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Expanded Remedial Investigation Work Plan Addendum for Deep Groundwater at Site 2, St. Juliens Creek Annex, Chesapeake, Virginia

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This technical memorandum provides the approach for investigating the presence of trichloroethene (TCE) in deep groundwater (Yorktown Aquifer) at Site 2, St. Juliens Creek Annex (SJCA), Chesapeake, Virginia. The potential causes include:

- The TCE was carried down during the well installation as a result of the drilling process
- A leaking Yorktown Confining Unit allowed the TCE to migrate into the Yorktown Aquifer due to its density (sink)
- The installation of the monitoring well created a conduit which allowed for migration into the lower aquifer

The proposed field activities to investigate the presence of TCE detected at SJS02-MW10D include:

- Conducting background barometric pressure and water level measurements prior to the aquifer tests in order to compensate for potential fluctuations in the data due to natural site conditions (tidal influence or barometric pressure)
- Conducting a well yield test to determine the production capacity of SJS02-MW10D
- Conducting an aquifer pumping test on the Yorktown Aquifer at Site 2 using monitoring well SJS02-MW10D to determine if the Yorktown Confining Unit is leaking and to significantly purge/redevelop the well prior to sampling
- Resampling of existing monitoring well SJS02-MW10D for volatile organic compounds (VOCs) analysis before and after the aquifer pumping test

Site 2 History and Description

Site 2 (Waste Disposal Area B) is an unlined waste disposal area that operated from 1921 to 1947. Site 2 covers approximately 4.4 acres at the corner of St. Juliens Drive and Cradock Street in the southwestern portion of the facility (Figure 1). Garbage, acids, and waste ordnance were reportedly disposed by open burning on site and the ash was used to fill the

adjacent inlet. The total volume of waste prior to burning is reported to have been approximately 35,185 cubic yards. Abrasive blast media (ABM) from ship overhaul and repair operations were also disposed of at the site. Construction debris (concrete and brick), as well as ABM, is visible at the site. In the center of Site 2 is a tidal inlet surrounded by brush, trees, and grass that is directly connected to St. Juliens Creek through a 24-inch culvert (Figure 2). The Site 2 topography is generally level, sloping towards the inlet and St. Juliens Creek.

Hydrogeology

The shallow subsurface hydrogeology at Site 2 can be separated into three hydrostratigraphic units: the Columbia Aquifer, the Yorktown Confining Unit, and the Yorktown Aquifer. Details of the hydrostratigraphic units at the 13 shallow and 4 deep existing monitoring wells at Site 2 are provided in Table 1. The locations of the hydrostratigraphic cross sections depicting the subsurface environment at Site 2 are shown in Figure 3 and the cross sections are presented in Figures 4 and 5.

The Columbia Aquifer (shallow groundwater) at Site 2 occurs in waste material, and the underlying, naturally occurring deposits of clay, silt, and sand. This aquifer extends to a depth of approximately 10 to 25 feet (ft) below ground surface (bgs). The water table hydraulic gradient is relatively flat, 0.004 ft/ft, and the groundwater flows toward the inlet. The depth to shallow groundwater ranges between 3 and 8 ft bgs (Table 2).

Underlying the Columbia Aquifer is the Yorktown Confining Unit, a clay unit with interbedded fine sand and silt, which separates the overlying Columbia Aquifer from the sand and silty sand of the underlying Yorktown Aquifer. The Yorktown Confining Unit is approximately 30 ft thick on average. Horizontal groundwater flow in the Yorktown Aquifer is generally toward the Southern Branch of the Elizabeth River. The horizontal hydraulic gradient is relatively flat (0.0008 ft/ft), based on the facility-wide groundwater levels previously collected, with the depth to groundwater ranging between 5 and 8 ft bgs.

Slug tests were conducted at Site 2 during both the Remedial Investigation (RI) (CH2M HILL, February 2004) and the Expanded RI (CH2M HILL, October 2005). The slug test results were used to calculate the hydraulic conductivity (K) of the Columbia and Yorktown Aquifers. Based on the RI data, the average geometric mean K for the Columbia Aquifer is 11 ft/day, and the for the Yorktown Aquifer is 186 ft/day, using the Bouwer-Rice method. Using the Cooper-Bredehoeft-Papadopulos method, the geometric average K for the Yorktown Aquifer is 31 ft/day. These values were calculated excluding the high-K values from the falling head slug test at SJS02-MW02D from the data set for both the Bouwer-Rice and Cooper-Bredehoeft-Papadopulos methods. The Cooper et al. average is more consistent with Yorktown Aquifer data previously evaluated for SJCA (Sites 3 through 6).

The more recent Expanded RI data indicate that the geometric average horizontal K and the standard deviation for the Columbia Aquifer is 3 ft/day and the geometric average horizontal K for the Yorktown Aquifer is 25 ft/day, using the Bouwer-Rice method (Table 3). The reason for the discrepancy is not known. Since the RI data were collected by a different contractor (CDM) who provided the results to CH2M HILL to evaluate, there may have been transcription errors. Therefore, the Expanded RI data will be used.

Based on available data from the shallow and deep groundwater well pairs, the vertical hydraulic gradient west of the Site 2 inlet is generally upward and the vertical hydraulic gradient east of the Site 2 inlet is downward (Table 2). However, it is expected that the direction of vertical groundwater flow at Site 2 varies seasonally.

Previous Investigation Results

Shallow and deep groundwater at Site 2 was evaluated during the RI (CH2M HILL, February 2004) and the Expanded RI (CH2M HILL, October 2005). A VOC plume is localized in the shallow groundwater at Site 2 (Figure 6). The highest VOC concentrations were detected in groundwater samples collected from SJS02-MW07S (270,000 µg/L) and SJS02-MW10S (330,000 µg/L). These elevated concentrations indicate the presence of pure phase TCE or dense non-aqueous phase liquid (DNAPL). Additionally, the significant presence of TCE degradation products (i.e., 1,2-dichloroethene and vinyl chloride) indicate that natural remediation processes are occurring. TCE was also detected at SJS02-MW11S at a significantly lower concentration (50 µg/L).

The VOCs in shallow groundwater are confined to a relatively small area (17,000 square ft), based on the location between the site drainages and inlet and the groundwater flow direction towards the inlet. Based on electron capture device (ECD) data from the Membrane Interface Probe (MIP) logs, the elevated VOCs begin around the water table at approximately 4 ft bgs and continue beyond the logged depth of approximately 16 ft bgs.

One deep monitoring well (SJS02-MW10D) was installed to evaluate the potential migration of VOCs from the Columbia Aquifer to the Yorktown Aquifer. For installation of the deep well, the depth of the top of the Yorktown Confining Unit was established and the well was double-cased to prevent a potential conduit for contamination. An 8-inch ID, Schedule 40 PVC casing was installed 2 ft into the top of the confining layer. The space between the native material and the PVC was grouted to the ground surface and allowed to set for 24 hours before drilling into the Yorktown Aquifer. TCE and its breakdown products were detected at SJS02-MW10D (Figure 7). The TCE concentrations were 2,200 µg/L in December 2004, 700 µg/L in January 2005, and 900 µg/L in March 2005. No VOCs were detected in upgradient (SJS02-MW01D) and downgradient (SJS02-MW02D) monitoring wells. The Expanded RI recommended additional investigation to aid in determining the potential cause for the presence of TCE detected in deep groundwater at SJS02-MW10D.

Field Investigation and Sampling Activities

A description of the proposed field activities is included in the following subsections. The *Final Master Project Plan, St. Juliens Creek Annex, Chesapeake, Virginia* (CH2M HILL, July 2003) addresses the protocols, standard operating procedures (SOPs), and health and safety plan (HASP) to be used for all investigations at SJCA. A site-specific HASP is provided as Attachment B.

Mobilization Activities

As part of the field mobilization, CH2M HILL will procure subcontractors; including an analytical laboratory, data validator, and investigation-derived waste (IDW) handler; to

support field activities. Mobilization for the field effort includes procurement of necessary field equipment and initial transport to the site. Equipment and supplies will be brought to the site when the CH2M HILL field team mobilizes for field activities.

Prior to beginning any phase of work, CH2M HILL and its subcontractors will have field meetings to discuss the work items, worker responsibilities, and familiarize workers with the HASP for SJCA. A photo-ionization detector (PID) will be used for monitoring VOCs during the field activities as a health and safety precaution.

Background Measurements

Background measurements of the ambient water levels and barometric pressure will be collected in the test well (SJS02-MW10D) and nearby shallow (SJS02-MW10S and SJS02-MW12S) and deep (SJS02-MW01D) monitoring wells using in-situ MiniTrolls. The purpose of the background measurements is to evaluate potential fluctuations in the water levels and barometric pressure due to natural site conditions/cycles (tidal influence, changes in barometric pressure, etc). The background measurements will be applied to the pump test data in order to mitigate potential outside influences on the pump test results, if necessary. The background measurements will be conducted over a 72 hour period approximately 1 to 2 weeks prior to the pump test.

Well Yield Testing

Based on regional information about the Yorktown Aquifer in the Portsmouth area (Hamilton and Larson, 1988), transmissivity can be estimated to be about 1,800 ft²/day, the storage coefficient to be about 0.000145, and leakance of the Yorktown Confining Unit to be about 2×10^{-5} ft²/day. This transmissivity estimate is about 3 times higher than the one in Table 3 (600 ft²/day), which is based on local slug testing. With the higher transmissivity estimate (1,800 ft²/day), a measurable drawdown should be produced if the test well can be pumped at 10 gpm. With the lower estimated transmissivity (600 ft²/day) it is possible for the test to be run at approximately 6 gpm, if the well is efficient. This should produce a measurable drawdown of approximately 1 ft in the adjacent deep monitoring well (SJS02-MW01D), located 150 ft away from the test well. The existing monitoring wells are two inches in diameter, which limits the size of the pump that can be used (10 gallons per minute [gpm]).

Well yield testing will be conducted to determine the production capacity of (SJS02-MW10D). The test well will be pumped for approximately 1 to 2 hours at the maximum flow rate attainable with a Grundfos Rediflo 2 submersible pump. A water level indicator will be used to record water levels and ensure that the drawdown in the well has stabilized. If the well yield is too low (i.e., 2 to 4 gpm) to conduct the aquifer testing, the well will be redeveloped using a pump and surge method until the flow is stabilized. If the yield of the well cannot be improved to the level needed to conduct the aquifer test, (i.e., minimum 5 to 6 gpm), other investigation options will need to be considered (i.e., dye/tracer testing, direct push exploration, etc.).

Aquifer Pumping Test

Success of the aquifer pumping test hinges on the productivity of the test well (SJS02-MW10D) and measurable hydraulic response in the nearby shallow (SJS02-MW10S and

SJS02-MW12S) and deep (SJS02-MW01D) monitoring wells. If the well yield testing is successful (i.e., minimum of 5 to 6 gpm), an aquifer pumping test will be conducted with the objective of determining whether the TCE contamination detected in the deep groundwater is due to one the following:

- A leaky spot in the Yorktown Confining Unit
- Contamination carried down from the upper aquifer during well installation
- Imperfect sealing that created a conduit through the confining layer along the well casing

Pressure transducers, used to record water levels, will be placed in the test well (SJS02-MW10D) and the nearby shallow (SJS02-MW10S and SJS02-MW12S) and deep (SJS02-MW01D) monitoring wells. The test well will be pumped using a Grundfos RediFlo 2, capable of producing approximately 10 gpm, for a period of 8 to 10 hours or until the water levels in each monitoring well have stabilized for at least 30 minutes. Recovery data will be collected as soon as the pumping phase has concluded; using the time the pump is turned off as the starting time. Water levels will be measured in the test and observation wells until water levels have recovered to 95% (estimated at approximately 2 to 4 hours).

Possible Outcomes

Possible outcomes of the aquifer pumping test include:

- If the leakance is locally more than 10 times higher than the regional estimate (i.e., a leaky spot in the confining unit), the test should show a leaky response in 10 hours. If the leakance is as low as suggested in Hamilton and Larson, 1988, however, flattening of the drawdown curve will not be observed within 10 hours and it can be concluded that the confining unit is not leaky enough to cause the TCE contamination problem. The problem, therefore, would more likely be a result of the deep well installation.
- If the TCE was carried down as a dissolved contaminant during well installation, the concentrations should decrease during the test, and only slight rebound of concentrations should be observable afterwards. A significant rebound in TCE concentrations would indicate the presence of DNAPL or the existence of a contaminant plume.
- If the monitoring well construction has created a vertical conduit, the drawdown from the aquifer test may be transmitted vertically up to the shallow aquifer. Monitoring well MW10S is a shallow well located adjacent to the deep test well (MW10D), in which this might be observable. If this is not observable, well construction may be ruled out as the source of the problem.

Groundwater Sampling

Groundwater levels will be measured and recorded from each deep monitoring well before resampling SJS02-MW10D. The station identification and depth to water below the top of the PVC well casing to the nearest 0.01 ft shall be recorded. The monitoring well construction diagram and soil boring log is provided in Attachment A.

Groundwater samples will be collected from SJS02-MW10D prior to the aquifer testing, immediately after the aquifer testing, and approximately one month after the aquifer

testing. The samples will be analyzed for Target Compound List (TCL) VOCs. The groundwater samples will be collected using a peristaltic pump and low-flow purging and sampling techniques to be consistent with previous sampling rounds. The groundwater samples will be collected by placing the sample tubing intake approximately 2-ft above the bottom of the well.

Water quality parameters (specific conductance, pH, turbidity, temperature, salinity, dissolved oxygen [DO], and oxidation reduction potential [ORP]) will be measured and recorded (approximately every 5 minutes) prior to sampling using a Horiba U-22® water quality meter, calibrated daily and as-needed. Groundwater will be purged from SJS02-MW10D until the water quality parameters have stabilized to within 10% for three consecutive readings. The water quality parameters, depth to water, approximate sampling depth, and total well depth measurements will be recorded in the log book.

Samples will be contained in laboratory-prepared, pre-preserved sample bottles (Table 4) and packed on ice for overnight shipment to an off-site laboratory. For the collection of water samples for VOC analysis, the pre-preserved bottles will be filled completely so as to minimize aeration, and capped to prevent the entrapment of any air bubbles in the vial. The appropriate Quality Assurance/Quality Control (QA/QC) sample collection frequency is as follows:

Type of Quality Control Sample	Frequency Collected
Field Duplicate	One per group of up to 10 samples
Field Blank	One per week
Trip Blank	One per cooler
Matrix Spike/Matrix Spike Duplicate	One per group of up to 20 samples (not required for low concentration analyses)

Groundwater samples should be labeled with site number, well number, and date/quarter as indicated in the Master Project Plan (CH2M HILL, July 2003).

Sampling Equipment Decontamination

All non-disposable sampling equipment; such as the water level indicator; will be decontaminated immediately after each use in accordance with the applicable SOPs.

Investigation-Derived Waste

IDW is expected to consist of purge water (from the aquifer testing and groundwater sampling). The aqueous IDW generated will either be containerized (using 55-gallon drums, a roll-off, or in a tanker truck; depending on volume) which will temporarily be stored adjacent to Site 2 and removed upon the completion of field activities. IDW will be labeled and handled in accordance with the procedures outlined in the Master Project Plan (CH2M HILL, July 2003).

The IDW will be properly disposed of by subcontractors within 90-days of generation, based on the results of the waste characterization. Disposable equipment (i.e., personal protective

equipment (PPE), sample tubing, poly sheeting, and paper towels) will be disposed of as solid waste.

Sample Analysis and Data Validation

CH2M HILL will track the samples from collection through analysis and obtain results from the subcontracted laboratory. All analyses will be conducted at a laboratory that fulfills all requirements of the Navy's QA/QC Program Manual and U.S. Environmental Protection Agency's (EPA's) Contract Laboratory Program (CLP). A signed certificate of analysis will be provided with each laboratory data package, along with the applicable federal, state, and local regulations. All analyses will be performed following the highest level of Navy guidance. Analyses will include the proper ratio of field QC samples recommended by Navy Facilities Engineering Service Center (NFESC) guidance for the data quality objectives (DQOs). The laboratory will submit the data in hard copy and an electronic format that can be amended and readily incorporated into the geographic information system (GIS) for SJCA. The off-site laboratory has not been determined for this sampling event, however once the lab and data validator are identified, EPA will be notified.

Analytical results will be validated by a CH2M HILL subcontractor approved by the Navy. Procedures used for the validation process will be in accordance with *Region III Modifications to National Functional Guidelines for Organic Data Review Mutli-media, Multi-concentration* (EPA, September 1994). Data that should be qualified will be flagged appropriately. Results for QA/QC samples will be reviewed and the data will be qualified further, if necessary. Finally, the data set as a whole will be examined for consistency, anomalous results, reasonableness, and utility.

The data validator will be provided with the hard copy and electronic version of the laboratory results and will add data validation qualifiers to both versions. The electronic version will be examined for completeness and accuracy and downloaded into the CH2M HILL master database.

Project Staff and Schedule

The CH2M HILL Activity Manager for SJCA is Ms. Kimberly Henderson. Ms. Henderson will also serve as the Project Manager when funding is awarded for these field activities. Activity and project management responsibilities include daily technical support and guidance, budget and schedule review and tracking, preparation and review of invoices, personnel resources, planning and allocation of resources, subcontractor coordination, preparation of monthly progress reports, and communication and coordination of events with the Navy and the project team.

Prior to initiating field activities, CH2M HILL will notify the Navy of the CH2M HILL staff and subcontracted personnel that will conduct the field investigations. Field activities are scheduled to begin May 2006. It is estimated that three days will be required to complete the initial field activities, a minimum of three days will be required to complete the aquifer test, and one day will be required to conduct an additional groundwater sample, approximately one month after the aquifer testing is complete.

Data Evaluation and Reporting

The aquifer pump test data will be analyzed using commercially available software such as Aqtesolv or Isoaqx. The method of data analysis (i.e. Theis, Jacob Straight-Line, etc.) will be determined based on the observations recorded during the field activities. The results of the deep groundwater investigation will be used to aid in determining the potential cause; carry down during the well installation, a leaking Yorktown Confining Unit, or a conduit created during monitoring well installation; for the presence of TCE in deep groundwater. The response observed during the aquifer test will be analyzed to determine leakance of the Yorktown Confining Unit. If TCE or its breakdown products are present in deep groundwater after the aquifer test is completed, an appropriate course of action for further investigation will be recommended. The results and recommendations will be summarized in an addendum to the Expanded RI Report. The report will be provided to the Navy, Virginia Department of Environmental Quality (VDEQ), and EPA for review. The report will be finalized following review and approval.

References

CH2M HILL, July 2003. *Final Master Project Plan, St. Juliens Creek Annex, Chesapeake, Virginia.*

CH2M HILL, February 2004. *Final Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment Report for Site 2. St. Juliens Creek Annex, Chesapeake, Virginia.*

CH2M HILL, October 2005. *Draft Expanded Remedial Investigation Report for Site 2. St. Juliens Creek Annex, Chesapeake, Virginia.*

EPA, 1994. *Region III Modifications to National Functional Guidelines for Organic Data Review Multi-media, Multi-concentration.*

Hamilton, A.P. and Larson, J.D., 1988. *Hydrogeology and Analysis of the Groundwater Flow System in the Coastal Plain of Southeastern Virginia.* USGS WRI Report 87-4240. 1988.



LEGEND

-  Site 2
-  St. Juliens Creek Annex

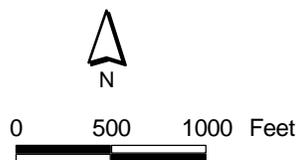


Figure 1
Location of Site 2
Within St. Juliens Creek Annex
Site 2 Expanded Remedial Investigation
St. Juliens Creek Annex
Chesapeake, Virginia



LEGEND

-  Drainage
-  Stormwater Sewers
-  Demolished Buildings
-  Former Site 17 Boundary



Figure 2
Site 2 Vicinity
Site 2 Expanded Remedial Investigation
St. Juliens Creek Annex
Chesapeake, Virginia



LEGEND

- Shallow Monitoring Well Locations
- Deep Monitoring Well Locations
- A - A' Cross Section
- B - B' Cross Section

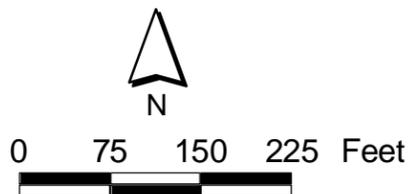
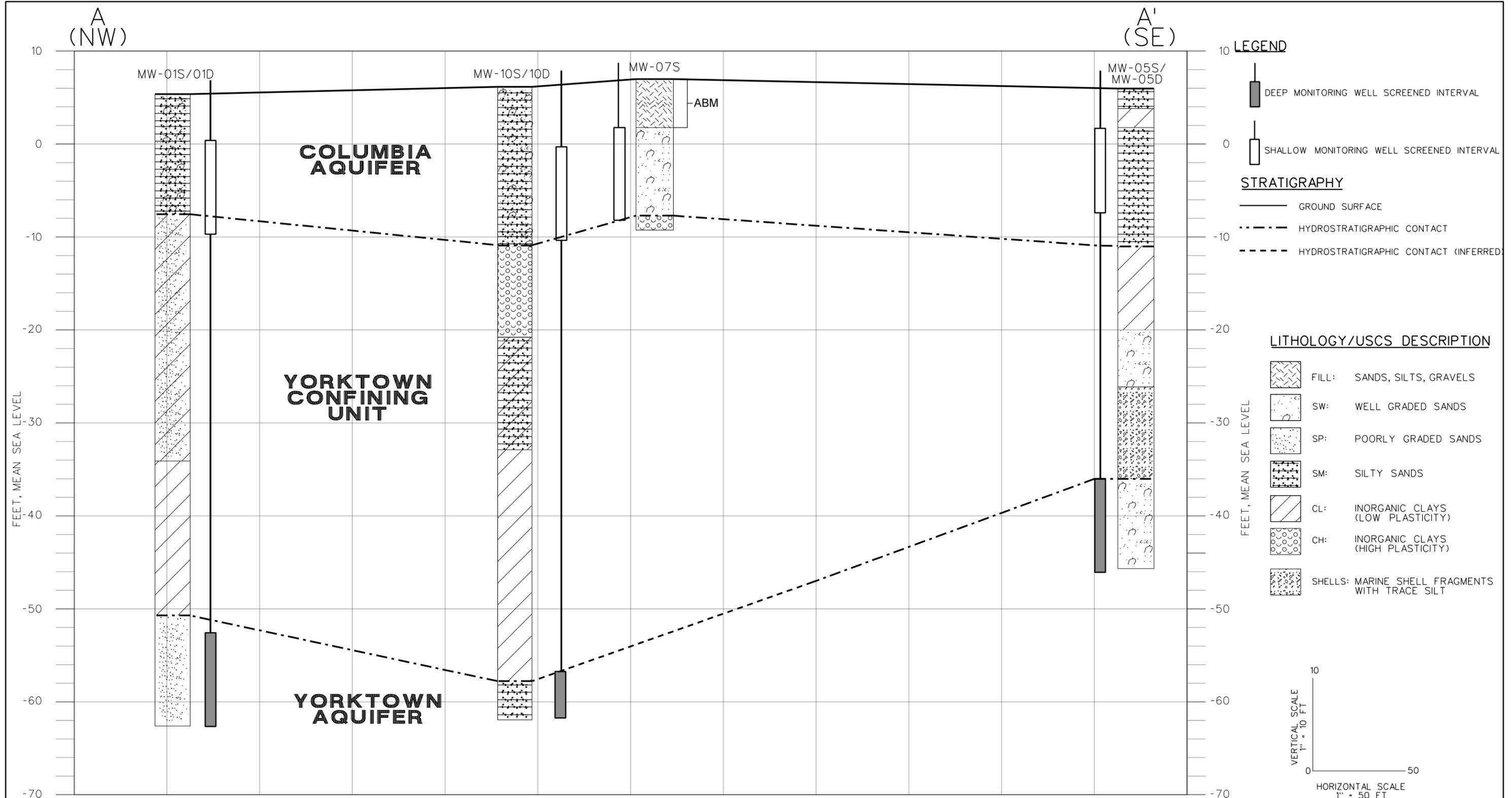
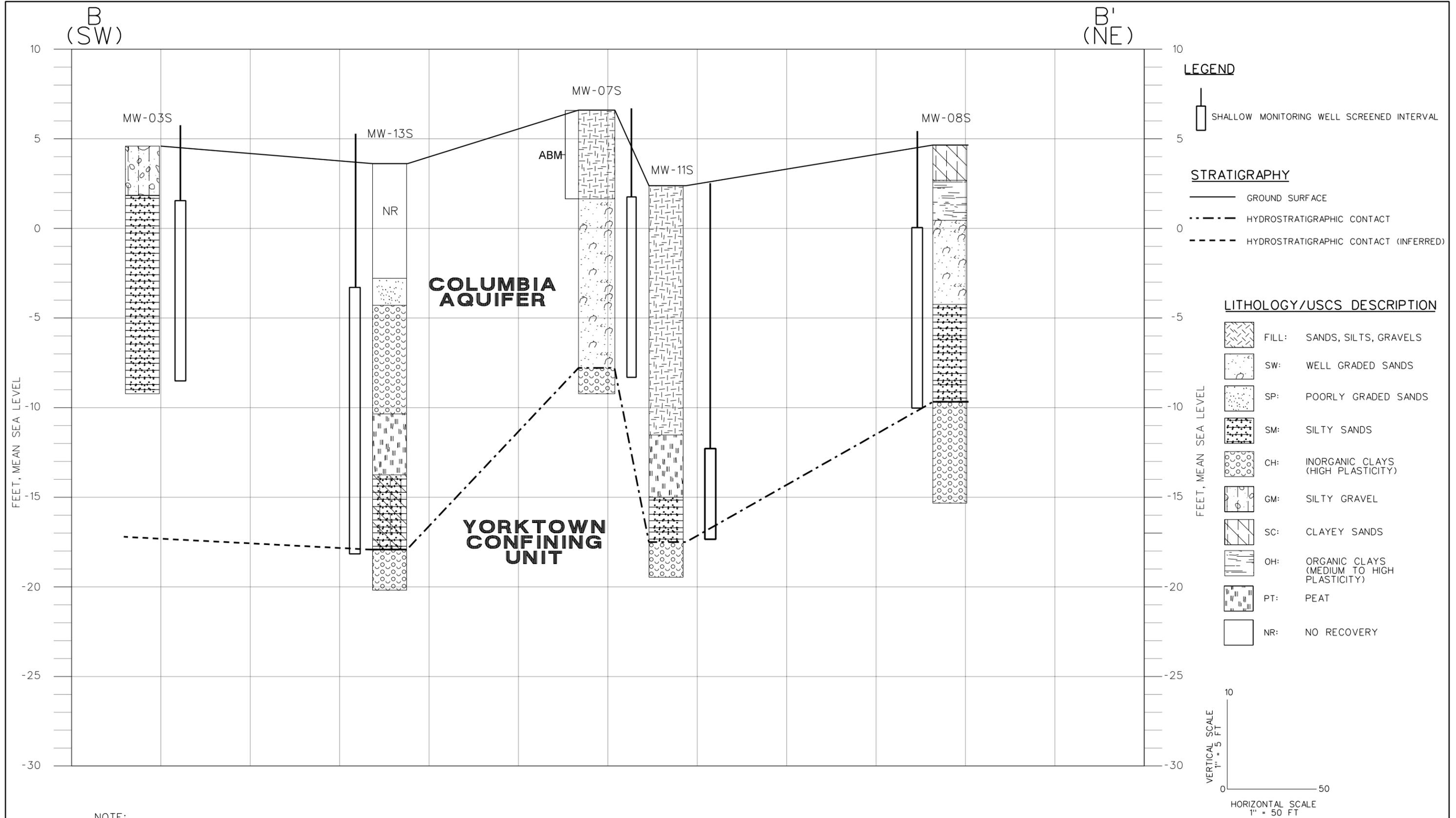


Figure 3
Hydrostratigraphic Cross Section Locations
Site 2 Expanded Remedial Investigation
St. Juliens Creek Annex
Chesapeake, Virginia



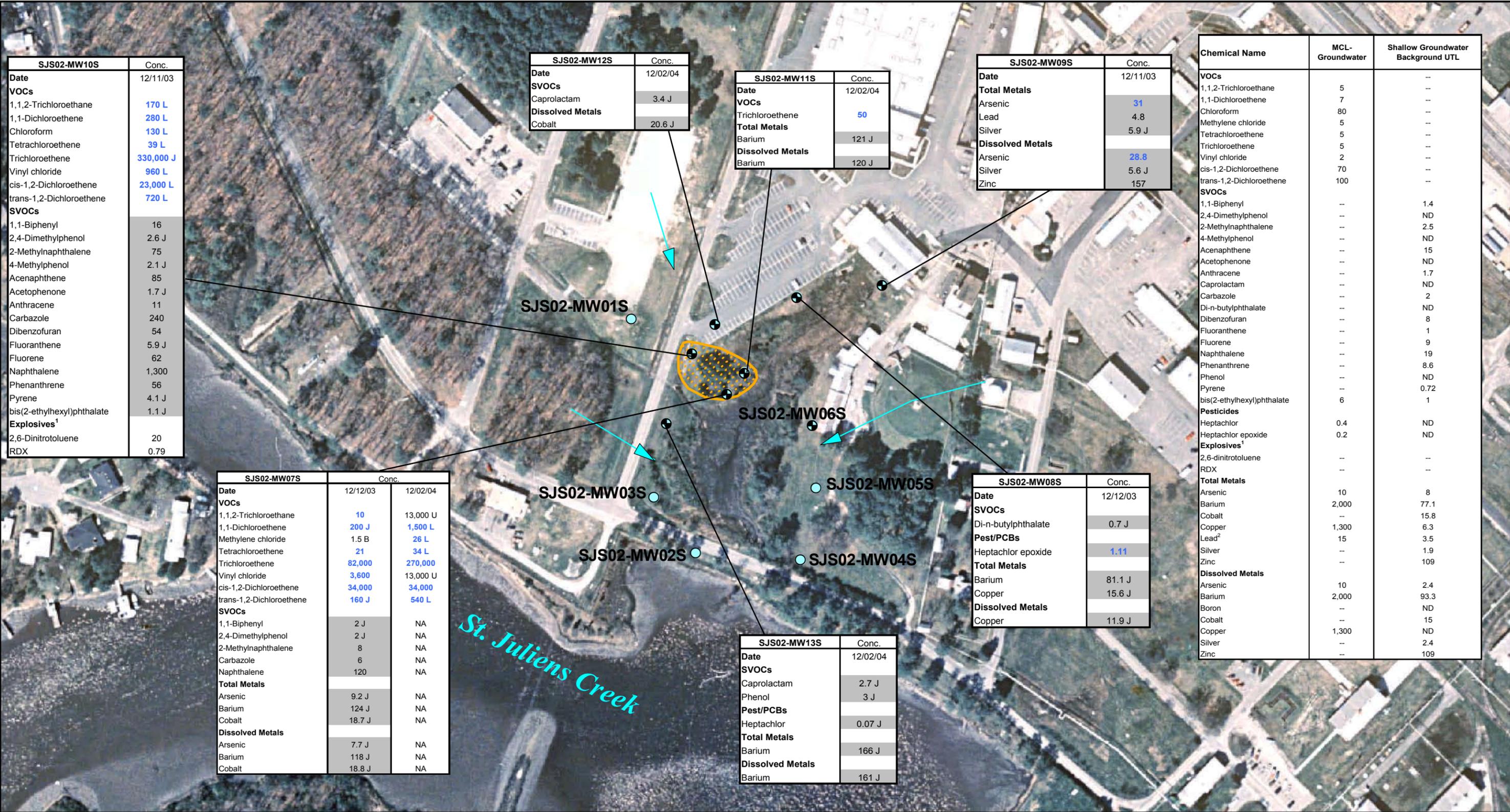
NOTE:
THIS CROSS SECTION IS INTERPRETIVE AND WAS PREPARED BY INTERPOLATION BETWEEN BORING LOCATIONS. ACTUAL CONDITIONS BETWEEN BORINGS MAY DIFFER FROM THOSE SHOWN HERE.

FIGURE 4
HYDROSTRATIGRAPHIC CROSS-SECTION A-A'
SITE 2 EXPANDED REMEDIAL INVESTIGATION
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VA



NOTE:
THIS CROSS SECTION IS INTERPRETIVE AND WAS PREPARED BY INTERPOLATION BETWEEN BORING LOCATIONS. ACTUAL CONDITIONS BETWEEN BORINGS MAY DIFFER FROM THOSE SHOWN HERE.

FIGURE 5
HYDROSTRATIGRAPHIC CROSS-SECTION B-B'
SITE 2 EXPANDED REMEDIAL INVESTIGATION
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VA



LEGEND

- Shallow Monitoring Well Locations sampled during ERI
- Shallow Monitoring Well Locations not sampled during ERI
- Estimated Extent of VOC Plume
- Groundwater Flow Direction

-- no criteria
 ND - No Detections
 NA - Not Analyzed
 J- Analyte present. Reported value is estimated.
 L- Analyte present. Reported value is biased low.
 U - Not Detected

Bold Blue text indicates MCL Exceedances
 Shaded cells indicate Background UTL Exceedances

Conc. - Concentration
 All concentrations are measured in ug/L.
¹All explosives detections are presented because no screening criteria exist.
²EPA Action Level for Lead

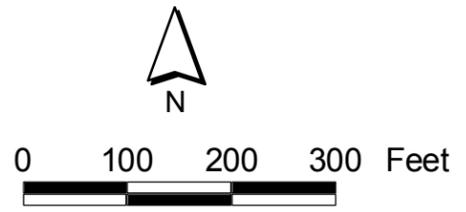


Figure 6
 Shallow Groundwater Detection and Exceedances of Screening Criteria
 Site 2 Expanded Remediation Investigation
 St. Juliens Creek Annex
 Chesapeake, Virginia



- LEGEND**
-  Deep Monitoring Well Locations sampled during ERI
 -  Deep Monitoring Well Locations not sampled during ERI

Conc. - Concentration
Concentrations are in ug/L.

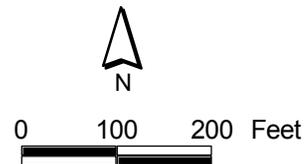


Figure 7
Deep Groundwater Detections and Exceedances of MCLs
Site 2 Expanded Remediation Investigation
St. Juliens Creek Annex
Chesapeake, Virginia

Table 1
Monitoring Well Construction Summary
Site 2 Expanded Remedial Investigation
St. Juliens Creek Annex
Chesapeake, Virginia

Table 1
Monitoring Well Construction Summary

Monitoring Well	Installation Date	Ground Elevation (ft msl)	Top of PVC Elevation (ft msl)	Total Well Depth (ft bgs)	Depth of Surface Casing (ft bgs)	Length of Screen (ft)	Depth of Top of Screen (ft bgs)	Depth of Bottom of Screen (ft bgs)	Depth to Base of Columbia Aquifer (ft bgs)	Depth to Base of Yorktown Confining Unit (ft bgs)	Thickness of Yorktown Confining Unit (ft)	Hydrogeologic Unit of Screened Interval	Description of Screened Lithology	Elevation of Top of Screen (ft msl)	Elevation of Bottom of Screen (ft msl)	Elevation of Base of Borehole (ft msl)	Elevation of Base of Columbia Aquifer (ft msl)	Elevation of Base of Yorktown Confining Unit (ft msl)
Shallow																		
SJS02-MW01S	07/01/97	5.19	7.72	15.1	NA	10	4.6	14.6	25	NA	NA	Columbia Aquifer	Columbia - sandy silt, silty fine sand, organics, interbedded clay, ~ last 3' soft silty clay - gray (fill materials)	0.59	-9.41	-9.91	NA	NA
SJS02-MW02S	06/30/97	4.59	6.98	13.5	NA	10	3	13	23	NA	NA	Columbia Aquifer	Columbia - silty fine sand, trace clay, trace shells/organics-gray to yellowish brown; 10-15' silty clay with fine sand and trace organics, soft, greenish gray; 10-12' petroleum odor no OVM	1.59	-8.41	-8.91	NA	NA
SJS02-MW03S	07/07/97	4.69	7.27	14	NA	10	3.2	13.2	23	NA	NA	Columbia Aquifer	Columbia - fill to ~3'; silty fine sand interbedded silty clay, yellowish brown, olive gray	1.49	-8.51	-9.31	NA	NA
SJS02-MW04S	04/27/99	4.6	5.53	13	NA	10	2	12	17	NA	NA	Columbia Aquifer	Columbia - silty fine sand, yellowish brown, some orange mottling and coarsening toward end of boring	2.6	-7.4	-8.4	NA	NA
SJS02-MW05S	04/27/99	5.87	8.52	13	NA	10	2	12	17	NA	NA	Columbia Aquifer	Columbia - silt and fine sand, trace clay (thin 2" interbedded layer), yellowish brown, 8' - oily odor no OVM hit	3.87	-6.13	-7.13	NA	NA
SJS02-MW06S	12/08/03	6.29	9.31	14	NA	10	4	14	14.5	NA	NA	Columbia Aquifer	Columbia-at 4 4-.5' clay mixed w/ sand, sand, mostly medium density, saturated, greenish yellow, no PID hit	2.29	-7.71	-7.71	NA	NA
SJS02-MW07S	12/09/03	6.79	6.87	15	NA	10	5	15	14.5	NA	NA	Columbia Aquifer	Columbia-medium sand, poorly sorted, pale yellowish brown, wet or saturated, some fines, PID hit 1.0 ppm	1.79	-8.21	-8.21	NA	NA
SJS02-MW08S	12/02/03	4.91	7.99	15	NA	10	5	15	15.5	NA	NA	Columbia Aquifer	Columbia-medium sand, pale yellowish brown, silty clay around 9 feet, then silty sand dark yellowish orange and saturated, medium density, no PID hit	-0.09	-10.09	-10.09	NA	NA
SJS02-MW09S	12/08/03	4.44	7.49	10	NA	5	5	10	10	NA	NA	Columbia Aquifer	Columbia-subrounded sand and silty sand, yellowish brown to light brown, wet, medium density, saturated at 9 feet with evidence of some oxidation, no PID hit	-0.56	-5.56	-5.56	NA	NA
SJS02-MW10S	11/16/04	6.2	9.18	16.5	NA	10	6.5	16.5	16	NA	NA	Columbia Aquifer	Columbia-fine sand (some clay from 5-7) (silty sand at 12-16), saturated, loose, odor (possibly TCE or petroleum), no PID hit	-0.3	-10.3	-10.3	NA	NA
SJS02-MW11S	11/16/04	2.5	5.68	20	NA	5	15	20	20	NA	NA	Columbia Aquifer	Columbia-peat with phragmites fibers, dark gray and moist with organic odor, silty peat with some fine sand and moist from 16.5-17.8, silty sand with some clay from 18-19, 19-20 fine sand with slight silt and then some andy clay, olive brown, saturated, no PID hit	-12.5	-17.5	-17.5	NA	NA
SJS02-MW12S	11/17/04	6.68	6.13	16	NA	10	6	16	16	NA	NA	Columbia Aquifer	Columbia-fine sand, wet, light gray changing to light olive brown, olive yellow, and brown, medium dense to dense, saturated at 7.5	0.68	-9.32	-9.32	NA	NA
SJS02-MW13S	11/17/2004	3.8	6.3	22	NA	15	7	22	21.7	NA	NA	Columbia Aquifer	Columbia-gravelly sands, dark gray/black and saturated, odor (possibly TCE), greenish gray clay at 10.5-14' with organic odor and wood fragment throughout, dark brown soft clayey peat with some organic and phragmites debris from 14-15', sandy peat and fine silty sand from 15.8-17.8, 17.8-20 clayey sand with silty and sandy silt, loose and saturated at 21.5', clay at 21.7', no PID hit	-3.2	-18.2	-18.2	NA	NA
Deep																		
SJS02-MW01D	07/11/97	5.27	7.94	70	44	10	58	68	25	56	31	Yorktown Aquifer	YCU - clay greenish gray, some organics and mica, trace very fine sand, few shell frags; YF - very fine to fine sand greenish	-52.73	-62.73	-64.73	-19.73	-50.73
SJS02-MW02D	07/12/97	4.71	7.04	67	45	10	54.6	64.6	23	51.5	28.5	Yorktown Aquifer	YCU - dark greenish gray, soft, organics, stiff at 48"; YF - fine sand, shell frags abundant in some intervals, organics, dark greenish gray,	-49.89	-59.89	-62.29	-18.29	-46.79
SJS02-MW05D	04/27/99	6.04	8.66	51	35.5	10	40	50	17	40	23	Yorktown Aquifer	YCU - clay greenish gray, some shells and interbedded sand, soft; YF - coarse shell frags, trace silt, light greenish gray, trace gravel	-33.96	-43.96	-44.96	-10.96	-33.96
SJS02-MW10D	11/12/04	6.5	9.24	68	19.6	5	63	68	17	54.5	37.5	Yorktown Aquifer	YCU-greenish gray, moist, clayey sand turning to fine silty sand with some clay at 64.2'; YF-fine grain saturated and loose sand at 64.7'; slag material from 65-65.2' and fine/medium sand with some silt, saturate	-56.5	-61.5	-61.5	-10.5	-48

NA - Not Available or Not Applicable
OVM - Organic Vapor Meter
YCU - Yorktown Confining Unit
YF - Yorktown Formation

Table 2
Groundwater Elevation Data
Site 2 Expanded Remedial Investigation
St. Juliens Creek Annex
Chesapeake, Virginia

Well Identification	Screened Aquifer	Elevation Bottom of Screen (ft)	Vertical Distance Between Well	Top of PVC Elevation (ft msl)	December-03			December-04			April-05		
					Depth to Water (ft)	Water Elevation (ft msl)	Vertical Gradient	Depth to Water (ft)	Water Elevation (ft msl)	Vertical Gradient	Depth to Water (ft)	Water Elevation (ft msl)	Vertical Gradient
SJS02-MW01S	Columbia Aquifer	-9.41	53.32	7.72	4.46	3.26	-0.01	5.74	1.98	0.00	5.44	2.28	0.00
SJS02-MW01D	Yorktown Aquifer	-62.73		7.94	5.27	2.67		5.99	1.95		5.42	2.52	
SJS02-MW02S	Columbia Aquifer	-8.41	51.48	6.98	7.64	-0.66	0.06	7.09	-0.11	0.04	6.38	0.6	0.04
SJS02-MW02D	Yorktown Aquifer	-59.89		7.04	4.45	2.59		5.05	1.99		4.5	2.54	
SJS02-MW03S	Columbia Aquifer	-8.51	NA	7.27	4.84	2.43	NA	5.57	1.7	NA	4.89	2.38	NA
SJS02-MW04S	Columbia Aquifer	-7.4	NA	5.53	3.78	1.75	NA	5.78	-0.25	NA	5.58	-0.05	NA
SJS02-MW05S	Columbia Aquifer	-6.13	37.83	8.52	3.51	5.01	-0.06	5.7	2.82	-0.03	5.63	2.89	-0.01
SJS02-MW05D	Yorktown Aquifer	-43.96		8.66	5.96	2.7		6.89	1.77		6.27	2.39	
SJS02-MW06S	Columbia Aquifer	-7.71	NA	9.31	3.88	5.43	NA	5.9	3.41	NA	6.07	3.24	NA
SJS02-MW07S	Columbia Aquifer	-8.21	NA	6.87	4.3	2.57	NA	5.65	1.22	NA	5.51	1.36	NA
SJS02-MW08S	Columbia Aquifer	-10.09	NA	7.99	5.91	2.08	NA	5	2.99	NA	5.92	2.07	NA
SJS02-MW09S	Columbia Aquifer	-5.56	NA	7.49	3.33	4.16	NA	4.24	3.25	NA	4.00	3.49	NA
SJS02-MW10S	Columbia Aquifer	-10.3	51.2	9.18	NA	NA	NA	7.74	1.44	0.01	7.72	1.46	0.02
SJS02-MW10D	Yorktown Aquifer	-61.5		9.24	NA	NA		7.54	1.7		6.77	2.47	
SJS02-MW11S	Columbia Aquifer	-17.5	NA	5.68	NA	NA	NA	4.14	1.54	NA	3.84	1.84	NA
SJS02-MW12S	Columbia Aquifer	-9.32	NA	6.13	NA	NA	NA	4.61	1.52	NA	4.63	1.5	NA
SJS02-MW13S	Columbia Aquifer	-18.2	NA	6.3	NA	NA	NA	4.02	2.28	NA	3.68	2.62	NA

Notes:
MSL - mean sea level
ft - feet
NA - Not Analyzed

Table 3
Slug Test Results
Site 2 Expanded Remedial Investigation
St. Juliens Creek Annex
Chesapeake, Virginia

Monitoring Well	Slug Test Type	Slug Test Analytical Method	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity (feet/day)	Saturated Thickness (feet)	Transmissivity (cm ² /sec)	Transmissivity (feet ² /day)
Columbia Aquifer - Unconfined Aquifer							
SJS02-MW01S	Rising Head	Bouwer-Rice	9.28E-04	2.63	12	0.34	31.5
SJS02-MW05S	Rising Head	Bouwer-Rice	2.13E-03	6.03	12	0.78	72.3
SJS02-MW07S	Rising Head	Bouwer-Rice	4.34E-04	1.23	12	0.16	14.8
SJS02-MW09S	Rising Head	Bouwer-Rice	3.19E-03	9.03	8.85	0.86	80.0
SJS02-MW10S	Rising Head	Bouwer-Rice	1.00E-03	2.83	11	0.34	31.2
Columbia Aquifer Geometric Mean:			1.22E-03	3		0.41	38
Columbia Aquifer Standard Deviation:			1.11E-03	3		0.31	29
Yorktown Aquifer (Bouwer-Rice)							
SJS02-MW01D	Rising Head	Bouwer-Rice	1.78E-02	50.34	145	78.49	7299.8
SJS02-MW05D	Rising Head	Bouwer-Rice	2.72E-02	77.22	145	120.39	11196.3
SJS02-MW10D	Rising Head	Bouwer-Rice	1.45E-03	4.10	145	6.39	594.3
Yorktown Aquifer Geometric Mean:			8.88E-03	25.16		39	3649
Yorktown Aquifer Standard Deviation:			1.30E-02	36.98		58	5363

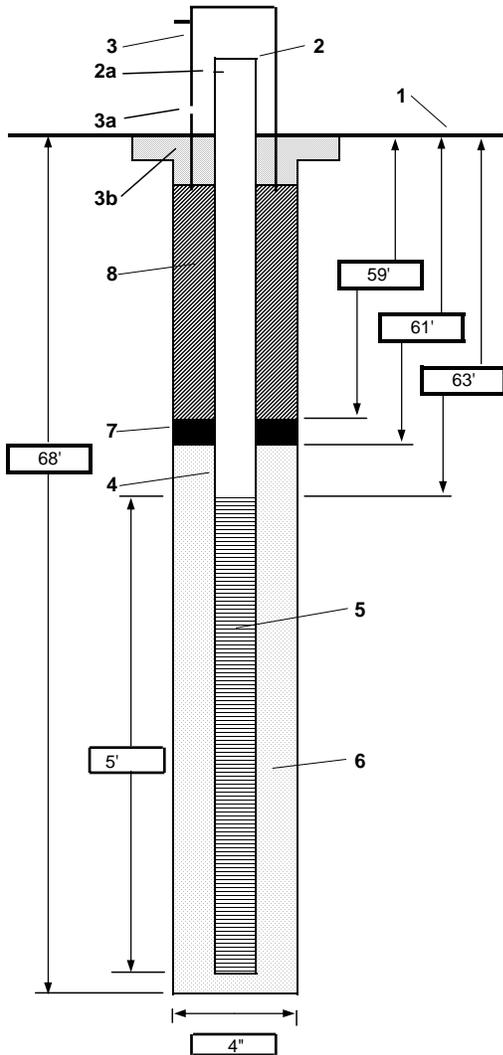
Table 4
Analytical Methods and Required Containers, Preservatives, and Holding Times For Samples
St. Juliens Creek Annex
Chesapeake, Virginia

Analysis	Method	Sample Container	Holding Time	Volume of Sample
Groundwater Samples and Aqueous QC Samples				
TCL VOCs	CLP OLM04	Three 40-ml glass vial with Teflon-lined cap	14 days	Fill completely; no air bubbles
Notes: CLP: Contract Laboratory Program TCL: Target Compound List TOC: Total Organic Carbon VOCs: Volatile Organic Compounds				



PROJECT NUMBER 181812.RP.DR	WELL NUMBER SJS02-MW10D	SHEET 1	OF 1
WELL COMPLETION DIAGRAM			

PROJECT : St. Juliens Creek Annex LOCATION : Site 2
 DRILLING CONTRACTOR : Parratt Wolff NORTHING: 3452833.87 EASTING: 12122477.36
 DRILLING METHOD AND EQUIPMENT USED : 4 1/4" Hollow Stem Auger
 WATER LEVELS : DTW = 7.54' btc START : 11/12/04 0745 END : 11/10/04 0800 LOGGER : Rebekah Ives & Jamie Butler



1- Ground elevation at well	6.5 ft amsl
2- Top of casing elevation (ft AMSL)	9.24 ft amsl
a) vent hole?	N/A
3- Wellhead protection cover type	stick-up
a) weep hole?	
b) concrete pad dimensions	~2 feet by 2 feet, elevation = 6.53 ft amsl
4- Dia./type of well casing	2" PVC Sch. 40 (Double cased to 19"6")
5- Type/slot size of screen	2" PVC Sch. 40 10 slot
6- Type screen filter	DSI #1 Filter Sand
a) Quantity used	4 BAGS
7- Type of seal	Bentonite, 3/8" chips
a) Quantity used	
8- Grout	
a) Grout mix used	Bentonite Cement Grout
b) Method of placement	
c) Vol. of well casing grout	
Development method	Whale Pump
Development time	approximately 40 minutes
Estimated purge volume	55 gallons
Comments	



PROJECT NUMBER
181812.SI.DR

BORING NUMBER
SJS02-MW12S

SHEET 1 OF 1

SOIL BORING LOG

PROJECT : SJCA Site 2 Investigation

LOCATION : Site 2

ELEVATION : 6.13 ft amsl

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" hollow stem auger

WATER LEVELS : 4.61 btc

START : 17 NOV 2004 1430

END : 1540

LOGGER : R.Ives

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)		STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	RECOVERY (IN)	#/TYPE			
0-4'	no sample collected		no blow counts recorded	No recovery	0 ppm
4-8'	42"			4.5-4.8': sandy clay (SC); olive brown (2.5Y4/6); stiff; gravel fragments 4.8-5.2': clayey sand (SC); yellowish brown (10YR5/6); 5.2-6': fine sand (SW); light olive brown (2.5Y5/4); wet; medium loose 6-7.5': fine sand (SW); light gray (2.5Y7/1); wet; medium dense	0 ppm
8-12'	42"			7.5-8': fine sand (SW); light olive brown (2.5Y5/4); saturated; dense 8.5-12': fine sand (SW); olive yellow (2.5Y6/8); saturated; dense; color change at 9' (2.5Y6/6); color change at 10.8' (2.5Y6/8)	0 ppm
12-16.2'	42"			12.5-13': fine sand (SW); olive yellow (2.5Y6/8); saturated; dense 13-15.5': same as above; brown (7.5YR5/8) 15.5-16': same as above; olive yellow (2.5Y6/8) 16-16.2': clay (CH); greenish gray (Gley 1 4/10Y); soft	0 ppm
				Boring Terminated at 16.2'	



PROJECT NUMBER 6207-028	BORING NUMBER MW-15	SJS02 SHEET 1 OF 1
SOIL BORING LOG		

PROJECT St. Julians Creek Annex LOCATION Land Fill B Site 2
 ELEVATION GROUND 5.19 (TOC 7.72 mg/l) DRILLING CONTRACTOR American Environmental Drilling Services
 DRILLING METHOD AND EQUIPMENT 6 1/4" ID Hollow Stem Auger - Ingersoll Rand - A-300 Drill Rig
 WATER LEVELS _____ START 7/2/97 FINISH 7/10/97 LOGGER S. Bittney (CDM Federal)

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	INTERVAL	NUMBER AND TYPE	RECOVERY (FT)			
5	3-5	S-1	23/24	1-2-2-1	3-4.4' Sandy silt ^(ML) trace gravel & organics interbedded with fine clay & coarse sand (ML) 4.4-5' Silty F. Sand with organics (SM) (roots) moist very dark greyish brown 10YR 3/2	Began Drilling 0800 color greenish grey 10Y 5/1 trace light olive brown 2.5Y 5/6 OVM - 0ppm
	5-7	S-2	9/24	2-2-3-3	Silty F. Sand wet subrounded well sorted trace organics (SM) greyish brown 2.5Y 5/2	5' Hit water very wet OVM - 0ppm
	10-12	S-3	24/24	2-3-4-1	Silty F. Sand wet subrounded (SM) Color bands - olive yellow 2.5Y 6/6 reddish yellow 7.5YR 6/8 11.8-12' soft silty clay (CL) gray N 5/1 Bottom of auger v. soft wet silty clay sand open N 5/ (CL)	OVM - 0ppm Dulker reports - Material got soft at 11.5' BGS
15					Bottom of Boring 15' BGS	0925 finished Drilling

Figure 1
SOIL BORING LOG,
FORM D1586



PROJECT NUMBER <u>CT02E</u>	BORING NUMBER <u>SJS02</u>
	MW01D SHEET 1 OF 3
SOIL BORING LOG	

PROJECT NAVY CLEAN II / ST. JULIENS CREEK ANNEX LOCATION SITE 2 MW01D
 ELEVATION GROUND: 5.27 TOC: 7.99 DRILLING CONTRACTOR AEDS
 DRILLING METHOD AND EQUIPMENT LUGER-SOL-RAND A300 RW / 3 1/4" and 4 1/4" HSA / 6" Mud Rotary
 WATER LEVELS _____ START _____ FINISH _____ LOGGER L. FRANCE

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-8"-8" (N)	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	INTERVAL	NUMBER AND TYPE	RECOVERY (FT)			
0-12'					SEE LOG FOR SITE 2 MW 01S FOR 0-12' INTERVAL	
12-14.0'	SP CL	1.4	22-1-2		SAND, f-med (SP). Strong brown (7.5YR 5/1E). Wet. to 14.0'	
14.0-15.0'	CL				CLAY (CL) Bluish grey (GLEYS 5/1). Sand in end of depth.	
15.0-16.0'	SP CL	1.5	2-1-1-2		SAND, med-fine. Same as @ 12'.	
16.0-18.0'					CLAY, DK. Greenish grey (GLEYS 4/1)	
18.0-20.0'		0.6	2-3-2-2		SAND and CLAY as above. Poor sample recovery.	
20.0-21.0'	SP	.2	7-7-8-8			
21.0-22.8'		1.6	4-9-3-4		SAND (SP) fine, DK. bluish grey (GLEYS 4/1). Wet. little clay in thin (<0.5") layers Increasing clay content to 22.8'	
22.8-25.0'	CL	2.0	4-3-3-4		CLAY (CL) DK greenish grey (GLEYS 4/1) Blocky.	
25.0-27.2'	SP CL	1.7	5-44-5		SAND (SP) CLAY, sandy to 27.2'	
27.2-28.0'	SP	2.0	5-6-6-7		SAND, fine (SP) shell fragments, little med. sand	
28.0-30.0'		NOT RECORDED	4-5-5-5		SAND, as above. Tr. organics and shells little clay.	



PROJECT NUMBER CT025	BORING NUMBER SJS02 MW010	SHEET 2 OF 3
SOIL BORING LOG		

PROJECT NANYCLEAN II / ST JULIENS CREEK LOCATION SITE 2 MW010
 ELEVATION _____ DRILLING CONTRACTOR MEPS
 DRILLING METHOD AND EQUIPMENT SEE p. 1
 WATER LEVELS _____ START _____ FINISH _____ LOGGER L. FRANCIS

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS 0'-8"-5" (M)	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	INTERVAL	NUMBER AND TYPE	RECOVERY (FT)			
30		SP	2.0	5-4-4-5	SAND, co above	
		CL	2.0	4-3-3-5	CLAY, little to no sand.	
35		CL	2.0	5-4-4-5	CLAY, (CL) with 0.25-3.0" thick layers of fine sand. Greenish gray (GLEY 5/1)	
		SW	2.0	3-3-5-5	SAND, (SP) med - coarse	
			2.0	3-2-2-3	SAND, (SW) fining downward to silt and clay (CL) at 38', tr. organics and shell fragments	
40		CL	2.0	3-3-2-3	CLAY, greenish grey (GLEY 5/1) Sandy to 40.5'	Stopped drilling 7/19/97 Set 6" PVC isolation casing to 44' Start sampling at 46' 7/11/97
			2.0	3-3-4-5	clay, as above, tr v. fine sand. Few shell fragments	
45			2.0	3-2-2-2		
			2.0	3-3-4-3	Some brown organic. Clay is DK. greenish grey (GLEY 3/1). Little mica.	
50			2.0	4-3-3-3		
			2.0	3-2-2-3		
			2.0	3-2-2-3	clay, as above	
55			1.0	3-3-2-3		
		SP	0.7	5-5-6-6	SAND, (SP), v. fine to fine DK greenish grey (GLEY 3/1)	Losing water to fm. at 56'
60			0.6	6-5-5-6	Fine sand, as above - Little mica	



PROJECT NUMBER CT025	BORING NUMBER MWOID	SJS02 SHEET 3 OF 3
SOIL BORING LOG		

PROJECT NAVYCLEANII/ST. JULENS CREEK ANNEX LOCATION SITE 2 MWOID
 ELEVATION _____ DRILLING CONTRACTOR AEDS
 DRILLING METHOD AND EQUIPMENT See p. 1
 WATER LEVELS _____ START _____ FINISH _____ LOGGER L. FRANCO

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-8"-6" (3)	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	INTERVAL	NUMBER AND TYPE	RECOVERY (FT)			
60	SP		1.0	6-6-5-6	SAND/SPTS ABOVE, WITH trace med. sand	
			0.5	6-6-6-5	SAND, as above, same med. sand	
65			1.5	7-7-6-7		
			1.5	7-6-6-7		
70					BORING TERMINATED 68'	
75						

END SAMPLING at 65'

Project-Specific Health and Safety Plan

Introduction

This Project-Specific Health and Safety Plan (HASP) presents the hazards known or anticipated to be present at the at the St. Juliens Creek Annex (SJCA)/Site 2 during the further delineation field effort scheduled to take place in the fall of 2004. This Project-Specific HASP will be used by CH2M HILL and its subcontractors to identify and mitigate task-specific hazards and to select appropriate health and safety protective measures not otherwise covered in the Master HASP.

The SJCA Master HASP has been previously developed and must accompany/supplement this Project-Specific HASP. The Master HASP contains information pertinent to the general conditions at SJCA, such as general site information, hazard evaluation and control, personnel responsibilities and requirements, a general description of personal protective equipment, customary decontamination procedures, and emergency response procedures. On-site personnel must review both the Master-HASP and the site-specific HASP and sign an agreement to comply with its provisions prior to commencing on-site work. The Master-HASP and site-specific HASP are considered operational documents that are subject to revisions in response to various site-specific conditions that may be encountered. However, these documents may be modified or updated only with the approval of the PHSO and Project Manager.

Policy

CH2M HILL's policy is that on-site hazardous waste management activities be performed in conformance with both the Master HASP and a Project-Specific HASPs. The documents are written based on the anticipated hazards and expected work conditions, and apply to field activities to be performed under the Work Plan. Applicability of this Master-HASP and the Project-Specific HASPs extends to all CH2M HILL employees, CH2M HILL's subcontractors, and visitors entering the site. CH2M HILL subcontractors must follow an established health and safety plan; in most cases, either adopting this master plan with appropriate site-specific HASP (e.g., surveyor), or adopting same and amending both with safety and/or health requirements specific to their work (e.g., driller). HASPs authored by a subcontractor must be reviewed by CH2M HILL's Project Health and Safety Officer (PHSO) before commencing on-site work. After being reviewed, this information will become part of the appropriate site-specific HASP.

This Project-Specific HASP in combination with the Master HASP will, at a minimum, meet the requirements under Occupational Safety and Health Administration (OSHA) Standard 29 *Code of Federal Regulations* (CFR) 1910.120 (Hazardous Waste Operations and Emergency Response).

PRE-ENTRY REQUIREMENTS

During site mobilization, the Site Health and Safety Officer (SHSO) will perform a reconnaissance of each site as identified in the site-specific Work Plan (WP) to evaluate and determine the chemical, physical, and environmental hazards; establish or confirm emergency points of contact and procedures; and review any other issues deemed necessary to address site safety and health. The SHSO will then conduct a health and safety briefing with the site personnel to discuss data obtained from the previous site reconnaissance, provisions outlined in this Master HASP and site-specific HASP, and appropriate safety and health procedures and protocols.

CH2M HILL HEALTH AND SAFETY PLAN

This Project-Specific Health and Safety Plan (HASP) will be kept on the site during field activities and will be reviewed as necessary. The plan will be amended or revised as project activities or conditions change or when supplemental information becomes available. The plan adopts, by reference, the Standards of Practice (SOPs) in the CH2M HILL *Corporate Health and Safety Program, Program and Training Manual*, as appropriate. In addition, this plan adopts procedures in the project Work Plan. The Site Safety Coordinator (SSC) is to be familiar with these SOPs and the contents of this plan. CH2M HILL's personnel and subcontractors must read both the Master HASP and this Project-Specific HASP, and sign **Attachment 1** of both documents.

Project Information and Description

PROJECT NO:	181812
CLIENT:	Department of the Navy
PROJECT/SITE NAME:	St. Juliens Creek Annex/Site 2
SITE ADDRESS:	Victory Blvd. Chesapeake, VA
CH2M HILL ACTIVITY MANAGER:	Kim Henderson/VBO
CH2M HILL OFFICE:	5700 Cleveland Street Suite 101 Virginia Beach, VA 23462
DATE HASP PREPARED:	June 2003
DATE HASP UPDATED:	April 2006
SITE ACCESS:	Refer to Master HASP
FACILITY DESCRIPTION:	Refer to Master HASP
CLIMATE	Refer to Master HASP
TOPOGRAPHY:	Refer to Master HASP
DESCRIPTION OF SPECIFIC TASKS TO BE PERFORMED:	Aquifer testing, collection of groundwater and sediment samples; oversight of direct-push technology, drilling, and well installation; and logging of drill cuttings.

1 Tasks to be Performed Under this Plan

1.1 Description of Tasks

(Reference Field Project Start-up Form)

Refer to project documents (i.e., Work Plan) for detailed task information. A health and safety risk analysis (Section 1.2) has been performed for each task and is incorporated in this plan through task-specific hazard controls and requirements for monitoring and protection. Tasks other than those listed below require an approved amendment or revision to this plan before tasks begin. Refer to Section 8.2 for procedures related to “clean” tasks that do not involve hazardous waste operations and emergency response (Hawwoper).

1.1.1 Hazwoper-Regulated Tasks

- Drilling
- Direct-push sampling
- Groundwater sampling
- Sediment sampling
- Hand Augering
- Groundwater Sampling
- Surveying
- Investigation-derived waste (drum) sampling and disposal
- Observation of material loading for offsite disposal
- Oversight of well installation
- Aquifer Testing

1.1.2 Non-Hazwoper-Regulated Tasks

- None

1.1.3 Project HS&E Change Management Form

*This evaluation form should be reviewed on a **continuous** basis to determine if the current site-specific health and safety plan adequately addresses ongoing project work, and should be completed whenever new tasks are contemplated or changed conditions are encountered..*

Project Task: Sampling		Activity Manager: Kim Henderson/VBO	
Project Number: 181812			
<i>Evaluation Checklist</i>		Yes	No
1.	Have CH2MHILL staff changed?		
2.	Has a new subcontractor been added to the project?		
3.	Is any chemical or product to be used that is not listed in Attachment 2 of the plan?		
4.	Are all tasks addressed in Section 1.1 of the site-specific HASP?		
5.	Have new contaminants or higher than anticipated levels of original contaminants been encountered?		
6.	Have other safety, equipment, activity or environmental hazards been encountered that are not addressed in Section 2.1 of the plan?		

If the answer is “YES” to Questions 1-3, an HSP revision is NOT needed. Please take the following actions:

- Confirm that staff’s medical and training status is current – check training records at: <http://www.int.ch2m.com/hands> (or contact your regional SPA), and confirm subcontractor qualifications.
- Confirm with the project KA that subcontractor safety performance has been reviewed and is acceptable
- Confirm with H&S that subcontractor safety procedures have been reviewed and are acceptable.

If the answer is “YES” to Questions 4-6, an HSP revision MAY BE NEEDED. To determine if revision is needed please contact HS&E directly or complete the field project start-up form at:

<http://www.int.ch2m.com/hsdocgen/fppricing.asp>.

1.2 Task Hazard Analysis

(Refer to Section 2 for hazard controls)

POTENTIAL HAZARDS	TASKS									
	Test pit/ excavation	Drilling, geoprobe, and well installation & abandonment	Groundwater monitoring, aquifer testing	Surface water and sediment sampling using a boat	Surface water and sediment sampling from the shore or water	Hand augering	Surveying	IDW drum sampling and disposal	Observation of loading material for offsite disposal	Remediation & construction oversight
Flying debris/objects	X	X		X	X	X		X	X	X
Noise > 85dBA	X	X		X					X	X
Electrical	X	X	X	X						X
Suspended loads	X	X		X					X	X
Buried utilities, drums, tanks	X	X				X				X
Slip, trip, fall	X	X	X	X	X	X	X	X	X	X
Back injury	X	X	X	X	X	X		X		X
Confined space entry	X						X			X
Trenches / excavations	X									X
Visible lightning	X	X	X	X	X	X	X	X	X	X
Vehicle traffic									X	X
Elevated work areas/falls	X				X					X
Fires	X	X			X			X		X
Entanglement		X				X				
Drilling		X								
Heavy equipment	X	X		X					X	X
Working near water					X					
Working from boat				X						
IDW Drum Sampling								X		

2 Hazard Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the site or the particular hazard. CH2M HILL employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M HILL employees and subcontractors who do not understand any of these provisions should contact the SSC for clarification.

In addition to the controls specified in this section, Project-Activity Self-Assessment Checklists are contained in **Attachment 6**. These checklists are to be used to assess the adequacy of CH2M HILL and subcontractor site-specific safety requirements. The objective of the self-assessment process is to identify gaps in project safety performance, and prompt for corrective actions in addressing these gaps. Self-assessment checklists should be completed early in the project, when tasks or conditions change, or when otherwise specified by the HSM. The self-assessment checklists, including documented corrective actions, should be made part of the permanent project records, and be promptly submitted to the HSM.

Project-specific frequency for completing self-assessments: **Weekly, during drilling.**

2.1 Project-Specific Hazards

2.1.1 Arsenic

(Reference CH2M HILL SOP HS-401, *Drilling*)

- Do not enter regulated work areas unless training, medical monitoring, and PPE requirements established by the competent person have been met.
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas.
- Avoid skin and eye contact with liquid and particulate arsenic or arsenic trichloride.
- Arsenic is considered a "Confirmed Human Carcinogen."
- Arsenic particulates (inorganic metal dust) are odorless. Vapor and gaseous odor varies depending upon specific organic arsenic compound.
- Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained from the competent person.
- Review Arsenic Fact Sheet found in **Attachment 5** of this Site Specific Health and Safety Plan.

2.1.2 Cadmium

(Reference CH2M HILL SOP HS-202, *Cadmium*)

- Do not enter regulated work areas unless training, medical monitoring, and PPE requirements established by the competent person have been met.
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas.
- Cadmium is considered a "Suspected Human Carcinogen."
- Cadmium particulates (fumes and dust) are odorless.
- Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained from the competent person.
- Review Cadmium Fact Sheet found in **Attachment 5** of this Site Specific Health and Safety Plan.

2.1.3 Vinyl Chloride

(Reference CH2M HILL SOP HSE-512, *Vinyl Chloride*)

- Do not enter regulated work areas unless training, medical monitoring, and PPE requirements established by the competent person have been met.
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas.
- Vinyl Chloride is considered a "Confirmed Human Carcinogen."
- A Short Term Exposure Limit (STEL: 15 minutes) exists for this material.
- Vinyl Chloride has a mild, sweet, chloroform-like odor.
- Review Vinyl Chloride Fact Sheet found in **Attachment 5** of this Site Specific Health and Safety Plan.

2.1.4 Lead

(Reference CH2M HILL SOP HS-508, *Lead*)

The following requirements pertain to lead contaminated soils:

- Work shall progress in a sequence from less contaminated to more contaminated areas.
- Water should be added to soils prior to and during excavation, air rotary drilling, and other activities that create or have the potential to create airborne lead contaminated dust. For air rotary drilling operations, water can be added to the boring to reduce dust generation from the cyclone. Depending upon soil type, watering of soil may be required several days prior to commencing ground intrusive activities.
- Personnel working in the vicinity of lead contaminated soil shall wear disposable coveralls or equal and exercise enhanced personal hygiene (i.e., frequent hand washing prior to eating, drinking, and smoking; separation of work and street clothing/footwear; etc.).
- Review Lead Fact Sheet found in **Attachment 5** of this Site Specific Health and Safety Plan.

2.1.5 Radar Hazards

- Airports and all branches of the military use radar of significant power for buildings, towers, aircraft, ships, armor vehicles and installations in general. Radar devices may emit harmful microwave radiation emissions.
- Microwave radiation is absorbed by the body and dissipated in the tissue as heat.
- The penetration ability of the radiation depends on the wavelength. Microwave wavelengths of 25-200 centimeters have the ability to reach the internal organs with potentially damaging effects. Wavelengths less than 25 centimeters are absorbed and dissipated by the skin and the human body is thought to be transparent to microwave wavelengths greater than 200 centimeters.
- The health effects of microwave radiation include deep burns and thermal damage to any organ or organ system with low blood flow, most notably the lenses of the eyes. If adequate time has elapsed between exposures, the repair mechanisms of the lens seems to limit damage.
- Studies have demonstrated that chronic microwave exposure can cause both psychological changes, disrupting task and function control, as well as chronic depression. Further studies suggest a possible relationship between mongolism (Down's Syndrome) in offspring and previous exposure of the male parent to radar, however the study was not conclusive.
- Microwave radiation can not be seen and it's effects can not be felt until serious damage has already occurred.
- Because of the inconclusive effects of microwave radiation, OSHA has set a conservative exposure limit of 10 milliwatt per square centimeter (10 mW/cm²) averaged over any 6 minute period.
- Warning signs must be posted in areas where potentially damaging microwave radiation exists.
- The prevention method for microwave radiation exposure is to not be in the path of radar or other microwave emitting devices by either ensuring that the device is not operating or ensuring that there is sufficient shielding between you and the microwave source.

2.1.6 Drilling/Direct-Push

(Reference CH2M HILL SOP HS-204, *Drilling*)

- Only authorized personnel are permitted to operate drill rigs.
- Stay clear of areas surrounding drill rigs during every startup.
- Stay clear of the rotating augers and other rotating components of drill rigs.
- Stay as clear as possible of all hoisting operations. Loads shall not be hoisted overhead of personnel.
- Do not wear loose-fitting clothing or other items such as rings or watches that could get caught in moving parts. Long hair should have it restrained.
- If equipment becomes electrically energized, personnel shall be instructed not to touch any part of the equipment or attempt to touch any person who may be in contact with the electrical current. The utility company or appropriate party shall be contacted to have line de-energized prior to approaching the equipment.
- Smoking around drilling operations is prohibited.

2.1.7 Working Above or Near Water

- Fall protection should be provided to prevent personnel from falling into water. Where fall protection systems are not provided and the danger of drowning exists, U.S. Coast Guard-approved personal flotation devices (PDFs), or life jacket, shall be worn.
- Inspect PFDs prior to use. Do not use defective PFDs.
- A life-saving skiff must be provided for emergency rescue.
- A minimum of one ring buoy with 90 feet of 3/8-inch solid-braid polypropylene (or equal) rope must be provided for emergency rescue.
- Use sampling and other equipment according to the manufacturers' instructions.

2.1.8 Groundwater Sampling & Aquifer Testing

- Tie down loose items if utilizing a van.
- Utilize a spotter if backing vehicles or equipment towards monitoring wells.
- Inspect the area around the well for obstructions and Poison Ivy and Poison Oak.
- If well locations are located in dense tall grassy areas consider utilizing a Bug-Out suit or Tyvek to mitigate the potential for tick bites.
- If lifting heavy equipment from vehicle, move items to the rear and get assistance when lifting.
- Be alert for bees, wasps and other insects when opening well housing.
- Ensure only personnel with current 40-hour HAZWOPER and 8 hour refresher training perform task.
- Log calibration of Direct Reading Instrument in either a field log book or on attached form.
- Notify others in area that task is going to be performed, delineate an exclusion zone as applicable.
- Don personal protective equipment (PPE) as specified in Section 4 of this Site Specific Health and Safety Plan.
- Position yourself upwind prior to sampling, and do not lean directly over the well when sampling.
- Review Material Safety Data Sheets for chemical preservatives, decontamination agents and calibration gas.
- Do not handle sample jars without nitrile gloves.

2.1.9 IDW Drum Sampling

Personnel are permitted to handle and/or sample drums containing investigation-derived waste (IDW) only; handling or sampling other drums requires a plan revision or amendment approved by the CH2M HILL HSM. The following control measures will be taken when sampling drums containing IDW:

- Minimize transportation of drums.
- Sample only labeled drums or drums known to contain IDW.
- Use caution when sampling bulging or swollen drums. Relieve pressure slowly.
- If drums contain, or potentially contain, flammable materials, use non-sparking tools to open.
- Picks, chisels, and firearms may not be used to open drums.
- Reseal bung holes or plugs whenever possible.
- Avoid mixing incompatible drum contents.
- Sample drums without leaning over the drum opening.
- Transfer the content of drums using a method that minimizes contact with material.
- PPE and air monitoring requirements specified in Sections 4 and 5 must address IDW drum sampling.
- Spill-containment procedures specified in Section 7 must be appropriate for the material to be handled.
- Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained from the competent person.

2.1.10 Ordnance and Explosives (OE)

Due to the site history, the potential for exposure to Ordnance and Explosives (OE) exist, the chance for encountering ordnance items during sampling activities is very small. An OE hazards awareness safety brief should be included as part of the site-specific briefing and discussed at daily tailgate briefings.

- Prior to any action being performed on an ordnance item, all fuzing shall be positively identified. This identification will consist of fuze type by function, condition (armed or unarmed), and physical state/condition of the fuze (burned, broken, parts exposed or sheared, etc.).
- A projectile containing a base-detonating (BD) fuze is to be considered armed if the round has been fired.
- Arming wires and pop-out pins on unarmed fuzes should be secured prior to any movement.
- Do not depress plungers, turn vanes, rotate spindles, or move levers, setting rings, or other external fittings on OE items. Such actions may arm or activate the OE.
- Do not attempt to remove any fuzes from the OE. Do not dismantle or strip components from any OE item unless the item is included in the SOW.
- UXO personnel are not authorized to inert any OE item found on site unless it is a part of the SOW.
- OE/UXO items shall not be taken from the site as souvenirs or training aids.
- Civil War ordnance shall be treated like any other OE.
- Before entering U.S. Army-controlled areas or ranges contaminated with improved conventional munitions (ICM), an approved Department of the Army (DA) waiver must be obtained.
- Whenever suspect Chemical Weapons Material (CWM) is encountered during conventional OE site activities, all work shall immediately cease. Project personnel shall withdraw along cleared paths upwind from the discovery. A team consisting of two personnel shall secure the area to prevent unauthorized access. Personnel should position themselves as far upwind as possible while still maintaining security of the area. The local point of contact designated in the work plan shall be immediately notified.
- Avoid inhalation and skin contact with smoke, fumes, and vapors of explosives and other related materials.
- Consider OE items that have been exposed to fire and detonation as extremely hazardous. Chemical and physical changes may have occurred to the contents, which might render them more sensitive than in their original state.
- Do not rely on the color coding of OE for positive identification. Munitions having incomplete or improper color codes have been encountered.

2.2 General Hazards

- **Refer to the MASTER HASP for General Hazards**

2.3 Biological Hazards

- **Refer to the MASTER HASP for Biological Hazards**

2.4 Radiological Hazards

- **Refer to the MASTER HASP for Radiological Hazards**

2.5 Contaminants of Concern

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum ^a Concentration (µg/L)	Exposure Limit ^b	IDLH ^c	Symptoms and Effects of Exposure	PIP ^d (eV)
Metals^e					
Aluminum	GW: 286 MW-06S	10 mg/m ³	ND	Eye, skin and respiratory system irritant.	NA
Arsenic	GW: 31 MW-09S	0.01 mg/m ³	5 mg/m ³ Ca	Ulceration of nasal septum, respiratory irritation, dermatitis, gastrointestinal disturbances, peripheral neuropathy, hyperpigmentation	NA
Barium	GW: 124 MW-07S	0.5 mg/m ³	50 mg/m ³	Eye, skin and upper respiratory system irritant; skin burns; gastroenteritis; muscle spasms, slow pulse, extrasystoles; hypokalemia	UK
Cadmium (dissolved)	GW: 0.22 MW-06S	0.005 mg/m ³	9 mg/m ³ Ca	Pulmonary edema, coughing, chest tightness/pain, headache, chills, muscle aches, nausea, vomiting, diarrhea, difficulty breathing, loss of sense of smell, emphysema, mild anemia	NA
Calcium (dissolved) (as CaCO ₃)	GW: 68700 MW-08S	15 mg/m ³	ND	Eye, skin and respiratory system irritant; cough	NA
Cobalt (dissolved) (metals, dust, fumes)	GW: 18.8 MW-07S	0.05 mg/m ³	20 mg/m ³	Coughing, difficulty breathing, wheezing, decreased pulmonary function, diffuse nodule fibrosous, dermatitis, respiratory hypersensitivity, asthma	NA
Copper (dusts and mists)	GW: 15.6 MW-08S	1 mg/m ³	100 mg/m ³	Eye, nose and pharynx irritant; nasal perforation, metallic taste, dermatitis (in animals: lung, liver, kidney damage; anemia)	NA
Cyanide (Potassium cyanide as CN)	GW: 13.2 MW-06S	5 mg/m ³	25 mg/m ³	Eye, skin, nose and upper respiratory system irritant; weakness; headache; confusion; nausea, vomiting; increased respiration rate; slow, gasping breathing; thyroid and blood changes	NA
Iron	GW: 41900 MW-09S	10 mg/ m ³	2500 mg/m ³	Benign pneumoconiosis with x-ray shadows indistinguishable from fibrotic pneumoconiosis (siderosis)	NA
Lead	GW: 4.8 MW-09S	0.05 mg/m ³	100 mg/m ³	Weakness lassitude, facial pallor, pal eye, weight loss, malnutrition, abdominal pain, constipation, anemia, gingival lead line, tremors, paralysis of wrist and ankles, encephalopathy, kidney disease, irritated eyes, hypertension	NA
Magnesium (oxide fume)	GW: 44200 MW-07S	15 mg/m ³	750 mg/m ³	Eye and nose irritant; metal fume fever; cough; chest pain; flu-like fever	NA
Manganese (dissolved)	GW: 1880 MW-08S	5 mg/m ³	500 mg/m ³	Parkinson's; asthenia, insomnia; mental confusion; metal fume fever; dry throat, cough, tight chest, dyspnea, rales, flu-like fever; low-back pain; vomiting; malaise; fatigue; kidney damage	NA

2.5 Contaminants of Concern

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum ^a Concentration (µg/L)	Exposure Limit ^b	IDLH ^c	Symptoms and Effects of Exposure	PIP ^d (eV)
Nickel	GW: 3.4 MW-09S	1 mg/m ³	10 mg/m ³ Ca	Dermatitis, sensitization; allergic asthma, pneumitis	NA
Potassium (dissolved) (as KOH)	GW: 12800 MW-08S	2 mg/m ³	ND	Eye, skin and respiratory system irritant; cough, sneezing; eye and skin burns; vomit, diarrhea	UK
Silver	GW: 5.9 MW-09S	0.01 mg/m ³	10 mg/m ³	Blue-gray eyes, nasal septum, throat and skin; irritation and ulceration of skin; GI disturbance	
Sodium	GW: 256000 MW-07S				
Thallium (dissolved)	GW: 2.3 MW-06S	0.1 mg/m ³	15 mg/m ³	Nausea, diarrhea, abdominal pain, vomiting; ptosis, strabismus; peripheral neuropathy, tremor; retrosternal tightness, chest pain, pulmonary edema, seizures, chorea, psychosis; liver and kidney damage; alopecia; paresthesia of legs	UK
Vanadium	GW: 1.1 MW-06S	0.05 mg/m ³	35 mg/m ³	Eye, skin and throat irritant; green tongue, metallic taste; eczema; cough; fine rales, wheezing, bronchitis, dyspnea	NA
Zinc (as ZnCl fume)	GW: 158 MW-09S	1 mg/m ³	50 mg/m ³	Eye irritant; (in animals: pulmonary irritation, eye injury; possible liver damage)	NA
Pesticides/ PCB's					
Heptachlor epoxide	GW: 1.06 MW-08S	0.5 mg/m ³	500 Ca	Paresthesia of tongue, lips, hand, and face; tremors; dizziness; confusion; headache; fatigue; convulsion; eye and skin irritation; vomiting	UK
VOC's					
1,1,2-Trichloroethane	GW: 10 MW-07S	10 ppm	100 ppm Ca	Eye and nose irritation, CNS depression, liver damage, dermatitis	11.00
1,1-Dichloroethene	GW: 200 MW-07S	NL	ND Ca	Eye, skin and throat irritation; dizziness, headache, nausea, liver and kidney dysfunction, pneumitis, dyspnea	10.00
1,2-Dichlorobenzene	GW: 0.44 MW-06S	25 ppm	200	Nose and eye irritation, liver and kidney damage, skin blisters	9.06
Acetone	GW: 17 MW-08S	1000 ppm	2500 ppm	Eye, nose and throat irritant; headache, dizziness, CNS depression; dermatitis	9.69
Chloroform	GW: 1.1 MW-06S	2 ppm	500 Ca	Dizziness, mental dullness, nausea, confusion, disorientation, headache, fatigue, eye and skin irritation, anesthesia, enlarged liver	11.42

2.5 Contaminants of Concern

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum ^a Concentration (µg/L)	Exposure Limit ^b	IDLH ^c	Symptoms and Effects of Exposure	PIP ^d (eV)
Ethylbenzene	GW: 2 MW-07S	100 ppm	800 ppm	Eye, skin and mucous membrane irritant; headache; dermatitis; narcosis; coma	8.76
Styrene	GW: 0.35 MW-07S	100 ppm C 200 ppm	700 ppm	Eye, nose and respiratory system irritation; headache, fatigue, dizziness, confusion, malaise, drowsiness, weakness, unsteady gait; narcosis; defatting dermatitis; possible liver injury; reproductive effects	8.40
Tetrachloroethene	GW: 21 MW-07S	25 ppm	150 ppm Ca	Eye, nose, and throat irritation; nausea; flushed face and neck; vertigo; dizziness; sleepiness; skin redness; headache; liver damage	9.32
Toluene	GW: 4.9 MW-07S	50 ppm	500 ppm	Eye and nose irritation, fatigue, weakness, confusion, dizziness, headache, dilated pupils, excessive tearing, nervousness, muscle fatigue, paresthesia, dermatitis, liver and kidney damage	8.82
Trichloroethylene (TCE)	GW: 82000 MW-07S	50 ppm	1,000 Ca	Headache, vertigo, visual disturbance, eye and skin irritation, fatigue, giddiness, tremors, sleepiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury	9.45
Vinyl Chloride	GW: 3600 MW-07S	1 ppm	NL Ca	Weakness, abdominal pain, gastrointestinal bleeding, enlarged liver, pallor or cyanosis of extremities	9.99
Xylene, total	GW: 11 MW-07S	100 ppm	900	Irritated eyes, skin, nose, and throat; dizziness; excitement; drowsiness; incoherence; staggering gait; corneal vacuolization; anorexia; nausea; vomiting; abdominal pain; dermatitis	8.56
Cis-1,2-dichloroethene	GW: 34000 MW-07S	200 ppm	1000 ppm	Irritation of eyes and respiratory system; CNS depression	9.65
Trans-1,2-dichloroethene	GW: 160 MW-07S	100 ppm	900 ppm	Irritated eyes, skin, nose, and throat; dizziness; excitement; drowsiness; incoherence; staggering gait; corneal vacuolization; anorexia; nausea; vomiting; abdominal pain; dermatitis	8.56
SVOC's					
1,1'-Biphenyl	GW: 2 MW-07S	1 ppm	100ppm	Eye and throat irritant; headache, nausea, fatigue, limb numbness; liver damage	7.95
2,4-Dimethylphenol	GW: 2 MW-07S	UK	UK	Not Known	UK
2-Methylnaphthalene	GW: 8 MW-07S	UK	UK	Not Known	UK
Acenaphthene	GW: 8 MW-07S	UK	UK	Not Known	UK

2.5 Contaminants of Concern

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum ^a Concentration (µg/L)	Exposure Limit ^b	IDLH ^c	Symptoms and Effects of Exposure	PIP ^d (eV)
Carbazole	GW: 6 MW-07S	UK	UK	Not Concerned	UK
Di-n-butylphthalate	GW: 0.7 MW-08S	5 mg/m ³	4000 mg/m ³	Eye, upper respiratory system and stomach irritant	UK
Dibenzofuran	GW: 5 MW-07S	UK	UK	Not Known	UK
Fluorene	GW: 5 MW-07S	UK	UK	Not Known	UK
Naphthalene	GW: 120 MW-07S	10 ppm	250 ppm	Eye irritant; headache, confusion, excitement, malaise; nausea, vomiting, abdominal pain; bladder irritation; profuse sweating; jaundice; hematuria, hemoglobinuria, renal shutdown; dermatitis; optical neuritis, corneal damage	8.12
Phenanthrene	GW: 4 MW-07S	UK	UK	Not Known	UK
Bis-(2-ethylhexyl)phthalate (DEHP, DOP)	GW: 0.6 MW-07S	5 mg/m ³	5,000 Ca	Eye and mucous membrane irritant	UK

Footnotes:

^a Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), S (Surface Soil), SL (Sludge), SW (Surface Water).

^b Appropriate value of PEL, REL, or TLV listed.

^c IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.

^d PIP = photoionization potential; NA = Not applicable; UK = Unknown.

^e Metal concentrations are of total metals unless noted

2.6 Potential Routes of Exposure

Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 4.

Inhalation: Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 4 and 5, respectively.

Other: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

3 Project Organization and Personnel

3.1 CH2M HILL Employee Medical Surveillance and Training

(Reference CH2M HILL SOPs HS-113, *Medical Surveillance*, and HS-110, *Health and Safety Training*)

The employees listed below are enrolled in the CH2M HILL Comprehensive Health and Safety Program and meet state and federal hazardous waste operations requirements for 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training. Employees designated “SSC” have completed a 12-hour site safety coordinator course, and have documented requisite field experience. An SSC with a level designation (D, C, B) equal to or greater than the level of protection being used must be present during all tasks performed in exclusion or decontamination zones. Employees designated “FA-CPR” are currently certified by the American Red Cross, or equivalent, in first aid and CPR. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones. The employees listed below are currently active in a medical surveillance program that meets state and federal regulatory requirements for hazardous waste operations. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

Pregnant employees are to be informed of and are to follow the procedures in CH2M HILL’s SOP HS-04, *Reproduction Protection*, including obtaining a physician’s statement of the employee’s ability to perform hazardous activities before being assigned fieldwork.

Employee Name	Office	Responsibility	SSC/FA-CPR
Ben Francisco	VBO	Field Team Leader/SC-HW	Level C SC-HW; FA-CPR
Anita Dodson	VBO	Field Team Leader/SC-HW	Level C SC-HW; FA-CPR

3.2 Field Team Chain of Command and Communication Procedures

3.2.1 Client

Contact Name:	Agnes Sullivan NAVFAC MID-LANT
Phone:	757/444-4120

3.2.2 CH2M HILL

Activity Manager:	Kim Henderson/VBO
Project Manager:	Kim Henderson/VBO
Health and Safety Manager:	Steve Beck/MKE
Field Team Leader:	Ben Francisco/VBO, Anita Dodson/VBO
Site Safety Coordinator:	Ben Francisco/VBO, Anita Dodson/VBO

The SSC is responsible for contacting the Field Team Leader and Project Manager. In general, the Project Manager will contact the client. The Health and Safety Manager should be contacted as appropriate.

3.2.3 CH2M HILL Subcontractors

(Reference CH2M HILL SOP HS-215, *Subcontractor, Contractor, and Owner*)

Ordnance Identification	Utilities Location
Subcontractor: NA Contact Name:	Subcontractor: NA Contact Name:

Telephone:	Telephone:
Drilling Subcontractor: NA Contact Name: Telephone:	IDW Subcontractor: TBD Contact Name: Telephone:

The subcontractors listed above are covered by this HSP and must be provided a copy of this plan. However, this plan does not address hazards associated with the tasks and equipment that the subcontractor has expertise in (e.g., drilling, excavation work, electrical). Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit these procedures to CH2M HILL for review before the start of field work. Subcontractors must comply with the established health and safety plan(s). The CH2M HILL SSC should verify that subcontractor employee training, medical clearance, and fit test records are current and must monitor and enforce compliance with the established plan(s). CH2M HILL's oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

CH2M HILL should continuously endeavor to observe subcontractors' safety performance. This endeavor should be reasonable, and include observing for hazards or unsafe practices that are both readily observable and occur in common work areas. CH2M HILL is not responsible for exhaustive observation for hazards and unsafe practices. In addition to this level of observation, the SSC is responsible for confirming CH2M HILL subcontractor performance against both the subcontractor's safety plan and applicable self-assessment checklists. Self-assessment checklists contained in **Attachment 6** are to be used by the SSC to review subcontractor performance.

Health and safety related communications with CH2M HILL subcontractors should be conducted as follows:

- Brief subcontractors on the provisions of this plan, and require them to sign the Employee Signoff Form included in Attachment 1.
- Request subcontractor(s) to brief the project team on the hazards and precautions related to their work.
- When apparent non-compliance/unsafe conditions or practices are observed, notify the subcontractor safety representative and require corrective action – the subcontractor is responsible for determining and implementing necessary controls and corrective actions.
- When repeat non-compliance/unsafe conditions are observed, notify the subcontractor safety representative and stop affected work until adequate corrective measures are implemented.
- When an apparent imminent danger exists, immediately remove all affected CH2M HILL employees and subcontractors, notify subcontractor safety representative, and stop affected work until adequate corrective measures are implemented. Notify the Project Manager and HSM as appropriate.
- Document all oral health and safety related communications in project field logbook, daily reports, or other records.

4 Personal Protective Equipment (PPE)

(Reference CH2M HILL SOP HS-117, *Personal Protective Equipment*, HS-121, *Respiratory Protection*)

PPE Specifications ^a

Task	Level	Body	Head	Respirator ^b
<ul style="list-style-type: none"> General site entry Surveying Observation of material loading for offsite disposal 	D	Work clothes; steel-toe, leather work boots; work glove.	Hardhat ^c Safety glasses Ear protection ^d	None required
<ul style="list-style-type: none"> Surface water sampling Sediment sampling Surface soil sampling Hand augering 	Modified D	Work clothes or cotton coveralls Boots: Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat ^c Safety glasses Ear protection ^d	None required
<ul style="list-style-type: none"> Groundwater sampling Aquifer Testing Soil boring Investigation-derived waste (drum) sampling and disposal 	Modified D	Coveralls: Uncoated Tyvek® Boots: Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat ^c Splash shield ^c Safety glasses Ear protection ^d	None required.
<ul style="list-style-type: none"> Tasks requiring upgrade 	C	Coveralls: Polycoated Tyvek® Boots: Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat ^c Splash shield ^c Ear protection ^d Spectacle inserts	APR, full face, MSA Ultratwin or equivalent; with GME-H cartridges or equivalent ^e .
<ul style="list-style-type: none"> Tasks requiring upgrade 	B	Coveralls: Polycoated Tyvek® Boots: Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat ^c Splash shield ^c Ear protection ^d Spectacle inserts	Positive-pressure demand self-contained breathing apparatus (SCBA); MSA Ultralite, or equivalent.

Reasons for Upgrading or Downgrading Level of Protection

Upgrade ^f	Downgrade
<ul style="list-style-type: none"> Request from individual performing tasks. Change in work tasks that will increase contact or potential contact with hazardous materials. Occurrence or likely occurrence of gas or vapor emission. Known or suspected presence of dermal hazards. Instrument action levels (Section 5) exceeded. 	<ul style="list-style-type: none"> New information indicating that situation is less hazardous than originally thought. Change in site conditions that decreases the hazard. Change in work task that will reduce contact with hazardous materials.

^a Modifications are as indicated. CH2M HILL will provide PPE only to CH2M HILL employees.

^b No facial hair that would interfere with respirator fit is permitted.

^c Hardhat and splash-shield areas are to be determined by the SSC.

^d Ear protection should be worn when conversations cannot be held at distances of 3 feet or less without shouting.

^e Cartridge change-out schedule is at least every 8 hours (or one work day), except if relative humidity is > 85%, or if organic vapor measurements are > midpoint of Level C range (refer to Section 5)--then at least every 4 hours. If encountered conditions are different than those anticipated in this HSP, contact the HSM.

^f Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the HSM, and an SSC qualified at that level is present.

5 Air Monitoring/Sampling

(Reference CH2M HILL SOP HS-207, *Exposure Assessment for Airborne Chemical Hazards*)

5.1 Air Monitoring Specifications

PID: OVM with 10.6eV lamp or equivalent	All intrusive activities	Up to 1 ppm →	Level D	Initially and periodically during task	Daily
		1 to 25 ppm above b.g. (Sustained for 1 minute) →	Level D; collect vinyl chloride tube; vinyl chloride action level not exceeded		
		25 to 100ppm above b.g. (Sustained for 1 minute) →	Level C		
		100 to 300ppm above b.g. (Sustained for 1 minute) →	Level B (Not Anticipated or authorized)		
Colormetric Tube: Drager vinyl chloride specific (0.5 to 30 ppm range) with pre-tube, or equivalent	All intrusive activities	<0.5 ppm→ 0.5 ppm→	Level D Level B	Initially and periodically when PID >1 ppm	Not applicable
Nose-Level Monitor: Voice	All	Conversations can be held at distances of 3 feet without shouting →	No action required	Initially and periodically during task	N/A
		Conversations cannot be held at distances of 3 feet without shouting →	Hearing protection required Stop; re-evaluate		
Dust Monitor: Visual	Drilling, digging or if dusty conditions exist.	No visual dust → Visual Dust →	Level D Level D - Use Dust Suppression techniques	Initially and periodically during tasks	N/A

^a Action levels apply to sustained breathing-zone measurements above background.

^b The exact frequency of monitoring depends on field conditions and is to be determined by the SSC; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3", "at surface/SB-2", etc.).

^c If the measured percent of O₂ is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O₂ action levels apply only to ambient working atmospheres, and not to confined-space entry. More-stringent percent LEL and O₂ action levels are required for confined-space entry (refer to Section 2).

^d Refer to SOP HS-10 for instructions and documentation on radiation monitoring and screening.

^e Noise monitoring and audiometric testing also required.

5.2 Calibration Specifications

(Refer to the respective manufacturer's instructions for proper instrument-maintenance procedures)

Instrument	Gas	Span	Reading	Method
PID: OVM, 10.6 or 11.8 eV bulb	100 ppm isobutylene	RF = 1.0	100 ppm	1.5 lpm reg T-tubing
PID: MiniRAE, 10.6 eV bulb	100 ppm isobutylene	CF = 100	100 ppm	1.5 lpm reg T-tubing
PID: TVA 1000	100 ppm isobutylene	CF = 1.0	100 ppm	1.5 lpm reg T-tubing

6 Decontamination

(Reference CH2M HILL SOP HSE-506, *Decontamination*)

- Refer to the **MASTER HASP for Decontamination Protocols**

6.1 General Decontamination Specifications

- Refer to the **MASTER HASP for Decontamination Specifications**

6.2 Diagram of Personnel-Decontamination Line

- Refer to the **MASTER HASP for Personnel-Decontamination Line**

7 Spill-Containment Procedures

- Refer to the **MASTER HASP for Spill-Containment Procedures**

8 Site-Control Plan

- Refer to the **Master HASP for details regarding the Site-Control Plan**

8.1 Site-Control Procedures

- Refer to the **Master HASP for details regarding Site -Control Procedures**

8.2 Hazwoper Compliance Plan

- Refer to the **Master HASP for details regarding the Hazwoper Compliance Plan**

9 Emergency Response Plan

- Refer to the **Master HASP for details regarding the Emergency Response Plan**

9.1 Pre-Emergency Planning

- Refer to the **Master HASP for details regarding the Emergency Response Planning**

9.2 Emergency Equipment and Supplies

- Refer to the Master HASP for details regarding Emergency Equipment and Supplies.

9.3 Incident Response

- Refer to the Master HASP for details regarding Incident response

9.4 Emergency Medical Treatment

- Refer to the Master HASP for details regarding Emergency Medical Treatment.

9.5 Evacuation

- Refer to the Master HASP for details regarding Evacuation Protocols.

9.6 Evacuation Signals

- Refer to the Master HASP for details regarding Evacuation Signals.

9.7 Incident Notification and Reporting

- Refer to the Master HASP for details regarding Incident Notification and Reporting.

10 Approval

This site-specific Health and Safety Plan has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

10.1 Original Plan

Written By: Dan Holloway

Date: 06/03/2003

Approved By: Steve Beck/MKE

Date: 07/02/03



10.2 Revisions

Revisions Made By: SteveBeck/MKE

Date: 04/18/2006



Revisions to Plan:

Revisions Approved By:

Date:

11 Attachments

- Attachment 1: Employee Signoff Form - Field Safety Instructions
- Attachment 2: Project-Specific Chemical Product Hazard Communication Form
- Attachment 3: Chemical-Specific Training Form
- Attachment 4: Emergency Contacts
- Attachment 5: Project H&S Forms/Permits
- Attachment 6: Project Activity Self-Assessment Checklists
- Attachment 7: Applicable Material Safety Data Sheets
- Attachment 8: Metal Facts Sheet

Employee Signoff Form

Project-Specific Chemical Product
Hazard Communication Form

CHEMICAL-SPECIFIC TRAINING FORM

CHEMICAL-SPECIFIC TRAINING FORM

Location:	Project #: 181812
HCC:	Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

The HCC shall use the product MSDS to provide the following information concerning each of the products listed above.

- Physical and health hazards
- Control measures that can be used to provide protection (including appropriate work practices, emergency procedures, and personal protective equipment to be used)
- Methods and observations used to detect the presence or release of the regulated product in the workplace (including periodic monitoring, continuous monitoring devices, visual appearance or odor of regulated product when being released, etc.)

Training participants shall have the opportunity to ask questions concerning these products and, upon completion of this training, will understand the product hazards and appropriate control measures available for their protection.

Copies of MSDSs, chemical inventories, and CH2M HILL's written hazard communication program shall be made available for employee review in the facility/project hazard communication file.

Emergency Contacts Page

Emergency Contacts

24-hour CH2M HILL Emergency Beeper – 888/444-1226

Medical Emergency – 911

Facility Medical Response #: 757-396-3333

Local Ambulance #: 757-396-3333

CH2M HILL Medical Consultant

Health Resources

Dr. Jerry H. Berke, M.D.,M.P.H.

600 West Cummings Park, Suite 3400

Woburn, MA 01801

1-781-938-4653 or 1-800-350-4511

(After hours calls will be returned within 20 minutes)

Fire/Spill Emergency – 911

Facility Fire Response #: 757-396-3335

Local Fire Dept #: 757-382-6297

Corporate Director Health and Safety

Name: Jerry Lyle/BOI

Phone: 208-383-6244

Cell: 208-850-2532

24-hour emergency beeper: 888-444-1226

Security & Police – 911

Facility Security #: 757-396-5111

Local Police #: 757-382-6161

Regional Health, Safety & Environmental Manager

Name: Steve Beck/MKE

Phone: 414-272-2426 ext. 277

Utilities Emergency

Water: 757-382-3550

Gas: 1-877-572-3342

Electric: 1-888-667-3000

Regional Environmental Compliance Coordinator

Name: Linda Hickok/SYC

Phone: 315-422-8495 ext. 229

Designated Safety Coordinator (DSC)

Name: Jamie Butler

Phone: 757-460-3734 x39

Regional Human Resources Department

Name: Cindy Bauder/WDC

Phone: 703-471-6405 ext. 4243

Project Manager

Name: Kim Henderson

Phone: 757-671-8311 x440

Corporate Human Resources Department

Name: Pete Hannon/DEN

Phone: 303/771-0900

Federal Express Dangerous Goods Shipping

Phone: 800/238-5355

CH2M HILL Emergency Number for Shipping

Dangerous Goods

Phone: 800/255-3924

Worker's Compensation

Contact either the Regional Human Resources Dept. to have an Incident Report Form (IRF) completed.

After hours contact Julie Zimmerman 303-664-3304

Auto Claims

Rental: Carol Dietz/DEN

1-303-713-2757

CH2M Hill owned: Zurich Insurance Company

1-800-987-3373

Contact the Project Manager. Generally, the Project Manager will contact relevant government agencies.

Facility Alarms: Sound Field Vehicle Horn (3x) **Evacuation Assembly Area(s):** Field Vehicle

Facility/Site Evacuation Route(s): See Site Map

Project Forms

Arsenic

Standard of Practice HSE-501

Arsenic Fact Sheet

Uses and Occurrences

The manufacture and transportation of arsenic compounds; use in the manufacture of herbicide, pesticide, fungicides, and defoliants; use in the manufacture and handling of calcium arsenate; use in the manufacture of electrical semiconductors, diodes, and solar batteries; as an additive for food and drinking water for animals; use as a preharvest desiccant, sugarcane ripener, soil sterilant, or for timber thinning; use as a bronzing or decolorizing addition in glass manufacturing; use in the production of opal glass and enamels; use as an addition to alloys to increase hardening and heat resistance; during smelting of ores; during the cleanup of soil contaminated with arsenic; military applications; and general handling, storage, and use of arsenic.

Physical Characteristics

Appearance:	Gray metal or white powder
Odor:	Garlic-like when heated
Flammable:	None
Flash Point:	None
Flammable Range:	None
Specific gravity:	5.73 for arsenic metal, 2.16 for arsenic trioxide
Stability:	Stable
Incompatibilities:	Heat, hydrogen gas, and oxidizing agents
Melting Point:	Sublimes at 613°C; -8.5°C for arsenic trioxide
Boiling Point:	Sublimes at 613°C; 130°C for arsenic trioxide

Signs and Symptoms of Exposure

Short term (Acute):	Nausea, vomiting, diarrhea, weakness, loss of appetite, cough, chest pain, giddiness, headache, and breathing difficulty.
Long term (Chronic):	Numbness and weakness in the legs and feet, skin and eye irritation, hyperpigmentation, thickening of palms and soles (hyperkeratosis), contact dermatitis, skin sensitization, warts, ulceration and perforation of the nasal septum

Modes of Exposure

Inhalation:	Dusts and Vapors
Absorption:	Liquid
Ingestion:	Dusts and Liquid

Exposure Limits

Action level	5 µg/m ³
PEL	10 µg/m ³
STEL	None
TLV	10 µg/m ³

Exposure Level vs. Regulatory Requirements

EXPOSURE LEVEL (EL)	REGULATORY REQUIREMENTS
EL < AL	Maintain exposure as low as reasonably achievable
AL > EL, EL < PEL	Implement portions of the OSHA Arsenic standard and Training
EL > PEL	Implement all portions of the OSHA Arsenic Standard including training, medical surveillance, engineering controls, establishment of work areas, etc.

PPE

Eye:	Safety Glasses; contact lenses should not be worn
Skin:	Chemical protective gloves and body protection
Respiratory:	Air purifying respirators and supplied air respirators, depending on the exposure

First Aid

Inhalation:	Move to fresh air; seek medical attention promptly
Skin:	Quick drenching with water; wash skin with soap and water; seek medical attention promptly
Eyes	Flush with water for 15 minutes, lifting the lower and upper lids occasionally; seek medical attention promptly
Ingestion:	Seek medical attention promptly

Cadmium

Standard of Practice HSE-504

Cadmium Fact Sheet

Uses and Occurrences

Coatings on metals; nickel-cadmium storage batteries; power transmission wire; pigments in ceramic glazes, enamels, and fungicides; corrosion-resistant coatings on marine, aircraft, and motor vehicles; manufacture of nuclear reactor rods; and welding electrodes and solder.

Physical Characteristics

Appearance:	Soft, blue-white, malleable, lustrous metal or grayish-white powder; some compounds may appear as a brown, yellow, or red powdery substance.
Odor:	None.
Flammable:	Noncombustible.
Flash Point:	Not Applicable.
Flammable Range:	Not Applicable.
Specific gravity:	8.64 (metal dust).
Stability:	Very stable.
Incompatibilities:	Nitric acid, boiling concentrated hydrochloric and sulfuric acids; contact of cadmium metal dust with strong oxidizers or with elemental sulfur, selenium, and tellurium may cause fires and explosion.
Melting Point:	321°C (metal dust).

Signs and Symptoms of Exposure

Short Term (Acute):	<u>Dust and Fume:</u> Irritation of nose and throat; inhalation may cause a delayed onset of cough, chest pain, sweating, chills, shortness of breath, and weakness. Death may occur. <u>Dust:</u> Ingestion may cause nausea, vomiting, diarrhea, and abdominal cramps.
Long Term (Chronic):	<u>Dust and Fume:</u> Repeated or prolonged exposure may cause loss of sense of smell, ulceration of the nose, shortness of breath (emphysema), kidney damage, and mild anemia. Exposure to cadmium has been reported to cause an increase incidence of cancer of the prostate in men.

Modes of Exposure

Inhalation:	Dusts and fumes.
Absorption:	None.
Ingestion:	Dusts and solids.

Exposure Limits

Action level	2.5 µg/m ³ .
PEL	5.0 µg/m ³ .
STEL	None.
PEL-C	None.
TLV	10.0 µg/m ³ ; 2.0 µg/m ³ (respirable fraction).

Exposure Level vs. Regulatory Requirements

EXPOSURE LEVEL (EL)	REGULATORY REQUIREMENTS
EL < AL	Maintain exposure as low as reasonable achievable
AL > EL, EL < PEL	Implement portions of the OSHA Cadmium standard and Training
EL > PEL	Implement all portions of the OSHA Cadmium Standard including training, medical surveillance, engineering controls, establishment of work areas, etc.

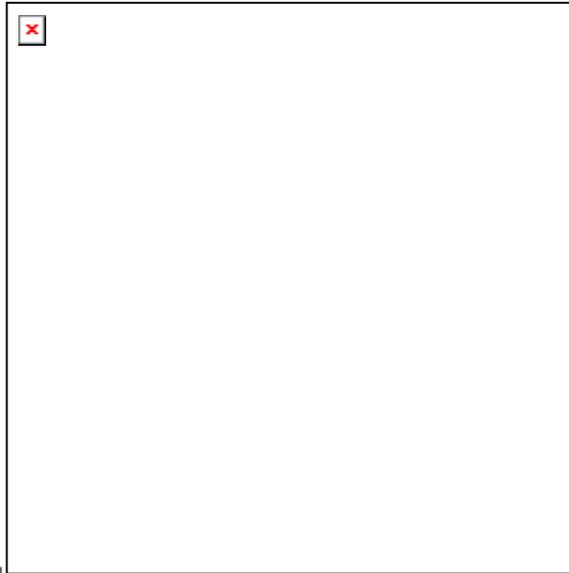
PPE

Eye:	Splash proof or dust resistant goggles; face shield.
Skin:	Protective coveralls, gloves, and footwear.
Respiratory:	Air purifying respirators and supplied air respirators, depending on the exposure.

First Aid

Inhalation:	Move to fresh air; seek medical attention immediately.
Skin:	Remove clothing and shoes; wash with soap or mild detergent and large amounts of water.
Eyes	Flush with water immediately, lifting the upper and lower eyelids; seek medical attention immediately.
Ingestion:	Under no circumstances should therapeutic chelation be administered; seek medical attention immediately.

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Lead

Standard of Practice HSE-508

Lead Fact Sheet

Uses and Occurrences

Lead can be found in the following: construction materials for tank linings and piping; component of lead-acid storage batteries; lead solder; plastics; steel; and pigments for paints. Lead can also be found in waste rock associated with mining activities, wood debris or stock used for electrical co-generation activities, and soil and waste associated with manufacturing activities. Elevated levels of naturally occurring lead may also be found in the soil in certain parts of this country.

Physical Characteristics

Appearance:	Bluish-white, silvery, gray metal. Very soft and easily malleable
Odor:	None
Flammable:	Noncombustible
Flash Point:	Not Applicable
Flammable Range:	Not Applicable
Specific gravity:	11.35
Stability:	very stable
Incompatibilities:	hot nitric acid, boiling concentrated hydrochloric and sulfuric acids
Melting Point:	327°C

Signs and Symptoms of Exposure

Skin and Eye: Irritation

Ingestion and Inhalation (Acute Overexposure): Lead is a potent, systemic poison that serves no known useful function once absorbed by your body. Taken in large enough doses, lead can kill you in a matter of days. A condition affecting the brain called acute encephalopathy may arise that develops quickly to seizures, coma, and death from cardio-respiratory arrest. A short term dose of lead can lead to acute encephalopathy. Short term occupational exposures of this magnitude are highly unusual, but not impossible. Similar forms of encephalopathy may, however, arise from extended, chronic exposure to lower doses of lead. There is no sharp dividing line between rapidly developing acute effects of lead, and chronic effects that take longer to acquire. Lead adversely

affects numerous body systems, and causes forms of health impairment and disease that arise after periods of exposure as short as days or as long as several years.

Ingestion and Inhalation (Chronic Overexposure):Chronic overexposure to lead may result in severe damage to your blood-forming, nervous, urinary and reproductive systems. Some common symptoms of chronic overexposure include loss of appetite, metallic taste in the mouth, anxiety, constipation, nausea, pallor, excessive tiredness, weakness, insomnia, headache, nervous irritability, muscle and joint pain or soreness, fine tremors, numbness, dizziness, hyperactivity and colic. In lead colic, there may be severe abdominal pain.

Modes of Exposure

Inhalation:	Dusts and fumes
Skin Absorption:	None
Ingestion:	Dusts and solids

Exposure Limits

Action level	0.03 mg/m ³
PEL	0.05 mg/m ³
STEL	None
PEL-C	None
TLV	0.05 mg/m ³

Exposure Level vs. Regulatory Requirements

EXPOSURE LEVEL (EL)	REGULATORY REQUIREMENTS
EL less than Action Level (AL)	Maintain exposure as low as reasonably achievable
EL greater than AL and less than PEL	Implement portions of the OSHA Lead Standard (i.e., initial medical monitoring) and Training
EL greater than PEL	Implement all portions of the OSHA Lead Standard including training, medical surveillance, engineering controls, establishment of work areas, etc.

PPE

Eye:	Safety Glasses
Skin:	Coveralls or disposable coveralls to keep lead off clothing and to prevent the spread of lead contamination.
Respiratory:	Air purifying respirators and supplied air respirators, depending on the exposure.

First Aid

Inhalation:	Move to fresh air, contact a physician
Skin:	Wash with water
Eyes:	Flush with water
Ingestion:	Contact a physician

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Vinyl Chloride

Standard of Practice HSE-512

Vinyl Chloride Fact Sheet

Uses and Occurrences – Polyvinyl chloride and copolymers, organic synthesis, adhesives for plastics, and as a precursor in the production of the common plastic polyvinyl chloride (PVC). It is often a degradation product of a number of chlorinated compounds, including tetra-chloroethylene and trichloroethylene, at hazardous waste sites in soils and groundwater. It can also be a breakdown product of the combustion of PVC or other chlorinated compounds.

Physical Characteristics

Appearance:	Colorless gas
Odor:	Sweet; Odor threshold: 3,000 ppm
Flammable:	Class IA Flammable Liquid Gas; NFPA Rating: 4
Flash Point:	-78 °C
Flammable Limits:	3.6% - 33.0% (% by volume in air)
Molecular Weight:	62.5
Vapor Pressure:	2530 mm Hg (at 20 °C)
Incompatibilities:	Atmospheric oxygen and strong oxidizers may react to produce peroxide, which can initiate a violent polymerization reaction
Melting Point:	-155.7 °C
Boiling Point:	-14 °C

Signs and Symptoms of Exposure

Short Term (Acute):	Dizziness, light-headedness, nausea, dullness of visual and auditory responses, drowsiness, and unconsciousness. Irritation of skin and eyes. Skin contact with liquid can cause frostbite.
Long Term (Chronic):	Thickening of skin, contact and allergic dermatitis, fatigue, coughing and sneezing, abdominal pain, gastrointestinal bleeding, nausea, vomiting, indigestion, diarrhea, jaundice, weight loss, anorexia, and cold and tingling sensations of the hands and feet, carcinogen.

Modes of Exposure

Inhalation:	Vapor
Absorption:	Liquid causes frostbite
Ingestion:	Ingestion of contaminated water

Exposure Limits

Action level	0.5 ppm
PEL	1 ppm
STEL	None
PEL-C	5 ppm (< 15 minutes)
TLV	1 ppm

Exposure Level vs. Regulatory Requirements

EXPOSURE LEVEL (EL)	REGULATORY REQUIREMENTS
EL < AL	Maintain exposure as low as reasonably achievable
EL > AL, EL < PEL	Implement portions of the OSHA Vinyl chloride standard and Training
EL > PEL	Implement all portions of the OSHA Vinyl Chloride Standard including training, medical surveillance, engineering controls, establishment of work areas, etc.

PPE

Eye: Safety Glasses

Skin: Tyvek or other full-body clothing, depending on the exposure.

Respiratory: Air purifying respirators and supplied air respirators, depending on the exposure.

First Aid

Inhalation: Move to fresh air, begin rescue breathing if breathing has stopped and CPR if heart action has stopped, transfer promptly to a medical facility.

Skin: Immerse affected part in warm water. Seek medical attention.

Eyes: Flush with large amounts of water for at least 15 minutes.

Ingestion: Contact a physician.

Site-Specific Investigation-Derived Waste Plan Checklist

This checklist supplements the Master IDW Plan with site-specific information. Once completed for a specific project, it provides necessary IDW information for each investigation. It is to be taken into the field with the Master IDW Plan.

Site: _____

1. IDW Media: _____ Soil cuttings
 _____ Well development or purge water
 _____ Decontamination residual soil and wastewater
 _____ PPE or disposable equipment
 _____ Other _____

2. Expected Regulatory Status: _____ Hazardous
 _____ Solid Waste
 _____ Unknown
 _____ Other _____

3. Site Location: _____

4. Nature of Contaminants Expected:
_____ Petroleum contamination _____ Herbicides
_____ Polyaromatic hydrocarbon _____ PCBs
_____ Pesticides _____ Metals
_____ Other _____

5. Volume of IDW Expected: _____ Drums
 _____ Cubic Yards
 _____ Tons
 _____ Gallons

6. Compositing Strategy for Sample Collection: _____

7. IDW Storage
 _____ As per Master IDW Plan _____ Other _____

8. Waste Disposal
 _____ As per Master IDW Plan _____ Other _____

Site-Specific Quality Assurance Project Plan Checklist

This checklist supplements the Master QAPP with site-specific information. Once completed for a specific project, it provides necessary quality assurance information for each investigation. It is to be taken into the field with the Master QAPP.

Site: _____

1. List sampling tasks:

2. List data quality objectives:

3. Organization:

LANTDIV IR Section Head	_____
LANTDIV Navy Technical Representative	_____
CNRMA IR Manager	_____
USEPA Remedial Project Manager	_____
VDEQ Federal Facilities Project Manager	_____
CH2M HILL Activity Manager	_____
CDM Federal Project Manager	_____
Quality Control Senior Review	_____
Technical Project Manager	_____
Field Team Leader	_____

4. Table of samples with analyses to be performed and associated QC samples (attached):

5. Analytical Quantitation Limits:

_____ As per Table 8-2 of Master QAPP _____ Other (attached)

6. QA/QC Acceptance Criteria (e.g., precision, accuracy)

_____ As per Table 4-1 of Master QAPP _____ Other (attached)

7. Data reduction, validation, and reporting:

_____ As per Section 9 of Master QAPP _____ Other (attached)

8. Internal QC Procedures (field and laboratory):

_____ As per Section 10 of Master QAPP _____ Other (attached)

9. Corrective Action:

_____ As per Section 14 of Master QAPP _____ Other (attached)

10. Other deviations from Master QAPP _____

Site-Specific Field Sampling Plan Checklist

This checklist supplements the Master Field Sampling Plan with site-specific information. Once completed for a specific project, it provides necessary field sampling information for each investigation. It is to be taken into the field with the Master FSP.

Site: _____

1. Tasks to be performed:

- | | |
|----------------------------------------------------|--------------------------------------------|
| _____ Geophysical surveys | _____ Groundwater sampling |
| _____ Soil gas surveys | _____ In-situ groundwater sampling |
| _____ Surface water and sediment sampling | _____ Aquifer testing |
| _____ Surface soil sampling | _____ Hydrogeologic measurements |
| _____ Soil boring installation | _____ Biota sampling |
| _____ Subsurface soil sampling | _____ Trenching |
| _____ Monitoring well installation and development | _____ Land surveying |
| _____ Monitoring well abandonment | _____ Investigation derived waste sampling |
| | _____ Decontamination |
| | _____ Other _____ |

2. Field measurements to be taken:

- | | |
|--------------------------------------|-----------------------------------|
| _____ temperature | _____ surveying |
| _____ pH | _____ magnetometry |
| _____ dissolved oxygen | _____ global positioning system |
| _____ turbidity | _____ soil gas parameters (list): |
| _____ specific conductance | _____ combustible gases |
| _____ organic vapor monitoring | _____ water-level measurements |
| _____ geophysical parameters (list): | _____ pumping rate |
| _____ electromagnetic induction | _____ other _____ |
| _____ ground-penetrating radar | |

3. Sampling program (nomenclature, etc.):

_____ As per Section 3.1 of Master FSP _____ Other _____

4. Map of boring and sampling locations (attach to checklist):

5. Table of field samples to be collected:

6. Applicable SOPs (attach to checklist) or references to specific pages in Master FSP:

7. Site-specific procedures or updates to protocols established in the Master FSP:

Site-Specific Health and Safety Plan

This checklist must be used in conjunction with the Master HASP. This checklist is intended for use by CDM Federal and CH2M HILL employees only. All CDM Federal and CH2M HILL employees performing tasks under this checklist must read and sign both this checklist and the Master HASP and agree to abide by their provisions (see EMPLOYEE SIGNOFF attached to the checklist).

Site: _____

Location(s) _____ (reference attached map)

This document shall be maintained on site with the Master Health and Safety Plan. It will include as attachments from the Work Plan a site map and the site characterization and objectives for this site.

The procedures described in the Master Health and Safety Plan will be followed unless otherwise specified in this Site-Specific Health and Safety Plan.

1. HAZWOPER-Regulated Tasks

- | | |
|------------------------------------------------|----------------------------------------------------------------|
| _____ Test pit and excavation | _____ Groundwater sampling |
| _____ Soil boring installation | _____ Aquifer testing |
| _____ Geoprobe boring | _____ Hydrologic measurements |
| _____ Geophysical surveys | _____ Surface water sampling |
| _____ Hand augering | _____ Biota sampling |
| _____ Subsurface soil sampling | _____ Investigation-derived waste (drum) sampling and disposal |
| _____ Surface soil sampling | _____ Observation of loading of material for offsite disposal |
| _____ Soil gas surveys | _____ Oversight of remediation and construction |
| _____ Sediment sampling | _____ Other _____ |
| _____ Monitoring well/drive point installation | |
| _____ Monitoring well abandonment | |

2. Hazards of Concern: (Check as many as are applicable. Refer to Section 3 of Master H&S Plan for control measures):

- | | |
|--------------------------------------|------------------------------|
| _____ Heat stress | _____ Vehicle traffic |
| _____ Cold stress | _____ Ladders, scaffolds |
| _____ Buried utilities, drums, tanks | _____ Fire |
| _____ Inadequate illumination | _____ Working on water |
| _____ Drilling | _____ Snakes or insects |
| _____ Heavy equipment | _____ Poison ivy, oak, sumac |
| _____ Working near water | _____ Ticks |
| _____ Flying debris | _____ Radiological |
| _____ Gas cylinders | _____ Other _____ |
| _____ Noise | |
| _____ Slip, trip, or fall hazards | |
| _____ Back injury | |
| _____ Confined space entry | |
| _____ Trenches, excavations | |
| _____ Protruding objects | |

3. Contaminants of Concern (List if known. Reduce Table 3.8 of the Master HASP to site-specific contaminants, add additional chemicals if necessary, and attach to this checklist):

_____	_____	_____
_____	_____	_____

4. Personnel (List CH2M HILL field team members and telephone numbers):

Field team leader(s)	_____	_____
Site safety coordinator(s)	_____	_____
Field team members	_____	_____
	_____	_____

5. Contractors/Subcontractors

_____ Procedures as per Master HASP

_____ Other _____

Name:	_____	_____	_____
Contact:	_____	_____	_____
Telephone:	_____	_____	_____

6. Level of personal protective equipment (PPE) required: _____
Refer to Table 5.1 of Master HASP, SOPs, and Respiratory Protection, Section 2 of the Site Safety Notebook.

7. Air monitoring instruments to be used:

_____ PID	_____ FID
_____ CGI	_____ Dust monitor
_____ O ₂	

8. Decontamination procedures:

_____ As per Section 7 of Master HASP

_____ Other _____

9. List any other deviations or variations from the Master HASP:

10. Emergency Response (Check that all names and numbers are correct on page 47 of Master HASP and attach corrected page to this checklist)

11. Map to hospital (Highlight route to hospital from site and attach to this checklist)
12. Emergency Contacts (Check that all names and numbers are correct on page 49 of Master HASP and attach corrected page to this checklist)
13. Approval. This prepared site-specific checklist must be approved Chuck Myers/CDM Federal or other authorized representative

Name_____Title_____Date_____

14. Employee Signoff. All CDM Federal and CH2M HILL employees working at the site must sign the attached Employee Signoff for the checklist as well as for the Master HASP.

Project Activity Self-Assessment Checklists

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where: 1) CH2M HILL employees are potentially exposed to hazards associated with drilling operations (complete Sections 1 and 3), and/or 2) CH2M HILL oversight of a drilling subcontractor is required (complete entire checklist).

SSC/DSC may consult with drilling subcontractors when completing this checklist, but shall not direct the means and methods of drilling operations nor direct the details of corrective actions. Drilling subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazard until corrected.

Completed checklists shall be sent to the health and safety manager for review.

Project Name: _____ Project No.: _____
 Location: _____ PM: _____
 Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

- Evaluate CH2M HILL employee exposures to drilling hazards
 - Evaluate a CH2M HILL subcontractor's compliance with drilling H&S requirements
- Subcontractors Name: _____

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the drilling subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HS-35.

SECTION 1

Yes No N/A N/O

PERSONNEL SAFE WORK PRACTICES (3.1)

1. Only authorized personnel operating drill rig	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Personnel cleared during rig startup	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Personnel clear of rotating parts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Personnel not positioned under hoisted loads	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Loose clothing and jewelry removed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Personnel instructed not to approach equipment that has become electrically energized	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Smoking is prohibited around drilling operation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Personnel wearing appropriate PPE, per HSP/FSI	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

<u>SECTION 2</u>	<u>Yes</u>	<u>No</u>	<u>N/A</u>	<u>N/O</u>
GENERAL (3.2.1)				
9. Daily safety briefing/ meeting conducted with crew	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Daily inspection of drill rig and equipment conducted before use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DRILL RIG PLACEMENT (3.2.2)				
11. Location of underground utilities identified	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Safe clearance distance maintained from overhead powerlines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Drilling pad established, when necessary	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Drill rig leveled and stabilized	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DRILL RIG TRAVEL (3.2.3)				
15. Rig shut down and mast lowered and secured prior to rig movement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. Tools and equipment secured prior to rig movement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. Only personnel seated in cab are riding on rig during movement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. Safe clearance distance maintained while traveling under overhead powerlines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. Backup alarm or spotter used when backing rig	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DRILL RIG OPERATION (3.2.4)				
20. Kill switch clearly identified and operational	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. All machine guards are in place	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. Rig ropes not wrapped around body parts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. Pressurized lines and hoses secured from whipping hazards	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. Drill operation stopped during inclement weather	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25. Air monitoring conducted per HSP/FSI for hazardous atmospheres	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26. Rig placed in neutral when operator not at controls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DRILL RIG MAINTENANCE (3.2.5)				
27. Defective components repaired immediately	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28. Lockout/ tagout procedures used prior to maintenance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
29. Cathead in clean, sound condition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30. Drill rig ropes in clean, sound condition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31. Fall protection used for fall exposures of 6 feet or greater	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
32. Rig in neutral and augers stopped rotating before cleaning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
33. Good housekeeping maintained on and around rig	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DRILLING AT HAZARDOUS WASTE SITES (3.2.6)				
34. Waste disposed of according to HSP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
35. Appropriate decontamination procedures being followed, per HSP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Material Safety Data Sheets

Section 1 - Product and Company Identification
ISOBUTYLENE

Product Identification: ISOBUTYLENE
Date of MSDS: 09/14/1989 **Technical Review Date:** 09/13/1995
FSC: 6830 **NIIN:** LIIN: 00N042744
Submitter: N EN
Status Code: C
MFN: 01
Article: N
Kit Part: N

Manufacturer's Information

Manufacturer's Name: SCOTT SPECIALTY GASES
Manufacturer's Address1: ROUTE 611
Manufacturer's Address2: PLUMSTEADVILLE, PA 18949
Manufacturer's Country: US
General Information Telephone: 215-766-8861
Emergency Telephone: 215-766-8861
Emergency Telephone: 215-766-8861
MSDS Preparer's Name: N/P
Proprietary: N
Reviewed: N
Published: Y
CAGE: 51847
Special Project Code: N

Contractor Information

Contractor's Name: SCOTT SPECIALTY GASES
Post Office Box: 310
Contractor's Address1: 6141 EASTON RD
Contractor's Address2: PLUMSTEADVILLE, PA 18949-0310
Contractor's Telephone: 215-766-8861
Contractor's CAGE: 51847

Section 2 - Composition /Information on Ingredients
ISOBUTYLENE

Ingredient Name: PROPENE, 2-METHYL-; (ISOBUTYLENE)
Ingredient CAS Number: 115-11-7 **Ingredient CAS Code:** M
RTECS Number: UD0890000 **RTECS Code:** M
=WT: =WT Code:
=Volume: =Volume Code:
>WT: >WT Code:
>Volume: >Volume Code:
<WT: <WT Code:
<Volume: <Volume Code:
% Low WT: % Low WT Code:
% High WT: % High WT Code:
% Low Volume: % Low Volume Code:
% High Volume: % High Volume Code:
% Text: 100
% Environmental Weight:
Other REC Limits: N/K
OSHA PEL: N/K (FP N) **OSHA PEL Code:** M
OSHA STEL: **OSHA STEL Code:**
ACGIH TLV: N/K (FP N) **ACGIH TLV Code:** M
ACGIH STEL: N/P **ACGIH STEL Code:**
EPA Reporting Quantity:

DOT Reporting Quantity:
Ozone Depleting Chemical: N

Section 3 - Hazards Identification, Including Emergency Overview
ISOBUTYLENE

Health Hazards Acute & Chronic: ACUTE:ASPHYXIANT. SYMPTOMS INCLUDE RAPID RESPIRATION, MUSCULAR INCOORDINATION, FATIGUE, NAUSEA & VOMITING. LOSS OF CONSCIOUSNESS & DEATH MAY OCCUR. CONTACT W/LIQUID MAY RESULT IN SYMPTOMS OF FROSTBITE . CHRONIC:NONE.

Signs & Symptoms of Overexposure:
SEE HEALTH HAZARDS.

Medical Conditions Aggravated by Exposure:
NONE

LD50 LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.

Route of Entry Indicators:

Inhalation: YES

Skin: NO

Ingestion: NO

Carcinogenicity Indicators

NTP: NO

IARC: NO

OSHA: NO

Carcinogenicity Explanation: NOT RELEVANT

Section 4 - First Aid Measures
ISOBUTYLENE

First Aid:

INGEST:CALL MD IMMED (FP N). INHAL:IMMED REMOVE VICTIM TO FRESH AIR. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN. SKIN:IMMED FLUSH W/ COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAM CLTHG. IF FROSTBITE OCCURS, WARM AFFECTED AREA W/WATER OR TOWEL. EYE:IMMED FLUSH W/COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES.

Section 5 - Fire Fighting Measures
ISOBUTYLENE

Fire Fighting Procedures:

USE NIOSH/MSHA APPROVED SCBA & FULL PROTECTIVE EQUIPMENT (FP N). FLAMMABLE HIGH PRESSURE LIQUID OR GAS.

Unusual Fire or Explosion Hazard:

DANGEROUS. VAP MAY TRAVEL CONSIDERABLE DIST TO SOURCE OF IGNIT & FLASH BACK. MAY FORM EXPLO MIXTS W/AIR. CAN REACT VIGOROUSLY W/OXIDIZING MATLS.

Extinguishing Media:

DO NOT EXTING BURNING GAS IF FLOW CANNOT BE SHUT OFF. USE WATER SPRAY TO KEEP FIRE EXPOS CYLS COOL. MOVE CYL (SUPDAT)

Flash Point: **Flash Point Text:** -105F,-76C

Autoignition Temperature:

Autoignition Temperature Text: N/A

Lower Limit(s): 1.8%

Upper Limit(s): 9.6%

**Section 6 - Accidental Release Measures
ISOBUTYLENE**

Spill Release Procedures:

EVACUATE & VENTILATE AREA. REMOVE LEAKING CYLINDER TO EXHAUST HOOD OR SAFE OUTDOORS AREA IF THIS CAN BE DONE SAFELY.

**Section 7 - Handling and Storage
ISOBUTYLENE**

Handling and Storage Precautions:

Other Precautions:

**Section 8 - Exposure Controls & Personal Protection
ISOBUTYLENE**

Respiratory Protection:

USE NIOSH/MSHA APPROVED SCBA IN CASE OF EMERGENCY OR NON-ROUTINE USE.

Ventilation:

PROVIDE ADEQUATE & LOCAL EXHAUST VENTILATION TO MAINTAIN CONCENTRATION BELOW EXPOSURE LIMITS.

Protective Gloves:

IMPERVIOUS GLOVES (FP N).

Eye Protection: SAFETY GOGGLES.

Other Protective Equipment: SAFETY SHOES WHEN HANDLING CYLINDERS.

Work Hygienic Practices: NONE SPECIFIED BY MANUFACTURER.

Supplemental Health & Safety Information: EXTING MEDIA:AWAY FROM FIRE IF THERE IS NO RISK. OTHER PREC:HAS NOT BEEN FILLED BY THE OWNER OR W/HIS WRITTEN CONSENT IS A VIOLATION OF FEDERAL LAW (49 CFR).

**Section 9 - Physical & Chemical Properties
ISOBUTYLENE**

HCC: G2

NRC/State License Number:

Net Property Weight for Ammo:

Boiling Point: Boiling Point Text: 19.6F,-6.9C

Melting/Freezing Point: Melting/Freezing Text: N/K

Decomposition Point: Decomposition Text: N/K

Vapor Pressure: 2.65@21.1C **Vapor Density:** 1.947

Percent Volatile Organic Content:

Specific Gravity: 0.588 (H2O=1)

Volatile Organic Content Pounds per Gallon:

pH: N/K

Volatile Organic Content Grams per Liter:

Viscosity: N/P

Evaporation Weight and Reference: NOT APPLICABLE

Solubility in Water: SLIGHT

Appearance and Odor: COLORLESS, ETHEREAL ODOR.

Percent Volatiles by Volume: 100

Corrosion Rate: N/K

Section 10 - Stability & Reactivity Data
ISOBUTYLENE

Stability Indicator: YES

Materials to Avoid:

OXIDIZING MATERIALS.

Stability Condition to Avoid:

NONE SPECIFIED BY MANUFACTURER.

Hazardous Decomposition Products:

CARBON MONOXIDE, CARBON DIOXIDE.

Hazardous Polymerization Indicator: NO

Conditions to Avoid Polymerization:

NOT RELEVANT

Section 11 - Toxicological Information
ISOBUTYLENE

Toxicological Information:

N/P

Section 12 - Ecological Information
ISOBUTYLENE

Ecological Information:

N/P

Section 13 - Disposal Considerations
ISOBUTYLENE

Waste Disposal Methods:

DISP MUST BE I/A/W FED, STATE & LOC REGS (FP N). RETURN CYLS TO SUPPLIER FOR PROPER DISP W/ANY VALVE OUTLET PLUGS/CAPS SECURED & VALVE PROT CAP IN PLACE. DO NOT REUSE CYL. EMPTY CYL WILL CONTAIN HAZ R ESIDUE.

Section 14 - MSDS Transport Information
ISOBUTYLENE

Transport Information:

N/P

Section 15 - Regulatory Information
ISOBUTYLENE

SARA Title III Information:

N/P

Federal Regulatory Information:

N/P

State Regulatory Information:

N/P

Section 16 - Other Information
ISOBUTYLENE

Other Information:

N/P

HAZCOM Label Information

Product Identification: ISOBUTYLENE

CAGE: 51847

Assigned Individual: N

Company Name: SCOTT SPECIALTY GASES

Company PO Box: 310

Company Street Address1: 6141 EASTON RD

Company Street Address2: PLUMSTEADVILLE, PA 18949-0310 US

Health Emergency Telephone: 215-766-8861

Label Required Indicator: Y

Date Label Reviewed: 09/08/1993

Status Code: C

Manufacturer's Label Number:

Date of Label: 09/08/1993

Year Procured: N/K

Organization Code: G

Chronic Hazard Indicator: N

Eye Protection Indicator: YES

Skin Protection Indicator: YES

Respiratory Protection Indicator: YES

Signal Word: DANGER

Health Hazard: Moderate

Contact Hazard: Slight

Fire Hazard: Severe

Reactivity Hazard: None

8/9/2002

MSDS Name: Nitric Acid, Reagent ACS

Synonyms: Azotic Acid, Engravers Nitrate, Hydrogen Nitrate.

Company Identification: Acros Organics N.V.

One Reagent Lane

Fairlawn, NJ 07410

For information in North America, call: 800-ACROS-01

For emergencies in the US, call CHEMTREC: 800-424-9300

2. Composition/Information on Ingredients

CAS#	Chemical Name	%	EINECS#
7697-37-2	Nitric acid	69-71%	231-714-2
7732-18-5	Water	Balance	231-791-2

Hazard Symbols: O C

Risk Phrases: 35 8

3. Hazards Identification

EMERGENCY OVERVIEW

Appearance: clear colorless to pale yellow.

Danger! Strong oxidizer. Contact with other material may cause a fire. Corrosive. Causes eye and skin burns. Causes digestive and respiratory tract burns. May be fatal if inhaled. Target Organs: None.

Potential Health Effects

Eye:

Causes severe eye burns. May cause irreversible eye injury.

Skin:

May cause severe skin irritation. Causes skin burns. May cause deep, penetrating ulcers of the skin.

Ingestion:

Causes gastrointestinal tract burns. May cause perforation of the digestive tract.

Inhalation:

May be fatal if inhaled. Effects may be delayed. May cause irritation of the respiratory tract with burning pain in the nose and throat, coughing, wheezing, shortness of breath and pulmonary edema.

Chronic:

Repeated inhalation may cause chronic bronchitis. Repeated exposure may cause erosion of teeth.

4. First Aid Measures

Eyes:

Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids. Get medical aid immediately. Do NOT allow victim to rub or keep eyes closed.

Skin:

Get medical aid immediately. Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops or persists. Wash clothing before reuse. Destroy contaminated shoes.

Ingestion:

If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately. Do NOT induce vomiting and seek IMMEDIATE MEDICAL ADVICE.

Inhalation:

Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid. DO NOT use mouth-to-mouth respiration.

Notes to Physician:

Treat symptomatically and supportively.

5. Fire Fighting Measures

General Information:

As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Strong oxidizer. Contact with combustible materials may cause a fire. Use water spray to keep fire-exposed containers cool. Substance is noncombustible. Containers may explode in the heat of a fire.

Extinguishing Media:

Substance is noncombustible; use agent most appropriate to extinguish surrounding fire. Do NOT get water inside containers. For large fires, use water spray, fog or alcohol-resistant foam. Do NOT use straight streams of water. For small fires, use dry chemical, carbon dioxide, sand, earth, water spray or regular foam. Cool containers with flooding quantities of water until well after fire is out.

Autoignition Temperature: Not available.

Flash Point: Not available.

NFPA Rating: Not published.

Explosion Limits, Lower: Not available.

Upper: Not available.

6. Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:

Absorb spill with inert material, (e.g., dry sand or earth), then place into a chemical waste container. Wear a self contained breathing apparatus and appropriate Personal protection. (See Exposure Controls, Personal Protection section). Neutralize spill with sodium bicarbonate. Use water spray to disperse the gas/vapor. Remove all sources of ignition. Use a spark-proof tool.

7. Handling and Storage

Handling:

Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use with adequate ventilation. Ground and bond containers when transferring material. Keep container tightly closed. Do not get on skin or in eyes. Do not ingest or inhale.

Storage:

Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances. Corrosives area.

8. Exposure Controls/Personal Protection

Engineering Controls:

Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Nitric acid	2 ppm ; 5.2 mg/m ³ ; 4 ppm STEL; 10 mg/m ³ STEL	2 ppm TWA; 5 mg/m ³ TWA 25 ppm IDLH	2 ppm TWA; 5 mg/m ³ TWA

OSHA Vacated PELs:

Nitric acid: 2 ppm TWA; 5 mg/m³ TWA

Personal Protective Equipment

Eyes:

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin:

Wear appropriate protective gloves and clothing to prevent skin exposure.

Clothing:

Wear appropriate protective clothing to prevent skin exposure.

Respirators:

Follow the OSHA respirator regulations found in 29CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

9. Physical and Chemical Properties (Nitric Acid)

Appearance:	clear colorless to pale yellow liquid
Odor:	strong odor, acrid odor
Solubility:	Soluble in water
Density/Spec. Grav:	1.50
pH:	1.0
% Volatiles by volume @ 21C (70F):	Not available
Boiling Point:	72 deg C
Melting Point:	-42 deg C
Vapor Density (Air=1):	Not available
Vapor Pressure (mm Hg):	6.8 mm Hg
Evaporation Rate (Butyl Acetate=1):	Not available
Viscosity:	Not available

Molecular Formula: HNO₃

Molecular Weight: 63.0119

10. Stability and Reactivity

Chemical Stability: Decomposes when in contact with air, light, or organic matter.

Conditions to Avoid: High temperatures, incompatible materials, moisture, reducing agents.

Incompatibilities with Other Materials: Reacts with over 150 chemical combinations. Refer to NFPA Fire Protection Guide for specifics. Reacts explosively with organic materials and combustibles.

Hazardous Decomposition Products: Nitrogen oxides.

Hazardous Polymerization: Has not been reported.

11. Toxicological Information

RTECS#:

CAS# 7697-37-2: QU5775000 QU5900000

CAS# 7732-18-5: ZC0110000

LD50/LC50:

CAS# 7697-37-2: Inhalation, rat: LC50 =67 ppm(NO₂)/4H.

CAS# 7732-18-5: Oral, rat: LD50 = >90 mL/kg.

Carcinogenicity:

Nitric acid -

Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.

Epidemiology:

No information available.

Teratogenicity:

Effects on newborn: biochemical and metabolic, Oral-rat TDLo=2345 mg/kg (female 18D post). Fetotoxicity: Stunted fetus, Oral-rat TDLo=21150 mg/kg (female 1-21D post).

Reproductive Effects:

No information available.

Neurotoxicity:

No information available.

Mutagenicity:

No information available.

Other Studies:

None.

12. Ecological Information

Ecotoxicity:

Mosquito fish: TLM=72 ppm/96H (fresh water) Cockle: LC50=330-1000 ppm/48H (salt water)

Environmental Fate:

No information reported.

Physical/Chemical:

No information available.

Other:

None.

13. Disposal Considerations

Dispose of in a manner consistent with federal, state, and local regulations.

RCRA D-Series Maximum Concentration of Contaminants: None listed.

RCRA D-Series Chronic Toxicity Reference Levels: None listed.

RCRA F-Series: None listed.

RCRA P-Series: None listed.

RCRA U-Series: None listed.

16. Other Information

MSDS Creation Date: 2/01/1996 Revision #4 Date: 12/16/1997

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

MSDS Name: **Hydrochloric Acid, Reagent ACS**

Chlorohydric acid, hydrogen chloride, muriatic acid, spirits of salt.
Company Identification: Acros Organics N.V.
One Reagent Lane
Fairlawn, NJ 07410
For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

2. Composition/Information on Ingredients

CAS#	Chemical Name	%	EINECS#
7647-01-0	Hydrochloric acid, reagent ACS	37%	231-595-7
7732-18-5	Water	Balance	231-791-2

Hazard Symbols: C
Risk Phrases: 34 37

3. Hazards Identification

Emergency Overview

EMERGENCY OVERVIEW

Appearance: Clear, colorless to faintly yellow.

Danger! Corrosive. Sensitizer. Causes eye and skin burns. May cause severe respiratory and digestive tract irritation with possible burns.

Target Organs: None.

Potential Health Effects

Eye:

May cause irreversible eye injury. Vapor or mist may cause irritation and severe burns. Contact with liquid is corrosive to the eyes and causes severe burns. May cause painful sensitization to light. May cause conjunctivitis.

Skin:

May be absorbed through the skin in harmful amounts. Contact with liquid is corrosive and causes severe burns and ulceration. May cause photosensitization in certain individuals.

Ingestion:

May cause circulatory system failure. Causes severe digestive tract burns with abdominal pain, vomiting, and possible death. May cause corrosion and permanent tissue destruction of the esophagus and digestive tract.

Inhalation:

Causes severe irritation of upper respiratory tract with coughing, burns, breathing difficulty, and possible coma. May cause pulmonary edema and severe respiratory disturbances.

Chronic:

Prolonged or repeated skin contact may cause dermatitis. Repeated exposure may cause erosion of teeth. May cause conjunctivitis and photosensitization.

4. First Aid Measures

Eyes:

Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids. Get medical aid immediately. Do NOT allow victim to rub or keep eyes closed.

Skin:

Get medical aid. Rinse area with large amounts of water for at least 15 minutes. Remove contaminated clothing and shoes.

Ingestion:

Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Get medical aid immediately.

Inhalation:

Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.

Notes to Physician:

Treat symptomatically and supportively.

5. Fire Fighting Measures

General Information:

As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Not flammable, but reacts with most metals to form flammable hydrogen gas. Use water spray to keep fire-exposed containers cool.

Extinguishing Media:

Substance is nonflammable; use agent most appropriate to extinguish surrounding fire.

Autoignition Temperature: Not available.

Flash Point: Not available.

NFPA Rating: Not published.

Explosion Limits, Lower: Not available.

Upper: Not available.

6. Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:

Large spills may be neutralized with dilute alkaline solutions of soda ash, or lime. Absorb spill using an absorbent, non-combustible material such as earth, sand, or vermiculite.

7. Handling and Storage

Handling:

Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use with adequate ventilation. Do not get on skin or in eyes. Do not ingest or inhale.

Storage:

Keep away from heat and flame. Do not store in direct sunlight. Store in a cool, dry, well-ventilated area away from incompatible substances.

8. Exposure Controls/Personal Protection

Engineering Controls:

Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name ACGIH NIOSH OSHA - Final PELs

Hydrochloric acid, reagent ACS C 5 ppm; C 7.5 mg/m³ 50 ppm IDLH C 5 ppm; C 7 mg/m³

OSHA Vacated PELs:

Hydrochloric acid, reagent ACS:

No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment

Eyes:

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin:

Wear appropriate protective gloves to prevent skin exposure.

Clothing:

Wear appropriate protective clothing to prevent skin exposure.

Respirators:

Follow the OSHA respirator regulations found in 29CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

9. Physical and Chemical Properties (Hydrochloric Acid)

Appearance:	Clear, colorless to faintly yellow liquid
Odor:	Strong, pungent
Solubility:	823g/L water at 32F
Density:	1.16-1.19
pH:	1.1 (0.1N sol)
% Volatiles by volume @ 21C (70F):	Not available
Boiling Point:	230 deg F
Melting Point:	-101 deg F
Vapor Density (Air=1):	1.257
Vapor Pressure:	160 mm Hg
Evaporation Rate (Butyl acetate =1):	2.0

Molecular Formula: HCl

Molecular Weight: 36.46

10. Stability and Reactivity

Chemical Stability:

Stable under normal temperatures and pressures.

Conditions to Avoid:

Incompatible materials, light.

Incompatibilities with Other Materials:

Acetate, acetic anhydride, alcohols + hydrogen cyanide, 2-aminoethanol, ammonium hydroxide, calcium carbide, calcium phosphide, cesium acetylene carbide, cesium carbide, chlorosulfonic acid, 1,1-difluoroethylene, ethylene diamine, ethyleneimine, fluorine, lithium silicide, magnesium boride, mercuric sulfate, oleum, perchloric acid, potassium permanganate, b-propiolactone, propylene oxide, rubidium acetylene carbide, rubidium carbide, silver perchlorate + carbon tetrachloride, sodium, sodium hydroxide, sulfuric acid, uranium phosphide, vinyl acetate. Substance polymerizes on contact with aldehydes or epoxides.

Hazardous Decomposition Products:

Hydrogen chloride, chlorine, carbon monoxide, carbon dioxide, hydrogen gas.

Hazardous Polymerization: May occur.

11. Toxicological Information

RTECS#:

CAS# 7647-01-0: MW4025000

CAS# 7732-18-5: ZC0110000

LD50/LC50:

CAS# 7647-01-0: Inhalation, mouse: LC50 =1108 ppm/1H; Inhalation, rat: LC50 =3124 ppm/1H; Oral, rabbit: LD50 = 900 mg/kg.

CAS# 7732-18-5: Oral, rat: LD50 = >90 mL/kg.

Carcinogenicity:

Hydrochloric acid, reagent ACS -
IARC: Group 3 carcinogen

Epidemiology:

No information available.

Teratogenicity:

Embryo or Fetus: Stunted fetus, ihl-rat TClO=450 mg/m3/1H Specific
Developmental Abnormalities: homeostasis, ihl-rat TClO=450 mg/m3/1H.

Reproductive Effects:

No information available.

Neurotoxicity:

No information available.

Mutagenicity:

No information available.

Other Studies:

None.

12. Ecological Information

Ecotoxicity:

Trout LC100=10 mg/L/24H Shrimp LC50=100-330 ppm Starfish LC50=100-330mg/L/48H Shore crab LC50=240 mg/L/48H
Chronic plant toxicity=100 ppm

Environmental Fate:

Substance will neutralize soil carbonate-based components.

Physical/Chemical:

No information available.

Other:

None.

13. Disposal Considerations

Dispose of in a manner consistent with federal, state, and local regulations.

RCRA D-Series Maximum Concentration of Contaminants: None listed.

RCRA D-Series Chronic Toxicity Reference Levels: None listed.

RCRA F-Series: None listed.

RCRA P-Series: None listed.

RCRA U-Series: None listed

16. Other Information

MSDS Creation Date: 11/09/1995 Revision #4 Date: 4/28/1998

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

MSDS Name: **Sulfuric acid**, reagent acs

Synonyms: Hydrogen Sulfate, Oil of Vitriol, Vitriol Brown Oil, Matting Acid, Battery Acid

Company Identification: Acros Organics N.V.

One Reagent Lane

Fairlawn, NJ 07410

For information in North America, call: 800-ACROS-01

For emergencies in the US, call CHEMTREC: 800-424-9300

2. Composition/Information on Ingredients

CAS#	Chemical Name	%	EINECS#
7664-93-9	Sulfuric acid	95-98.0%	231-639-5
7732-18-5	Water	Balance	231-791-2

Hazard Symbols: XI C

Risk Phrases: 35 36/38

3. Hazards Identification

EMERGENCY OVERVIEW

Appearance: colorless to brown.

Danger! Harmful if inhaled. Corrosive. Hygroscopic. Causes digestive and respiratory tract burns. Causes digestive and respiratory tract irritation. Causes severe eye and skin irritation and burns. Target Organs: None known.

Potential Health Effects

Eye:

May cause irreversible eye injury. Causes eye irritation and burns.

Skin:

Causes severe skin irritation and burns.

Ingestion:

Causes gastrointestinal tract burns.

Inhalation:

Harmful if inhaled. May cause severe irritation of the respiratory tract with sore throat, coughing, shortness of breath and delayed lung edema. Causes chemical burns to the respiratory tract.

Chronic:

Prolonged or repeated skin contact may cause dermatitis. Prolonged or repeated inhalation may cause nosebleeds, nasal congestion, erosion of the teeth, perforation of the nasal septum, chest pain and bronchitis. Prolonged or repeated eye contact may cause conjunctivitis.

4. First Aid Measures

Eyes:

Get medical aid immediately. Do NOT allow victim to rub or keep eyes closed. Extensive irrigation is required (at least 30 minutes).

Skin:

Get medical aid immediately. Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. **SPEEDY ACTION IS CRITICAL!**

Ingestion:

Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.

Inhalation:

Get medical aid immediately. Remove from exposure to fresh air immediately. If breathing is difficult, give oxygen.

Notes to Physician:

Treat symptomatically and supportively.

5. Fire Fighting Measures

General Information:

Wear appropriate protective clothing to prevent contact with skin and eyes. Wear a self-contained breathing apparatus (SCBA) to prevent contact with thermal decomposition products. Contact with water can cause violent liberation of heat and splattering of the material.

Extinguishing Media:

Do NOT use water directly on fire. Use water spray to cool fire-exposed containers. Use carbon dioxide or dry chemical.

Autoignition Temperature: Not available.

Flash Point: 340 deg C (644.00 deg F)

NFPA Rating: Not published.

Explosion Limits, Lower: Not available.

Upper: Not available.

6. Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:

Cover with sand, dry lime or soda ash and place in a closed container for disposal.

7. Handling and Storage

Handling:

Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use only in a well ventilated area. Do not get in eyes, on skin, or on clothing. Keep container tightly closed. Do not ingest or inhale. Do not allow contact with water. Discard contaminated shoes.

Storage:

Keep container closed when not in use. Store in a cool, dry, well-ventilated area away from incompatible substances. Corrosives area.

8. Exposure Controls/Personal Protection

Engineering Controls:

Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Sulfuric acid	1 mg/m3; 3 mg/m3 STEL	1 mg/m3 TWA; 15 mg/m3 IDLH	1 mg/m3 TWA

OSHA Vacated PELs:

Sulfuric acid:1 mg/m3 TWA

Personal Protective Equipment

Eyes:

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin:

Wear appropriate protective gloves to prevent skin exposure.

Clothing:

Wear appropriate protective clothing to prevent skin exposure.

Respirators:

Follow the OSHA respirator regulations found in 29CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

9. Physical and Chemical Properties ()

Appearance:	colorless to brown liquid
Odor:	Odorless
Solubility:	
Density:	1.8400 g/cm ³
pH:	Not available
% Volatiles by volume @ 21C (70F):	
Boiling Point:	280 deg C @ 760.00mm Hg
Melting Point:	3 deg C
Vapor Density (Air=1):	1.2 kg/m ³
Vapor Pressure (mm Hg):	< 0.00120 mm Hg
Evaporation Rate:	Slower than ether
Viscosity:	Not available

Molecular Formula: H₂O₄S

Molecular Weight: 98.08

10. Stability and Reactivity

Chemical Stability:

Stable under normal temperatures and pressures.

Conditions to Avoid:

Contact with water, metals, excess heat, combustible materials, organic materials.

Incompatibilities with Other Materials:

Acids (mineral, oxidizing, e.g. chromic acid, hypochlorous acid, nitric acid, sulfuric acid), alcohols and glycols (e.g. butyl alcohol, ethanol, methanol, ethylene glycol), aldehydes (e.g. acetaldehyde, acrolein, chloral hydrate, formaldehyde), amines (aliphatic and aromatic, e.g. dimethyl amine, propylamine, pyridine, triethylamine), azo, diazo, and hydrazines (e.g. dimethyl hydrazine, hydrazine, methyl hydrazine), caustics (e.g. ammonia, ammonium hydroxide, calcium hydroxide, potassium hydroxide, sodium hydroxide), cyanides (e.g. potassium cyanide, sodium cyanide), dithiocarbamates (e.g. ferbam, maneb, metham, thiram), fluorides (inorganic, e.g. ammonium fluoride, calcium fluoride, cesium fluoride), isocyanates (e.g. methyl isocyanate), metals (alkali and alkaline, e.g. cesium, potassium, sodium), metals as powders (e.g. hafnium, raney nickel), metals and metal compounds (toxic, e.g. beryllium, lead acetate, nickel carbonyl, tetraethyl lead), nitrides (e.g. potassium nitride, sodium n.

Hazardous Decomposition Products:

Oxides of sulfur.

Hazardous Polymerization: Has not been reported.

11. Toxicological Information

RTECS#:

CAS# 7664-93-9: WS5600000

LD50/LC50:

CAS# 7664-93-9: Inhalation, mouse: LC50 =320 mg/m³/2H; Inhalation, rat: LC50 =510 mg/m³/2H; Oral, rat: LD50 = 2140 mg/kg.

Carcinogenicity:

Sulfuric acid -

ACGIH: A2 - Suspected Human Carcinogen

OSHA: Select carcinogen

IARC: Group 1 carcinogen

Epidemiology:

Workers exposed to industrial sulfuric acid mist showed a statistical increase in laryngeal cancer. This data suggests a possible relationship between carcinogenesis and inhalation of sulfuric acid mist.

Teratogenicity:

No data available.

Reproductive Effects:

No data available.

Neurotoxicity:

No data available.

Mutagenicity:

No data available.

Other Studies:

No data available.

12. Ecological Information

Ecotoxicity:

Sulfuric acid is harmful to aquatic life in very low concentrations. It may be dangerous if it enters water intakes. The aquatic toxicity for bluegill in fresh water was 24.5 ppm/24 hr, which was lethal.

Environmental Fate:

Not available.

Physical/Chemical:

Not available.

Other:

Not available.

13. Disposal Considerations

Dispose of in a manner consistent with federal, state, and local regulations.

RCRA D-Series Maximum Concentration of Contaminants: None listed.

RCRA D-Series Chronic Toxicity Reference Levels: None listed.

RCRA F-Series: None listed.

RCRA P-Series: None listed.

RCRA U-Series: None listed.

16. Other Information

MSDS Creation Date: 2/01/1996 Revision #3 Date: 10/01/1997

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

MSDS: Sodium Hydroxide

HAZARDOUS ACCORDING TO WORKSAFE CRITERIA

Supplied by: Chemical Co.

UN Number: 1823

Dangerous Goods Class: 8

Hazchem Code: 2X

Other Names: Caustic Soda

Soda Lye

White caustic

Properties: White deliquescent crystalline flakes or pearls

Health Hazard Information Acute Health Effects Swallowed:

Ingestion of the substance causes severe burns of the mouth and the oesophagus, nausea, vomiting and edema of the pharynx. In the worst cases perforation of the gastrointestinal tract and heart failure may occur.

Eyes: Contact of this substance with the eyes may cause severe lesions and possible loss of sight.

Skin: Skin contact with this substance causes severe burns and necrosis.

Inhaled: Inhalation of dusts may cause pulmonary congestion with subsequent compromise of respiratory functionality followed by loss of consciousness. Extremely irritative to respiratory tract (including mucous membranes, throat and lungs). Slightly toxic.

Chronic Health Effects

Prolonged and reiterated inhalations of the dusts may cause chronic disturbance of the respiratory routes. May cause dermatitis.

First Aid Swallowed:

Contact a Doctor or the Poisons Information Centre immediately. Give patient 1 - 3 cups of water. DO NOT induce vomiting. Immediately transport to a hospital or doctor.

Eyes: Flood eyes with clean water for 15 minutes - retract eyelids often. Immediately transport to a hospital or doctor **Skin:** Remove all contaminated clothing including footwear. Wash affected areas thoroughly with mild soap and water. Seek medical advice.

Inhaled: Remove from contaminated area immediately; avoid becoming a casualty. If NOT breathing apply artificial resuscitation. Experienced person may administer oxygen if breathing is difficult. Immediately transport to a hospital or doctor.

Safe Handling Information PPE:

Goggles, face screen, rubber or PVC gloves. Acid-proof overalls for operations in which there is a risk of splashes. Avoid contact with skin and eyes. Do not eat, drink or smoke in storage areas or during handling. Wash hands and face thoroughly after handling and before work breaks, eating, drinking, smoking and using toilet facilities.

Storage and Transport: Transport or store in a cool, dry place. Transport or store away from strong acids. The drums must be stored in suitable storage rooms equipped with impermeable floors, eye wash fountains and water inlets for rinsing the floor in case of spills.

Spills and Disposal:

Spills

Clean-up personnel should wear full protective clothing. Prevent product access to rivers and canals. Absorb with sand or soil, scoop up and place in suitable containers for later treatment/disposal.

Disposal

Use very dilute acid for neutralisation. Dispose of in accordance with Local, State and Federal regulations at an approved waste disposal facility. Neutralise aqueous solutions by diluting with very diluted hydrochloric acid. Drain effluent with plenty of water, keeping pH under control. Beware of heat and splashes caused by water reactions (dissolution heat) or neutralisation.

Fire/Explosion Hazard: Fire/Explosion

Generally all the reactions with acids and halogenated substances are strongly exothermic. It forms explosive products (Chloroacetylenic derivatives) by reacting with Trichloroethylene at warm temperatures. It can cause the decomposition of

maleic anhydride at explosive speed. It causes violent polymerisation of acrolein and acrylonitrile. It reacts exothermically with alcohol and chloroform mixtures. Incompatible with strong oxidising agents and strong acids, organic materials, aluminum, tin, zinc and nitro compounds. Absorbs CO₂ from air. Decomposition products: nature of decomposition products not known. Material itself is not flammable or explosive but reactions with metals can generate hydrogen gas, which is flammable in air (between 4% and 75% volume). May start fires in contact with fuels.

Extinguishing Media

Evacuate area - move upwind of fire. Summon Fire Brigade immediately, DIAL 000.

DO NOT USE WATER. Fire-fighters should wear full protective clothing including self-contained breathing apparatus.

Fire Fighting: Keep containers cool, Water spray/fog, Foam-alcohol type

MSDS: METHANOL

HAZARDOUS ACCORDING TO WORKSAFE CRITERIA

Supplied by Chemical Co. **Date:** 7/1/98 UN Number: 1230 Dangerous Goods Class: 3 3(6.1) Hazchem Code: 2WE Poisons Schedule S6

Other Names Methyl alcohol

Properties Liquid. Mixes with water.

Health Hazard Information Acute Health Effects:

Irritating to eyes.

Vapours may cause dizziness or suffocation.

Ingestion may produce health damage.

Chronic Health Effects: Cumulative effects may result following exposure (limited evidence).

First Aid Swallowed: Contact a Doctor or Poisons Centre. If more than 15 mins from a Doctor, induce vomiting (if conscious).

Eyes: Wash with running water (for 15 mins). Seek medical attention. Skin: Remove contaminated clothing. Wash with water and soap. Inhaled: Fresh air. Rest and keep warm. If breathing shallow, give oxygen. Seek medical attention.

Safe Handling Information PPE:

Gloves, rubber or plastic

Goggles or face-shield

Laboratory coat, plastic apron if large quantities are handled

Fume cupboard

Respirator as required when vapours/aerosols generated.

Storage and Transport:

Keep container in a well ventilated place.

Keep away from sources of ignition.

Avoid heating. No smoking.

Store in a cool, dry protected area.

Incompatible with acid halides, alkaline earth metals, oxidising agents.

Spills and Disposal:

Turn off all sources of flame.

Inform others to keep a safe distance.

Consider evacuation if it is a major spill.

Prevent from entering drains.

Contain spillage by any means.

Mop up with plenty of water.

Control vapour with water spray/fog.

Absorb with dry agent.

Fire/Explosion Hazard: Highly flammable. Vapour/air mixture explosive. Fire Fighting:

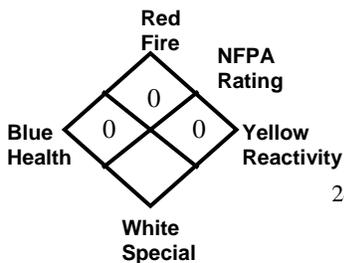
Keep containers cool.

Water spray/fog. Full protective apparatus and contain.

Warning Signs F = Flammable; T=Toxic

Alconox®

MATERIAL SAFETY DATA SHEET



Alconox, Inc.
30 Glenn Street
White Plains, NY 10603

24 Hour Emergency Number – Chem-Tel (800) 255-3924

I. IDENTIFICATION

Product Name (as appears on label)	ALCONOX
CAS Registry Number:	Not Applicable
Effective Date:	January 1, 2001
Chemical Family:	Anionic Powdered Detergent
Manufacturer Catalog Numbers for sizes	1104, 1125, 1150, 1101, 1103 and 1112

II. HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

There are no hazardous ingredients in ALCONOX as defined by the OSHA Standard and Hazardous Substance List 29 CFR 1910 Subpart Z.

III. PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point (F):	Not Applicable
Vapor Pressure (mm Hg):	Not Applicable
Vapor Density (AIR=1):	Not Applicable
Specific Gravity (Water=1):	Not Applicable
Melting Point:	Not Applicable
Evaporation Rate (Butyl Acetate=1):	Not Applicable
Solubility in Water:	Appreciable-Soluble to 10% at ambient conditions
Appearance:	White powder interspersed with cream colored flakes.
pH:	9.5 (1%)

IV. FIRE AND EXPLOSION DATA

Flash Point (Method Used):	None
Flammable Limits:	LEL: No Data UEL: No Data
Extinguishing Media:	Water, dry chemical, CO ₂ , foam
Special Fire fighting Procedures:	Self-contained positive pressure breathing apparatus and protective clothing should be worn when fighting fires involving chemicals.
Unusual Fire and Explosion Hazards:	None

V. REACTIVITY DATA

Stability:	Stable
Hazardous Polymerization:	Will not occur
Incompatibility (Materials to Avoid):	None
Hazardous Decomposition or Byproducts:	May release CO ₂ on burning

VI. HEALTH HAZARD DATA

Route(s) of Entry:	Inhalation? Yes Skin? No Ingestion? Yes
Health Hazards (Acute and Chronic):	Inhalation of powder may prove locally irritating to mucous membranes. Ingestion may cause discomfort and/or diarrhea. Eye contact may prove irritating.
Carcinogenicity:	NTP? No IARC Monographs? No OSHA Regulated? No
Signs and Symptoms of Exposure:	Exposure may irritate mucous membranes. May cause sneezing.
Medical Conditions Generally Aggravated by Exposure:	Not established. Unnecessary exposure to this product or any industrial chemical should be avoided. Respiratory conditions may be aggravated by powder.
Emergency and First Aid Procedures:	Eyes: Immediately flush eyes with water for at least 15 minutes. Call a physician. Skin: Flush with plenty of water. Ingestion: Drink large quantities of water or milk. Do not induce vomiting. If vomiting occurs administer fluids. See a physician for discomfort.

VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken if Material is Released or Spilled:	Material foams profusely. Recover as much as possible and flush remainder to sewer. Material is biodegradable.
Waste Disposal Method:	Small quantities may be disposed of in sewer. Large quantities should be disposed of in accordance with local ordinances for detergent products.
Precautions to be Taken in Storing and Handling:	Material should be stored in a dry area to prevent caking.
Other Precautions:	No special requirements other than the good industrial hygiene and safety practices employed with any industrial chemical.

VIII. CONTROL MEASURES

Respiratory Protection (Specify Type):	Dust mask - Recommended
Ventilation:	Local Exhaust-Normal Special-Not Required Mechanical-Not Required Other-Not Required
Protective Gloves:	Impervious gloves are useful but not required.
Eye Protection:	Goggles are recommended when handling solutions.
Other Protective Clothing or Equipment:	None
Work/Hygienic Practices:	No special practices required

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Liqui-nox® Material Safety Data Sheet

Alconox, Inc.
30 Glenn Street, Suite 309
White Plains, NY 10603
24 Hour Emergency Number - Chem-Tel (800) 255-3924

I. Identification

Product Name (shown on label): LIQUI-NOX

CAS Registry Number: Not Applicable

Effective Date: January 1, 2001

Chemical Family: Anionic Liquid Detergent

Mfr. Catalog #s for Sizes: 1232, 1201, 1215, 1255

II. Hazardous Ingredients/Identity Information

There are no hazardous ingredients in LIQUI-NOX™ as defined by the OSHA Standard and Hazardous Substance List 29 CFR 1910 Subpart Z.

National Fire Protection
Association 704 Labeling:

NJTSRN: 1200

III. Physical/Chemical Characteristics

Boiling Point (F): 214°F

Vapor Pressure (mm Hg): No Data

Vapor Density (AIR=1): No Data

Specific Gravity (Water=1): 1.075

Evaporation Rate (Butyl Acetate=1): Slower

Melting Point: No Data

Solubility in Water: Completely soluble in all proportions

Appearance: Yellow liquid, nearly odorless

pH: 8.5 (1%)

IV. Fire and Explosion Data

Flash Point (Method Used): None (Cleveland Open Cup)

Flammable Limits: LEL: No Data

UEL: No Data

Extinguishing Media: Water, dry chemical, CO2, foam

Special Fire fighting Procedures: Self-contained positive pressure breathing apparatus and protective clothing should be worn when fighting fires involving chemicals.

Unusual Fire and Explosion Hazards: None

V. Reactivity Data

Stability: Stable

Hazardous Polymerization: Will not occur.

Incompatibility (Materials to Avoid): Oxidizing agents.

Hazardous Decomposition or Byproducts: May release SO2 on burning.

VI. Health Hazard Data

Route(s) of Entry: Inhalation? No

Skin? Yes

Ingestion? Yes

Health Hazards (Acute and Chronic): Skin contact may prove locally irritating, causing drying and/or chapping. Ingestion may cause discomfort and/or diarrhea.

Carcinogenicity: NTP? No

IARC Monographs? No

OSHA Regulated? No

Signs and Symptoms of Exposure: Prolonged skin contact may cause drying and/or chapping.

Medical Conditions Generally Aggravated by Exposure: Not established. Unnecessary exposure to this product or any industrial chemical should be avoided.

Emergency and First Aid Procedures: Eyes: Immediately flush eyes with water for at least 15 minutes. Call a physician.

Skin: Flush with plenty of water.

Ingestion: Drink large quantities of water or milk. Do not induce vomiting. If vomiting occurs administer fluids. See a physician for discomfort.

VII. Precautions for Safe Handling and Use

Steps to be Taken if Material is Released or Spilled: Material foams profusely. For small spills recover as much as possible with absorbent material and flush remainder to sewer. Material is biodegradable.

Waste Disposal Method: Small quantities may be disposed of in sewer. Large quantities should be disposed of in accordance with local ordinances for detergent products.

Precautions to be Taken in Storing and Handling: No special precautions in storing. Use protective equipment when handling undiluted material.

Other Precautions: No special requirements other than the good industrial hygiene and safety practices employed with any industrial chemical.

VII. Control Measures

Respiratory Protection (Specify Type): None Required

Ventilation: Local Exhaust-Normal

Special-Not Required

Mechanical-Not Required

Other-Not Required

Protective Gloves: Impervious gloves are recommended.

Eye Protection: Goggles and/or splash shields are recommended.

Other Protective Clothing or Equipment: Not required

Work/Hygienic Practices: No special practices required.

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Metal Fact Sheets

Lead Fact Sheet

Uses and Occurrences

Lead can be found in the following: construction materials for tank linings and piping; component of lead-acid storage batteries; lead solder; plastics; steel; and pigments for paints. Lead can also be found in waste rock associated with mining activities, wood debris or stock used for electrical co-generation activities, and soil and waste associated with manufacturing activities. Elevated levels of naturally occurring lead may also be found in the soil in certain parts of this country.

Physical Characteristics

Appearance:	Bluish-white, silvery, gray metal. Very soft and easily malleable
Odor:	None
Flammable:	Noncombustible
Flash Point:	Not Applicable
Flammable Range:	Not Applicable
Specific gravity:	11.35
Stability:	very stable
Incompatibilities:	hot nitric acid, boiling concentrated hydrochloric and sulfuric acids
Melting Point:	327°C

Signs and Symptoms of Exposure

Skin and Eye: Irritation

Ingestion and Inhalation (Acute Overexposure): Lead is a potent, systemic poison that serves no known useful function once absorbed by your body. Taken in large enough doses, lead can kill you in a matter of days. A condition affecting the brain called acute encephalopathy may arise that develops quickly to seizures, coma, and death from cardio-respiratory arrest. A short term dose of lead can lead to acute encephalopathy. Short term occupational exposures of this magnitude are highly unusual, but not impossible. Similar forms of encephalopathy may, however, arise from extended, chronic exposure to lower doses of lead. There is no sharp dividing line between rapidly developing acute effects of lead, and chronic effects that take longer to acquire. Lead adversely affects numerous body systems, and causes forms of health impairment and disease that arise after periods of exposure as short as days or as long as several years.

Ingestion and Inhalation (Chronic Overexposure): Chronic overexposure to lead may result in severe damage to your blood-forming, nervous, urinary and reproductive systems. Some common symptoms of chronic overexposure include loss of appetite, metallic taste in the mouth, anxiety, constipation, nausea, pallor, excessive tiredness, weakness, insomnia, headache, nervous irritability, muscle and joint pain or soreness, fine tremors, numbness, dizziness, hyperactivity and colic. In lead colic, there may be severe abdominal pain.

Modes of Exposure

Inhalation: Dusts and fumes
Skin Absorption: None
Ingestion: Dusts and solids

Exposure Limits

Action level 0.03 mg/m³
PEL 0.05 mg/m³
STEL None
PEL-C None
TLV 0.05 mg/m³

Exposure Level vs. Regulatory Requirements

EXPOSURE LEVEL (EL)	REGULATORY REQUIREMENTS
EL < AL	Maintain exposure as low as reasonably achievable
AL > EL, EL < PEL	Implement portions of the OSHA Lead Standard (i.e., initial medical monitoring) and Training
EL > PEL	Implement all portions of the OSHA Lead Standard including training, medical surveillance, engineering controls, establishment of work areas, etc.

PPE

Eye: Safety Glasses
Skin: Coveralls or disposable coveralls to keep lead off clothing and to prevent the spread of lead contamination.
Respiratory: Air purifying respirators and supplied air respirators, depending on the exposure.

First Aid

Inhalation: Move to fresh air, contact a physician
Skin: Wash with water
Eyes: Flush with water
Ingestion: Contact a physician

2.2.1 Cadmium Fact Sheet

Uses and Occurrences

Coatings on metals; nickel-cadmium storage batteries; power transmission wire; pigments in ceramic glazes, enamels, and fungicides; corrosion-resistant coatings on marine, aircraft, and motor vehicles; manufacture of nuclear reactor rods; and welding electrodes and solder.

Physical Characteristics

Appearance:	Soft, blue-white, malleable, lustrous metal or grayish-white powder; some compounds may appear as a brown, yellow, or red powdery substance.
Odor:	None.
Flammable:	Noncombustible.
Flash Point:	Not Applicable.
Flammable Range:	Not Applicable.
Specific gravity:	8.64 (metal dust).
Stability:	Very stable.
Incompatibilities:	Nitric acid, boiling concentrated hydrochloric and sulfuric acids; contact of cadmium metal dust with strong oxidizers or with elemental sulfur, selenium, and tellurium may cause fires and explosion.
Melting Point:	321°C (metal dust).

Signs and Symptoms of Exposure

Short Term (Acute):	<u>Dust and Fume:</u> Irritation of nose and throat; inhalation may cause a delayed onset of cough, chest pain, sweating, chills, shortness of breath, and weakness. Death may occur. <u>Dust:</u> Ingestion may cause nausea, vomiting, diarrhea, and abdominal cramps.
Long Term (Chronic):	<u>Dust and Fume:</u> Repeated or prolonged exposure may cause loss of sense of smell, ulceration of the nose, shortness of breath (emphysema), kidney damage, and mild anemia. Exposure to cadmium has been reported to cause an increase incidence of cancer of the prostate in men.

Modes of Exposure

Inhalation:	Dusts and fumes.
Absorption:	None.
Ingestion:	Dusts and solids.

Exposure Limits

Action level	2.5 µg/m ³ .
PEL	5.0 µg/m ³ .
STEL	None.
PEL-C	None.
TLV	10.0 µg/m ³ ; 2.0 µg/m ³ (respirable fraction).

Exposure Level vs. Regulatory Requirements

EXPOSURE LEVEL (EL)	REGULATORY REQUIREMENTS
EL < AL	Maintain exposure as low as reasonable achievable
AL > EL, EL < PEL	Implement portions of the OSHA Cadmium standard and Training
EL > PEL	Implement all portions of the OSHA Cadmium Standard including training, medical surveillance, engineering controls, establishment of work areas, etc.

PPE

Eye: Splash proof or dust resistant goggles; face shield.
Skin: Protective coveralls, gloves, and footwear.
Respiratory: Air purifying respirators and supplied air respirators, depending on the exposure.

First Aid

Inhalation: Move to fresh air; seek medical attention immediately.
Skin: Remove clothing and shoes; wash with soap or mild detergent and large amounts of water.
Eyes: Flush with water immediately, lifting the upper and lower eyelids; seek medical attention immediately.
Ingestion: Under no circumstances should therapeutic chelation be administered; seek medical attention immediately.

Arsenic Exposure Instructions

This module was designed for employees who work in areas with percent levels of inorganic arsenic or areas where there is a potential arsenic exposure above the action level of $5\mu\text{ g}/\text{m}^3$.

Arsenic Exposure Training Program

The OSHA arsenic standard (29 CFR 1910.1018), requires employers to provide arsenic training for those employees who may be exposed to inorganic arsenic above the action level of $5\mu\text{ g}/\text{m}^3$. This training program satisfies this OSHA requirement and is provided to assist employees in recognizing arsenic exposure hazards and understanding the procedures to be followed to minimize exposure.

Objectives

1. Inform employees of the possible adverse health effects of arsenic exposure
2. Inform employees of the regulatory requirements when working with or around arsenic
3. Identify how arsenic exposures could occur on CH2M HILL projects

How to complete this training

Employees are required to read the training materials that follow and complete a short quiz. The training materials must be read thoroughly and understood before completing the quiz; you will have only one chance at answering each question.

Quiz scores will automatically be sent electronically to the Health and Safety Training Administrator. A minimum score of 70% must be obtained to receive credit for this training. If a passing score is obtained, the H&S Training Administrator will issue you a certificate of completion. If a passing score is not obtained, you are required to contact your regional health and safety program manager to discuss the training material directly.

Arsenic Exposure Training

1. Use And Occurrences

Arsenic is a naturally occurring element found in the earth's crust. In industry, it is usually associated with the smelting of lead and copper. It was also used in various types of pesticides, but most arsenic-containing pesticides are now banned in the U.S. It continues to have limited use in the semiconductor industry, as a wood preservative, a corrosion inhibitor and a hardener in lead and copper metal. It is a frequent contaminant at hazardous waste sites. It can also be found in well water where there is naturally high amounts of arsenic in the soil.

2. Physical Characteristics

Arsenic exists as a gray solid as elemental arsenic, a white solid, as arsenic trioxide, an orange-red solid as arsenic disulfide. Arsenic compounds are generally insoluble in water.

3. Toxicity And Hazards

Arsenic is a well-known poison that causes a variety of adverse health effects from both acute and chronic exposures. Exposure can be by inhalation of arsenic-containing dust or by ingestion of arsenic-contaminated water. It causes various skin lesions including skin cancer, damage to the nervous system and the brain, and lung cancer. It can also cause birth defects to the offspring of both men and women. The highly toxic gas arsine can be formed if arsenic comes in contact with an acid. Some common symptoms of chronic overexposure include weakness, loss of appetite, nausea, vomiting, diarrhea and a sense of heaviness in the stomach.

4. Regulations

Arsenic has been specifically regulated by OSHA since 1978 (29 CFR 1910.1018). The 8-hour permissible exposure limit (PEL) is 10 micrograms per cubic meter of air (10 $\mu\text{g}/\text{m}^3$). OSHA has specified an action level of 5 $\mu\text{g}/\text{m}^3$. There is no short term exposure limit (STEL), but 5000 $\mu\text{g}/\text{m}^3$ is considered immediately dangerous to life or health (IDLH). Initial air monitoring must be done whenever there are indications of arsenic exposure above the action level. If the action level is not exceeded, air monitoring can cease. If the action level is exceeded, arsenic training must be provided. If the action level is exceeded for more than 30 days in a year, medical surveillance must be provided which includes a medical history and physical examination (chest x-ray, skin and nasal exam, and a sputum cytology test for detection of lung cancer). If the PEL is exceeded, engineering controls must be implemented to reduce exposure. If engineering controls are not feasible or ineffective, respirators must be provided and worn. Air-purifying respirators with high-efficiency (HEPA) filters can be worn when airborne levels are as high as 100 $\mu\text{g}/\text{m}^3$. If levels exceed that amount, supplied air respirators must be worn. In addition, if the PEL is exceeded, OSHA requires the establishment of regulated areas, showers and change rooms, separate clean lunchrooms and warning signs. Regulated areas are demarcated from the rest of the workplace to limit access to authorized personnel who have received arsenic training. To enter a regulated area you must also wear protective clothing (coveralls, gloves and eye protection).

5. How Exposures Can Occur At Ch2m Hill Projects

Most exposures to elemental arsenic or arsenic trioxide would occur at hazardous waste sites where arsenic is found in soil or groundwater. Exposure to arsenic-containing dust could occur during drilling, heavy equipment movement or other soil-disturbing activities. Dust formation can be minimized by wetting soils. Exposure to arsenic in groundwater would be hazardous only if ingested. Exposure could also occur during project work at smelters, mines or at an industrial plant where arsenic is part of the manufacturing process.

6. Additional Information

If you have information or suspect you have been exposed to arsenic above the action level, contact a health and safety manager to determine if medical monitoring is needed or other regulatory requirements apply. 1% (10,000 ppm) or greater levels of arsenic in soils at a hazardous waste site would normally require air sampling and blood testing.

CH2MHILL
Health and Safety Plan
Attachment 9

MEC / UXO Avoidance Plan

MEC / UXO AVOIDANCE PLAN

1.0 INTRODUCTION

This UXO Avoidance plan has been developed as an attachment to the Health and Safety Plan for CH2M HILL personnel.

1.1 Plan Objective

This plan is designed to inform CH2MHILL employees of the specific hazards and procedures when performing operations in or around areas where Munitions & Explosives of Concern (MEC) / Unexploded Ordnance (UXO) materials may be encountered. All CH2M HILL employees who are not UXO qualified must become familiar with the sections of this plan, and all requirements of the subcontractors specific Safety & Health Plan while on site. Any discrepancies in the directives of this plan, and that of the subcontractor should be brought to the immediate attention of the CH2M HILL RHSM or MEC Health & Safety Staff for resolution.

1.2 General Safety Requirements

MEC/UXO may be present and may be encountered during site activities. All CH2MHILL non-UXO qualified personnel will follow the safe work practices listed below:

- Non-UXO qualified personnel will receive site-specific UXO recognition briefing prior to participation in site activities.
- No soil penetrating activities will be allowed without the area first being cleared by UXO qualified personnel.
- Non-UXO qualified personnel will not touch or disturb any object which could potentially be UXO/MEC-related, and will immediately notify the nearest UXO qualified person of the presence of the object.
- All CH2MHILL employees will be at least 200 feet from any excavation activities. After the intrusive excavation has been completed, and the removed soil screened for MEC / UXO, CH2M HILL employees may return to the site to perform their sampling procedures.
- Immediately notify the UXO qualified escort of any suspicious items or possible MEC / UXO in the area of operation.
- If the UXO qualified escort finds an item of MEC / UXO and must uncover it for identification or marking, all CH2MHILL employees will depart the area in the same direction they entered to a distance of 200 feet, and remain there until notified by the UXO qualified escort that it is safe to return.

Information on the exact types and density of MEC is vague. Projectile cartridge casings, propellant, and primers are the most likely items to be encountered. Should anything more hazardous be encountered, plans and procedures will be updated to accommodate safety requirements for more hazardous UXO/MEC.

1.3 UXO Recognition and Safety

As part of the site-specific training, project Non-UXO personnel will receive Unexploded Ordnance Recognition and Safety training. Training will include a review of the MEC Removal Action Explosive Safety Submission Addendum, UXO terms and definitions, ordnance identification, and reporting and specific safety procedures.

2.0 HAZARD/RISK ANALYSIS

Unexploded ordnance is a safety hazard that may constitute an imminent and substantial danger to the personnel performing environmental investigation and removal action activities and the public in general. UXO contamination must be considered a possibility on all formerly used defense sites (FUDS) and active military installations. The surface danger zone of a range (active or inactive), the target area, impact area, ricochet area and the secondary danger zones may be contaminated with UXO (both surface and/or subsurface contamination). The varying types of ammunition, angle of fire, and soil types preclude the accurate estimation of the depth of any subsurface UXO.

2.1 Site Tasks and Operations

CH2MHILL will perform or have subcontractors perform the following tasks where MEC / UXO may be encountered:

- Near Surface (less than 2 feet) soil sampling
- Soil sampling from excavated areas
- Drilling of environmental sampling wells
- Surface water sampling
- Sampling from environmental sampling wells

2.1.1 Near Surface Soil Sampling

The collection of near surface soil sampling will be conducted utilizing the following general requirements:

- The access routes have been surface cleared and marked to allow safe entrance and exit of employees
- All CH2M HILL employees are escorted by a UXO qualified individual
- The area to be sampled has been determined free of anomalies by the use of subsurface detection equipment by a UXO qualified individual, and a recheck is accomplished prior to digging the sample
- No sample will be taken deeper than 2 feet without the area being re-checked for anomalies with the subsurface detection equipment
- If significant resistance is encountered while taking a sample, remove the sample tool and inform a UXO qualified individual

2.1.2 Soil Sampling Excavated Areas

- Stay 200 feet from the work site while excavations are being accomplished, and until the soil has been emptied from the bucket and screened for MEC / UXO
- Do not enter an excavation unless it has been properly shored or sloped
- Do not enter an excavation until a UXO qualified individual has entered the area and performed a surface and subsurface search for MEC / UXO items
- No sample will be taken deeper than 2 feet without the area being re-checked for anomalies with the subsurface detection equipment

2.1.3 Drilling of Environmental Sampling Wells

- The route into the site for the drill rig will be surface and sub surface cleared by UXO qualified personnel. The lanes will be clearly marked for all personnel to see
- There will be adequate surface and subsurface clearance to allow the drill rig movement around the area to be sampled
- During the intrusive operation, all non-essential personnel will be evacuated to a distance of 200 feet
- The bore hole will be checked by MEC detection instrument at 2-foot intervals until the final depth is reached.
- Hard hats will be worn in the working area of the drill rig by all personnel, including the UXO qualified personnel

2.1.4 Surface Water Sampling

- The access routes to the sampling area will be surface cleared by UXO qualified personnel prior to CH2MHILL employees entering the area
- If the water area to be sampled does not allow for an easy observation of what is below the surface, care should be taken when inserting instruments or equipment into the water for sampling. MEC / UXO items may be located below the surface

2.1.5 Sampling from Environmental Wells

- Ensure to stay on the cleared pathways when approaching the well site. Weather and other conditions may uncover MEC / UXO items that were previously unseen
 - CH2MHILL employees should be escorted by UXO qualified personnel when entering a potentially contaminated MEC /UXO area that has not already been cleared
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