Effluent Gross Value	*****	*****	*****	*****	40 Monthly Average	89 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	10	10			
Tetrachloroethylene	Effluent Gross Value	*****	*****	*****	*****	22 Monthly Average	56 Daily Maximum	UG/L	1/Quarter	Grab
January thru December	RQL	***	***		***	9	9			
Trichloroethylene	Effluent Gross Value	*****	*****	*****	*****	21 Monthly Average	54 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	5	5			

Surface Water DMR Reporting Requirements:

Submit a Monthly DMR: within twenty-five days after the end of every month beginning from the effective date of the permit (EDP).

Comments:

Outfall DSN001A is for the long term cleanup project. DSN002A and DSN003A are for the temporary construction treatment system. A Chronic WET limit of 61% shall become effective on EDP+3 years.

Table III - A - 2: Surface Water DMR Limits and Monitoring Requirements

PHASE: 2 Final **PHASE Start Date:** 07/01/2013 **PHASE End Date:**

Parameter	Sample Point	Limit	Limit	Units	Limit	Limit	Limit	Units	Frequency	Sample Type
2,4-Dimethylphenol	Effluent Gross Value	*****	*****	*****	*****	18 Monthly Average	36 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	13.5	13.5			
Phenol Single Compound	Effluent Gross Value	*****	*****	*****	*****	15 Monthly Average	26 Daily Maximum	UG/L	1/Month	Grab
January thru December	RQL	***	***		***	10	10			

ATTACHMENT 8
PIEZOMETERS, GROUNDWATER MONITORING WELLS, HYDRAULIC CONTROL WELLS, AND DNAPL RECOVERY WELLS LOGS

BOREHOLE LOG: DRWL-1

DATE DRILLED: 2/28/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 03	DRILLING RIG: Watson
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Bucket Auger(s)
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 32

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		36" Diameter Borehole from 0 to 9.5 ft
1								
2								
3								
4								30" Steel Casing
5								
6								
7								18" o.d. HDPE Riser
8								
9		PT	Meadow Mat					Grout
10								
11								27" Diameter Borehole from 9.5 to 32 ft
12								
13		SM	12.5-13.5' Gray Silty SAND, some Clay					Bentonite Seal
14		SW	13.5-16.75' Brownish gray fm SAND, black stain below 15.5 ft					
15								
16								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-1

DATE DRILLED: 2/28/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 03	DRILLING RIG: Watson
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Bucket Auger(s)
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 32

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
17		SM	16.75-17.75' Grayish brown Silty SAND, with streaks of Sand and product-like material					#1 Sand Pack
18								
19		ML	17.75-20.1' Med Brown SILT					
20								18" o.d. HDPE Screen (20 slot)
21								
22								
23								
24								18" o.d. HDPE Sump
25								
26		CL	Varved Silty Clay					Bentonite Seal
27								
28								
29								
30								
31								
32								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-2

DATE DRILLED: 3/7/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: Jeff Orsini
PROJECT NO: 201011 03	DRILLING RIG: IR DM-45
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 29

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		36" Diameter Borehole from 0 to 8.5 ft
1								
2								30" Steel Casing
3								
4								18" o.d. HDPE riser
5								
6								Grout
7								
8		PT	Meadow Mat					24" Diameter Borehole from 8.5 to 29 ft
9								
10								Bentonite Seal
11		SW	Gray fm Sand					
12								
13								
14		SW	Gray fmc Sand, black staining below 12.5ft					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-2

DATE DRILLED: 3/7/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: Jeff Orsini
PROJECT NO: 201011 03	DRILLING RIG: IR DM-45
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 29

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
15								#1 Sand Pack
16		ML	Medium brown Silt					18" o.d. HDPE screen (20 slot)
17								
18								
19								
20								
21								
22								18" o.d. HDPE Sump
23		CL	Varved Silty Clay					
24								
25								
26								Bentonite Seal
27								
28								
29								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-3

DATE DRILLED: 3/8/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: Jeff Orsini
PROJECT NO: 201011 03	DRILLING RIG: IR DM-45
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 31

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		36" Diameter Borehole from 0 to 10 ft
1								
2								
3								
4								30" Steel Casing
5								
6								Grout
7								
8								18" o.d. HDPE Riser
9		PT	Meadow Mat					
10								27" Diameter Borehole from 10 to 31 ft
11								
12		CL	Gray silty Clay, some sand, dense					
13								Bentonite Seal
14								
15		SW	Gray fm Sand					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-3

DATE DRILLED: 3/8/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: Jeff Orsini
PROJECT NO: 201011 03	DRILLING RIG: IR DM-45
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 31

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
16								#1 Sand Pack
17								
18		ML	Medium brown Silt					18" o.d. HDPE Screen (30 slot)
19								
20								
21								
22								
23								
24								18" o.d. HDPE Sump
25		CL	Varved Silty Clay					
26								
27								Bentonite Seal
28								
29								
30								
31								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-4

DATE DRILLED: 3/10/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: Jeff Orsini
PROJECT NO: 201011 03	DRILLING RIG: IR DM-45
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 31

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		36" Diameter Borehole from 0 to 9.5 ft
1								
2								
3								
4								30" Steel Casing
5								
6								Grout
7								
8								18" o.d. HDPE Riser
9		PT	Meadow Mat					
10								27" Diameter Borehole from 9.5 to 31 ft
11								
12		CL	Gray silty Clay, some dense sand					
13								Bentonite Seal
14		SW	Gray fm Sand					
15								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-4

DATE DRILLED: 3/10/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: Jeff Orsini
PROJECT NO: 201011 03	DRILLING RIG: IR DM-45
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 31

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
16								#1 Sand Pack
17		ML	Medium brown Silt					18" o.d. HDPE Screen (20 slot)
18								
19								
20								
21								
22								
23								
24								18" o.d. HDPE Sump
25		CL	Varved Silty Clay					
26								
27								Bentonite Seal
28								
29								
30								
31								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-5

DATE DRILLED: 3/14/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: Jeff Orsini
PROJECT NO: 201011 03	DRILLING RIG: IR DM-45
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 31

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		36" Diameter Borehole from 0 to 9 ft
1								
2								
3								30" Steel Casing
4								
5								Grout
6								
7		PT	Meadow Mat					18" o.d. HDPE Riser
8								
9								27" Diameter Borehole from 9 to 31 ft
10								
11								
12		CL	Gray silty Clay, some dense sand					Bentonite Seal
13		SM	Gray silty Sand with thin sand streaks					
14								
15								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-5

DATE DRILLED: 3/14/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: Jeff Orsini
PROJECT NO: 201011 03	DRILLING RIG: IR DM-45
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 31

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
16								#1 Sand Pack
17		SW	Gray fm Sand, saturated with product-like material					
18		ML	Medium brown Silt					18" o.d. HDPE Screen (20 slot)
19								
20								
21								
22								
23								
24								18" o.d. HDPE Sump
25		CL	Varved Silty Clay					
26								
27								Bentonite Seal
28								
29								
30								
31								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-6

DATE DRILLED: 2/15/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 03	DRILLING RIG: Watson
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Bucket Auger(s)
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 33

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		36" Diameter Borehole from 0 to 12 ft
1								
2								
3								30" Steel Casing
4								
5								
6								18" o.d. HDPE riser
7								
8								
9								Grout
10								
11		PT	Meadow Mat					27" Diameter Borehole from 12 to 33 ft
12								
13								
14								
15		SP	Brownish gray Sand					Bentonite Seal
		CL	Gray silty Clay, some dense sand					
16								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-6

DATE DRILLED: 2/15/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 03	DRILLING RIG: Watson
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Bucket Auger(s)
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 33

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
17								
18		SW	Gray fm Sand, with product-like material below 20ft					#1 Sand Pack
19								
20								
21								18" o.d. HDPE screen (20 slot)
22								
23								
24								
25								
26								18" o.d. HDPE Sump
27		CL	Varved Silty Clay					
28								
29								
30								
31								Bentonite Seal
32								
33								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-7

DATE DRILLED:

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: Jeff Orsini
PROJECT NO: 201011 03	DRILLING RIG: IR DM-45
FIELD GEOLOGIST: M Valesky	DRILLING METHOD: Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 29

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		36" Diameter Borehole from 0 to 9 ft
1								
2								30" Steel Casing
3								
4								18" o.d. HDPE riser
5								
6								Grout
7		PT	Meadow Mat					
8								
9								24" Diameter Borehole from 9 to 29 ft
10								
11		CL	Light gray Silty CLAY, some dense sand					Bentonite Seal
12								
13		SW	Gray fm Sand					
14								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-7

DATE DRILLED:

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: Jeff Orsini
PROJECT NO: 201011 03	DRILLING RIG: IR DM-45
FIELD GEOLOGIST: M Valesky	DRILLING METHOD: Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 29

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
15								#1 Sand Pack
16		ML	Medium brown Silt					18" o.d. HDPE screen (20 slot)
17								
18								
19								
20								
21								
22								18" o.d. HDPE Sump
23		CL	Varved Silty Clay					
24								
25								
26								Bentonite Seal
27								
28								
29								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-8

DATE DRILLED: 3/9/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: Jeff Orsini
PROJECT NO: 201011 03	DRILLING RIG: IR DM-45
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 31

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		36" Diameter Borehole from 0 to 8 ft
1								
2								
3								30" Steel Casing
4								
5								Grout
6								
7		PT	Meadow Mat					18" o.d. HDPE Riser
8								
9								24" Diameter Borehole from 8 to 31 ft
10								
11		CL	Gray silty Clay, some dense sand					
12								
13								Bentonite Seal
14		SW	Gray fmc Sand					
15								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-8

DATE DRILLED: 3/9/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: Jeff Orsini
PROJECT NO: 201011 03	DRILLING RIG: IR DM-45
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 31

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
16								
17		ML	Medium brown Silt					#2 Sand Pack
18								18" o.d. HDPE Screen (40 slot)
19								
20								
21								
22								
23								
24								
25		CL	Varved Silty Clay					18" o.d. HDPE Sump
26								
27								
28								Bentonite Seal
29								
30								
31								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-9

DATE DRILLED: 3/11/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: Jeff Orsini
PROJECT NO: 201011 03	DRILLING RIG: IR DM-45
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 30.5

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		36" Diameter Borehole from 0 to 11 ft
1								
2								
3								30" Steel Casing
4								
5								
6								Grout
7								
8								18" o.d. HDPE Riser
9		PT	Meadow Mat					
10								
11								24" Diameter Borehole from 11 to 30.5 ft
12								
13		CL	Gray silty Clay, some dense sand					Bentonite Seal
14								
15								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-9

DATE DRILLED: 3/11/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: Jeff Orsini
PROJECT NO: 201011 03	DRILLING RIG: IR DM-45
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 30.5

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
16		SW	Dark brown to black fm Sand, product-like material observed below 17 ft.					#1 Sand Pack
17								
18								18" o.d. HDPE Screen (20 slot)
19		CL	Varved Silty Clay					
20								
21								
22								
23								
24								18" o.d. HDPE Sump
25								
26								
27								Bentonite Seal
28								
29								
30								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-10

DATE DRILLED: 3/15/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: Jeff Orsini
PROJECT NO: 201011 03	DRILLING RIG: IR DM-45
FIELD GEOLOGIST: M Valesky	DRILLING METHOD: Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 31.75

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Gray silty clayey Sand, with some fm gravel/rock fragments	N/A	N/A	N/A		36" Diameter Borehole from 0 to 11 ft
1								
2								
3								30" Steel Casing
4								
5								
6		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					Grout
7								
8								18" o.d. HDPE Riser
9								
10		PT	Meadow Mat					
11								24" Diameter Borehole from 11 to 31.75 ft
12								
13								
14								Bentonite Seal
15								
16		CL	Gray silty Clay, some dense sand					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-10

DATE DRILLED: 3/15/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: Jeff Orsini
PROJECT NO: 201011 03	DRILLING RIG: IR DM-45
FIELD GEOLOGIST: M Valesky	DRILLING METHOD: Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 31.75

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
17		SW	Gray fm Sand, dark staining below 19.25 ft, saturated w/strong odor/sheen					#1 Sand Pack
18								18" o.d. HDPE Screen (20 slot)
19								
20		ML	Medium brown Silt					
21		CL	Varved Silty Clay					
22								
23								
24								18" o.d. HDPE Sump
25								
26								
27								Bentonite Seal
28								
29								
30								
31								
32								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-11

DATE DRILLED: 3/16/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: Jeff Orsini
PROJECT NO: 201011 03	DRILLING RIG: IR DM-45
FIELD GEOLOGIST: M Valesky	DRILLING METHOD: Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 34.7

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0				N/A	N/A	N/A		36" Diameter Borehole from 0 to 11.5 ft
1								
2								
3			Gray silty clayey Sand, with fm gravel/rock fragments					30" Steel Casing
4								
5								
6								18" o.d. HDPE riser
7								
8		N/A	Cinder/slag material, with tar-like material, wet					
9								Grout
10								
11								
12								24" Diameter Borehole from 11.5 to 34.7 ft
13		PT	Meadow Mat					
14								
15								Bentonite Seal
16								
17		CL	Grayish brown silty Clay, some dense sand					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWL-11

DATE DRILLED: 3/16/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: Jeff Orsini
PROJECT NO: 201011 03	DRILLING RIG: IR DM-45
FIELD GEOLOGIST: M Valesky	DRILLING METHOD: Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 34.7

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
18								#1 Sand Pack
19								
20		SW	Dark gray to black fm SAND, saturated, strong odor, w/product like material below 20 ft					
21								18" o.d. HDPE screen (20 slot)
22								
23								
24								
25								
26								18" o.d. HDPE Sump
27								
28								
29		CL	Varved Silty Clay					
30								
31								Bentonite Seal
32								
33								
34								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWU-1

DATE DRILLED: 2/24/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 03	DRILLING RIG: Watson
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Bucket Auger(s)
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 10.5

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0				N/A	N/A	N/A		Grout
								30" Diameter Borehole
1								Bentonite Seal
2								18" o.d. HDPE Riser
3		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel, with product-like material below 6ft					
4								
5								18" o.d. HDPE Screen (20 slot)
6								
								#1 Sand Pack
7								
8		PT	Meadow Mat					
9								18" o.d. HDPE Sump
10								Bentonite Seal

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWU-2

DATE DRILLED: 2/24/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 03	DRILLING RIG: Watson
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Bucket Auger(s)
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 11

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel, with some product-like material below 6 ft	N/A	N/A	N/A		30" Diameter Borehole
1								Grout
2								18" o.d. HDPE Riser
3								
4								Bentonite Seal
5								#2 Sand Pack
6								
7								
8								18" o.d. HDPE Screen (40 slot)
9		PT	Meadow Mat					
10								18" o.d. HDPE Sump
11								Bentonite Seal

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWU-3

DATE DRILLED: 2/15/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 03	DRILLING RIG: Watson
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Bucket Auger(s)
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 16

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel, with product-like material below 12.5ft	N/A	N/A	N/A		30" Diameter Borehole
1								Grout
2								
3								18" o.d. HDPE Riser
4								
5								Bentonite Seal
6								
7								
8								
9								#0 Sand Pack
10								
11								18" o.d. HDPE Screen (10 slot)
12								
13								
14		PT	Meadow Mat					18" o.d. HDPE Sump
15								Bentonite Seal
16								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWU-4

DATE DRILLED: 2/23/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 03	DRILLING RIG: Watson
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Bucket Auger(s)
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 14

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel, with some product-like material below 7.8ft	N/A	N/A	N/A		30" Diameter Borehole
1								
2								Grout
3								
4								Bentonite Seal
5								18" o.d. HDPE Riser
6								
7								#1 Sand Pack
8								
9		PT	Meadow Mat					18" o.d. HDPE Screen (20 slot)
10								
11								
12								18" o.d. HDPE Sump
13								
14								Bentonite Seal

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: DRWU-5

DATE DRILLED: 2/23/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 03	DRILLING RIG: Watson
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Bucket Auger(s)
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 10.5

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		30" Diameter Borehole
								Grout
1								
2								Bentonite Seal
3								18" o.d. HDPE Riser
4								
5								#1 Sand Pack
6								
7								18" o.d. HDPE Screen (30 slot)
8		PT	Meadow Mat					18" o.d. HDPE Sump
9								
10								Bentonite Seal

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-1

DATE DRILLED: 2/4/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 15.77

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								
2								Bentonite Seal
3								
4								6" o.d. PVC Riser
5								
6								
7								
8								#1 Sand Pack
9								
10								
11								6" o.d. PVC Screen (20 slot)
12								
13								
14								
15		PT	Meadow Mat					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-2

DATE DRILLED: 2/3/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 16

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								
2								Bentonite Seal
3								6" o.d. PVC Riser
4								
5								#1 Sand Pack
6								
7								
8								
9								
10								6" o.d. PVC Screen (20 slot)
11								
12								
13								
14								
15		PT	Meadow Mat					
16								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-3

DATE DRILLED: 2/3/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 15.45

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								Bentonite Seal
2								6" o.d. PVC Riser
3								
4								#1 Sand Pack
5								
6								
7								
8								
9								
10								6" o.d. PVC Screen (20 slot)
11								
12								
13								
14								
15		PT	Meadow Mat					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-4

DATE DRILLED: 2/3/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 14.95

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0				N/A	N/A	N/A		12" Diameter Borehole
1								
2								Bentonite Seal
3								
4								6" o.d. PVC Riser
5								
6								
7		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					#1 Sand Pack
8								
9								
10								
11								6" o.d. PVC Screen (20 slot)
12								
13								
14		PT	Meadow Mat					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-5

DATE DRILLED: 2/4/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 13.45

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								Bentonite Slurry
2								
3								6" o.d. PVC Riser
4								
5								Bentonite Seal
6								
7								#1 Sand Pack
8								
9								
10								6" o.d. PVC Screen (20 slot)
11								
12								
13		PT	Meadow Mat					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-6

DATE DRILLED: 2/8/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 11.75

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								
2								Bentonite Seal
3								6" o.d. PVC Riser
4								
5								#1 Sand Pack
6								
7								6" o.d. PVC Screen (20 slot)
8								
9								
10								
11		PT	Meadow Mat					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-7

DATE DRILLED: 2/7/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 9.78

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								Bentonite Seal
2								6" o.d. PVC Riser
3								
4								#1 Sand Pack
5								
6								6" o.d. PVC Screen (20 slot)
7								
8								
9		PT	Meadow Mat					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-8

DATE DRILLED: 2/7/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 13.49

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								Bentonite Slurry
2								
3								6" o.d. PVC Riser
4								
5								Bentonite Seal
6								
7								#1 Sand Pack
8								
9								
10								6" o.d. PVC Screen (20 slot)
11								
12								
13		PT	Meadow Mat					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-9

DATE DRILLED: 2/7/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 8.88

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								Bentonite Seal
2								6" o.d. PVC Riser
3								
4								#1 Sand Pack
5								
6								6" o.d. PVC Screen (20 slot)
7								
8		PT	Meadow Mat					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-10

DATE DRILLED: 2/9/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 8.5

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								Bentonite Seal
2								
3								6" o.d. PVC Riser
4								#1 Sand Pack
5								
6								6" o.d. PVC Screen (20 slot)
7								
8		PT	Meadow Mat					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-11

DATE DRILLED: 2/8/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 9.9

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								Bentonite Seal
2								6" o.d. PVC Riser
3								
4								#1 Sand Pack
5								
6								6" o.d. PVC Screen (20 slot)
7								
8								
9		PT	Meadow Mat					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-12

DATE DRILLED: 2/8/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 10.43

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								Bentonite Seal
2								6" o.d. PVC Riser
3								
4								#1 Sand Pack
5								
6								6" o.d. PVC Screen (20 slot)
7								
8								
9								
10		PT	Meadow Mat					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-13

DATE DRILLED: 2/1/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 10.41

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								Bentonite Seal
2								6" o.d. PVC Riser
3								
4								#1 Sand Pack
5								
6								6" o.d. PVC Screen (20 slot)
7								
8								
9								
10		PT	Meadow Mat					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-14

DATE DRILLED: 2/9/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 7.71

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								Bentonite Seal
2								6" o.d. PVC Riser
3								
4								#1 Sand Pack
5								
6								6" o.d. PVC Screen (20 slot)
7		PT	Meadow Mat					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-15

DATE DRILLED: 1/28/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 9.9

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								Bentonite Seal
2								6" o.d. PVC Riser
3								
4								#1 Sand Pack
5								
6								6" o.d. PVC Screen (20 slot)
7								
8								
9		PT	Meadow Mat					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-17

DATE DRILLED: 1/31/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 9.17

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								Bentonite Seal
2								6" o.d. PVC Riser
3								
4								#1 Sand Pack
5								
6								6" o.d. PVC Screen (20 slot)
7								
8		PT	Meadow Mat					
9								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-18

DATE DRILLED: 2/11/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 8

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0				N/A	N/A	N/A		12" Diameter Borehole
1								Bentonite Seal
2								6" o.d. PVC Riser
3		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
4								#1 Sand Pack
5								
6								6" o.d. PVC Screen (20 slot)
7		PT	Meadow Mat					
8								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-19

DATE DRILLED: 2/1/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 9.83

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								Bentonite Seal
2								6" o.d. PVC Riser
3								
4								#1 Sand Pack
5								
6								6" o.d. PVC Screen (20 slot)
7								
8								
9		PT	Meadow Mat					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-20

DATE DRILLED: 2/1/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 9.29

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								Bentonite Seal
2								6" o.d. PVC Riser
3								
4								#1 Sand Pack
5								
6								6" o.d. PVC Screen (30 slot)
7								
8		PT	Meadow Mat					
9								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-21

DATE DRILLED: 2/10/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 12.82

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								
2								Bentonite Seal
3								
4								6" o.d. Stainless Steel Riser
5								#1 Sand Pack
6								
7								6" o.d. Stainless Steel Screen (20 slot)
8								
9								
10								
11								
12		PT	Meadow Mat					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-22

DATE DRILLED: 2/11/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 10.25

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								Bentonite Seal
2								6" o.d. PVC Riser
3								
4								#1 Sand Pack
5								
6								6" o.d. PVC Screen (20 slot)
7								
8								
9		PT	Meadow Mat					
10								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-23

DATE DRILLED: 2/10/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 17

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0				N/A	N/A	N/A		12" Diameter Borehole
1								
2								Bentonite Seal
3								
4								6" o.d. PVC Riser
5								
6								#1 Sand Pack
7								
8		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
9								
10								6" o.d. PVC Screen (20 slot)
11								
12								
13								
14								
15								
16		PT	Meadow Mat					
17								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-24

DATE DRILLED: 2/11/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 14

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								Bentonite Seal
2								6" o.d. PVC Riser
3								
4								
5								
6								
7								#1 Sand Pack
8								
9								
10								6" o.d. PVC Screen (20 slot)
11								
12								
13		PT	Meadow Mat					
14								

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-25

DATE DRILLED: 2/9/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 16.75

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								Bentonite Slurry
2								
3								Bentonite Seal
4								
5								6" o.d. PVC Riser
6								
7								
8								#1 Sand Pack
9								
10								
11								6" o.d. PVC Screen (20 slot)
12								
13								
14								
15								
16		PT	Meadow Mat					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HCWU-26

DATE DRILLED: 2/10/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Mooretrench
SITE LOCATION: Kearny, NJ	DRILLER: William Hess
PROJECT NO: 201011 02	DRILLING RIG: Simco
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Wash Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: TBD N: TBD	ELEVATION: GND SURF: TBD TOC: TBD
DATUM: TBD	TOTAL DEPTH: 15.5

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		12" Diameter Borehole
1								
2								Bentonite Seal
3								6" o.d. PVC Riser
4								
5								#1 Sand Pack
6								
7								
8								
9								
10								6" o.d. PVC Screen (20 slot)
11								
12								
13								
14								
15		PT	Meadow Mat					

NOTES:

Draft Log - To be finalized upon well-head completion

BOREHOLE LOG: HC-PZ-1L

DATE DRILLED: 12/21/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 601891.8 N: 698408.4	ELEVATION: GND SURF: 11.8 ft. TOC: 11.8 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 25 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0				N/A	N/A	N/A		10" Diameter Borehole
1								
2								
3								
4								6" Steel Casing
5								
6								
7								2" PVC Riser
8								
9		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					Grout
10								
11								
12								

NOTES:

BOREHOLE LOG: HC-PZ-1L

DATE DRILLED: 12/21/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 601891.8 N: 698408.4	ELEVATION: GND SURF: 11.8 ft. TOC: 11.8 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 25 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
13								
14								
15								Bentonite Seal
16								
17								#00 Sand Pack
18								
19		PT	Meadow Mat					6" Diameter Borehole
20								#1 Sand Pack
21								
22		SW	Deep Sand					
23								2" PVC Well Screen (10 slot)
24								
25		CL	Varved Silty Clay					

NOTES:

BOREHOLE LOG: HC-PZ-1U

DATE DRILLED: 12/20/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: Hollow Stem Auger
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 601900.3 N: 698402.2	ELEVATION: GND SURF: 11.5 ft. TOC: 11.5 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 17 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	0		6" Diameter Borehole
1								
2								
3								Grout
4								
5								2" o.d. PVC Riser
6								
7								
8								Bentonite Seal
9								#00 Sand
10								
11								#1 Sand Pack
12								
13								
14								2" o.d. PVC Screen (10 slot)
15								
16								
17		PT	Meadow Mat					

NOTES:

BOREHOLE LOG: HC-PZ-2L

DATE DRILLED: 12/21/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 601863.4 N: 698421.9	ELEVATION: GND SURF: 12.8 ft. TOC: 12.8 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 25 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0				N/A	N/A	N/A		10" Diameter Borehole
1								
2								
3								
4								6" Steel Casing
5								
6								
7								2" PVC Riser
8		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
9								Grout
10								
11								
12								

NOTES:

BOREHOLE LOG: HC-PZ-2L

DATE DRILLED: 12/21/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 601863.4 N: 698421.9	ELEVATION: GND SURF: 12.8 ft. TOC: 12.8 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 25 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
13								
14								
15								Bentonite Seal
16								
17		PT	Meadow Mat					#00 Sand Pack
18								
19								6" Diameter Borehole
20								#1 Sand Pack
21		SW	Deep Sand					
22								
23								2" PVC Well Screen (10 slot)
24								
25		CL	Varved Silty Clay					

NOTES:

BOREHOLE LOG: HC-PZ-2U

DATE DRILLED: 12/20/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: Hollow Stem Auger
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 601869.8 N: 698411.4	ELEVATION: GND SURF: 11.8 ft. TOC: 11.8 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 16.5 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0				N/A	N/A	0		6" Diameter Borehole
1								
2								
3								Grout
4								
5								2" o.d. PVC Riser
6								
7								Bentonite Seal
8		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
9								#00 Sand
10								
11								#1 Sand Pack
12								
13								
14								2" o.d. PVC Screen (10 slot)
15								
16		PT	Meadow Mat					

NOTES:

BOREHOLE LOG: HC-PZ-3L

DATE DRILLED: 12/14/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 602718.2 N: 698796.5	ELEVATION: GND SURF: 10.7 ft. TOC: 10.7 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 24 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0				N/A	N/A	N/A		10" Diameter Borehole
1								
2								
3								
4								6" Steel Casing
5								
6								
7		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					2" PVC Riser
8								
9								Grout
10								
11								
12								

NOTES:

BOREHOLE LOG: HC-PZ-3L

DATE DRILLED: 12/14/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 602718.2 N: 698796.5	ELEVATION: GND SURF: 10.7 ft. TOC: 10.7 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 24 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
13								
14								
15								Bentonite Seal
16		PT	Meadow Mat					#00 Sand Pack
17								
18								
19								6" Diameter Borehole
20								#1 Sand Pack
21		SW	Deep Sand					
22								
23								2" PVC Well Screen (10 slot)
24		CL	Varved Silty Clay					

NOTES:

BOREHOLE LOG: HC-PZ-3U

DATE DRILLED: 12/12/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: Hollow Stem Auger
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 602669.3 N: 698774.3	ELEVATION: GND SURF: 10.7 ft. TOC: 10.7 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 15 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	0		6" Diameter Borehole
1								
2								Grout
3								
4								2" o.d. PVC Riser
5								
6								Bentonite Seal
7								#00 Sand
8								
9								
10								
11								#1 Sand Pack
12								
13								
14								2" o.d. PVC Screen
15		PT	Meadow Mat					

NOTES:

BOREHOLE LOG: HC-PZ-4L

DATE DRILLED: 12/14/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 602707 N: 698822.1	ELEVATION: GND SURF: 10 ft. TOC: 10 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 20.5 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0				N/A	N/A	N/A		10" Diameter Borehole
1								
2								
3								
4								6" Steel Casing
5								
6								
7		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					2" PVC Riser
8								
9								Grout
10								

NOTES:

BOREHOLE LOG: HC-PZ-4L

DATE DRILLED: 12/14/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 602707 N: 698822.1	ELEVATION: GND SURF: 10 ft. TOC: 10 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 20.5 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
11								Bentonite Seal
12								
13								#00 Sand Pack
14								
15		PT	Meadow Mat					6" Diameter Borehole
16								
17								#1 Sand Pack
18		SW	Deep Sand					
19								2" PVC Well Screen (10 slot)
20		CL	Varved Silty Clay					

NOTES:

BOREHOLE LOG: HC-PZ-6L

DATE DRILLED: 12/9/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 603380.3 N: 699140.3	ELEVATION: GND SURF: 7.1 ft. TOC: 7.1 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 17.5 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		10" Diameter Borehole
1								
2								Grout
3								
4								6" Steel Casing
5								
6								2" PVC Riser
7								
8								Bentonite Seal

NOTES:

BOREHOLE LOG: HC-PZ-6L

DATE DRILLED: 12/9/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 603380.3 N: 699140.3	ELEVATION: GND SURF: 7.1 ft. TOC: 7.1 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 17.5 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
9								Bentonite Seal
10		PT	Meadow Mat					#00 Sand Pack
11								6" Diameter Borehole
12		SW	Deep Sand					
13								#1 Sand Pack
14								
15								
16								2" PVC Well Screen (10 slot)
17		CL	Varved Silty Clay					

NOTES:

BOREHOLE LOG: HC-PZ-6U

DATE DRILLED: 12/5/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: Hollow Stem Auger
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 603344.4 N: 699123.8	ELEVATION: GND SURF: 7.7 ft. TOC: 7.7 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 10 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	0		6" Diameter Borehole
1								Grout
								Bentonite Seal
2								#00 Sand
3								2" o.d. PVC Riser
4								#1 Sand Pack
5								
6								
7								
8								
9								2" o.d. PVC Screen (10 slot)
10		PT	Meadow Mat					

NOTES:

BOREHOLE LOG: HC-PZ-7L

DATE DRILLED: 12/8/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 603403.7 N: 699089.5	ELEVATION: GND SURF: 6.6 ft. TOC: 6.6 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 17.5 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		10" Diameter Borehole
1								
2								Grout
3								
4								6" Steel Casing
5								
6								2" PVC Riser
7								
8								Bentonite Seal

NOTES:

BOREHOLE LOG: HC-PZ-7L

DATE DRILLED: 12/8/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 603403.7 N: 699089.5	ELEVATION: GND SURF: 6.6 ft. TOC: 6.6 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 17.5 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
9								Bentonite Seal
10		PT	Meadow Mat					#00 Sand Pack
11								6" Diameter Borehole
12		SW	Deep Sand					
13								#1 Sand Pack
14								
15								
16								2" PVC Well Screen (10 slot)
17		CL	Varved Silty Clay					

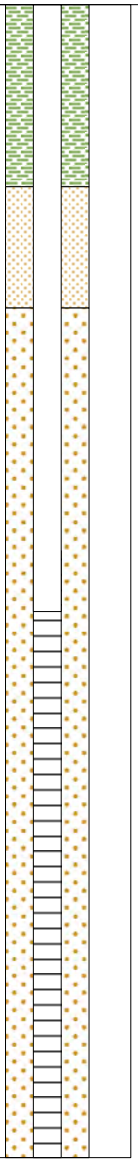
NOTES:

BOREHOLE LOG: HC-PZ-7U

DATE DRILLED: 12/6/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: Hollow Stem Auger
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 603367.4 N: 699070.9	ELEVATION: GND SURF: 7 ft. TOC: 7 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 9.5 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	0		6" Diameter Borehole
1								Bentonite Seal
2								#00 Sand
3								2" o.d. PVC Riser
4								
5								#1 Sand Pack
6								
7								
8								2" o.d. PVC Screen (10 slot)
9		PT	Meadow Mat					



NOTES:

BOREHOLE LOG: HC-PZ-8L

DATE DRILLED: 11/19/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Dan
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 604210.2 N: 697752.4	ELEVATION: GND SURF: 8.9 ft. TOC: 8.9 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 21.5 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0				N/A	N/A	N/A		10" Diameter Borehole
1								
2								
3								
4								6" Steel Casing
5		N/A	Processed Dredge Material					
6								
7								2" PVC Riser
8								
9								Grout
10								

NOTES:

BOREHOLE LOG: HC-PZ-8L

DATE DRILLED: 11/19/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Dan
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 604210.2 N: 697752.4	ELEVATION: GND SURF: 8.9 ft. TOC: 8.9 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 21.5 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
11								
12								Bentonite Seal
13		PT	Meadow Mat					
14								#00 Sand Pack
15								6" Diameter Borehole
16								
17								#1 Sand Pack
18		SW	Deep Sand					
19								2" PVC Well Screen (10 slot)
20								
21		CL	Varved Silty Clay					

NOTES:

BOREHOLE LOG: HC-PZ-8U

DATE DRILLED: 11/21/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Hollow Stem Auger
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 604188.7 N: 697734.1	ELEVATION: GND SURF: 8.9 ft. TOC: 8.9 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 12 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	0		6" Diameter Borehole
1								Grout
2								2" o.d. PVC Riser
3								Bentonite Seal
4								#00 Sand
5								
6								#1 Sand Pack
7								
8								2" o.d. PVC Screen (10 slot)
9								
10								
11								
12		PT	Meadow Mat					

NOTES:

BOREHOLE LOG: HC-PZ-9L

DATE DRILLED: 11/19/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Dan
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 604220.4 N: 697735.6	ELEVATION: GND SURF: 9.2 ft. TOC: 9.2 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 21 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0				N/A	N/A	N/A		10" Diameter Borehole
1								
2								
3								
4								6" Steel Casing
5		N/A	Processed Dredge Material					
6								
7								2" PVC Riser
8								
9								Grout
10								

NOTES:

BOREHOLE LOG: HC-PZ-9L

DATE DRILLED: 11/19/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Dan
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 604220.4 N: 697735.6	ELEVATION: GND SURF: 9.2 ft. TOC: 9.2 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 21 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
11								
12		PT	Meadow Mat					Bentonite Seal
13								#00 Sand Pack
14								
15		SW	Deep Sand					6" Diameter Borehole
16								
17								#1 Sand Pack
18								
19								2" PVC Well Screen (10 slot)
20								
21		CL	Varved Silty Clay					

NOTES:

BOREHOLE LOG: HC-PZ-9U

DATE DRILLED: 11/21/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: HC-PZ-9U	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: Hollow Stem Auger
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 604203.8 N: 697718	ELEVATION: GND SURF: 9.2 ft. TOC: 9.2 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 13 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	0		6" Diameter Borehole
1								Grout
2								2" o.d. PVC Riser
3								
4								Bentonite Seal
5								
6								#00 Sand
7								#1 Sand Pack
8								
9								2" o.d. PVC Screen (10 slot)
10								
11								
12								
13		PT	Meadow Mat					

NOTES:

BOREHOLE LOG: HC-PZ-10L

DATE DRILLED: 12/1/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: ATV
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 603636.4 N: 697482	ELEVATION: GND SURF: 6.8 ft. TOC: 6.8 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 19 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		10" Diameter Borehole
1								
2								Grout
3								
4								6" Steel Casing
5								
6								
7								2" PVC Riser
8								
9								

NOTES:

BOREHOLE LOG: HC-PZ-10L

DATE DRILLED: 12/1/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: ATV
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 603636.4 N: 697482	ELEVATION: GND SURF: 6.8 ft. TOC: 6.8 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 19 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		PT	Meadow Mat					Bentonite Seal
11								#00 Sand Pack
12								
13		SW	Deep Sand					6" Diameter Borehole
14								
15								#1 Sand Pack
16								
17								2" PVC Well Screen (10 slot)
18								
19		CL	Varved Silty Clay					

NOTES:

BOREHOLE LOG: HC-PZ-10U

DATE DRILLED: 11/30/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: Hollow Stem Auger
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 603589.8 N: 697490.6	ELEVATION: GND SURF: 6.6 ft. TOC: 6.6 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 10 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	0		6" Diameter Borehole
								Grout
1								Bentonite Seal
2								#00 Sand
3								2" o.d. PVC Riser
4								#1 Sand Pack
5								
6								
7								
8								
9								2" o.d. PVC Screen (10 slot)
10		PT	Meadow Mat					

NOTES:

BOREHOLE LOG: HC-PZ-11L

DATE DRILLED: 12/2/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: ATV
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 603638.3 N: 697455.2	ELEVATION: GND SURF: 7.4 ft. TOC: 7.4 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 19.5 ft.

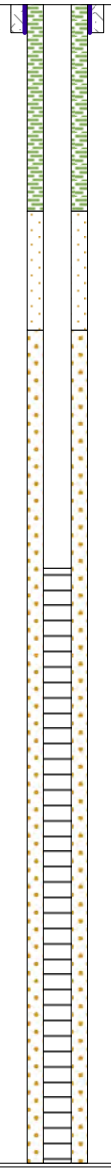
Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		10" Diameter Borehole
1								
2								Grout
3								
4								6" Steel Casing
5								
6								
7								2" PVC Riser
8								
9								

NOTES:

BOREHOLE LOG: HC-PZ-11L

DATE DRILLED: 12/2/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: ATV
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 603638.3 N: 697455.2	ELEVATION: GND SURF: 7.4 ft. TOC: 7.4 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 19.5 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		PT	Meadow Mat					Bentonite Seal
11								
12								#00 Sand Pack
13								6" Diameter Borehole
14		SW	Deep Sand					
15								#1 Sand Pack
16								
17								2" PVC Well Screen (10 slot)
18								
19		CL	Varved Silty Clay					

NOTES:

BOREHOLE LOG: HC-PZ-11U

DATE DRILLED: 11/30/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: Hollow Stem Auger
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 603588.4 N: 697465.4	ELEVATION: GND SURF: 7.3 ft. TOC: 7.3 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 10.5 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0				N/A	N/A	0		6" Diameter Borehole
1								Grout
2								Bentonite Seal
3								#00 Sand
4								2" o.d. PVC Riser
5		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
6								#1 Sand Pack
7								
8								2" o.d. PVC Screen (10 slot)
9								
10		PT	Meadow Mat					

NOTES:

BOREHOLE LOG: HC-PZ-12L

DATE DRILLED: 11/29/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 602970 N: 697615.8	ELEVATION: GND SURF: 5.6 ft. TOC: 5.6 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 16 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0				N/A	N/A	N/A		10" Diameter Borehole
1								
2								Grout
3								
4								6" Steel Casing
5		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
								2" PVC Riser
6								
7								Bentonite Seal
8								

NOTES:

BOREHOLE LOG: HC-PZ-12L

DATE DRILLED: 11/29/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 602970 N: 697615.8	ELEVATION: GND SURF: 5.6 ft. TOC: 5.6 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 16 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
8								#00 Sand Pack
9								
10		PT	Meadow Mat					6" Diameter Borehole
11								
12								
13		SW	Deep Sand					#1 Sand Pack
14								
15								2" PVC Well Screen (10 slot)
16		CL	Varved Silty Clay					

NOTES:

BOREHOLE LOG: HC-PZ-12U

DATE DRILLED: 11/27/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: Hollow Stem Auger
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 602960.2 N: 697634.3	ELEVATION: GND SURF: 6.3 ft. TOC: 6.3 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 9 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	0		6" Diameter Borehole
1								Bentonite Seal
								#00 Sand
2								
3								2" o.d. PVC Riser
4								
								#1 Sand Pack
5								
6								
7								
								2" o.d. PVC Screen (10 slot)
8								
9		PT	Meadow Mat					

NOTES:

BOREHOLE LOG: HC-PZ-13L

DATE DRILLED: 11/28/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 602918.7 N: 697599.9	ELEVATION: GND SURF: 5.4 ft. TOC: 5.4 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 16.5 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		10" Diameter Borehole
1								
2								Grout
3								
4								6" Steel Casing
5								2" PVC Riser
6								
7								Bentonite Seal
8								

NOTES:

BOREHOLE LOG: HC-PZ-13L

DATE DRILLED: 11/28/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 602918.7 N: 697599.9	ELEVATION: GND SURF: 5.4 ft. TOC: 5.4 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 16.5 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
9		PT	Meadow Mat					#00 Sand Pack
10								
11		SW	Deep Sand					6" Diameter Borehole
12								
13								#1 Sand Pack
14								
15								2" PVC Well Screen (10 slot)
16		CL	Varved Silty Clay					

NOTES:

BOREHOLE LOG: HC-PZ-13U

DATE DRILLED: 11/22/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: Hollow Stem Auger
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 602921.9 N: 697617.2	ELEVATION: GND SURF: 5.7 ft. TOC: 5.7 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 8.5 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	0		6" Diameter Borehole
1								Bentonite Seal
								#00 Sand
2								2" o.d. PVC Riser
3								
4								#1 Sand Pack
5								
6								
7								2" o.d. PVC Screen (10 slot)
8		PT	Meadow Mat					

NOTES:

BOREHOLE LOG: HC-PZ-14L

DATE DRILLED: 12/21/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 602475.2 N: 697789.4	ELEVATION: GND SURF: 7 ft. TOC: 7 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 19 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	N/A		10" Diameter Borehole
1								
2								Grout
3								
4								6" Steel Casing
5								
6								
7								2" PVC Riser
8								
9								

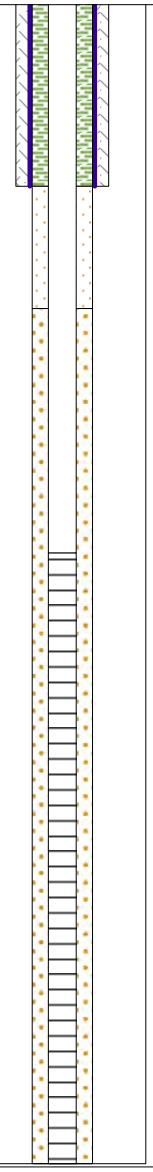
NOTES:

BOREHOLE LOG: HC-PZ-14L

DATE DRILLED: 12/21/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 602475.2 N: 697789.4	ELEVATION: GND SURF: 7 ft. TOC: 7 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 19 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10								Bentonite Seal
11		PT	Meadow Mat					#00 Sand Pack
12								
13								6" Diameter Borehole
14								
15								#1 Sand Pack
16		SW	Deep Sand					
17								2" PVC Well Screen (10 slot)
18								
19		CL	Varved Silty Clay					



NOTES:

BOREHOLE LOG: HC-PZ-14U

DATE DRILLED: 11/30/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: Hollow Stem Auger
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 602482.7 N: 697780.3	ELEVATION: GND SURF: 7.1 ft. TOC: 7.1 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 10.5 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	0		6" Diameter Borehole
1								Grout
2								Bentonite Seal
3								#00 Sand
4								2" o.d. PVC Riser
5								
6								#1 Sand Pack
7								
8								2" o.d. PVC Screen (10 slot)
9								
10		PT	Meadow Mat					

NOTES:

BOREHOLE LOG: HC-PZ-15U

DATE DRILLED: 12/15/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: Hollow Stem Auger
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 602455.6 N: 697753.8	ELEVATION: GND SURF: 9 ft. TOC: 9 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 12 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel	N/A	N/A	0		6" Diameter Borehole
1								Grout
2								2" o.d. PVC Riser
3								Bentonite Seal
4								#00 Sand
5								
6								#1 Sand Pack
7								
8								2" o.d. PVC Screen (10 slot)
9								
10								
11								
12		PT	Meadow Mat					

NOTES:

BOREHOLE LOG: HC-MW-16L

DATE DRILLED: 12/15/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 602444.7 N: 697765.5	ELEVATION: GND SURF: 8.9 ft. TOC: 8.9 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 20 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0				N/A	N/A	N/A		10" Diameter Borehole
1								
2								Grout
3								
4								6" Steel Casing
5								
6		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
7								2" PVC Riser
8								
9								
10								

NOTES:

BOREHOLE LOG: HC-MW-16L

DATE DRILLED: 12/15/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Brad Panaia
PROJECT NO: 201114	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jim Zubrow	SAMPLING METHOD: N/A
COORDINATES: E: 602444.7 N: 697765.5	ELEVATION: GND SURF: 8.9 ft. TOC: 8.9 ft.
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 20 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10								Bentonite Seal
11								
12								#00 Sand Pack
13		PT	Meadow Mat					6" Diameter Borehole
14								
15								#1 Sand Pack
16								
17		SW	Deep Sand					
18								
19								2" PVC Well Screen (10 slot)
20		CL	Varved Silty Clay					

NOTES:

ATTACHMENT 9
STANDARD OPERATING PROCEDURE:
DNAPL RECOVERY OPERATION

SOP – DNAPL RECOVERY OPERATION

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) describes procedures to be followed for recovering dense non-aqueous phase liquids (DNAPL) from recovery wells using a non-dedicated air diaphragm pump coupled with a gasoline powered compressor at the Cooperating Party Group's Standard Chlorine Chemical Co., (SCCC) site located in Kearny, NJ. DNAPL recovery field operations will be completed in accordance with the Health and Safety Plan (HASP) and as described herein.

2.0 REQUIRED MATERIALS

The following list identifies the preferred types of equipment and materials to be used when recovering DNAPL from recovery wells.

- Items listed in the HASP;
- Field Note Book and/or DNAPL recovery log sheets (Attachment A);
- Interface meter;
- Plastic sheeting;
- Absorbent pads;
- Spill kit, including: oil dry, absorbent booms, shovel, trash bags;
- Appropriate Standard Level D PPE for including: nitrile or latex gloves, steel toed work boots, hardhat, safety glasses and Tyvek;
- Suitable storage container for the DNAPL present (55-gallon drums and/or dedicated 55-gallon poly container);
- Air diaphragm pump with appropriate air supply hose and quick connect air fittings;
- Gasoline powered air compressor;
- Decontamination solutions (acetone, Liquinox®); and,
- Paper towels.

3.0 METHODOLOGY

3.1 This section describes how to determine when DNAPL accumulation has achieved a sufficient volume to initiate recovery.

- Place a clean piece of plastic sheeting on the ground adjacent to the DNAPL recovery well in the area which you will be working in order to contain minor spills and keep monitoring equipment from contacting the ground;

- Identify the DNAPL recovery well being evacuated and record date and time on the associated DNAPL recovery data log;

- Observations of the particular well vault are to be recorded in the "notes" column of the DNAPL recovery form. Items to be noted:

  - Operational status of the DNAPL recovery well groundwater pump (on or off);
  - Level of water accumulated in the well vault relative to the ground surface and top of casing (TOC) elevation;
  - Note if a sheen is present within the well vault;
    - If a NAPL sheen is present within a well vault, install a floating hydrophobic pad to capture, contain, and recover the NAPL.

- Lower the interface meter into the well and record the depth to water, depth to DNAPL, and total depth measurements onto the HCTS Well Network Gauging Form:

  - Typically interface probes provide an audible tone to differentiate between NAPL and water matrix. Intermittent audible alarms typically indicate groundwater has been encountered by the probe, while a solid audible tone indicates NAPL has been encountered. Confirm operational details of the interface probe if you are unsure.

- Slowly reel up the interface meter tape and wipe clean using the decontamination solution and paper towels:

  - Always observe visual NAPL staining (if possible) on the interface probe tape as you extract the tooling from the well to confirm audible indicator alarm measurements. Depending on the matrix of the NAPL being measured, a clear and accurate audible tone may not be achievable and hence, observed staining on the interface probe tape becomes necessary to qualify NAPL thickness.

- Calculate the DNAPL thickness by subtracting the total depth measurement from the depth to the DNAPL/groundwater interface measurement. If product thickness exceeds the threshold of 5.00 feet, DNAPL recovery is required.

- Estimate the total volume of DNAPL present by multiplying the DNAPL thickness by 13.22 gallons per foot to determine gallons of DNAPL contained within the well.

- The total volume of DNAPL calculated can then be used to estimate the required number of 55-gallon DOT approved drums needed to containerize the DNAPL for transport and subsequent off-site disposal at an approved facility.

- Reference the Site Specific Waste Management Guide (Attachment B) to ensure proper waste stream guidance is followed. The Waste Management Guide was generated for HCTS and DNAPL recovery wells and will need to be updated as necessary as DNAPL recovery efforts are expanded. All waste generated under separate waste classes should be pumped, transferred, stored, and labeled separately.

3.2 This section describes how to prepare for and recover DNAPL from the DNAPL Recovery Well Network located at the former SCCC site.

- Place spill kit and related materials immediately adjacent to the work area such that they are easily accessible while operating the DNAPL recovery equipment in the event of a leak or spill;

- Inspect the DNAPL collection container before filling for holes, rust, missing bungs or securing hardware for open-top drums;

- Inspect all lines, connections, valves, and associated O-rings prior to beginning recovery;

- Connect the recovery hose at the bottom of the pump to the stinger pipe cam-lock fitting at the base of the well head. Make sure the discharge end of the hose is securely connected to both the top of the pump and the storage container;

- Connect the supply air hose from the compressor to the diaphragm pump air inlet line and make sure the compressed air is valved off;

- Make sure there is sufficient oil and gasoline in the compressor, then start it. After allowing the compressor to run for 30 seconds, slowly open the air ball valve at the compressor and adjust pressure regulator to obtain desired flow rate (DO NOT EXCEED 90 psi);

- Monitor volume in the DNAPL storage container to avoid overfilling (NOTE: several 55-gallon drums or mobile storage container transfers may be required). Continue pumping DNAPL until the discharge turns watery. This can be verified by visual observation of the discharge hose. Often, the change in viscosity can be verified by the sound of the pouring fluid;

- Log the volume of DNAPL recovered at each location and record measurements and observations in the log book;

- After the wells have been pumped, transfer any remaining contents of the mobile storage container into 55-gallon drums at the secondary contained Hazardous Waste Storage Area using the same practice as DNAPL recovery. The secondary containment area is to be secured under lock and key;

- Ensure all drums generated are properly sealed and labeled using the Site Specific Waste Management Guide (Attachment B). Drums are to be inspected weekly using the Drum Inspection Form (Attachment C); and,

- Properly dispose of all plastic sheeting, personal protective equipment, and absorbent and decontamination materials.

4.0 QC PROCEDURES

Quality control procedures include the following:

- DNAPL levels are measured to the nearest hundredth of a foot before and after pumping to accurately determine volume pumped; and,

- Pumping records are documented to track the total DNAPL volume recovered.

5.0 DATA RECORDING OR MANAGEMENT

Proper field data collection and management is important. Field notes and observations are to be recorded in a bound field log book. Data collected during recovery efforts are to be recorded on the attached forms herein and submitted to the project manager for review upon completion.

ATTACHMENT A
FIELD NOTE BOOK AND/OR DNAPL RECOVERY LOG SHEETS

PRG
HCTS DNAPL Recovery Log

WELL:

Date	Time (hrs)	DTW (ft TOC)	DTP (ft TOC)	TD (ft TOC)	DNAPL Tickness (ft)	Estimated Volume of DNAPL (Gal)	Recovery Start Time	Recovery Stop Time	Actual Estimated Total Volume of DNAPL Recovered (Gal)	Estimated Volume of Water Recovered (Gal)	Post Recovery DTW (ft TOC)	Post Recovery DTP (ft TOC)
				Total Running Summary					**0**	**0**		

PRG
60 Day Startup
Post DNAPL Recovery Gauging
WELL:

Date	Time (hrs)	Post Recovery DTW (ft TOC)	Post Recovery DTP (ft TOC)	Post Recovery TD (ft TOC)	Post Recovery DNAPL Tickness (ft)	Estimated Volume of DNAPL In Well (Gal)	Notes

ATTACHMENT B
SITE SPECIFIC WASTE MANAGEMENT GUIDE DRUMS

Table 1
Standard Chlorine Chemical Company (SCCC) Site, Kearny NJ
Site Specific Waste Management Guidance

Waste Stream	Non-HAZ	HAZ	Profile No.	Waste Codes			U.S. DOT Description	Transporter	Disposal / Regen Facility	Waste Characterization Analysis	
										Date of Waste Characterization Sampling	Waste Stream Analysis (TestAmerica Laboratories)
DNAPL											
DRWL-1		X	334530	D018 D027	D021 D032	PCB2	UN2810, HAZ WASTE LIQUIDS, ORGANICS, n.o.s., (1,4-Dichlorobenzene), 6.1, II, RQ, (PCB)	T1 - Veolia - (NJD080631369) T2 - ENVIRON- (NJD000692061)	Veolia ES Technical Solutions, LLC. 1 EDEN Lane Flanders, NJ 07836 (NJD000536693) FINAL DISPOSAL - Port Arthur TX (Incineration)	9/17/2012	PCBs (8082)
DRWL-5		X	280054	D018 D021	D027 D032	PCB2	UN2810, HAZ WASTE LIQUIDS, ORGANICS, n.o.s., (Benzene, 1,4-DICHLOROBENZENE), 9, III, RQ, (PCB)	T1 - Veolia - (NJD080631369) T2 - ENVIRON - (NJD000692061)	Veolia ES Technical Solutions, LLC. 1 EDEN Lane Flanders, NJ 07836 (NJD000536693) FINAL DISPOSAL - Port Arthur TX (Incineration)	3/1/2012	PCBs (8082)
DRWL-7		X	280059	D018 D021	D027 D032		UN2810, HAZ WASTELIQUIDS, ORGANICS, n.o.s., (Benzene, 1,4-DICHLOROBENZENE), 6.1, II	T1 - Veolia - (NJD080631369)	Veolia ES Technical Solutions, LLC. 125 Factory Lane Middlesex, NJ 08846 (NJD002454544) (Fuel Blending)	3/1/2012	PCBs (8082)
DRWL-9		X	279747	D007 D018	D021 D027	D032 PCB2	UN2810, HAZ WASTE LIQUIDS, ORGANICS, n.o.s., (BENZENE, 1,4-DICHLOROBENZENE), 6.1, II, RQ (PCB)	T1 - Veolia - (NJD080631369) T2 - ENVIRON - (NJD000692061)	Veolia ES Technical Solutions, LLC. 1 EDEN Lane Flanders, NJ 07836 (NJD000536693) FINAL DISPOSAL - Port Arthur TX (Incineration)	2/2/2012	TCLP VOCs (8260B), TCLP SVOCs (8270C), TCLP Pesticides (8081A), PCBs (8082), TCLP Herbicides (8151A), Dioxins/Furans (8280A), Metals (6010B), TCLP Metals (6010B), Corrosivity, Hexavalent Chromium (7196A), TOC (Walkley Black), Reactive Cyanide (9014), Reactive Sulfide (9034), BTU (D240-87), Flashpoint (D93-02a), TSS (SM 2540D), Total Halogenated Hydrocarbons (8021B)
DRWL-10		X	448406	D018 D021	D027 D032		UN2810, HAZ WASTELIQUIDS, ORGANICS, n.o.s., (Benzene, 1,4-DICHLOROBENZENE), 6.1, II	T1 - Veolia - (NJD080631369)	Veolia ES Technical Solutions, LLC. 125 Factory Lane Middlesex, NJ 08846 (NJD002454544) (Fuel Blending)	4/24/2013	PCB's (8082)
DRWL-11		X	279757	D018 D021	D027		UN2810, HAZ WASTE LIQUIDS, ORGANICS, n.o.s., (BENZENE, 1,4-DICHLOROBENZENE), 6.1, II	T1 - Veolia - (NJD080631369)	Veolia ES Technical Solutions, LLC. 125 Factory Lane Middlesex, NJ 08846 (NJD002454544) (Fuel Blending)	2/15/2012	TCLP VOCs (8260B), TCLP SVOCs (8270C), TCLP Pesticides (8081A), PCBs (8082), TCLP Herbicides (8151A), Dioxins/Furans (8280A), Metals (6010B), TCLP Metals (6010B), Corrosivity, Hexavalent Chromium (7196A), TOC (Walkley Black), Reactive Cyanide (9014), Reactive Sulfide (9034), BTU (D240-87), Flashpoint (D93-02a), TSS (SM 2540D), Total Halogenated Hydrocarbons (8021B)
PPE		X	280047	D018 D021	D027 D032	PCB2	NA3077, HAZ WASTE, SOLID, n.o.s., (Benzene, 1,4-DICHLOROBENZENE), 9, III	T1 - Veolia - (NJD080631369) T2 - ENVIRON - (NJD000692061)	Veolia ES Technical Solutions, LLC. 1 EDEN Lane Flanders, NJ 07836 FINAL DISPOSAL - Port Arthur TX (Incineration)	NA	NA
Filter Cake	X		474434PAE	NA	NA	NA	201 - NonHazardous Industrial Filter-Cake	T1- Freehold Cartage (NJD054126164)	G.R.O.W.S. North Landfill 1000 New Ford Mill Road Morrisville PA, 19067 (PADEP Permit # 101680) (Landfill)	2/2/2012	TCLP VOCs (8260B), TCLP SVOCs (8270C), TCLP Pesticides (8081A), PCBs (8082), TCLP Herbicides (8151A), Dioxins/Furans (8280A), Metals (6010B), TCLP Metals (6010B), Corrosivity, Hexavalent Chromium (7196A), TOC (9060), Reactive Cyanide (9014), Reactive Sulfide (9034), Total Sulfide (9034), Sulfate (BTU (D240-67), Flashpoint (D92), Total Halogenated Hydrocarbons (8021B) *2013 annual waste characterization recertification sampling completed 4/23/13
GAC/ OrganoClay	X		339506	ID27			Non-RCRA Solid, n.o.s.	TBD	Veolia ES Technical Solutions, LLC. 1 EDEN Lane Flanders, NJ 07836 FINAL DISPOSAL - TBD	5/10/2012	TCLP VOCs (8260B), TCLP SVOCs (8270C), TCLP Pesticides (8081A), PCBs (8082), TCLP Herbicides (8151A), Dioxins/Furans (8280A), TCLP Metals (6010B), Metals (6010B), Corrosivity, Hexavalent Chromium (7196A), Sulfide (9034), Reactive Sulfide (9034), Total Volatile Solids(160.4), Reactive Cyanide (9014), Free Liquid, BTU (D240-87), Flashpoint (D92), Ammonia (4500), TOC (9060), Sulfate (D516-90), Total Solids (SM2540B), COD (SM5220D), Oil and Grease (1664 and 9071), Total Halogenated Hydrocarbons (8021B)
GAC	X			NA	NA	NA	Bulk Bags /Spent Carbon (Non-RCRA, Non-Regulated)	T1 - EncoTech	Norit Americas Inc. 1432 6th Street Pryor OK, 74361	3/29/2012	TCLP VOCs (8260B), TCLP SVOCs (8270C), TCLP Pesticides (8081A), PCBs (8082), TCLP Herbicides (8151A), Dioxins/Furans (8280A), Metals (6010B), TCLP Metals (6010B), Hexavalent Chromium (7196A), Reactive Cyanide (9014), Reactive Sulfide (9034), Corrosivity, BTU (D240-87), Flashpoint (D92), TOC (9060), Total Halogenated Hydrocarbons (8021B)
										5/1/2012	VOCs (8260B), SVOCs (8270C)
										5/23/2012	VOCs (624), TOC (5310B)
										5/29/2012	VOCs (624)
										6/29/2012	VOCs (624), TOC (9060)
										7/12/2012	TOC (SM 5310B)
										7/23/2012	TCLP VOCs (8260B), TCLP SVOCs (8270C), TCLP Pesticides (8081A), TCLP Herbicides (8151A), TCLP Metals (6010B), PCBs (8082), Dioxin/Furans (8280A)
TCTS Related FRAC Tank Solidification											
TCTS - FRAC Tank Solidification		X	CH559127B	D027			NA3077, HAZ WASTE, SOLID, n.o.s., (Benzene, 1,4-DICHLOROBENZENE), 9, III	T1 - EPIC, A Synagro Co, (NJD986647501) T2 - CSX Transportation (FLD006921340)	Clean Harbors Clive, LLC Aragonite, Utah (Incineration)	3/21/2012 (TA) 11/16/11 - PACE Analytical 12/15/11 - ALS Environmental	TCLP VOCs (8260B), TCLP SVOCs (8270C), TCLP Pesticides (8081A), PCBs (8082), TCLP Herbicides (8151A), Dioxins/Furans (8280A), TCLP Metals (6010B), Total Metals/Mercury (6010B/7470A), Ignitibility, Corrosivity, Hexavalent Chromium (7196A), Reactive Sulfide (9034), Reactive Cyanide (9014), BTU (D240-87), TOC (9060), TSS (SM2540D),Total Halogenated Hydrocarbons (8021B)
Other IDW											
Soils		X	439825	D018 D021	D027 D032	PCB2	NA3077, HAZ WASTE, SOLID, n.o.s., (Benzene, 1,4-DICHLOROBENZENE), 9, III	T1 - Veolia - (NJD080631369) T2 - ENVIRON - (NJD000692061)	Veolia ES Technical Solutions, LLC. 1 EDEN Lane Flanders, NJ 07836 FINAL DISPOSAL - Port Arthur TX (Incineration)	NA	Residual soil samples from IR activities -

ATTACHMENT C
DRUM INSPECTION FORM

HAZARDOUS WASTE DRUM/CONTAINER INSPECTION CHECKLIST - WEEKLY

Location: SCCC Site, Kearny, NJ	**Date:**	**Time:**

Complete each week whether waste is present or not

# OF CONTAINERS PRESENT	CAPACITY (GALLONS)

ITEM	OK	Not OK	OBSERVATIONS
All Drums/Containers:			
Drums/Containers sealed			
Drums/Containers labeled			
Exterior – Corrosion, Cracks, Bulges, etc.			
Spill Prevention:			
Bungs, spigots, valves closed			
Storage Area:			
No spills			
No leaks			
Spill control materials immediately available (absorbents, pigs, booms, mat, etc.)			.

Date and Nature of Repairs or Other Action Taken: _____

_____

_____

Inspector Name:_____ _____

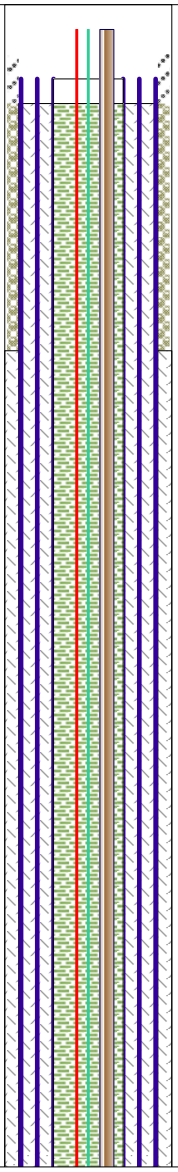
Signature:

ATTACHMENT 10
ANODE WELL LOGS

BOREHOLE LOG: AW-01

DATE DRILLED: 12/15/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604206 N: 698272.4	ELEVATION: GND SURF: 9.6 ft msl TOC: 9.06 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		SM	Structural Fill	14"	NA	0		Concrete Pad
1					NA			Bedding Stone
2					NA			18" Diameter Borehole
3		N/A	Capillary Break		NA			Capillary Break 1.5" Clean Stone
4		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel		NA			
5					NA			
6					NA			14" Steel Casing
7					NA			
8					NA			
9					NA			Cement-Bentonite Grout
10					NA			
11		PT	Meadow Mat		NA			

NOTES:

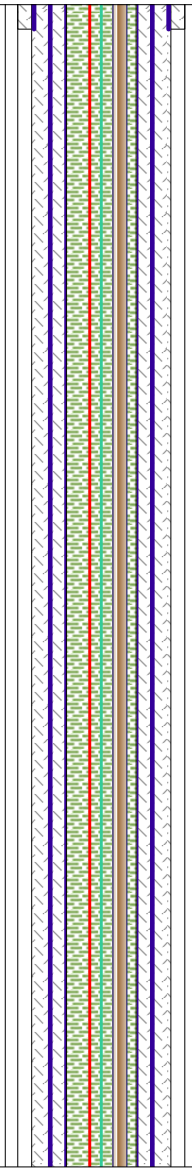
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-01

DATE DRILLED: 12/15/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604206 N: 698272.4	ELEVATION: GND SURF: 9.6 ft msl TOC: 9.06 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
12								
13		PT	Meadow Mat					14" Diameter Borehole
14								
15								10" Steel Casing
16								
17								
18								
19		SW	Deep Sand					
20								
21								
22								
23								



NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-01

DATE DRILLED: 12/15/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604206 N: 698272.4	ELEVATION: GND SURF: 9.6 ft msl TOC: 9.06 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
24		SW	Deep Sand					
25								
26								
27								10" Diameter Borehole
28								6" PVC Casing
29								
30		CL	Varved Silty Clay					Env Bentonite Plug
31								
32								Coke Breeze
33								
34								
35								Upper Lead Cable (green)

NOTES:

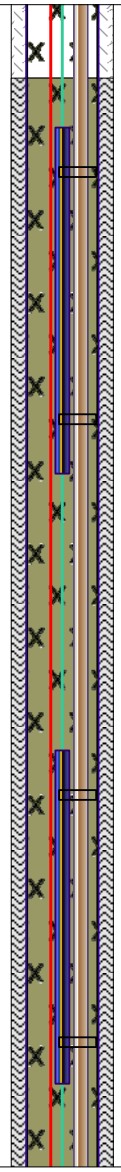
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-01

DATE DRILLED: 12/15/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604206 N: 698272.4	ELEVATION: GND SURF: 9.6 ft msl TOC: 9.06 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
36								
37								6" Steel Casing
38								
39								
40								
41		CL	Varved Silty Clay					Steel Casing Grouted With Conducrete Mix
42								
43								
44								
45								Anode Assembly Within 6"Steel Casing
46								
47								



NOTES:

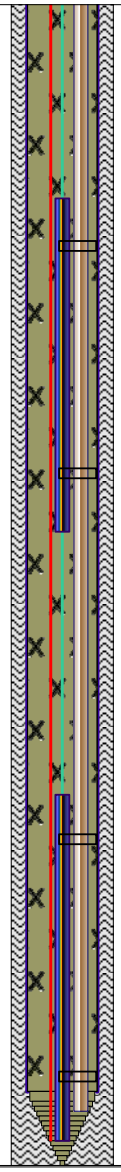
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-01

DATE DRILLED: 12/15/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604206 N: 698272.4	ELEVATION: GND SURF: 9.6 ft msl TOC: 9.06 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
47								
48								
49								
50								
51								1" Slotted Vent Tube (0 ft bgs - end depth)
52								
53		CL	Varved Silty Clay					
54								
55								
56								Centralizers
57								Lower Lead Cable (red)
58								Beveled, Welded Point



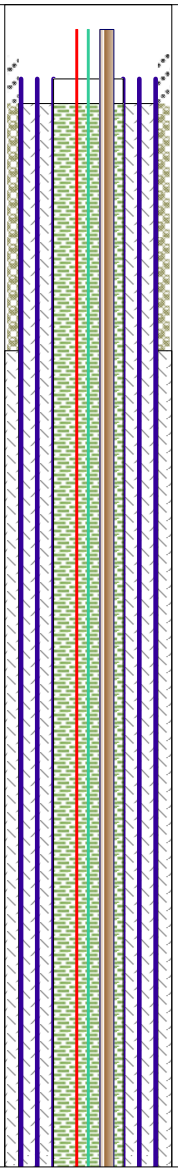
NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-02

DATE DRILLED: 12/16/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti/S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604178.4 N: 698336.5	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.38 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		SM	Structural Fill	13"	5 8 4 1	0		Concrete Pad Bedding Stone 18" Diameter Borehole Capillary Break 1.5" Clean Stone 14" Steel Casing Cement-Bentonite Grout
1								
2								
3		N/A	Capillary Break					
4		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
5								
6								
7								
8								
9								
10								
11		PT	Meadow Mat					

NOTES:

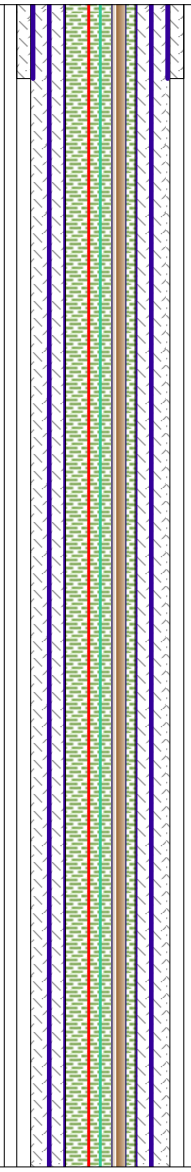
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-02

DATE DRILLED: 12/16/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti/S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604178.4 N: 698336.5	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.38 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
12								
13		PT	Meadow Mat					14" Diameter Borehole
14								
15								10" Steel Casing
16								
17								
18								
19		SW	Deep Sand					
20								
21								
22								
23								



NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-02

DATE DRILLED: 12/16/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti/S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604178.4 N: 698336.5	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.38 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
24		SW	Deep Sand					
25								
26								
27								10" Diameter Borehole
28								6" PVC Casing
29								
30		CL	Varved Silty Clay					Env Bentonite Plug
31								
32								Coke Breeze
33								
34								
35								Upper Lead Cable (green)

NOTES:

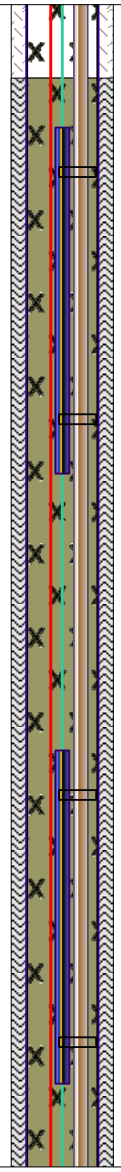
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-02

DATE DRILLED: 12/16/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti/S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604178.4 N: 698336.5	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.38 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
36								
37								6" Steel Casing
38								
39								
40								
41		CL	Varved Silty Clay					Steel Casing Grouted With Conducrete Mix
42								
43								
44								
45								Anode Assembly Within 6"Steel Casing
46								
47								



NOTES:

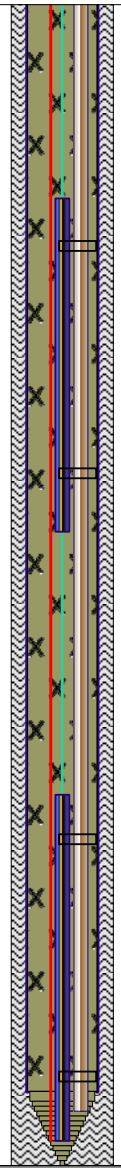
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-02

DATE DRILLED: 12/16/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti/S Bagnull	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604178.4 N: 698336.5	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.38 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
47								
48								
49								
50								
51								1" Slotted Vent Tube (0 ft bgs - end depth)
52								
53		CL	Varved Silty Clay					
54								
55								
56								Centralizers
57								Lower Lead Cable (red)
58								Beveled, Welded Point



NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-03

DATE DRILLED: 12/17/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604144.7 N: 698397.3	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.36 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0								Concrete Pad
1		SM	Structural Fill					Bedding Stone 18" Diameter Borehole
2								
3		N/A	Capillary Break					Capillary Break 1.5" Clean Stone
4								
5								
6								14" Steel Casing
7		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
8					5			
9				8"	7 8	0		Cement-Bentonite Grout
10					12 4			
11		PT	Meadow Mat	1"	2 1	0		

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-03

DATE DRILLED: 12/17/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604144.7 N: 698397.3	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.36 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
12					1			
13		PT	Meadow Mat					14" Diameter Borehole
14								
15								10" Steel Casing
16								
17								
18								
19		SW	Deep Sand					
20					9			
21				11"	11 12	0.2		
22					11 6			
23				20"	7 20	0		

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-03

DATE DRILLED: 12/17/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604144.7 N: 698397.3	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.36 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
24		SW	Deep Sand		18			
25								
26								
27								10" Diameter Borehole
28								6" PVC Casing
29								
30		CL	Varved Silty Clay					Env Bentonite Plug
31								
32								Coke Breeze
33								
34								
35								Upper Lead Cable (green)

NOTES:

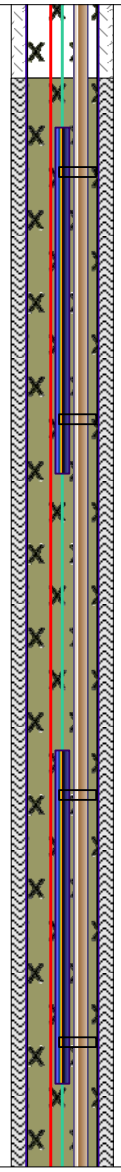
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-03

DATE DRILLED: 12/17/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604144.7 N: 698397.3	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.36 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
36								
37								6" Steel Casing
38								
39								
40								
41		CL	Varved Silty Clay					Steel Casing Grouted With Conducrete Mix
42								
43								
44								
45								Anode Assembly Within 6"Steel Casing
46								
47								



NOTES:

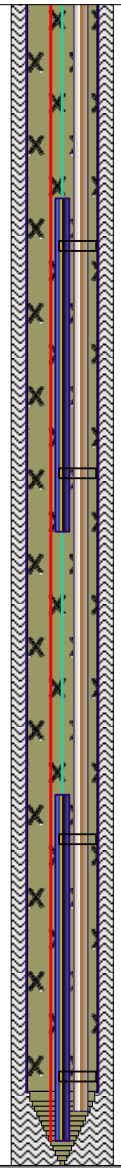
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-03

DATE DRILLED: 12/17/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604144.7 N: 698397.3	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.36 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
47								
48								
49								
50								
51								1" Slotted Vent Tube (0 ft bgs - end depth)
52								
53		CL	Varved Silty Clay					
54								
55								
56								Centralizers
57								Lower Lead Cable (red)
58								Beveled, Welded Point



NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-04

DATE DRILLED: 12/22/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604116.3 N: 698460.8	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.23 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		SM	Structural Fill					Concrete Pad Bedding Stone 18" Diameter Borehole
1								
2								Capillary Break 1.5" Clean Stone
3		N/A	Capillary Break					
4		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
5								
6								14" Steel Casing
7								
8					7			
9				8"	5 3	0		Cement-Bentonite Grout
10					1 4			
11		PT	Meadow Mat	19"	3 2	0		

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-04

DATE DRILLED: 12/22/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604116.3 N: 698460.8	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.23 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
12					2			
13		PT	Meadow Mat					14" Diameter Borehole
14								
15								10" Steel Casing
16								
17								
18								
19		SW	Deep Sand					
20					17			
21				10"	40 39	0		
22					19 3			
23				22"	7 7	0		

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-04

DATE DRILLED: 12/22/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604116.3 N: 698460.8	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.23 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
24		SW	Deep Sand		12			
25								
26								
27								10" Diameter Borehole
28								6" PVC Casing
29								
30		CL	Varved Silty Clay					Env Bentonite Plug
31								
32								Coke Breeze
33								
34								
35								Upper Lead Cable (green)

NOTES:

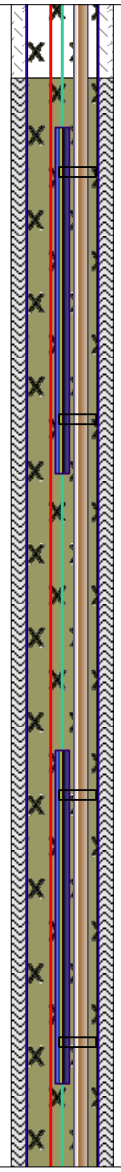
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-04

DATE DRILLED: 12/22/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604116.3 N: 698460.8	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.23 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
36								
37								6" Steel Casing
38								
39								
40								
41		CL	Varved Silty Clay					Steel Casing Grouted With Conducrete Mix
42								
43								
44								
45								Anode Assembly Within 6"Steel Casing
46								
47								



NOTES:

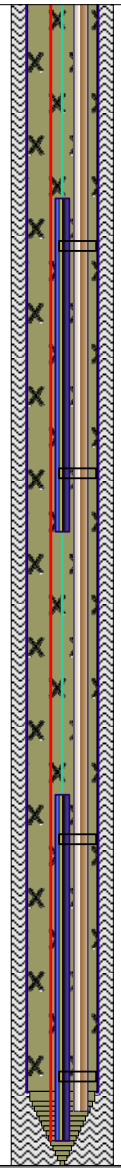
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-04

DATE DRILLED: 12/22/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604116.3 N: 698460.8	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.23 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
47								
48								
49								
50								
51								1" Slotted Vent Tube (0 ft bgs - end depth)
52								
53		CL	Varved Silty Clay					
54								
55								
56								Centralizers
57								Lower Lead Cable (red)
58								Beveled, Welded Point



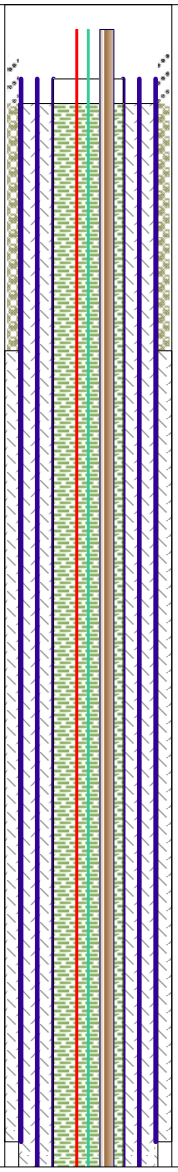
NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-05

DATE DRILLED: 12/23/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604088.3 N: 698522.2	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.04 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		SM	Structural Fill					Concrete Pad Bedding Stone 18" Diameter Borehole Capillary Break 1.5" Clean Stone
3		N/A	Capillary Break					
4		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					14" Steel Casing Cement-Bentonite Grout
11		PT	Meadow Mat	18"	7 4 4	0		

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-05

DATE DRILLED: 12/23/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604088.3 N: 698522.2	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.04 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
12		PT	Meadow Mat		2			14" Diameter Borehole
13								
14								10" Steel Casing
15								
16		SW	Deep Sand					
17								
18								
19								
20					4			
21				22"	4 10	0.2		
22					15 8			
23				20"	13 11	0		

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-05

DATE DRILLED: 12/23/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604088.3 N: 698522.2	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.04 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
24		SW	Deep Sand		8			
					3			
25				22"	2	0		
					3			
26					2			
27								10" Diameter Borehole
28								6" PVC Casing
29								
30		CL	Varved Silty Clay					Env Bentonite Plug
31								
32								Coke Breeze
33								
34								
35								Upper Lead Cable (green)

NOTES:

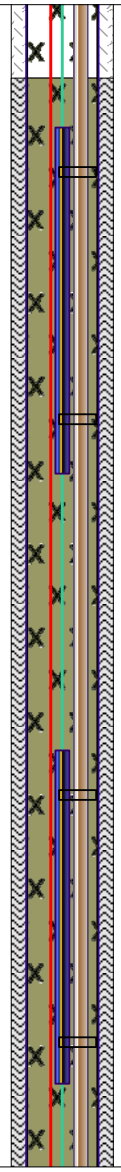
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-05

DATE DRILLED: 12/23/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604088.3 N: 698522.2	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.04 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
36								
37								6" Steel Casing
38								
39								
40								
41		CL	Varved Silty Clay					Steel Casing Grouted With Conducrete Mix
42								
43								
44								
45								Anode Assembly Within 6"Steel Casing
46								
47								



NOTES:

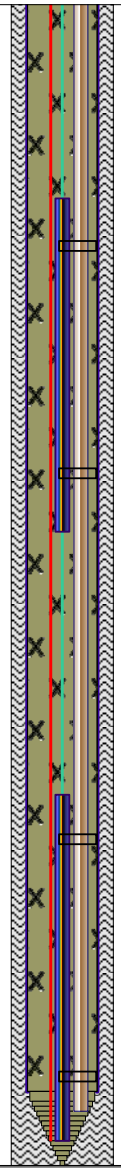
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-05

DATE DRILLED: 12/23/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604088.3 N: 698522.2	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.04 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
47								
48								
49								
50								
51								1" Slotted Vent Tube (0 ft bgs - end depth)
52								
53		CL	Varved Silty Clay					
54								
55								
56								Centralizers
57								Lower Lead Cable (red)
58								Beveled, Welded Point



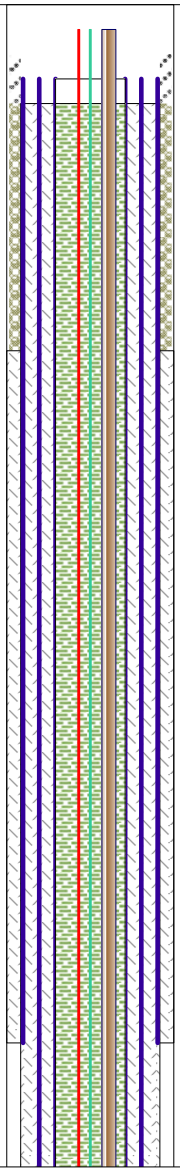
NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-06

DATE DRILLED: 12/23/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604052.8 N: 698590.9	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.15 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		SM	Structural Fill	22"	8 4 5 1	0		Concrete Pad Bedding Stone 18" Diameter Borehole Capillary Break 1.5" Clean Stone 14" Steel Casing Cement-Bentonite Grout
3		N/A	Capillary Break					
6		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
10		PT	Meadow Mat					

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-06

DATE DRILLED: 12/23/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604052.8 N: 698590.9	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.15 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
12								
13		PT	Meadow Mat					14" Diameter Borehole
14								
15								10" Steel Casing
16								
17								
18								
19		SW	Deep Sand					
20					10			
21				14"	6	0.2		
					4			
22					4			
					5			
23				13"	10	0		
					20			

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-06

DATE DRILLED: 12/23/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604052.8 N: 698590.9	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.15 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
24		SW	Deep Sand		15			
25								
26								
27								10" Diameter Borehole
28								6" PVC Casing
29								
30		CL	Varved Silty Clay					Env Bentonite Plug
31								
32								Coke Breeze
33								
34								
35								Upper Lead Cable (green)

NOTES:

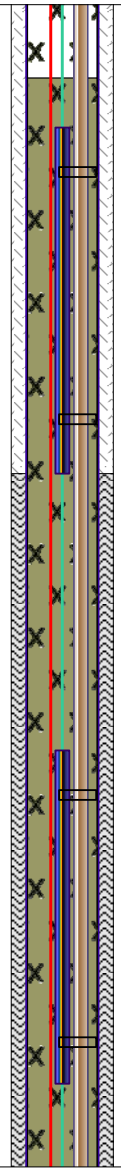
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-06

DATE DRILLED: 12/23/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604052.8 N: 698590.9	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.15 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
36								
37								6" Steel Casing
38								
39								
40								
41		CL	Varved Silty Clay					Steel Casing Grouted With Conducrete Mix
42								
43								
44								
45								Anode Assembly Within 6"Steel Casing
46								
47								



NOTES:

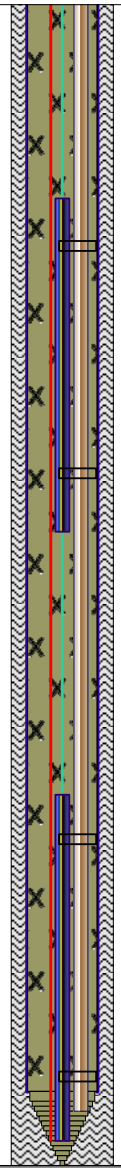
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-06

DATE DRILLED: 12/23/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604052.8 N: 698590.9	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.15 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
47								
48								
49								
50								
51								1" Slotted Vent Tube (0 ft bgs - end depth)
52								
53		CL	Varved Silty Clay					
54								
55								
56								Centralizers
57								Lower Lead Cable (red)
58								Beveled, Welded Point



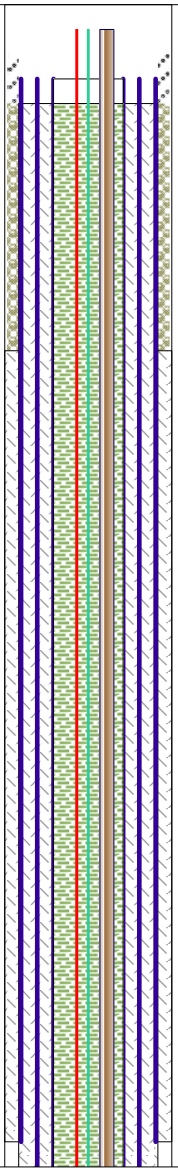
NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-07

DATE DRILLED: 12/27/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604021.7 N: 698654.4	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.23 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0								Concrete Pad
1		SM	Structural Fill					Bedding Stone 18" Diameter Borehole
2								
3		N/A	Capillary Break					Capillary Break 1.5" Clean Stone
4								
5								
6								14" Steel Casing
7		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
8					5			
9				13"	10 8	0		Cement-Bentonite Grout
10					2			
11		PT	Meadow Mat					

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-07

DATE DRILLED: 12/27/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604021.7 N: 698654.4	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.23 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
12								
13		PT	Meadow Mat					14" Diameter Borehole
14								
15								10" Steel Casing
16					1			
17				17"	9	0		
					15			
18					14			
19		SW	Deep Sand					
20					2			
21				14"	2	65		
					7			
22					10			
					10			
23					14			
		CL	Varved Silty Clay	14"	16	0.7		

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-07

DATE DRILLED: 12/27/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604021.7 N: 698654.4	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.23 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
24					14			
25								
26								
27								10" Diameter Borehole
28								6" PVC Casing
29		CL	Varved Silty Clay					
30								Env Bentonite Plug
31								
32								Coke Breeze
33								
34								
35								Upper Lead Cable (green)

NOTES:

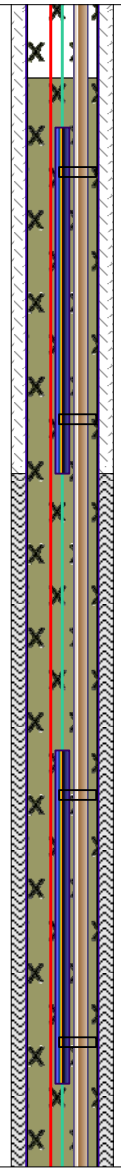
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-07

DATE DRILLED: 12/27/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604021.7 N: 698654.4	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.23 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
36								
37								6" Steel Casing
38								
39								
40								
41		CL	Varved Silty Clay					Steel Casing Grouted With Conducrete Mix
42								
43								
44								
45								Anode Assembly Within 6"Steel Casing
46								
47								



NOTES:

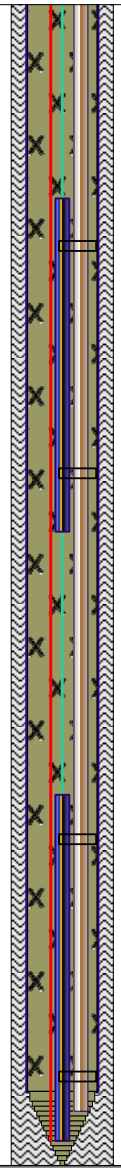
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-07

DATE DRILLED: 12/27/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 604021.7 N: 698654.4	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.23 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
47								
48								
49								
50								
51								1" Slotted Vent Tube (0 ft bgs - end depth)
52								
53		CL	Varved Silty Clay					
54								
55								
56								Centralizers
57								Lower Lead Cable (red)
58								Beveled, Welded Point



NOTES:

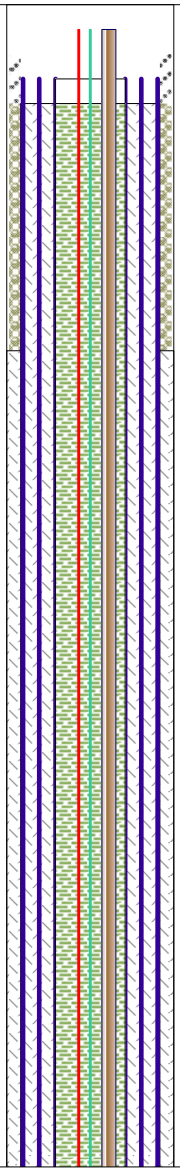
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-08

DATE DRILLED: 12/27/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603995.3 N: 698722.1	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.32 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0								Concrete Pad
1		SM	Structural Fill					Bedding Stone 18" Diameter Borehole
2								Capillary Break 1.5" Clean Stone
3		N/A	Capillary Break					
4								
5								
6								14" Steel Casing
7		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
8					1			
9				15"	1 3	0		Cement-Bentonite Grout
10					5 3			
11				18"	1 3	0		
		PT	Meadow Mat					



NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-08

DATE DRILLED: 12/27/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603995.3 N: 698722.1	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.32 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
12					1			
13		PT	Meadow Mat					14" Diameter Borehole
14								10" Steel Casing
15								
16					2			
17				10"	2	0		
					3			
18					3			
19		SW	Deep Sand					
20					12			
21				14"	10	53		
					8			
22					25			
23		CL	Varved Silty Clay					

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-08

DATE DRILLED: 12/27/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603995.3 N: 698722.1	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.32 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
24					4			
25				10"	5	0		
					5			
26					6			
27								10" Diameter Borehole
28								6" PVC Casing
29		CL	Varved Silty Clay					
30								Env Bentonite Plug
31								
32								Coke Breeze
33								
34								
35								Upper Lead Cable (green)

NOTES:

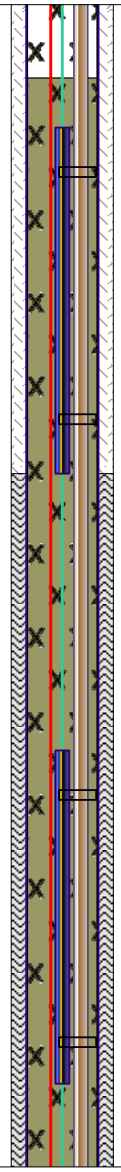
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-08

DATE DRILLED: 12/27/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603995.3 N: 698722.1	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.32 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
36								
37								6" Steel Casing
38								
39								
40								
41		CL	Varved Silty Clay					Steel Casing Grouted With Conducrete Mix
42								
43								
44								
45								Anode Assembly Within 6"Steel Casing
46								
47								



NOTES:

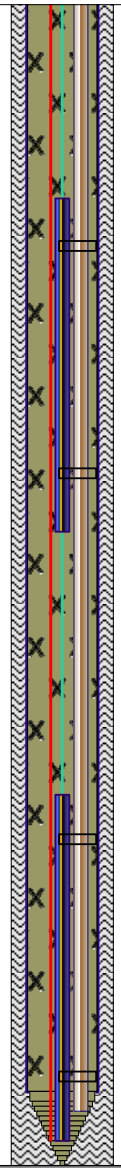
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-08

DATE DRILLED: 12/27/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603995.3 N: 698722.1	ELEVATION: GND SURF: 9.8 ft msl TOC: 9.32 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 58.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
47								
48								
49								
50								
51								1" Slotted Vent Tube (0 ft bgs - end depth)
52								
53		CL	Varved Silty Clay					
54								
55								
56								Centralizers
57								Lower Lead Cable (red)
58								Beveled, Welded Point



NOTES:

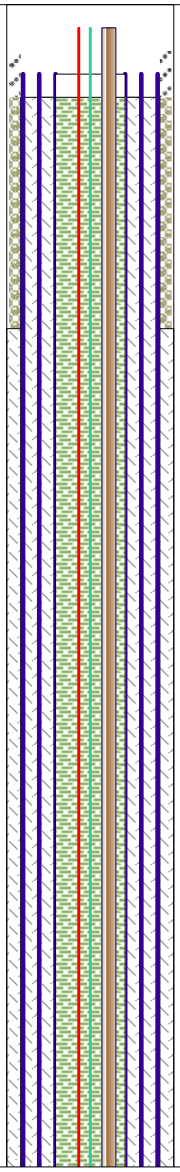
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-09

DATE DRILLED: 12/23/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603961.3 N: 698820.3	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.13 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0								Concrete Pad
1		SM	Structural Fill					Bedding Stone 18" Diameter Borehole
2								
3		N/A	Capillary Break					Capillary Break 1.5" Clean Stone
4								
5								
6								14" Steel Casing
7								
8		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
9								Cement-Bentonite Grout
10								
11								
12								



NOTES:

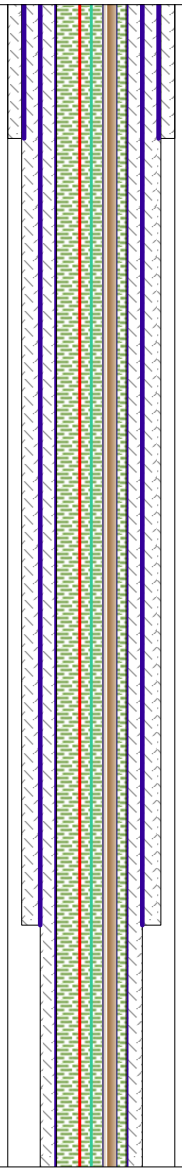
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-09

DATE DRILLED: 12/23/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603961.3 N: 698820.3	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.13 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
13		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
14								
15		PT	Meadow Mat					14" Diameter Borehole
16								10" Steel Casing
17								
18		SW	Deep Sand		8			
19				15"	10 7	1.5		
20					4 4			
21				12"	4 8	11.1		
22		CL	Varved Silty Clay		10			
23								
24								
25								



NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-09

DATE DRILLED: 12/23/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603961.3 N: 698820.3	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.13 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
26								
27								10" Diameter Borehole
28								6" PVC Casing
29								
30								
31		CL	Varved Silty Clay					
32								Env Bentonite Plug
33								
34								
35								
36								Coke Breeze
37								

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-09

DATE DRILLED: 12/23/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603961.3 N: 698820.3	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.13 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
38								
39								Upper Lead Cable (green)
40								
41								6" Steel Casing
42								
43								
44		CL	Varved Silty Clay					Steel Casing Grouted With Conducrete Mix
45								
46								
47								
48								
49								
50								

NOTES:

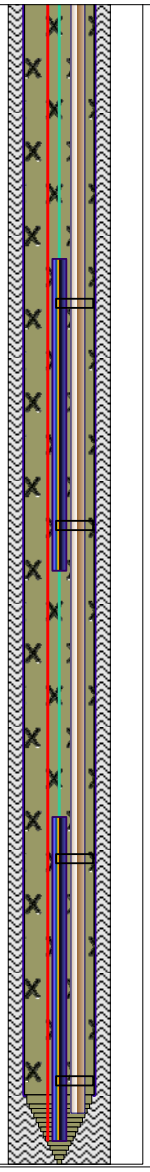
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-09

DATE DRILLED: 12/23/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603961.3 N: 698820.3	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.13 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
51								1" Slotted Vent Tube (0 ft bgs - end depth)
52								
53								
54								Anode Assembly Within 6"Steel Casing
55								
56								Centralizers
		CL	Varved Silty Clay					
57								
58								
59								
60								
61								Lower Lead Cable (red)
62								Beveled, Welded Point



NOTES:

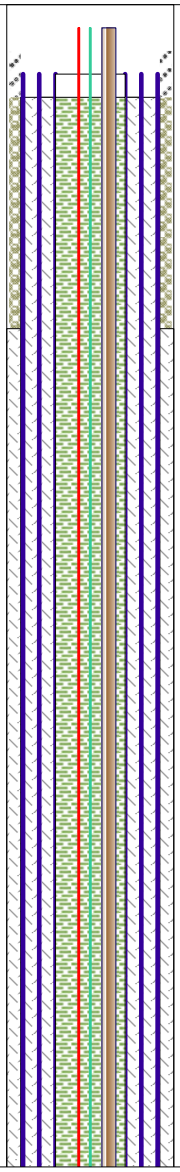
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-10

DATE DRILLED: 12/28/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603947.2 N: 698883.5	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.32 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0								Concrete Pad
1		SM	Structural Fill					Bedding Stone 18" Diameter Borehole
2								
3		N/A	Capillary Break					Capillary Break 1.5" Clean Stone
4								
5								
6								14" Steel Casing
7								
8		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
9								Cement-Bentonite Grout
10								
11								
12								



NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-10

DATE DRILLED: 12/28/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603947.2 N: 698883.5	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.32 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
13								
14								
15		PT	Meadow Mat					14" Diameter Borehole
16								10" Steel Casing
17								
18					8			
19		SW	Deep Sand	11"	6 4	0		
20					6 5			
21				12"	5 4	0.6		
22					10			
23		CL	Varved Silty Clay	16"	6 9 9	0		
24					9			
25								

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-10

DATE DRILLED: 12/28/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603947.2 N: 698883.5	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.32 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
26								
27								10" Diameter Borehole
28								6" PVC Casing
29								
30								
31		CL	Varved Silty Clay					
32								Env Bentonite Plug
33								
34								
35								
36								Coke Breeze
37								

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-10

DATE DRILLED: 12/28/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603947.2 N: 698883.5	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.32 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
38								
39								Upper Lead Cable (green)
40								
41								6" Steel Casing
42								
43								
44		CL	Varved Silty Clay					Steel Casing Grouted With Conducrete Mix
45								
46								
47								
48								
49								
50								

NOTES:

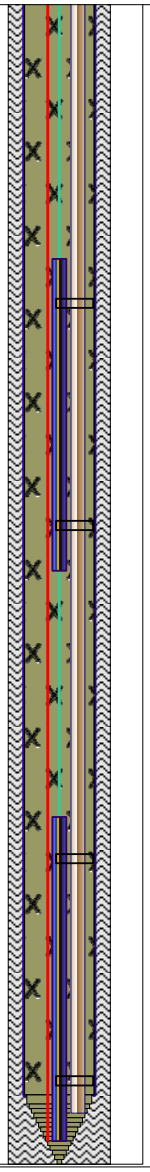
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-10

DATE DRILLED: 12/28/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603947.2 N: 698883.5	ELEVATION: GND SURF: 9.9 ft msl TOC: 9.32 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
51								1" Slotted Vent Tube (0 ft bgs - end depth)
52								
53								
54								Anode Assembly Within 6"Steel Casing
55								
56								Centralizers
		CL	Varved Silty Clay					
57								
58								
59								
60								
61								Lower Lead Cable (red)
62								Beveled, Welded Point



NOTES:

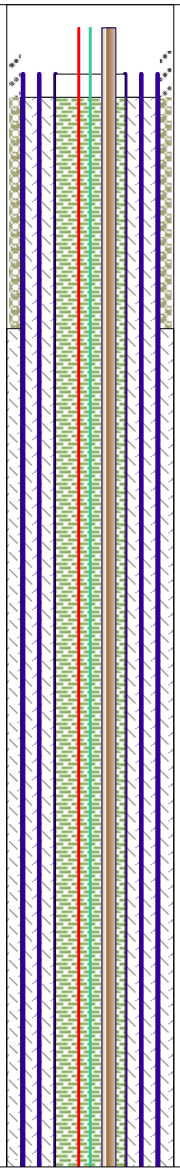
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-11

DATE DRILLED: 12/29/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603936.8 N: 698958.1	ELEVATION: GND SURF: 9.8 ft msl TOC: 8.93 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0								Concrete Pad
1		SM	Structural Fill					Bedding Stone 18" Diameter Borehole
2								
3		N/A	Capillary Break					Capillary Break 1.5" Clean Stone
4								
5								
6								14" Steel Casing
7								
8		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
9								Cement-Bentonite Grout
10								
11								
12								



NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-11

DATE DRILLED: 12/29/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603936.8 N: 698958.1	ELEVATION: GND SURF: 9.8 ft msl TOC: 8.93 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
13		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
14								
15		PT	Meadow Mat					14" Diameter Borehole
16								10" Steel Casing
17								
18					3			
19		SW	Deep Sand	14"	7 6	0		
20					6 4			
21				16"	5 6	0		
22					8			
23		CL	Varved Silty Clay					
24								
25								

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-11

DATE DRILLED: 12/29/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603936.8 N: 698958.1	ELEVATION: GND SURF: 9.8 ft msl TOC: 8.93 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
26								
27								10" Diameter Borehole
28								6" PVC Casing
29								
30								
31		CL	Varved Silty Clay					
32								Env Bentonite Plug
33								
34								
35								
36								Coke Breeze
37								

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-11

DATE DRILLED: 12/29/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603936.8 N: 698958.1	ELEVATION: GND SURF: 9.8 ft msl TOC: 8.93 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
38								
39								Upper Lead Cable (green)
40								
41								6" Steel Casing
42								
43								
44		CL	Varved Silty Clay					Steel Casing Grouted With Conducrete Mix
45								
46								
47								
48								
49								
50								

NOTES:

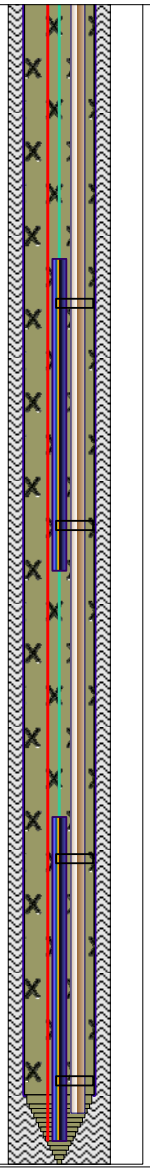
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-11

DATE DRILLED: 12/29/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603936.8 N: 698958.1	ELEVATION: GND SURF: 9.8 ft msl TOC: 8.93 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
51								1" Slotted Vent Tube (0 ft bgs - end depth)
52								
53								
54								Anode Assembly Within 6"Steel Casing
55								
56								Centralizers
		CL	Varved Silty Clay					
57								
58								
59								
60								
61								Lower Lead Cable (red)
62								Beveled, Welded Point



NOTES:

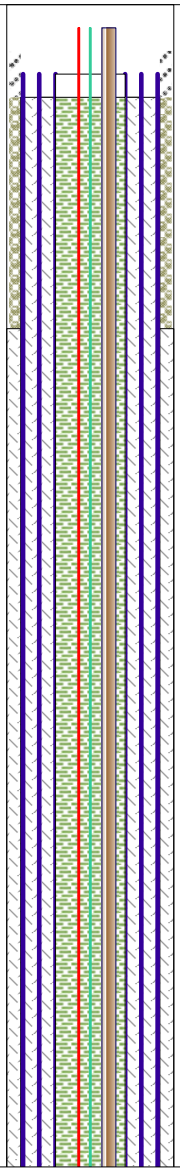
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-12

DATE DRILLED: 12/29/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603909.2 N: 699024.4	ELEVATION: GND SURF: 9.9 ft msl TOC: 8.99 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0								Concrete Pad
1		SM	Structural Fill					Bedding Stone 18" Diameter Borehole
2								
3		N/A	Capillary Break					Capillary Break 1.5" Clean Stone
4								
5								
6								14" Steel Casing
7								
8		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
9								Cement-Bentonite Grout
10								
11								
12								



NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-12

DATE DRILLED: 12/29/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603909.2 N: 699024.4	ELEVATION: GND SURF: 9.9 ft msl TOC: 8.99 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
13		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
14								14" Diameter Borehole
15		PT	Meadow Mat					10" Steel Casing
16								
17								
18					8			
19		SW	Deep Sand	15"	6 6	0		
20					6 6			
21				16"	8 8	0		
22					6			
23								
24		CL	Varved Silty Clay					
25								

NOTES:

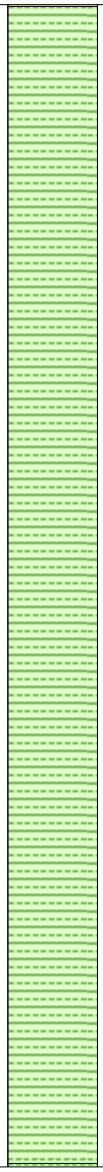
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

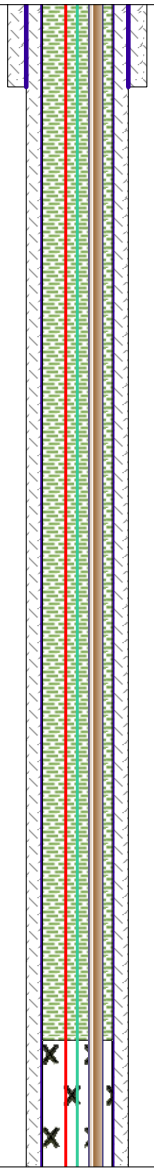
BOREHOLE LOG: AW-12

DATE DRILLED: 12/29/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603909.2 N: 699024.4	ELEVATION: GND SURF: 9.9 ft msl TOC: 8.99 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
26								
27								10" Diameter Borehole
28								6" PVC Casing
29								
30								
31		CL	Varved Silty Clay					
32								Env Bentonite Plug
33								
34								
35								
36								Coke Breeze
37								





NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-12

DATE DRILLED: 12/29/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603909.2 N: 699024.4	ELEVATION: GND SURF: 9.9 ft msl TOC: 8.99 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
38								
39								Upper Lead Cable (green)
40								
41								6" Steel Casing
42								
43								
44		CL	Varved Silty Clay					Steel Casing Grouted With Conducrete Mix
45								
46								
47								
48								
49								
50								

NOTES:

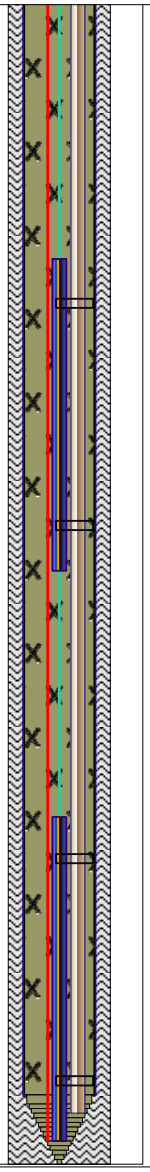
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-12

DATE DRILLED: 12/29/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603909.2 N: 699024.4	ELEVATION: GND SURF: 9.9 ft msl TOC: 8.99 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
51								1" Slotted Vent Tube (0 ft bgs - end depth)
52								
53								
54								Anode Assembly Within 6"Steel Casing
55								
56								Centralizers
		CL	Varved Silty Clay					
57								
58								
59								
60								
61								Lower Lead Cable (red)
62								Beveled, Welded Point



NOTES:

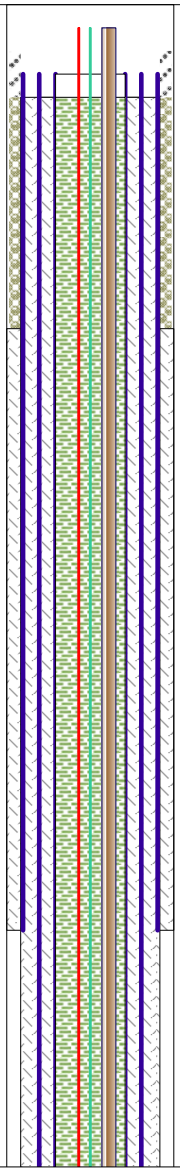
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-13

DATE DRILLED: 12/30/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603878.1 N: 699087.5	ELEVATION: GND SURF: 10.0 ft msl TOC: 9.13 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		SM	Structural Fill					Concrete Pad Bedding Stone 18" Diameter Borehole
3		N/A	Capillary Break					Capillary Break 1.5" Clean Stone
6		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					14" Steel Casing
9		PT	Meadow Mat					Cement-Bentonite Grout



NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-13

DATE DRILLED: 12/30/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603878.1 N: 699087.5	ELEVATION: GND SURF: 10.0 ft msl TOC: 9.13 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
13								14" Diameter Borehole
14								
15		PT	Meadow Mat	15"	1 1 1 1	2.1		10" Steel Casing
16								
17								
18				15"	3 3 5 8	0		
19		SW	Deep Sand					
20								
21				12"	4 4 7 8	0		
22								
23		CL	Varved Silty Clay	17"	6 8 10 10	1.3		
24								
25								

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-13

DATE DRILLED: 12/30/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603878.1 N: 699087.5	ELEVATION: GND SURF: 10.0 ft msl TOC: 9.13 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
26								
27								10" Diameter Borehole
28								6" PVC Casing
29								
30								
31		CL	Varved Silty Clay					
32								Env Bentonite Plug
33								
34								
35								
36								Coke Breeze
37								

NOTES:

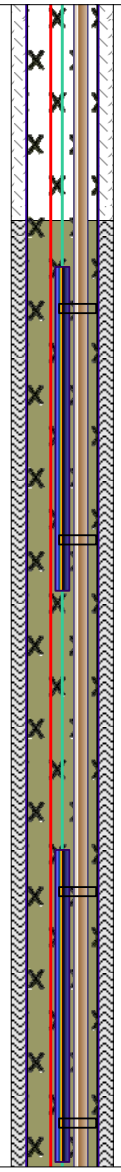
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-13

DATE DRILLED: 12/30/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603878.1 N: 699087.5	ELEVATION: GND SURF: 10.0 ft msl TOC: 9.13 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
38								
39								Upper Lead Cable (green)
40								
41								6" Steel Casing
42								
43								
44		CL	Varved Silty Clay					Steel Casing Grouted With Conducrete Mix
45								
46								
47								
48								
49								
50								



NOTES:

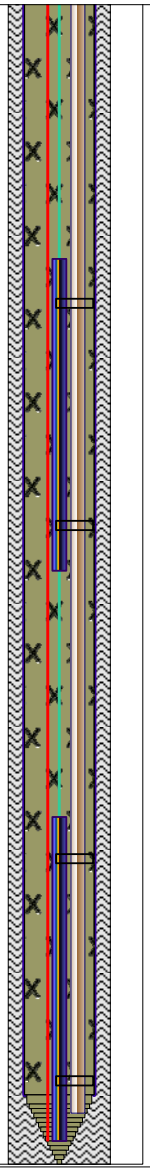
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-13

DATE DRILLED: 12/30/11

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603878.1 N: 699087.5	ELEVATION: GND SURF: 10.0 ft msl TOC: 9.13 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
51								1" Slotted Vent Tube (0 ft bgs - end depth)
52								
53								
54								Anode Assembly Within 6"Steel Casing
55								
56								Centralizers
		CL	Varved Silty Clay					
57								
58								
59								
60								
61								Lower Lead Cable (red)
62								Beveled, Welded Point



NOTES:

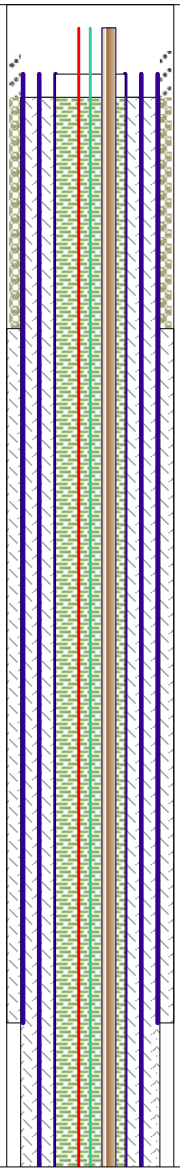
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-14

DATE DRILLED: 1/4/12

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603851.7 N: 699152.7	ELEVATION: GND SURF: 10.1 ft msl TOC: 9.16 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		SM	Structural Fill					Concrete Pad Bedding Stone 18" Diameter Borehole
3		N/A	Capillary Break					Capillary Break 1.5" Clean Stone
6		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					14" Steel Casing
9								Cement-Bentonite Grout
11		PT	Meadow Mat					



NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-14

DATE DRILLED: 1/4/12

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603851.7 N: 699152.7	ELEVATION: GND SURF: 10.1 ft msl TOC: 9.16 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
13								
14								14" Diameter Borehole
15		PT	Meadow Mat					10" Steel Casing
16				20"	1 1 1 1 5	0		
17								
18				21"	6 7 8 7	0		
19		SW	Deep Sand					
20				18"	10 10 10	0		
21								
22				18"	3 4 5 5	0		
23		CL	Varved Silty Clay					
24								
25								

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-14

DATE DRILLED: 1/4/12

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603851.7 N: 699152.7	ELEVATION: GND SURF: 10.1 ft msl TOC: 9.16 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
26								
27								10" Diameter Borehole
28								6" PVC Casing
29								
30								
31		CL	Varved Silty Clay					
32								Env Bentonite Plug
33								
34								
35								
36								Coke Breeze
37								

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-14

DATE DRILLED: 1/4/12

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603851.7 N: 699152.7	ELEVATION: GND SURF: 10.1 ft msl TOC: 9.16 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
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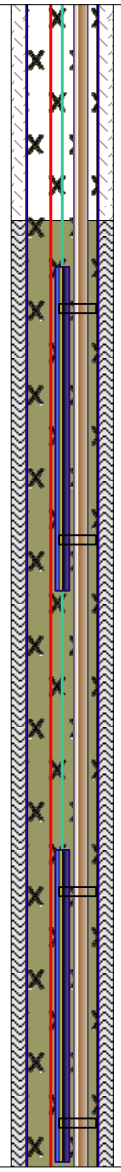
39								Upper Lead Cable (green)
40								
41								6" Steel Casing
42								
43								
44		CL	Varved Silty Clay					Steel Casing Grouted With Conducrete Mix
45								
46								
47								
48								
49								
50								



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DATE DRILLED: 1/4/12

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Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
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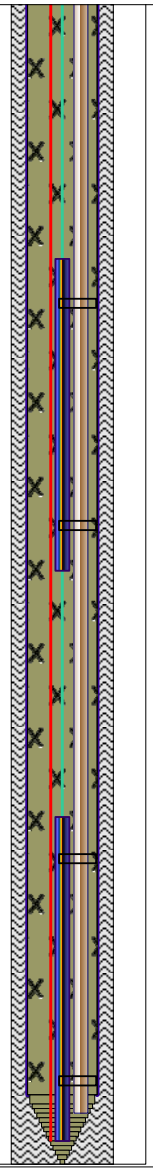
52								
53								
54								Anode Assembly Within 6"Steel Casing
55								
56		CL	Varved Silty Clay					Centralizers
57								
58								
59								
60								
61								Lower Lead Cable (red)
62								Beveled, Welded Point



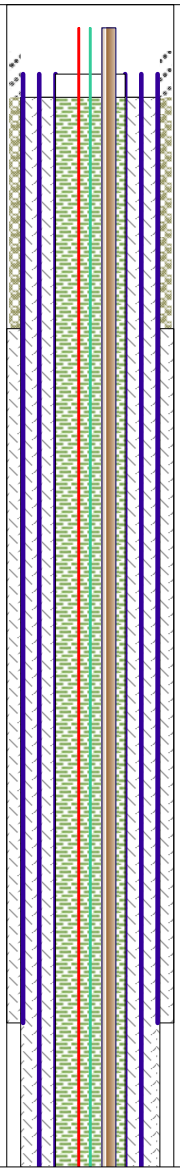
NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-15

DATE DRILLED: 1/5/12

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603831.9 N: 699218.6	ELEVATION: GND SURF: 9.9 ft msl TOC: 8.86 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		SM	Structural Fill	N/A		0		Concrete Pad Bedding Stone 18" Diameter Borehole Capillary Break 1.5" Clean Stone 14" Steel Casing Cement-Bentonite Grout
3		N/A	Capillary Break					
4		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
9		PT	Meadow Mat					

0 1 2 3 4 5 6 7 8 9 10 11 12

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

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Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
13								14" Diameter Borehole
14								
15		PT	Meadow Mat					10" Steel Casing
16				17"	1 1 2 3	1.3		
17								
18								
19				12"	5 5 7	0		
20		SW	Deep Sand		6 6			
21				13"	6 7	0		
22					9			
23		CL	Varved Silty Clay	17"	3 6 7 7	0		
24								
25								

NOTES:

Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-15

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Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
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29								
30								
31		CL	Varved Silty Clay					
32								Env Bentonite Plug
33								
34								
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36								Coke Breeze
37								

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Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
38								Upper Lead Cable (green)
39								
40								
41								6" Steel Casing
42								
43								
44		CL	Varved Silty Clay					Steel Casing Grouted With Conducrete Mix
45								
46								
47								
48								
49								
50								

NOTES:

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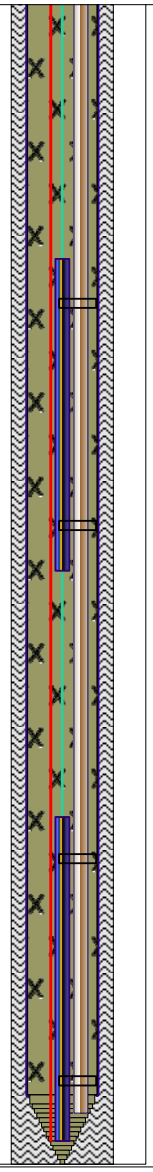
52								
53								
54								Anode Assembly Within 6"Steel Casing
55								
56								Centralizers
		CL	Varved Silty Clay					
57								
58								
59								
60								
61								Lower Lead Cable (red)
62								Beveled, Welded Point



NOTES:

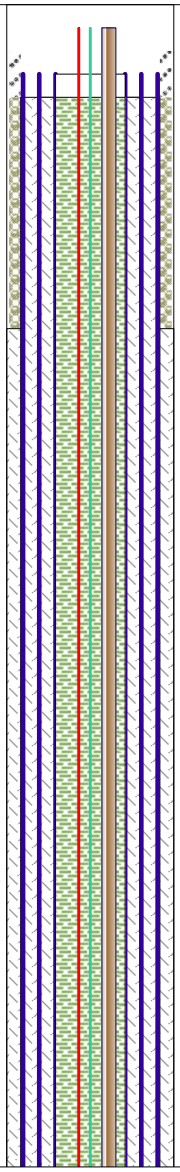
Wells constructed with 1 anode cable, 4 sections, 1" slotted vent tube, centralizers and wiring connections to rectifiers

BOREHOLE LOG: AW-16

DATE DRILLED: 1/5/12

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: Peninsula Restoration Group	DRILLING CO: Talon
SITE LOCATION: Kearny, NJ	DRILLER: Joe Deithorn
PROJECT NO: 201113	DRILLING RIG: Mobile B-59
FIELD GEOLOGIST: J Pieretti	DRILLING METHOD: HSA/Mud Rotary
PROJECT MANAGER: Jacob Bourdeau	SAMPLING METHOD: Split Spoon
COORDINATES: E: 603818.8 N: 699294	ELEVATION: GND SURF: 10.0 ft msl TOC: 9.11 ft msl
DATUM: N.J.-State Plane NAD 83	TOTAL DEPTH: 62.75 ft.

Depth (ft-bgs)	Lithol Log	USCS	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0								Concrete Pad
1		SM	Structural Fill					Bedding Stone 18" Diameter Borehole
2								
3		N/A	Capillary Break					Capillary Break 1.5" Clean Stone
4								
5								
6								14" Steel Casing
7								
8		N/A	Historic Fill-Cinder, glass, concrete, silt, sand and gravel					
9								Cement-Bentonite Grout
10								
11								
12								



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15		PT	Meadow Mat					10" Steel Casing
16								
17								
18					3			
19				13"	4 7	0		
20		SW	Deep Sand		10 9			
21				11"	8 6	6.7		
22					5 7			
23				18"	9 10	0.6		
24		CL	Varved Silty Clay		9			
25								

NOTES:

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34								
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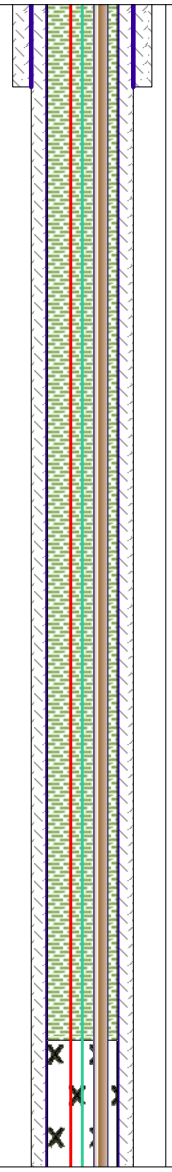
37								



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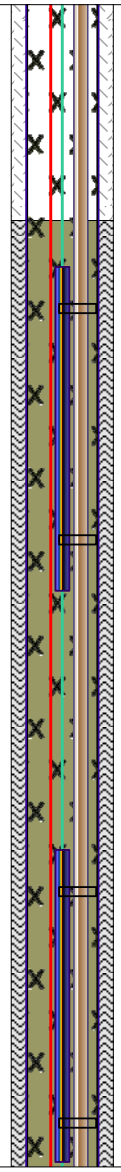

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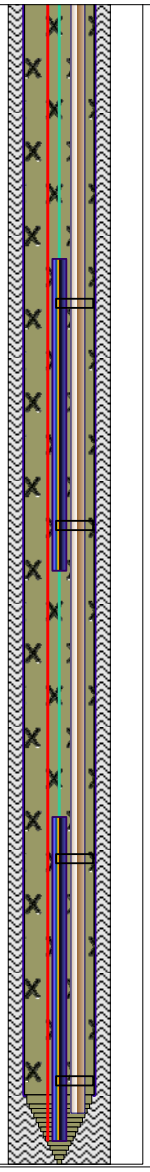

NOTES:

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APPENDIX E

CULTURAL RESOURCES SURVEY WORK PLAN

CULTURAL RESOURCE SURVEY WORK PLAN

For Incorporation into the Remedial Investigation/ Focused Feasibility Study (RI/FFS) Work Plan

Standard Chlorine Chemical Site
1025-1035 Belleville Turnpike
Block 287, Lots 48, 49, 50, 51, 52 and 52.01 (aka 52R)
Town of Kearny, Hudson County, New Jersey

Submitted To:

United States Environmental Protection Agency
Region 2
290 Broadway
New York, NY 10007

Prepared For:

SCCC Site Performing Parties Group
c/o Key Environmental, Inc.
200 Third Avenue
Carnegie, PA 15106

Prepared By:

Langan Engineering and Environmental Services, Inc.
River Drive Center 1
Elmwood Park, New Jersey 07407
NJ Certificate of Authorization No.: 24GA27996400

24 July 2013
001872507

LANGAN

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	3.1 Recordation of Buildings and Inventory Forms	3
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LIST OF FIGURES

Figure 1 Site Location Map

Figure 2 Tax Map

1.0 INTRODUCTION

Langan Engineering and Environmental Services (Langan), in consultation with ARCH2, Inc., has prepared this Cultural Resource Survey Work Plan (CRSWP) to address the United States Environmental Protection Agency (USEPA) request to comply with the requirements of the National Historic Preservation Act (NHPA) as part of the Remedial Investigation/Focused Feasibility Study (RI/FFS) to be performed for the Standard Chlorine Chemical Company (Standard Chlorine or SCCC) Site located at 1025 through 1035 Belleville Turnpike in the Town of Kearny, Hudson County, New Jersey (Figure 1). The property is identified on the Town of Kearny Tax Maps as Block 287, Lots 48, 49, 50, 51, 52 and 52.01 (aka 52R)(Figure 2). Portions of Lot 50 the Standard Chlorine property contain the former Edison Battery Company. The New Jersey State Historic Preservation Office (NJSHPO) issued an Opinion of Eligibility in 2008 that the former Edison Battery Company property, including Buildings 1, 2, 3, 4 and 23, is eligible for inclusion in the National Register of Historic Places (NRHP) (NJDEP 2008).

The work described in this CRSWP will support remedial investigations and activities conducted in accordance with the May 3, 2013 Administrative Settlement Agreement and Order on Consent for Remedial Investigation and Focused Feasibility Study between the USEPA and Apogent Transition Corp.; Beazer East, Inc.; Cooper Industries, LLC; and, Occidental Chemical Corporation (USEPA Region 2, CERCLA Docket No. 02-2013-2015). All of the five buildings on the Standard Chlorine property are anticipated to be demolished, thereby resulting in an adverse effect to the buildings evaluated by the NJSHPO as eligible for inclusion in the National Register of Historic Places. This CRSWP presents the steps that will be taken during the RI/FFS period to develop and implement appropriate cultural resource mitigation measures, specifically the recordation of the identified historic buildings and preparation of interpretive materials to document the activities that occurred within the historic buildings and on Edison Battery Company property.

The work will be conducted in accordance with the requirements of Section 106 of the NHPA and its implementing regulations. Individuals performing the work will meet the National Park Service professional qualifications standards for the appropriate discipline (See Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation, 48 Federal Register 44738-39).

A Memorandum of Agreement (MOA) regarding cultural resources compliance pursuant to 36 CFR Part 800 will be prepared by the USEPA and the NJSHPO in concert with any consulting and interested parties. The MOA will identify the required mitigation activities to be performed in order to address the requirements of the NHPA, and may require activities outlined in this work plan as well as additional tasks agreed upon during the Section 106 consultation process.

In addition to the MOA, the RI Reuse Assessment will briefly examine the potential reuse of the historic buildings; however, given the current dilapidated condition of the buildings and remedial requirements that will ultimately require the removal of the buildings, avoidance of adverse effects to the historic buildings does not appear to be feasible.

2.0 BACKGROUND

The NHPA requires federal agencies to conduct activities to identify, evaluate and protect significant Historic and Pre-Contact period resources that their actions potentially affect. To address these requirements for the Standard Chlorine property, a series of cultural resource studies has been completed to define significant cultural resources. As part of the 2008 studies for NJ Transit's and Amtrak's Portal Bridge Project (located to the north of the Standard Chlorine property), five buildings on the Standard Chlorine property were investigated (AKRF 2008). This study identified the former Edison Battery Company property as a complex of five buildings associated with the prolific inventor Thomas A. Edison and his refinements in battery development. The five concrete buildings (Gatehouse (Bldg 23), Laboratory and Office (Bldg 1), Battery Manufacturing Building (Bldg 2), Service and Maintenance Building (Bldg 3), and Boiler House (Bldg 4)) were constructed by the Edison Battery Company in 1927 (AKRF 2008) and operated by Edison Battery Company from 1929 to 1954, when SCCC purchased the property. The April 2008 NJSHPO opinion letter concluded that the former Edison Battery Company property appears to meet the criteria for listing under Criterion A, for its association with Thomas A. Edison and his development of the battery, and under Criterion C, as an example of the Art Deco style applied to the exterior facade of industrial buildings (NJDEP 2008).

A Phase IA Cultural Resource Survey Report was prepared in 2009 by Langan as part of the implementation of the Interim Response Action Work Plan for the property (Langan 2009). The Phase IA report concluded that the property had a low sensitivity for prehistoric archeological resources and contained a significant historic industrial property associated with the former Edison Battery Company. A geomorphological assessment and Phase IB Archaeological Survey during construction of the slurry wall were performed in 2010 and 2011 to address potential prehistoric archeological resources that might be affected by installation of a slurry wall around the perimeter of the property (Langan 2010 and Langan 2012).

3.0 MITIGATION ACTIVITIES

Given the eligibility of the former Edison Battery Company property and the anticipated demolition of the five associated buildings, mitigation activities are proposed to record and historically interpret the former Edison Battery Company property complex, including the five buildings. These activities are intended to provide the USEPA and NJSHPO with sufficient documentation to mitigate impacts from the proposed demolition of the buildings.

3.1 Recordation of Buildings and Inventory Forms

Former Edison Battery Company property buildings 1, 2, 3, 4 and 23 will be recorded through Historic American Building Survey (HABS) documentation per the standards and guidelines acceptable to USEPA and NJSHPO. The HABS documentation will include a description of the overall complex and setting as well as individual descriptions of each building; a narrative with a thorough site history and evaluation of significant architectural and historic themes, especially in relation to Thomas A. Edison, his development of batteries for the Model A Ford, and his model for modern research and development; photographs of the site and individual buildings keyed to a map and index; and copies or photographs of relevant historical documents, including historical photographs and architectural plans.

Research to develop the site history will utilize relevant primary source material from, but not limited to, the Thomas Edison National Historical Park, Rutgers University's Edison Papers, The Henry Ford Museum, and the Institute of Electrical and Electronics Engineers (IEEE). In addition to providing the basis for the historical narrative for the HABS documentation, this research will assist in the development of the public education material described in Section 3.2 below.

Photographic documentation of the five buildings will be obtained to highlight industrial processes that once occurred within the buildings and stylistic or architectural elements of interest, such as windows, doors, and existing and former machinery locations. Views of exterior elevations of each building, general interior spaces, and general surround landscapes will also be included. The photographs will be color with a digital format of a minimum of 1600 x 1200 pixels at 300 pixels per inch or larger; all photographs will be prepared using the current standards of the National Register of Historic Places.

The New Jersey State Historic Property Inventory forms that were developed in 2008 for the former Edison Battery Company property will be reviewed and updated to address current site conditions, additional historic documentation, and updated analysis of significance.

3.2 Development of Public Education Materials

Booklet – An illustrated booklet on the abstracted history of the former Edison Battery Company property will be developed for the general public. The booklet will draw upon the research conducted for the HABS narrative and will include appropriate images, including historic photographs. The booklet will be distributed to local governments, museums and historical societies as well as to historical and technical organizations related to the study of Thomas A. Edison, electronics, and automotive history.

Teachers' Tools for Local History – A teachers' guide and lesson plans will be developed to be utilized in schools as part of the teaching of New Jersey history. These teaching tools will be organized by the historic themes identified in the HABS narrative and will include appropriate graphics.

Interpretive Exhibit – An interpretive exhibit will be developed to discuss the history of the site, its ties to Thomas A. Edison, and its significance in terms of electronic and automotive history. The exhibit will include historical images and, if possible, certain uncontaminated or decontaminated identified artifacts and/or copies of historical documents. The exhibit will be designed as a traveling exhibit to be offered to area historical societies as well as to historical and technical organizations related to the study of Thomas A. Edison, electronics, and automotive history. A plan for the exhibit circulation and its ultimate ownership will be developed and submitted to the NJSHPO for their review and approval. The exhibit will be developed by a professional historian and a professional exhibit designer, both of whom have experience developing exhibits related to Thomas A. Edison.

4.0 DELIVERABLES AND SCHEDULE

4.1 Deliverables

The results of the CRSWP described in this document will be presented in a written, bound report to the USEPA and NJSHPO for their review and comment. Electronic copies of the materials will also be provided upon acceptance of the final report. During the MOA process it is anticipated that members of the public will also be provided an opportunity to comment on the mitigation activities presented in this work plan. Upon receipt of comments from USEPA and/or NJSHPO, the draft report will be revised and the following will be submitted to USEPA and NJSHPO as final.

- Three (3) bound hard copies (one to USEPA and two to NJSHPO) of the HABS Report printed on an 8 by 10-inch format on archival stable paper to current National Register standards, including a full set of Architectural Survey Forms.

- Three (3) electronic copies of the final report in PDF format, on an archival disc meeting National Register standards.

- Ten (10) hard copies and five (5) DVDs of the public education materials.

4.2 Schedule

The CRSWP will be implemented in concert with the schedule for the overall RI/FFS implementation. The fieldwork portion of the recordation of the historic buildings will be performed prior to commencement of building pre-demolition and demolition-related activities. Periodic progress reports will be provided to USEPA. Coordination will occur through the SCCC Site Performing Parties Group, USEPA with NJSHPO, and as necessary, with ACHP and other interested parties.

5.0 REFERENCES

AKRF. 2008. Portal Bridge Capacity Enhancement Project: Final Environmental Impact Statement, Hudson County, New Jersey. For Amtrak and NJ Transit.

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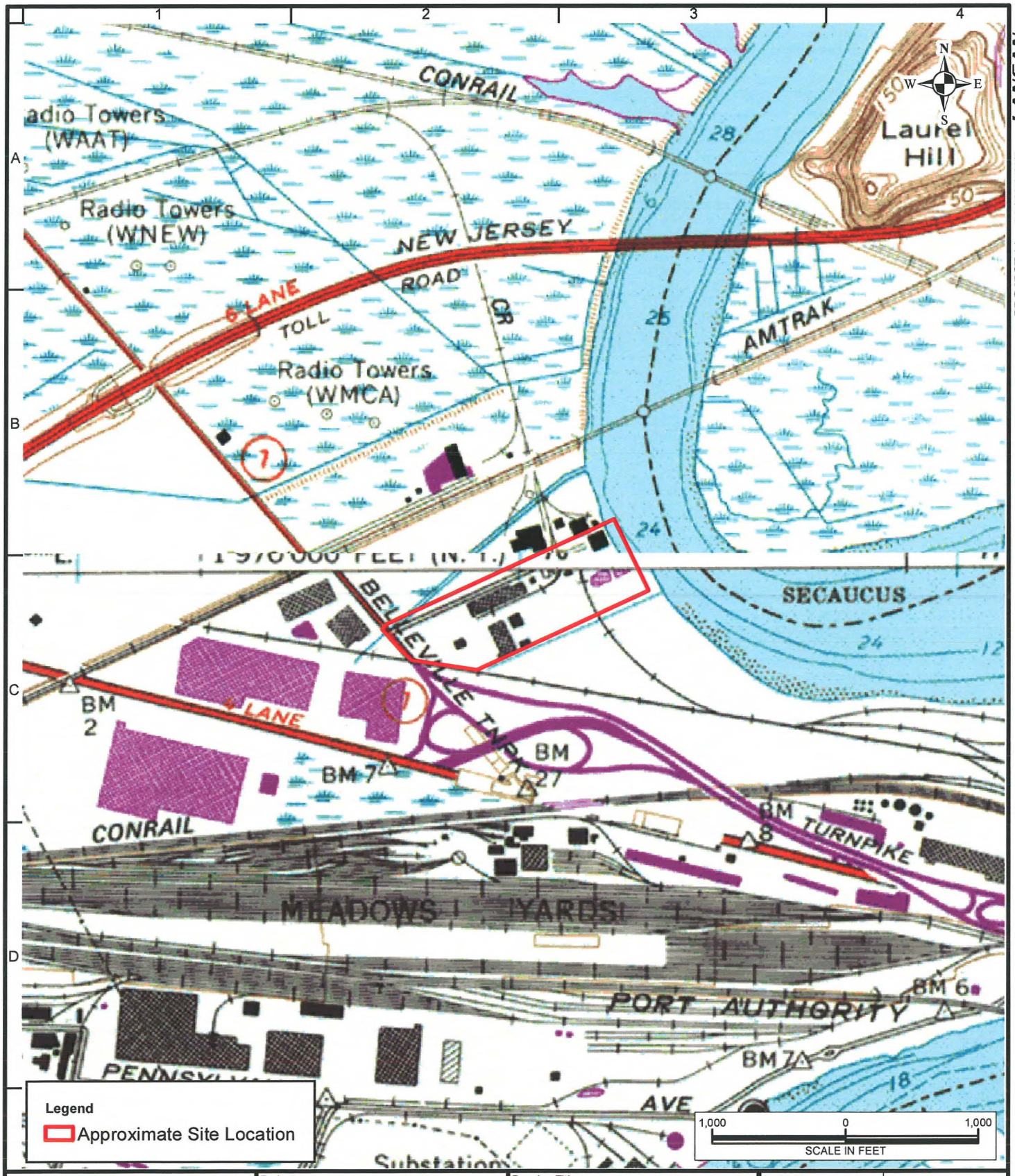

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Collectively known as Langan

NJ CERTIFICATE OF AUTHORIZATION No. 24GA27996400

Project
STANDARD CHLORINE CHEMICAL COMPANY
CULTURAL RESOURCE SURVEY WORK PLAN
KEARNY TOWNSHIP
BLOCK 287
LOT 48, 49, 50, 51, 52, 52R
HUDSON COUNTY NEW JERSEY

Drawing Title
SITE LOCATION MAP

Project No. 001872507	Figure 1
Date 7/18/2013	
Scale 1" = 1,000'	
Drawn By ARL	

Map References: USGS Topographic Quadrangle Jersey City(C: 1967, R: 1981, Vertical Datum NGVD 1929) AND Weehawken (C:1988, Vertical Datum NGVD 1929)

PROJECT No. 001872507

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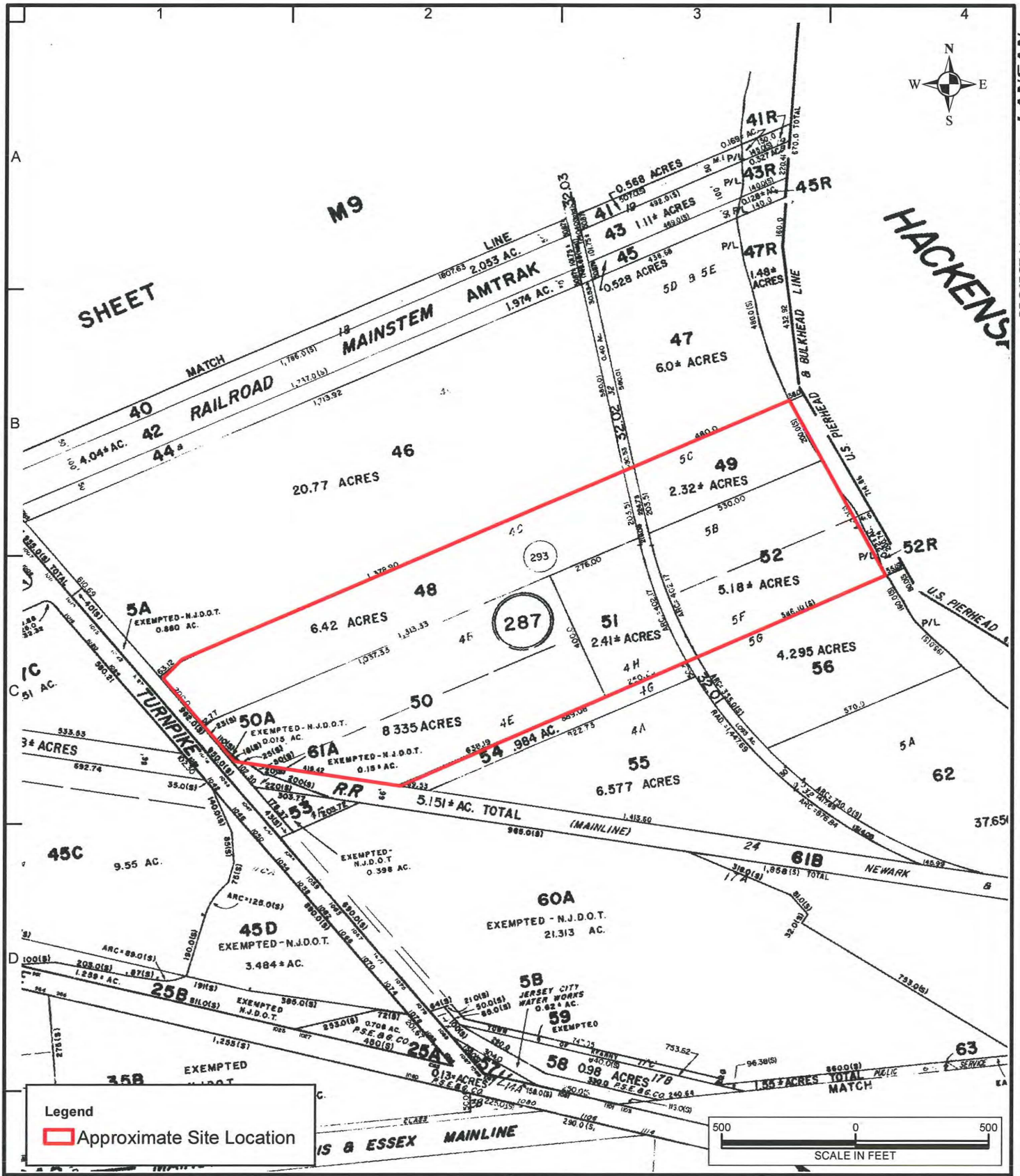

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Project
STANDARD CHLORINE CHEMICAL COMPANY
CULTURAL RESOURCE SURVEY WORK PLAN
KEARNY TOWNSHIP
BLOCK 287
LOT 48, 49, 50, 51, 52, 52R (aka 52.01)
HUDSON COUNTY NEW JERSEY

Drawing Title
TAX MAP

Project No. 001872507	Figure 2
Date 7/18/2013	
Scale 1" = 500'	
Drawn By ARL	

Map References: Kearny Township Tax Map - Sheet M8
C: November 1, 1964, R: November 3, 1992

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APPENDIX F

DRAFT RI/FFS REPORT OUTLINE

Appendix F
Remedial Investigation/Focused Feasibility Study Work Plan
Standard Chlorine Chemical Co., Inc. Site, Kearny, New Jersey

DRAFT REMEDIAL INVESTIGATION REPORT OUTLINE

Executive Summary

1. Introduction

1.1 Purpose of Report

1.2 Site Background

1.2.1 Site Description
1.2.2 Site History
1.2.3 Previous Investigations

1.3 Report Organization

2. Study Area Investigation

2.1 Includes field activities associated with site characterization.

2.1.1 Surface Features (topographic mapping, etc.) (natural and manmade features)
2.1.2 Contaminant Source Investigations
2.1.3 Surface-Water and Sediment Investigations
2.1.5 Geological Investigations
2.1.6 Soil and Vadose Zone Investigations

2.1.6.1 Surface Soil
2.1.6.2 Subsurface Soil

2.1.7 Ground-Water Investigations

2.1.7.1 Shallow Fill Unit
2.1.7.2 Sand Unit
2.1.7.3 DNAPL

2.2 Field Activities Technical Summary.

3. Physical Characteristics of the Study Area

3.1 Includes results of field activities to determine physical characteristics. These may include some, but not necessarily all, of the following:

3.1.1 Surface Features
3.1.2 Meteorology
3.1.3 Surface-Water Hydrology
3.1.4 Geology
3.1.5 Soils
3.1.6 Hydrogeology
3.1.7 Demography and Land Use
3.1.8 Ecology

4. Nature and Extent of Contamination

4.1 Presents the results of site characterization, both natural and chemical components and contaminants in some, but not necessarily all, of the following media:

4.1.1 Potential Sources
4.1.2 Soils and Vadose Zone
4.1.3 Ground Water
4.1.4 Surface Water and Sediments
4.1.5 Air

5. Contaminant Fate and Transport

5.1 Potential Routes of Migration
5.2 Contaminant Persistence
5.3 Contaminant Migration

6. Baseline Risk Assessment

6.1 Human Health Evaluation

6.1.1 Data Evaluation
6.1.2 Exposure Assessment
6.1.3 Toxicity Assessment
6.1.4 Risk Characterization
6.1.5 Uncertainty

6.2 Environmental Evaluation

7. Summary and Conclusions

7.1 Summary

7.1.1 Nature and Extent of Contamination
7.1.2 Fate and Transport
7.1.3 Risk Assessment

7.2 Conclusions

7.2.1 Data Limitations and Recommendations for Future Work
7.2.2 Recommended Remedial Action Objectives

Bibliography
References
Appendices

DRAFT FOCUSED FEASIBILITY STUDY REPORT OUTLINE

Executive Summary

1. Introduction

1.1 Purpose and Organization Report

1.2 Background Information (Summarized from RI Report)

1.2.1 Site Description

1.2.2 Site History

1.2.3 Nature and Extent of Contamination

1.2.4 Contaminant Fate and Transport

1.2.5 Baseline Risk Assessment

2. Identification and Screening of Technologies

2.1 Introduction

2.2 Remedial Action Objectives:

- Contaminants of interest
- Allowable exposure based on risk assessment (including ARARs)
- Development of remediation goals

2.3 General Response Actions

2.4 Identification and Screening of Technology Types and Process Options

2.4.1 Identification and Screening of Technologies

2.4.2 Evaluation of Technologies and Selection of Representative Technologies

3. Development and Screening of Alternatives

3.1 Development of Alternatives

3.2 Screening of Alternatives (if conducted)

3.2.1 Introduction

3.2.2 Alternative 1

3.2.2.1 Description
3.2.3.2 Evaluation

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3.2.x Alternative x

3.2.x.1 Description
3.2.x.2 Evaluation

4. Detailed Analysis of Alternatives

4.1 Introduction

4.2 Individual Analysis of Alternatives

4.2.1 Alternative 1

4.2.1.1 Description
4.2.1.2 Assessment

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4.2.y Alternative y

4.2.y.1 Description
4.2.y.2 Assessment

4.3 Comparative Analysis

Bibliography
References
Appendices