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WORK PLAN ADDENDUM NO 09 SITE CHARACTERIZATION FOR SITE 1159 OUTLYING LANDING FIELD BRONSON NAS PENSACOLA FL

11/01/2007

CH2MHILL

Work Plan Addendum No. 09
Site Characterization for Site 1159
Outlying Landing Field Bronson

Naval Air Station Pensacola
Pensacola, Florida

Revision 00

Contract No. N62467-98-D-0995
Contract Task Order No. 0071

Submitted to:

U.S. Naval Facilities
Engineering Command
Southeast

Prepared by:

CH2MHILL Constructors, Inc.

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C Health and Safety Plan
D O_2/LEL and FID Specifications
E System Design Drawings
F Low-Flow Groundwater Sampling Procedures
G Transportation and Disposal Log
H Quality Control Attachments
- Submittal Register
- Testing Plan and Log
- Project QC Manager Appointment Letter

Acronyms and Abbreviations

AAS	aquifer air sparge
AFCEE	Air Force Center for Engineering and the Environment
AHA	Activity Hazard Analysis
ASTM	American Society for Testing and Materials
AVGAS	aviation gas
bls	below land surface
BTEX	benzene, toluene, ethylbenzene, and total xylenes
CA	Contamination Assessment
CAR	Contamination Assessment Report
CFR	Code of Federal Regulation
CH2M HILL	CH2M HILL Constructors, Inc.
CH_4	methane
CO	Contracting Officer
CO_2	carbon dioxide
COC	chemical of concern
COTR	Contracting Officer's Technical Representative
CTO	Contract Task Order
DO	dissolved oxygen
DOT	Department of Transportation
DPT	direct push technology
DPT	direct-push technology
EISOPQAM	Environmental Investigations Standard Operating Procedures and Quality Assurance Manual
EPA	U.S. Environmental Protection Agency
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FID	flame ionization detector
FL-PRO	Florida Petroleum Residual Organic
FSG	flame safe guard
GCTLs	Groundwater Cleanup Target Levels
H_2SO_4	sulfuric acid
HCL	hydrochloric acid
HDPE	high density polyethylene
HNO_3	nitric acid
HSA	hollow stem auger
HSP	Health and Safety Plan
ICP	inductively coupled plasma
IDW	investigation-derived waste
IR CDQM	Installation Restoration Chemical Data Quality Manual
LDR	Land Disposal Restriction
LEL	lower explosive limit
LNAPL	light non-aqueous phase liquid

MCL	Maximum Contaminant Level
µg/L	micrograms per liter
MRW	Morale, Recreation, and Welfare
MS/MSD	matrix spike/matrix spike duplicate
MSDS	Material Safety Data Sheet
msl	mean sea level
MSR	Monthly Status Report
MTBE	methyl tert-butyl ether
NA	natural attenuation
NAD	North American Datum
NADCs	natural attenuation default concentrations
NAIP	Natural Attenuation Indicator Parameters
NAS	Naval Air Station
NAVD	North American Vertical Datum
NAVFAC SE	Naval Facilities Engineering Command Southeast
NIOSH	National Institute for Occupational Safety and Health
NPWC	Navy Public Works Center
O&M	operation and maintenance
O_2	oxygen
^oC	degrees Celsius
^oF	degrees Fahrenheit
OLF	Outlying Landing Field
OSHA	Occupational Safety and Health Administration
OVA	organic vapor analyzer
PAHs	polycyclic aromatic hydrocarbons
PCB	polychloride biphenyl
PLC	process logic controller
PMO	Program management Office
POTW	publicly owned treatment works
PPE	personal protective equipment
ppm	parts per million
psig	pounds per square inch gauge
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RAC	Response Action Contract
RAP	Remedial Action Plan
RBCA	Risk Based Corrective Action
RCRA	Resource Conservation and Recovery Act
RFI	Request for Information
RIO	radius of influence
RMO	Risk Management Option
ROICC	Resident Officer in Charge of Construction
RPM	Remedial Project Manager
RPO	remediation process optimization
SAP	Sampling and Analysis Plan
scfm	standard cubic feet per minute
SCTLs	Soil Cleanup Target Levels

SOP	Standard Operating Procedure
SVE	soil vapor extraction
SVOC	semi-volatile organic compound
SZMP	saturated zone monitoring points
T&D	transportation and disposal
TAT	turnaround time
TCLP	Toxicity Characteristic Leachate Procedure
TEL	tetraethyl lead
TM	technical memorandum
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
TSD	treatment, storage, and disposal
TtNUS	Tetra Tech NUS, Inc.
TVA	toxic vapor analyzer
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
UST	underground storage tank
VOAs	volatile organic aromatics
VOC	volatile organic compound
VZMP	vadose zone monitoring points

1.0 Introduction

CH2M HILL Constructors, Inc. (CH2M HILL) was contracted by the Department of the Navy, Naval Facilities Engineering Command Southeast (NAVFAC SE), to prepare this Work Plan Addendum to supplement the overall design and design objectives presented in the *Remedial Action Plan Addendum Site 1159-Outlying Landing Field Bronson, Naval Air Station Pensacola* (CH2M HILL, December 2004), provide an update on site conditions, and summarize full-scale remedial system modifications at Site 1159, per U.S. Navy-required Remediation Process Optimization (RPO) meetings conducted on June 23, 2005 and November 15, 2006. The work is being performed under Response Action Contract (RAC) No. N62467-98-D-0995, Contract Task Order (CTO) No. 0071 in accordance with the management approach outlined in the Contract Management Plan (CH2M HILL, 2003).

The optimization process yielded recommendations for changes to the system design at Site 1159 at Outlying Landing Field (OLF) Bronson, including aggressively treating the source area groundwater/vadose zone light non-aqueous phase liquid (LNAPL) regions using aquifer air sparge (AAS) and soil vapor extraction (SVE) with off-gas treatment, in addition to natural attenuation (NA) in the periphery and the downgradient portions of the dissolved-phase plume. Global Risk Based Corrective Action (RBCA) Risk Management Options (RMOs) will be included as a key element of the exit strategy for the site. Site-specific decision logic was developed outlining the lifecycle alternatives and milestones that could be applicable at the site based on current site knowledge and regulatory requirements (CH2M HILL, December 2004).

This Work Plan Addendum fulfills the requirements established in the RAP Addendum, and will be used in planning and executing the work for this project at Naval Air Station (NAS) Pensacola.

The purpose of this Work Plan Addendum is to describe the procedures that will be used to implement the following site remediation activities:

- Installation of treatment wells and system field piping
- System installation
- System Startup and Long-term operations and maintenance (O&M)
- Quarterly groundwater and free product level monitoring

The full scope of site activities is included in Section 2. This Work Plan Addendum is supplemental to the Basewide Work Plan (CH2M HILL, 2000), prepared by CH2M HILL for use as the master document for RAC work at NAS Pensacola. CH2M HILL will use the procedures outlined in this Work Plan Addendum, in conjunction with the Basewide Work Plan, to complete field activities at Site 1159.

This Work Plan Addendum is organized into seven sections. A brief description of each section is presented below:

Section 1.0 Introduction. This section describes how this Work Plan Addendum is organized and includes the site description and history.

Section 2.0 Execution and Remediation Plan. This section includes the scope of work activities, project objectives, project schedule, and communications plan.

Section 3.0 Sampling and Analysis Plan. This section addresses project specific sampling and analysis issues for the activities to be completed at OLF Bronson.

Section 4.0 Waste Management Plan. The Basewide Work Plan discusses the characterization, disposal, handling, and transportation of wastes encountered or generated during work at NAS Pensacola. Additional information specific to OLF Bronson for handling wastes is provided in this Work Plan Addendum.

Section 5.0 Environmental Protection Plan. The Basewide Work Plan addresses the Environmental Protection Plan to be implemented at OLF Bronson. Additional information is provided in this Work Plan Addendum.

Section 6.0 Quality Control Plan. Task-specific quality control information, including project organization, for this CTO is included in this Work Plan Addendum. All other quality control information is contained in the Basewide Work Plan.

Section 7.0 References lists the references used in developing this Work Plan Addendum.

The following support documents are presented as appendices to this Work Plan Addendum:

- Appendix A, Project Schedule
- Appendix B, University of Florida Tree Trimming Standards
- Appendix C, Site-Specific Health and Safety Plan
- Appendix D, Specifications for Oxygen/Lower Explosive Limit (O_2/LEL) Meter and Photoionization Detector/Flame Ionization Detector (PID/FID)
- Appendix E, System Design Drawings
- Appendix F, Low Flow Groundwater Sampling Procedures
- Appendix G, Transportation and Disposal Log
- Appendix H, Quality Control Attachments

1.1 Site Description

OLF Bronson is located in Escambia County in northwest Florida approximately 5 miles west of Pensacola, Florida, and approximately 1 mile east of the Alabama state line. OLF Bronson is primarily surrounded by forest, wetlands, and Perdido Bay. OLF Bronson resides on the western portion of the Florida panhandle, within the Coastal Plain physiographic province. The site resides in the Coastal lowland topographic subdivision of the coastal plain. The climate at OLF Bronson is humid and subtropical with long, warm summers and relatively mild winters. Conditions are affected by the Gulf of Mexico, which tends to moderate temperature extremes. The average annual temperature is 68.1 degrees Fahrenheit (°F) and the average annual rainfall is 62.9 inches.

Site 1159 is located at Bronson Field with dense woods to the north, a dirt road to the south, woods and a camp ground to the east, and a concrete parking area for campers to the west.

The site location is shown on the U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle of Lillian, Alabama-Florida (Figure 1-1).

1.1.1 Site History

OLF Bronson was used as an active airfield from 1942 through 1950, consisting of a paved airfield and seaplane ramp. During that time, large amounts of aviation gasoline (AVGAS), oil products, and solvents were used at the field. The Navy demolished most of the temporary wartime buildings constructed during World War II at OLF Bronson in the 1950s, but continued to use the hangers for parts storage for the next 10 years. After the airfield was closed, helicopters from Combat Support Squadron 16 used the land for occasional training until 1995.

Based on historic site maps, Building 1159 was used as a boiler house when the airfield was active [Navy Public Works Center (NPWC), 1997] (Figure 1-2). A 500-gallon underground storage tank (UST), which was used to store diesel fuel for an emergency generator, was located on the east side of the building. In addition, six 25,000-gallon USTs and a fuel distribution line were located to the northeast of Building 1159, upgradient of the site. These tanks were used to store AVGAS for refueling aircraft. The source of contamination at the site is assumed to be from leaks from the USTs and associated pipeline.

Presently, Bronson Field is known as Blue Angel Recreation Park and is maintained by the Morale, Welfare, and Recreation (MWR) department of NAS Pensacola. All runways are inactive and all buildings have been dismantled. The old seaplane ramp serves as a parking and storage area for campers.

1.1.2 Regulatory History

A closure assessment was performed in 1994 under the Florida Petroleum Cleanup Program (Chapter 62-770 Florida Administrative Code [FAC]) during the removal of the 500-gallon diesel UST. The closure assessment identified benzene, total xylenes, and total volatile aromatics (VOAs) concentrations in groundwater above the Florida Department of Environmental Protection (FDEP) regulatory levels. Concentrations of volatile organic compounds (VOCs) in soil were all reported below laboratory detection limits. No free product was observed during the diesel tank removal.

A contamination assessment (CA) was conducted at the site from 1996 through 2000 to determine the presence and extent of soil and groundwater contamination at the site. During this investigation, the six former AVGAS USTs were identified from an old field diagram. It was determined that these tanks were removed in the 1980s by E. C. Jordan (NPWC, 1997). The CA Report (CAR) determined that VOC and lead concentrations in groundwater were in exceedance of the Florida groundwater criteria. In addition, free product was identified in site wells. Soil samples were analyzed for compounds in the Gasoline and Kerosene analytical groups; all parameters were below the Florida direct exposure and leachability criteria. The CAR suggested that the primary source of groundwater contamination at Site 1159 was the AVGAS USTs and associated distribution line due to the lack of polycyclic aromatic hydrocarbons (PAHs) found in groundwater around the former diesel UST.

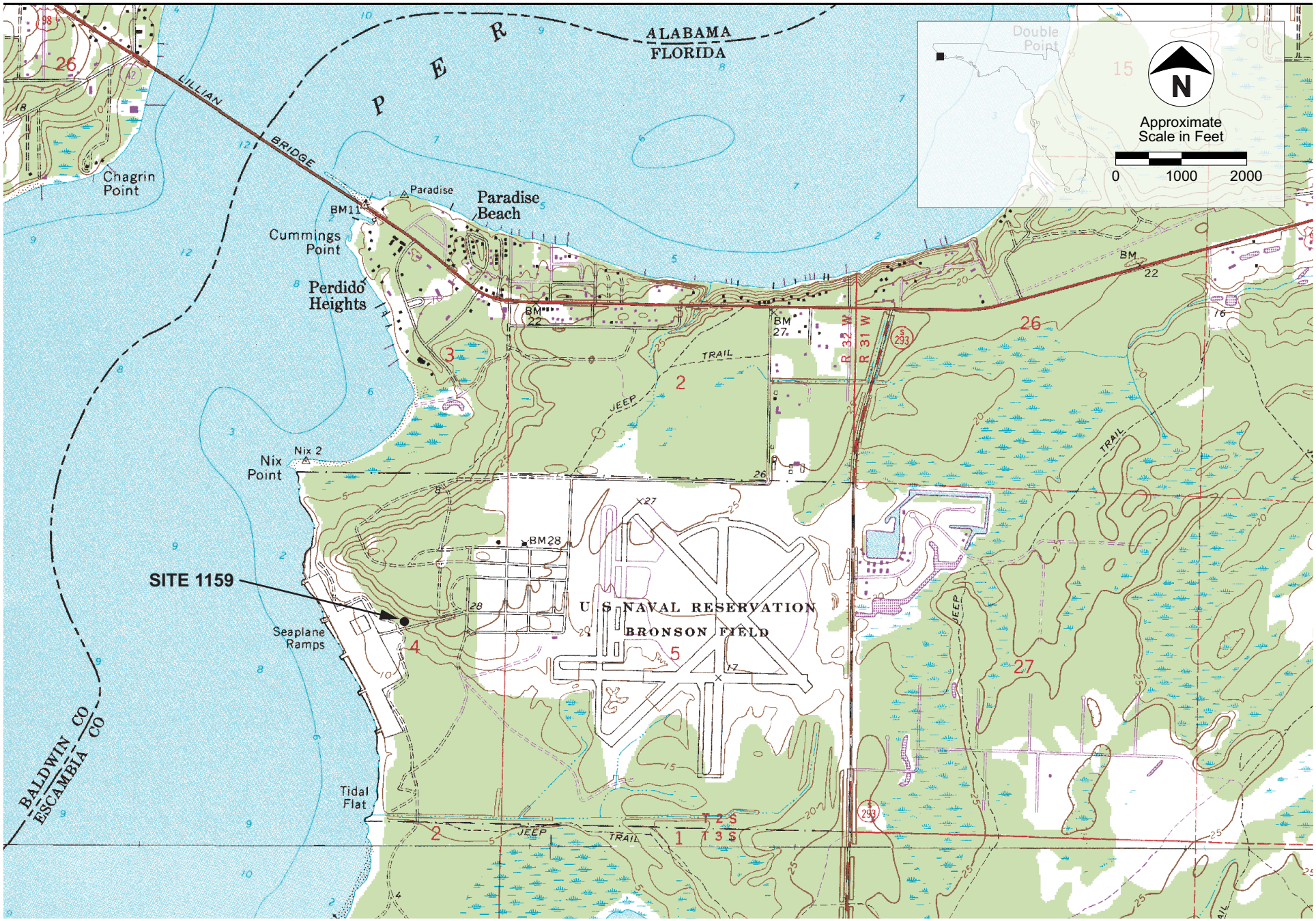

Figure 1-1 Site Topo, USGS 7.5-minute Quadrangle of Lillian, Alabama-Florida. 1987

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f1-1

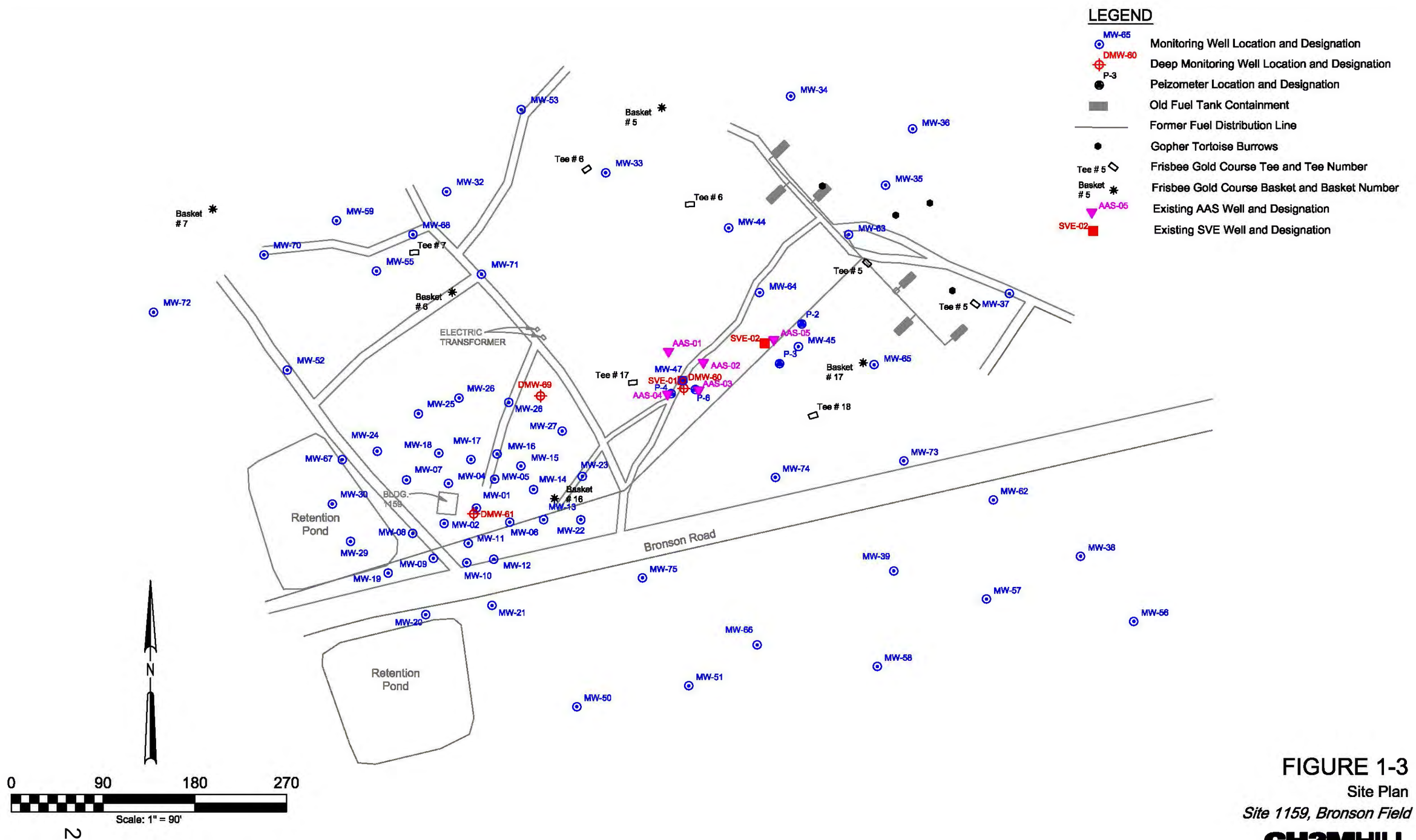

FIGURE 1-3
Site Plan
Site 1159, Bronson Field

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The CAR Addendum, completed by Tetra Tech NUS, Inc. (TtNUS) in May 2001, estimated that an AVGAS free-product plume was present over approximately 107,000 square feet of the site up to a measured thickness of 2.74 feet. The estimated free-product mass was 1,560,000 pounds. The CAR Addendum recommended that a RAP be completed for free product and contaminated groundwater at Site 1159.

TtNUS completed the RAP in September 2002. Based on the remedial technology screening, the remedial alternative selected was free-product recovery with bioslurping, groundwater remediation by pump and treat, and discharge of the water fraction to the publicly owned treatment works (POTW). The RAP provided a preliminary design of the treatment system. CH2M HILL was contracted to complete the design and implement the remedial alternative. Groundwater levels fluctuated approximately 5.62 feet (17.94 to 12.32 feet below land surface [bls]) over a 10-year period (1996 to 2005). Over this same period, free product in monitoring well MW-47 ranged from a 2.74-foot column (2000) to a 1.74-foot column (2001) to non-measurable (2003). Free product was present in MW-45 during this same period, with free product persisting in this well through February 2004. In July 2000, the lowest site groundwater levels since wells were installed in 1996 were recorded at MW-47 (17.94 feet bls) and MW-45 (22.88 feet bls), respectively. Respective product thicknesses were 2.74 feet and 2.54 feet for MW-47 and MW-45.

CH2M HILL conducted a site evaluation at Site 1159 Bronson Field between July 2003 and May 2004. During the site evaluation, free product was measurable in only three wells, MW-45 (0.18 feet), MW-64 (0.16 feet), and MW-65 (0.05 feet). Because of unexpected changes in site conditions at Site 1159, the free product recovery with bioslurping, as recommended in the RAP, would be ineffective**.** This evaluation is based on the area of observable free product and magnitude of the smear zone.

CH2M HILL proposed that a pilot study be conducted in order to assess the potential effectiveness of AAS and SVE for full-scale remediation at Site 1159 because site conditions at that time indicated that free product recovery with bioslurping would not be an effective remedial alternative. A technical memorandum (TM) was submitted to the Navy and FDEP on July 8, 2004. In August 2004, comments were received from FDEP and the decision was made to forego the pilot study and move forward with implementation of a full-scale AAS/SVE remediation system based on the observed efficacy of AAS/SVE at similar sites in the Florida panhandle.

In July 2005, average rainfall conditions raised the groundwater table to 12.32 feet bls in monitoring well MW-47 (17.23 feet bls at MW-45). This is the highest groundwater level recorded since well installation took place in 1996, with no measurable free product. Thereafter, the water table levels began decreasing due to below average rainfall in the northwest Florida panhandle area, and free product was rediscovered on October 20, 2006, at near record low water table levels.

Site 1159 was included in the Navy's Optimization program in 2005. This included an optimization meeting in June 2005, during which the system-proposed layout presented in the CH2M HILL RAP Addendum was modified. As a result of the optimization process, the overall system footprint was optimized to meet cleanup objectives. Additional optimization activities occurred in 2006; these activities included further revision of the remediation system footprint due to changing site conditions and incorporating RMOs per Global RBCA

into the overall site exit strategy. The final revisions to the remediation system for Site 1159 are included in the RAP Addendum (CH2M HILL, 2007).

1.1.3 Site Geology and Hydrogeology

A detailed description of regional geology and hydrogeology is included in the CAR (NPWC, 1997). Based on lithologic data collected during the CA, Site 1159 is generally characterized by a fine sand from 0 to 17 feet bls, a silty, fine sand with some clay from 17 to 30 feet bls, and coarse to medium sand from 30 to 40 feet bls. Site soils have a moderate to high permeability and increase in density and stiffness with depth. All site wells are screened in the Sand and Gravel Aquifer. The maximum depth explored during the CA was 40 feet bls.

Site 1159 is located approximately 900 feet to the northeast of Perdido Bay, an impaired surface water body. The general groundwater flow direction across Site 1159 is to the west, toward Perdido Bay; however, the flow direction changes slightly to the southwest as it approaches the bay. Shallow groundwater of the sand and gravel aquifer is unconfined and discharges into the bay.

The groundwater table at the site is relatively flat. During the July 2000 groundwater monitoring event, the groundwater elevation in site wells ranged from 16.8 to 26.8 feet mean sea level (msl). The horizontal hydraulic gradient was measured at 0.00096 feet per foot (foot/foot). Vertical gradients were inconclusive. Figure 1-3 presents the potentiometric surface observed during the October 2006 event. The groundwater table in July 2007 ranged from 4.92 to 23.61 feet msl.

Aquifer slug tests were performed as part of the CA on two willow wells (MW-4 and MW-63) and one deep well (DMW-60) located at the site. The average hydraulic conductivity estimated from the slug tests was 0.000386 feet/second. This is greater than results from slug tests performed in wells located at other sites on Bronson Field (an average of 7.09E-06 feet/second). Assuming an effective porosity of 0.30 and the above hydraulic gradient, the calculated groundwater seepage velocity is 39 feet/year. The hydraulic conductivity and groundwater velocity at the site will be re-evaluated during this site investigation.

1.2 Project Objectives

The overall objective for the selected remedial technologies implemented at Site 1159 is to protect human health and the environment by remediating soil and groundwater contamination to levels consistent with current and future land use.

FDEP specifies groundwater cleanup target levels (GCTLs) in Table I, Chapter 62-777, FAC and the Florida maximum contaminant levels (MCLs) in Chapter 62-550, FAC. Table 1-1 lists GCTLs and groundwater natural attenuation default concentrations (NADCs) for chemicals of concern (COCs) from Table V, Chapter 62-777, FAC.

The COCs in groundwater were identified as benzene, toluene, ethylbenzene, and total xylenes (BTEX), total recoverable petroleum hydrocarbons (TRPH), methyl tert-butyl ether (MTBE), and lead (Pb) (TtNUS, 2002). These COCs vary from the compounds exceeding GCTLs as of May 2006. Groundwater monitoring and tree coring activities were conducted during the site evaluation period between January 2005 and November 2006.

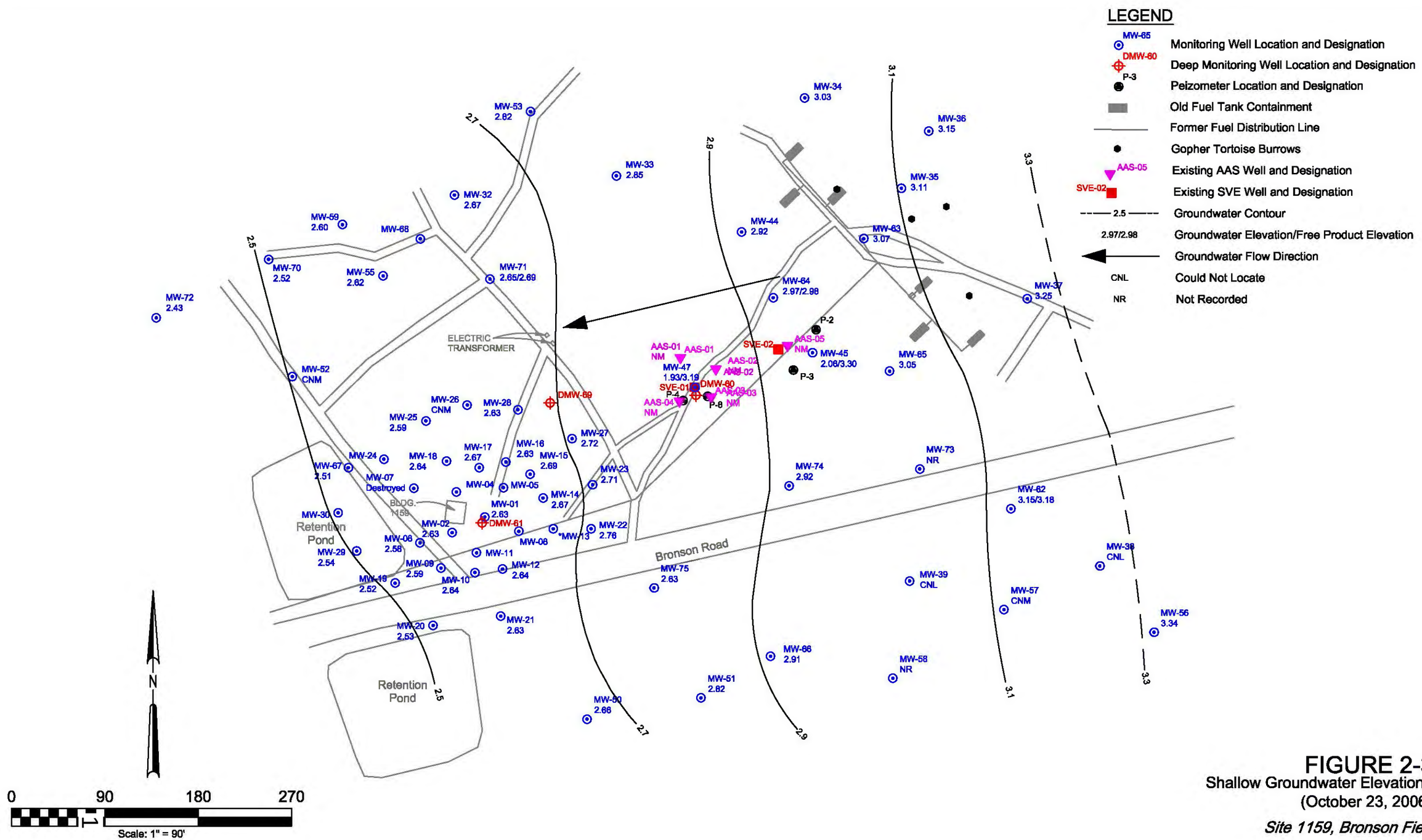

FIGURE 2-3
Shallow Groundwater Elevations
(October 23, 2006)

Site 1159, Bronson Field

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TABLE 1-1
Groundwater Cleanup Target Levels
Site 1159, OLF Bronson, NAS Pensacola, Florida

Analytes	GCTL (μg/L)	Groundwater NADC (μg/L)
Benzene	1	100
Toluene	40	400
Ethylbenzene	30	300
Total Xylenes	20	200
MTBE	20	500
TRPH	5,000	50,000
Lead	15	150

Source: FDEP, Chapters 62-550 and 62-777, FAC
NADC natural attenuation default criteria
μg/L micrograms per liter

Recognizing the potential difficulty in remediating LNAPL compounds, the soil cleanup target levels (SCTLs) for various fractions of TRPH will also be applied to this site. Table 1-2 presents the FDEP SCTLs in Table II, Chapter 62-777, FAC for site COCs. Industrial SCTLs will be applied at the site.

TABLE 1-2
Soil Cleanup Target Levels
Site 1159, OLF Bronson, NAS Pensacola, Florida

	Residential SCTL (mg/kg)	Commercial/Industrial SCTL (mg/kg)	Leachability SCTL (mg/kg)
Benzene[1]	1.2	1.7	0.007
Toluene[1]	7500	60,000	0.5
Ethylbenzene[1]	1,500	9,200	0.6
Total Xylenes[1]	130	700	0.2
TRPH[1]	460	2,700	340
TRPH Fractions[2]			
C_5-C_7 Aromatics	340	1,800	34
C_7-C_8 Aromatics	490	3,700	59
C_8-C_{10} Aromatics	460	2,700	340
C_{10}-C_{12} Aromatics	900	5,900	520
C_{12}-C_{16} Aromatics	1,500	12,000	1,000
C_{16}-C_{21} Aromatics	1,300	11,000	3,200
C_{21}-C_{35} Aromatics	2,300	40,000	25,000
C_5-C_6 Aliphatics	6,200	33,000	470
C_6-C_8 Aliphatics	8,700	46,000	1,300
C_8-C_{10} Aliphatics	850	4,800	7,000
C_{10}-C_{12} Aliphatics	1,700	10,000	51,000
C_{12}-C_{16} Aliphatics	2,900	21,000	*
C_{16}-C_{35} Aliphatics	42,000	280,000	*

Source:
[1]Chapter 62-777, FAC
[2]Development of TPH fraction Cleanup Target Levels for Chapter 62-777, FAC, April 17, 2005 (based on TPHCWG Method).
* Not a health concern for this exposure scenario
mg/kg milligrams per kilogram

1.3 Project Schedule

The project is expected to begin in late November 2007. A project schedule is provided in Appendix A. The schedule details all tasks, the proposed work breakdown structure for the scope of work, and the duration required to complete site remediation.

CH2M HILL will provide the resources necessary to complete the work within the timeframe presented in the final project schedule. The proposed site operations are 5 days a week; no weekend work is anticipated. Work will be scheduled as follows: 07:00 to 18:00 hours. An alternative work schedule may be proposed depending on weather impacts or other unplanned project delays.

A detailed schedule outlining the critical path information will be provided in the form of a Gantt chart that will be attached to the Monthly Status Report (MSR).

The schedule will be resource loaded at the detail level and maintained weekly. A target schedule will be created and used to monitor progress. If activities fall behind schedule, a corrective action plan will be submitted to the Navy Remedial Project Manager (RPM) outlining the proposed remedy to be implemented. The schedule will be updated weekly and will be available at the weekly progress meetings.

Depending on the magnitude of adverse weather and its potential impact to the project schedule, time lost during the schedule work shift may be made up on an accelerated schedule, including working on scheduled off days.

A summary of the anticipated schedule for the implementation of the activities described herein for Site 1159 at OLF Bronson is listed in Table 1-3.

TABLE 1-3
Project Schedule
Site 1159, OLF Bronson, NAS Pensacola, Florida

Date	Activity
March 2007	Submit Addendum to RAP Addendum to NAVFAC SE
July 2007	Obtain Approval from NAVFAC SE
August 2007	Submit Addendum to RAP Addendum to FDEP
August 2007	Obtain FDEP Approval
September 2007	Conduct System Procurement (note that system delivery could take 8 to 12 weeks) Procure and award Drilling and Equipment Subcontractors
	Revise Work Plan
	Conduct Treatment System Well and Monitoring Well Installation
	Collect Additional/Baseline Soil Data
	Conduct Baseline Groundwater Sampling
November 2007	Conduct System Startup (1.5 months to 2 months due to Pb emissions monitoring)
November 2007	Begin Routine System Operations
Spring 2008	Submit Construction Completion Report and First Quarter Monitoring Report
May 2008	Submit Second Quarter Monitoring Report
August 2008	Submit Third Quarter Monitoring Report
Fall 2008	Conduct System Confirmation Soil Sampling
February 2009	Submit Fourth Quarter Monitoring Report

1.4 Communications Plan

A communications matrix outlining the lines of communication for NAVFAC SE and CH2M HILL personnel is presented in Table 1-4.

TABLE 1-4
Communication Matrix
NAS Pensacola, Pensacola, Florida

CH2M HILL Position	Navy Direct Report
Sid Allison, Program Manager	Richard Stanley, Contracting Officer (CO)
Michael Halil, Deputy Program Manager	Dorothy Okamoto, Contracting Officer's Technical Representative (COTR)
Greg Wilfley, Project Manager	Bill Hill, Remedial Project Manager (RPM)

1.4.1 Project Organization

Table 1-5 lists the key team members who are scheduled to work on the project. The following discussion outlines the processes that will be employed to achieve effective communications among the project team. Overall, project communications procedures will clarify the flow of information that is expected to occur at the project level.

TABLE 1-5
Project Personnel Directory
NAS Pensacola, Pensacola, Florida

Contact	Role	Address	Phone No.	Fax No.	E-mail
Bill Hill	Navy RPM	NAVFAC SE P.O. Box 190010 North Charleston, SC 29419-9010	(843) 820-7324	(843) 820-7465	william.j.hill@navy.mil
Sid Allison/ATL	Program Manager	1000 Abernathy Road, Suite 1600, Atlanta, GA 30328	(770) 604-9182	(770) 604-9183	salliso2@ch2m.com
Mike Halil/JAX	Senior Project Manager	9428 Baymeadows Road, Suite 300, Jacksonville, FL 32256	(904) 733-8150	(352) 381-3916	mhalil@ch2m.com
Rich Rathnow/ KNV	Program Health & Safety Manager	2035 Lakeside Centre Way Suite 200 Knoxville, TN 37922	(865) 560-2801	(865) 481-3541	rrathnow@ch2m.com
Theresa Rojas/ATL	Program Quality Control Manager	1000 Abernathy Road, Suite 1600, Atlanta, GA 30328	(770) 604-9182 EXT 568	(770) 604-9183	trojas@ch2m.com
Nancy Ballantyne/DEN	Program Compliance Coordinator	9191 South Jamaica Street, Englewood, CO 80112	720-286-5561	720-286-9590	nballant@ch2m.com
Lisa Schwan/ATL	Waste Coordinator	1000 Abernathy Road, Suite 1600, Atlanta, GA 30328	(770) 604-9182, EXT 561	(770) 604-9183	lschwan@ch2m.com

TABLE 1-5
Project Personnel Directory
NAS Pensacola, Pensacola, Florida

Contact	Role	Address	Phone No.	Fax No.	E-mail
Greg Wilfley/ATL	Project Manager	1000 Abernathy Road, Suite 1600, Atlanta, GA 30328	(770) 604-9182 EXT 390	(770) 604-9183	gwilfley@ch2m.com
Tom Broz/ATL	Subcontracts Administrator	1000 Abernathy Road, Suite 1600, Atlanta, GA 30328	(770) 604-9182 EXT 421	(678) 579-8146	tom.broz@ch2m.com
Bethany Garvey/ATL	Project Chemist	1000 Abernathy Road, Suite 1600, Atlanta, GA 30328	(770) 604-9182 EXT 496	(770) 604-9183	bethany.garvey@ch2m.com
TBD	Site Superintendent				
Phyllis Zerangue/NVR	Project QC Manager	1766 Sea Lark Lane, Navarre, FL32566-7472	(850) 939-8300 EXT 23	(850) 939-0035	pzerangu@ch2m.com
Chad Diamond	Site Health & Safety Specialist	1766 Sea Lark Lane, Navarre, FL32566-7472	(850) 939-8300 EXT 44	(850) 939-0035	chad.diamond@ch2m.com

ATL - Atlanta, GA; DEN – Denver, CO; JAX – Jacksonville, FL; NVR – Navarre, Florida; KNV – Knoxville, TN

1.4.2 Communications with FDEP and EPA

All communications with the FDEP and the U.S. Environmental Protection Agency (EPA) will be conducted by Navy personnel. In addition to the standard communications, NAS Pensacola team meetings are typically used to disseminate information to the regulators. CH2M HILL will play an active role in the planning efforts that occur as part of the work for this project at NAS Pensacola.

1.4.3 Communications with the Navy

The Project Manager or his designee(s) will actively communicate with Navy personnel through the use of weekly project status meetings, as well as other needed communications during periods of heavy workload.

1.5 Project Control and Reporting

This section provides procedures and guidelines for managing the project schedule, budget, and reporting.

1.5.1 Project Status and Reporting Procedures

The Project Manager will coordinate with the project controls group to determine the status of the project schedule and cost control reports each month. Project team members will provide the Project Manager with project status updates for their areas of responsibility.

Schedule Status Procedures

The Project Manager will coordinate with project team members (Site Superintendent and Project Quality Control [QC] Manager) to determine the status of the following information for each scheduled activity:

- Start and end dates
- Project management milestones
- Percent complete
- Logic between activities

Cost Control Status Procedures

The Project Manager will coordinate with project team members (Site Superintendent and Task Managers) regarding status cost control reports as follows:

- **Progress Updates –** Actual progress will be updated weekly by the Site Superintendent using the Weekly Job Status Report generated by the Field Engineer. Committed costs will be updated using the Purchase Requisition Form generated by the Project QC Manager. The updates will reflect progress through Sunday of each week.

- **Engineering Updates –** Committed costs and estimated total cost will be updated monthly for each budgeted activity using the project cost estimate in the Progress Update Report generated by the project controls group. The total cost will be estimated using the task estimate spreadsheet generated by the Site Superintendent. The updates will reflect progress through the final Friday of the month.

- **Labor and Expense Updates –** CH2M HILL labor and expenses to project controls will be updated by Wednesday morning each week.

- **Subcontractor Costs –** Subcontractor costs will be tracked during the weekly meeting.

Monthly Project Status Reporting Schedule

Monthly project status reports will be prepared by the PM and the project controls group. Project status reports include the following:

- View of project plan and progress
- Planned versus actual project costs
- Schedule
- Change log
- Completed milestones and significant future milestones

The MSR is utilized to communicate the project status to the Navy. The MSR is developed using project management milestones (identified below) and is presented in a P3 format to communicate project status to the Program Management Office (PMO) and NAVFAC SE. The Project Manager will provide comments regarding each top task relating to the scope, schedule, and budget.

The Scheduling, Cost Control, and Cost Variance section of the MSR addresses schedule and cost variances. Any scope changes or scope growth occurring during the reporting period will be addressed in the cost section. Schedule impacts relating to planned versus actual and

the rationale for changes to the schedule will be addressed in the schedule section. Indications as to whether costs at completion are within budgeted amounts and an explanation when planned versus actual data are not consistent will be provided in the cost variance section.

Project Management Milestones

The planned/actual top task budgets and milestones will be in the schedule each month. The following milestones have been identified as those needed to conduct reporting to the PMO and NAVFAC SE:

- Phases 1 and 2
  - Request for Bid (RFB) Issued
  - Cost Proposal submitted to NAVFAC SE
  - Negotiations
  - Revised Cost Proposal
  - Remedial Action Plan Addendum Approval
  - Phase 3 Award
- Phase 3
  - Work Plan Approval
  - Pre-construction Conference
  - Mobilization for Response Action
  - Response Action Completed
  - Final Inspection
  - Project Acceptance
  - Site Construction Closeout
  - Draft Project Completion Report to NAVFAC SE
  - Final Project Completion Report submitted to NAVFAC SE

1.5.2 Work Breakdown Structure and Cost Codes

The work breakdown structure and cost codes have been provided in the Cost Proposal previously submitted to NAVFAC SE. Work breakdown structure follows the definable feature of work concept and flows along discrete manageable portions of the work.

1.5.3 Change Management

Changes to the project scope, schedule, or budget will be managed through a Request for Information (RFI) process. An RFI will be submitted when information is required from a team member. The purpose of a RFI is to document a specific problem, question, or concern, and the answer or direction obtained in response to the RFI. The RFI may be originated by any team member (such as construction, engineering, management, or subcontractor).

The procedures for issuing a RFI are:

- List the appropriate distribution.
- Provide a complete description of the problem, question, or concern.

- Use input from engineering, construction, management, project controls and subcontractors, when required, to complete the RFI.
- Request a reasonable response date (typically 5 to 7 days).
- Sign the RFI and submit to document control for distribution.

The recipient will answer and sign the RFI and return it to CH2M HILL.

CH2M HILL will maintain an RFI log that will include the person originating the RFI, person responding, subject matter, and status of the RFI.

1.6 Project Deliverables

Major project deliverables include the MSRs and the Project Completion Report.

1.6.1 Monthly Status Reports

MSRs will be prepared to inform the RPM of the status, progress, and upcoming events of the project. The information required in the MSR is defined in Section 1.5.1 of this work plan addendum. A copy of the MSR will be submitted to the RPM no later than the 20th of the following month.

1.6.2 Project Completion Report

The Project Completion Report will be submitted within 60 days of the completion of demobilization from the project site and/or all waste is properly disposed of. CH2M HILL will submit a draft Project Completion Report to the RPM. This report will include a general description of project activities, summary of analytical data, summary of waste quantities disposed, and supporting documentation.

1.7 Project Operations

1.7.1 Operation Considerations

Several considerations related to the execution of the field work at Site 1159 are listed below.

- **Frisbee Golf**
  - The Frisbee golf course is located within the area of site activities.
  - CH2M HILL will coordinate with MWR personnel to ensure that interference with recreational site usage is minimal.
  - During working hours, CH2M HILL will secure the working area from non-authorized persons with warning tape, orange safety fencing, or other appurtenances to prevent unwanted intrusion.
  - During non-working hours, CH2M HILL will be responsible for securing our equipment and other appurtenances at the site.

- **Site Access**
  - Site 1159 is open to visitors. A paved road runs east-west along the southern portion of the site. A dirt road runs north-south on the western portion of the site. All other paths into the site area are foot trails.
  - The installation of treatment wells will be performed using limited access rigs.
- **Site Preparation**
  - Trees will be trimmed prior to drill rig mobilization. Tree debris will be chipped on site and removal will be coordinated with the park manager.
  - Piping will be rerouted around the roots of trees when possible. The trenches will be cut using a Ditch Witch® prior to trench excavation to avoid pulling on root systems.
  - Tree loss is possible; however, CH2M HILL will do everything possible to minimize damage or loss. CH2M HILL will adhere to the University of Florida Standard Operating Procedures (SOPs) for trimming trees (Appendix B).

1.7.2 Health and Safety

Worker and community safety is of the utmost importance on this project. CH2M HILL will comply with the health and safety requirements outlines in the project Health and Safety Plan (HSP) (Appendix C). All workers involved in any intrusive work or those who may be exposed to subsurface soils, groundwater or waste-impacted materials will provide evidence of medical certification, respirator fit test and 40-hour or 8-hour refresher Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations (HAZWOPER) training to CH2M HILL prior to the start of work. No onsite work will be allowed until all the information is provided to CH2M HILL.

1.7.3 Traffic Control Plan

Traffic control will be the responsibility of the CH2M HILL Site Superintendent. However, traffic control is not anticipated to be a major concern during completion of this work at OLF Bronson since there is only one paved road through the area. CH2M HILL will consult with MWR personnel to evaluate placement of equipment, temporary storage areas, and traffic flow to minimize the impact of this work.

2.0 Execution and Remediation Plan

The following modifications have been made to the overall remediation system design and strategy as a result of the discussions from the Navy Optimization Meetings:

- **Optimized SVE System Design** by reducing the total number of SVE wells to focus treatment on the source area, AAS off-gas capture, and modification of SVE system operating regimes
- **Optimized AAS System Design** by reducing the total number of AAS wells and total flow rate to focus treatment on the product/source area only and through modification of AAS system operating regimes
- **Monitored NA Implementation** for the leading edges of the plume and downgradient dissolved-phase plume

The system was designed based on the performance of similar remediation systems abating petroleum contamination in similar hydrogeologic formations in the Florida panhandle, historical and current soil and groundwater data, and engineering judgment. Active treatment emphasis will be placed on the areas where LNAPL is present and groundwater criteria exceed NADCs specified in Table V, Chapter 62-777 FAC.

To facilitate decision-making during the remedial installation and implementation phases of the work, CH2M HILL developed site-specific decision logic for Site 1159. The decision logic outlines the major milestones and respective decision criteria for the site life-cycle. The decision logic is discussed in detail in the *Remedial Action Plan Addendum Site 1159 – Outlying Landing Field Bronson, Naval Air Station Pensacola* (CH2M HILL, 2007).

Full-scale remediation system installation and O&M entails the following field tasks:

- Mobilization and Site Setup
- Site Preparation
- Treatment Wells Installation/Soil Sampling
- System Field Piping
- AAS System Components Installation
- SVE System Components and Off-Gas Treatment Installation
- Process Instruments and System Controls Installation
- System Enclosure Installation
- Aquifer and Vadose Zone Monitoring System
- System O&M/Air and Groundwater Sampling
- Air, Soil and Water Sampling
- Site Cleanup and Restoration
- Decontamination and Demobilization

2.1 Mobilization and Site Setup

CH2M HILL will mobilize all resources necessary to perform the scope of work. These resources will include personnel, equipment, materials, supplies, lower tier subcontractors,

and support facilities. CH2M HILL will stage its equipment and temporary facilities within the areas designated by NAS Pensacola personnel. As part of the mobilization effort, a pre-construction meeting will be held at OLF Bronson. The purpose of this meeting is to fully understand the project and communicate how it will proceed among the Navy, CH2M HILL and its subcontractors, and any other involved parties. CH2M HILL will also obtain and coordinate all necessary Base access requirements for its personnel and subcontractors on base. Mobilization and site setup activities will occur at the beginning of each project task.

Prior to commencement of any subsurface work, CH2M HILL will obtain digging permits, as required, from NAS Pensacola personnel, and will coordinate to locate and verify subsurface utilities present in the work area and to determine whether the utility is active or inactive. Utilities that are identified and located at the site by the Navy will be marked with a point or stakes, as appropriate. Based on the current site plan, utilities such as power and phone may not be available in the vicinity of the site characterization activities.

CH2M HILL will be responsible for maintaining appropriate security, work zones and access controls (i.e., orange safety fencing) and erosion control measures around all drilling stockpiles or other areas disturbed by their operations. CH2M HILL will be responsible for keeping trees around the open area undisturbed.

Security will not be present at the park entry gate; the subcontractor will be responsible for all equipment and materials left at the site.

2.2 Site Preparation

Following mobilization to the site and prior to drilling, activities will be conducted to set up construction areas and safety zones, and to establish field equipment and utilities. Construction and roadway signs may also be set up in this phase of the project.

The following subsections discuss details of the site preparation.

- Clearing the site including chipping and tree debris disposal
- Stockpile area setup
- Waste accumulation area setup
- Precut trench lines using a Ditch Witch® to avoid ripping tree roots

2.2.1 Assess Impact of Field Activities on Natural Resources

There are two known resource issues at the site: gopher tortoise habitats, a state-listed species of special concern, and the high density of live oak trees. Gopher tortoise habitats have been observed during field activities by CH2M HILL since July 2003. These burrows move from season to season, but are generally located in a clearing around the old tank support structures located on the northeastern side of the site between MW-34 and MW-37. Since July 2003, no gopher tortoise habitats have been observed in the area of the proposed treatment system or wells; however, care will be taken to prevent habitat disturbance.

Field piping will be kept to a minimum around the old growth oak trees. When possible, the root systems will be avoided. Tree trimming will adhere to the University of Florida SOPs for trimming trees (Appendix B).

2.2.2 Utility Clearance and Work Zone Setup

A utility survey will be conducted at the site to identify possible subsurface utilities in the excavation zone. Locations of subsurface utilities will be marked and avoided.

Site Security

Blue Angel Recreation Park is open to all military retired and enlisted personnel including their families; any visitor can gain assess to visit the park where the site is located. Field equipment, electrical power generators, material storage area(s) and other supplies will be secured/locked after work hours. CH2M HILL will coordinate with park personnel to set up project-specific laydown areas for project field activities.

Work Zone Setup

The locations of project operational areas are shown on Figure 2-1.

Safety Zone

The safety zones will be set up in the areas where active site work is being conducted. Access to these areas will be restricted and only authorized personnel will be allowed to enter those areas.

Chemical Storage Area

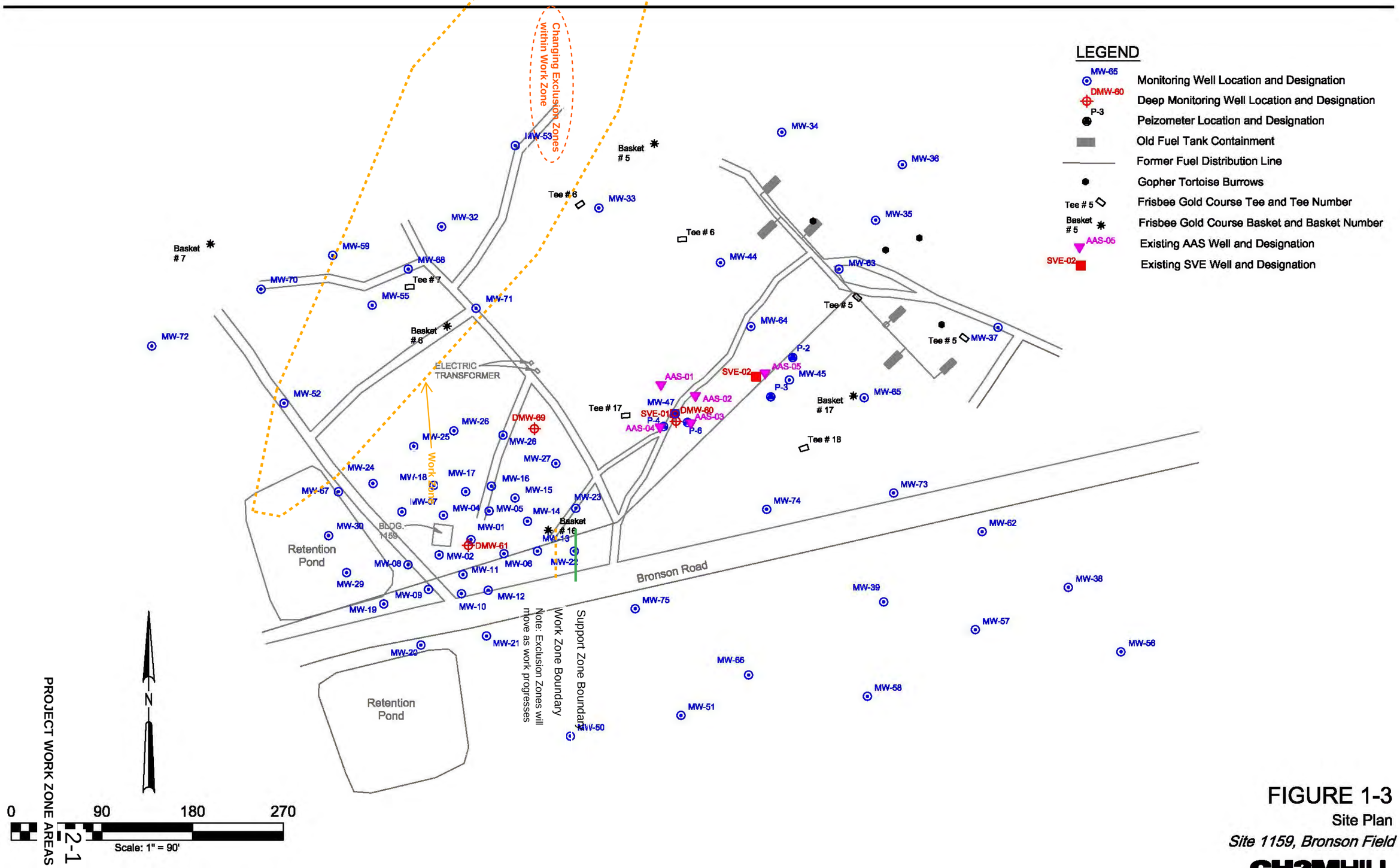
The chemical storage area will be maintained in a facility rental cabin at the Blue Angel Recreation Park. All site chemicals will be maintained in the project cabin including, but not limited to, compressed gases for a flame ionization detector (FID) and MSA 260 (O_2/LEL) explosimeter (hydrogen, methane, isobutylene, pentane, and Zero Air), sample bottles with low volume preservative aliquots (hydrochloric acid [HCL], sulfuric acid [H_2SO_4], nitric acid [HNO_3]), and standard decontamination supplies such as isopropanol, de-ionized water, and Liquinox. Material Safety Data Sheets (MSDS) will be maintained for each chemical on site.

Waste Storage Area

The waste storage area will be set up near Building 1159, in a predetermined laydown area. The waste storage area will not interfere with the activities at Blue Angel Recreation Park and will be maintained out of direct viewing from the park visitors. All wastes contained in the storage area will be properly labeled. Characterization sampling for containerized waste streams will be collected for ultimate transport and disposal (T&D) of the waste to a Navy-approved landfill.

Work Zones

Because there is little or no concern about surface contamination at the site, OSHA standard three-zone configuration (exclusion, contamination reduction, and support zones) for hazardous waste operations will be used in a modified format as detailed in the project-specific HSP (Appendix C). The various zone boundaries will be set in place and marked using a combination of yellow caution tape and highly visible marker flags. The exact zone boundaries will be determined by the Site Superintendent and Site Health and Safety Specialist based on each day's work, and will change as new drilling and piping areas are established.



PROJECT WORK ZONE AREAS

2-1

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FIGURE 1-3
Site Plan
Site 1159, Bronson Field

CH2MHILL

2.1.1 Stormwater Protection and Erosion Controls

It is estimated that the construction activities will disturb less than 1 acre of land. Accordingly, these activities are not subject to FDEP's Generic Permit for Stormwater Discharge from Large and Small Construction Activities. Erosion and sediment controls will be installed prior to any land disturbing activities. These controls will be maintained throughout the duration of the project to control erosion and stormwater run-on and run-off during excavation and site restoration.

2.2.3 Establishment of Field Office, Equipment and Utilities

Field equipment and utilities (water and electricity) will be set up and readied for use prior to beginning remediation activities.

Field Equipment

Field equipment for site remediation system will include the following:

- SVE blowers
- Moisture separators and condensate pumps
- AAS compressors
- AAS heat exchangers
- Main control panel components including process logic controller (PLC), telemetry system, and operator interface for each of the systems
- Off-gas treatment system and all components
- Two remediation system enclosures with appropriately sized main electrical disconnects
- Field piping to system remediation wells

Additional field sampling equipment may include the following:

- Stainless steel bowls and spoons
- Decontamination equipment (spray bottles, buckets, Liquinox, Isopropanol, etc.)
- Mason jars and aluminum foil
- Water level indicators
- Product interface probes
- Geo-pump peristaltic pumps
- Teflon tubing
- Horiba U-22 water quality indicators
- Hach turbidimeters
- Teflon disposable bailers
- Portable system gauging equipment for O&M
- YSI dissolved oxygen (DO) probes

Air Monitoring Instruments

Air monitoring instruments including an oxygen/lower explosive limit (O_2/LEL) meter and a flame ionization detector (FID) will be used during drilling activities. These instruments will be maintained in the site office for storage while not in use. Specifications for the O_2/LEL and FID unit are provided in Appendix D.

Utilities

Electricity and a water source are available at the site office/project cabin.

2.3 Treatment Wells and System Field Piping

2.3.1 AAS Wells and Field Piping

The AAS system optimization consisted of a reduction in the total number of AAS wells from 51 to 31 new wells in order to aggressively aerate the source area (where LNAPL has been observed at the site), and where exceedances in SCTLs specified in Table II, Chapter 62-777 FAC, were observed. Figure 2-2 depicts the extents of LNAPL that will be the target treatment zone for the AAS/SVE system.

The 31 AAS wells will be spaced approximately 60 feet on center, with an estimated radius of influence (ROI) of 30 feet. Figure 2-3 depicts the AAS ROI and general field piping layout.

The AAS wells will be installed using Rotasonic drilling techniques. The boring will be continuously cored to terminal depth and the AAS wells will be installed inside the annulus of the drive casing. Cuttings will be screened using a toxic vapor analyzer (TVA) 1000. All cuttings above 50 parts per million (ppm) will be containerized in approved 55-gallon drums or roll-off containers for characterization sampling and disposal. Due to the varying surface elevations at Site 1159, the AAS wells will be installed to varying depths (measured in feet bls) in order to maintain 30 feet of submergence below the water table across the treatment area. Table 2-1 presents the proposed construction details for the additional AAS wells that will be part of the full-scale remediation system. Actual well locations and construction may change slightly from those shown as a result of field conditions during system installation.

Each AAS well will be constructed of 2-inch diameter, Schedule 40 PVC and will have a 0.020-inch slotted screen. The bottom of each AAS well will be fitted with a threaded well point and will be set at the bottom of the borehole. A 6-20 coarse silica sand pack will then be placed to at least 1 foot above the screen. A bentonite seal will then be placed atop the filter pack. The remainder of the boring will be grouted to approximately 18 inches bls, where a wellhead completion will be assembled, connecting the AAS well to the field piping.

The AAS system field piping will consist of mains, locking manifold enclosures, and individual lines to each wellhead. The AAS wells have been divided into three sections, as depicted on Figure 2-3. Once startup activities have been completed for both systems, the AAS system will operate in a pulsed mode with up to 17 wells operating at a time.

All AAS field piping will be installed below grade to protect the piping and minimize impacts on the facilities located at the site. Depending on the installation technique used, the AAS mains will be constructed from 4-inch DR-21 high density polyethylene (HDPE) or Schedule 40 PVC pipe, and will convey airflow from the AAS compressors to the AAS manifold enclosures. AAS manifold enclosures will be constructed above grade and will be secured in a lockable enclosure. The 4-inch AAS main will manifold to 2-inch, DR-17 HDPE or Schedule 40 PVC lines to each AAS well. Each AAS line housed within the manifold enclosures will have a brass globe valve, Pitot port, thermometer, and pressure gauge.

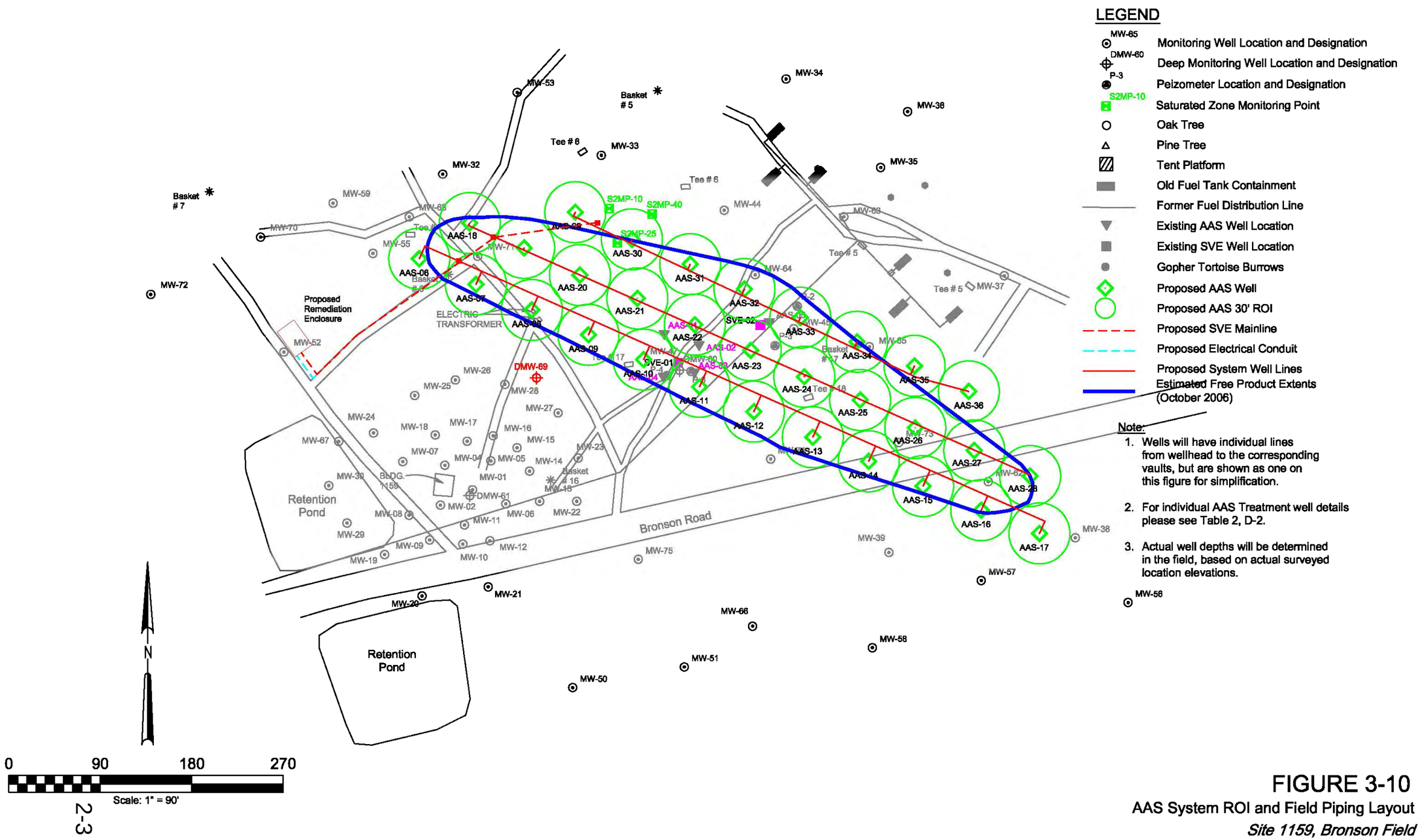

FIGURE 3-10

AAS System ROI and Field Piping Layout

Site 1159, Bronson Field

CH2MHILL

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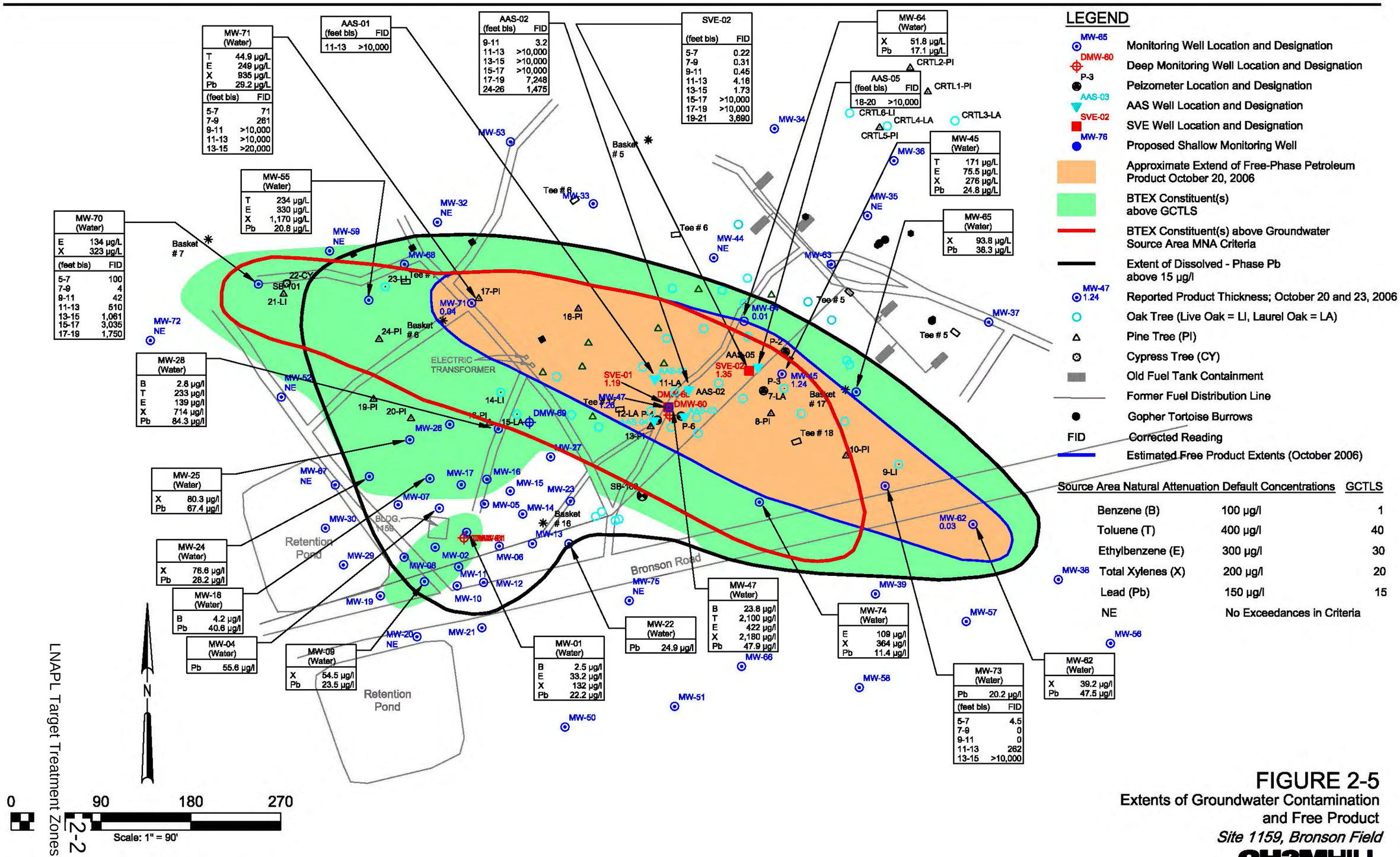

LNAPL Target Treatment Zones

2-2

FIGURE 2-5

Extents of Groundwater Contamination and Free Product

Site 1159, Bronson Field

CH2MHILL

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The globe valves will allow for flow control to each wellhead. The Pitot ports, thermometers, and pressure gauges will be used to calculate the flow to each well. Each well line will terminate at an AAS well with a threaded PVC clean-out port for wellhead access, and each wellhead will be finished with a 12-inch diameter steel well vault encased in a 2-foot by 2-foot by 6-inch concrete pad. See Appendix E for system design drawings.

TABLE 2-1
Proposed AAS System Treatment Well Characteristics
Site 1159, OLF Bronson, NAS Pensacola, Florida

Treatment Well ID	Diameter (inches)	Screened Interval (feet bls)	Screen Size (inches)	Total Depth (feet bls)	System Manifold
1159-AAS-06	2	38-40	0.020	40.5	Leg A1
1159-AAS-07	2	38-40	0.020	40.5	Leg A1
1159-AAS-08	2	40-42	0.020	42.5	Leg A1
1159-AAS-09	2	42-44	0.020	44.5	Leg A1
1159-AAS-10	2	42-44	0.020	44.5	Leg A1
1159-AAS-11	2	44-46	0.020	46.5	Leg A1
1159-AAS-12	2	43-45	0.020	45.5	Leg A1
1159-AAS-13	2	43-45	0.020	45.5	Leg A1
1159-AAS-14	2	46-48	0.020	48.5	Leg A1
1159-AAS-15	2	46-48	0.020	48.5	Leg A1
1159-AAS-16	2	46-48	0.020	50.5	Leg A1
1159-AAS-17	2	46-48	0.020	48.5	Leg A1
1159-AAS-18	2	40-42	0.020	42.5	Leg A2
1159-AAS-19	2	40-42	0.020	42.5	Leg A2
1159-AAS-20	2	42-44	0.020	44.5	Leg A2
1159-AAS-21	2	42-44	0.020	44.5	Leg A2
1159-AAS-22	2	42-44	0.020	44.5	Leg A2
1159-AAS-23	2	42-44	0.020	44.5	Leg A2
1159-AAS-24	2	42-44	0.020	44.5	Leg A2
1159-AAS-25	2	40-42	0.020	42.5	Leg A2
1159-AAS-26	2	40-42	0.020	42.5	Leg A2
1159-AAS-27	2	46-48	0.020	48.5	Leg A2
1159-AAS-28	2	46-48	0.020	48.5	Leg A3
1159-AAS-29	2	52-54	0.020	54.5	Leg A3
1159-AAS-30	2	52-54	0.020	54.5	Leg A3
1159-AAS-31	2	52-54	0.020	54.5	Leg A3
1159-AAS-32	2	52-54	0.020	54.5	Leg A3
1159-AAS-33	2	52-54	0.020	54.5	Leg A3
1159-AAS-34	2	52-54	0.020	54.5	Leg A3
1159-AAS-35	2	52-54	0.020	54.5	Leg A3
1159-AAS-36	2	50-52	0.020	52.5	Leg A3

Note: All wells will be constructed using Schedule 40 polyvinyl chloride risers and well screens.

2.3.2 SVE Wells and Field Piping

The SVE system optimization includes a reduction in the total number of SVE wells, which reduces the total design extraction air flow rate. The total number of SVE wells has been reduced from 22 to 15 (13 new SVE wells and 2 existing SVE wells) in order to focus vapor capture from the areas where the AAS system is operating, areas where LNAPL persists, and areas where contaminant concentrations exceed the FDEP SCTLs as presented in Chapter 62-770 FAC.

Existing wells 1159-SVE-01 and 1159-SVE-02 will be incorporated into the SVE system. Design air extraction from this system will be 600 standard cubic feet per minute (scfm) at 100 inches of water (in. H_2O) vacuum (approximately 1.7 times the proposed maximum AAS injection rate).

SVE well designs will vary in the areas where the vadose zone is less than 6 feet thick to reduce potential problems associated with excess moisture in the system lines, which has been noted in similar situations. Figure 2-2 depicts the extents of LNAPL that will be the target treatment zone for the remediation system. The 13 new SVE wells will be spaced approximately 100 feet on center with a ROI of 50 feet. Figure 2-4 depicts the SVE ROI and general field piping. The SVE wells will be installed using 8.25-inch ID Rotasonic drilling techniques. The boring will be drilled to terminal depth, and the SVE wells will be installed inside the annulus of the drive casing. Drill cuttings will be screened using a TVA-1000. Cuttings exhibiting concentrations greater than 50 ppm corrected will be containerized in approved 55-gallon drums or roll-off containers.

Actual well locations may change slightly from those shown due to field conditions during system installation. Changes may include reducing or adding to the total number of SVE wells. Construction details for the revised SVE system, along with the expected design ROI for each well, are summarized in Table 2-2.

SVE wells will be constructed of 4-inch diameter, Schedule 40 PVC, and will have 0.020-inch slotted screens. Depths will vary based upon installation location (see Table 2-2). The bottom of each SVE well will be fitted with a threaded well point and will be set at the bottom of the borehole. A 6-20 coarse silica sand pack will then be placed to at least 1 foot above the screen. A bentonite seal will then be placed atop the filter pack. The remainder of the boring will be grouted to approximately 18 inches bls, where a wellhead completion will be assembled, connecting the SVE well to the field piping.

The SVE system field piping will consist of mains, manifold boxes, and individual lines from each wellhead. The SVE field piping will be installed below grade to protect the piping and minimize the impacts on the facility. The 4-inch DR 21 HDPE or Schedule 40 PVC lines from the SVE wells will be piped to manifold enclosures housing brass gate valves, Pitot ports, thermometers, and vacuum gauges. The gate valves will be used for flow control, and the Pitot ports, thermometers, and vacuum gauges will be used to calculate flow in each line. The individual lines will manifold into 6-inch DR 21 HDPE or Schedule 40 PVC mains, which will carry the extracted off-gas to the SVE system blowers and off-gas treatment. See Appendix E for system design drawings.

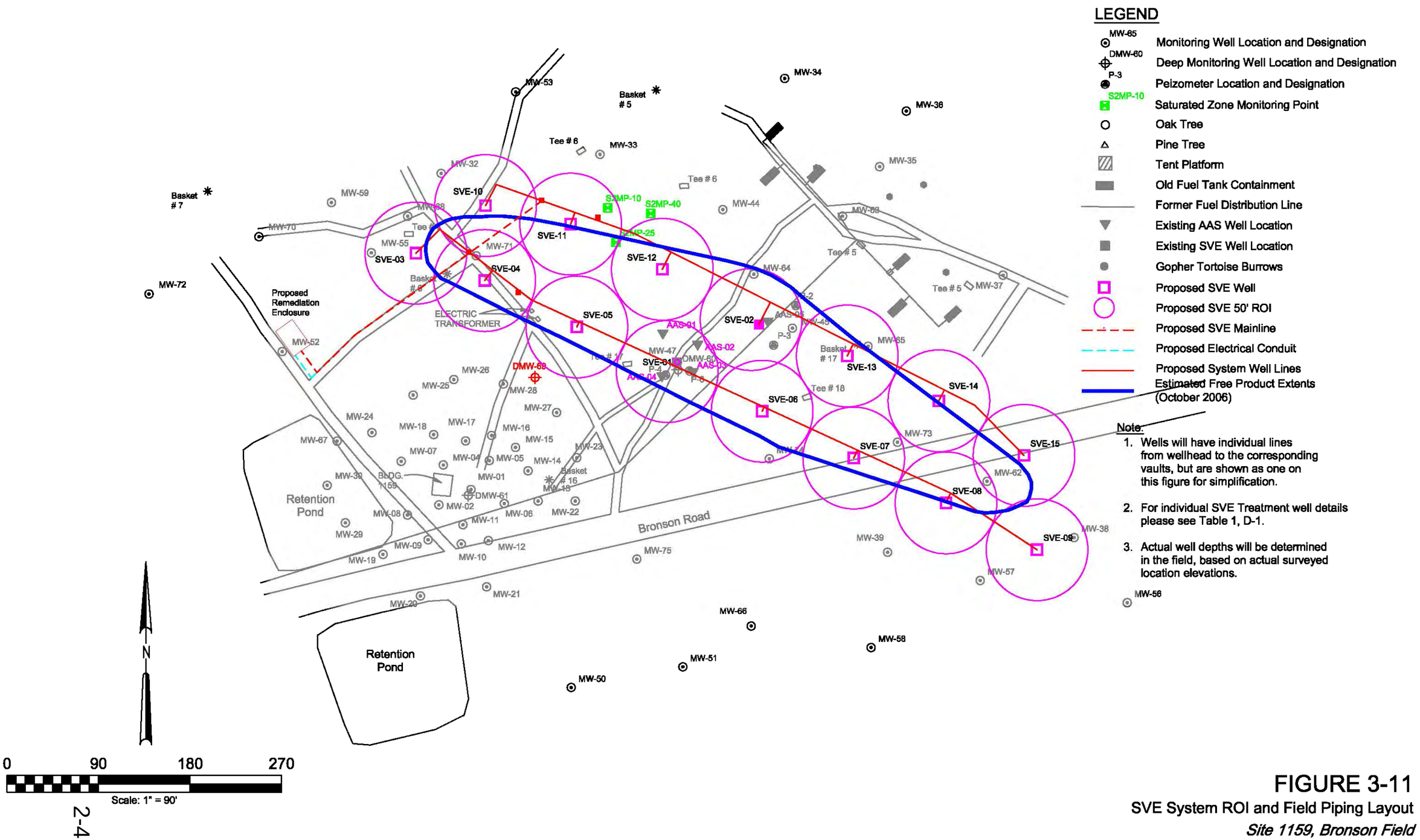

FIGURE 3-11

SVE System ROI and Field Piping Layout

Site 1159, Bronson Field

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TABLE 2-2
Proposed SVE System Treatment Well Design Characteristics
Site 1159, OLF Bronson, NAS Pensacola, Florida

Treatment Well ID	Diameter (inches)	Screened Interval (feet bls)	Screen Size (inches)	Total Depth (feet bls)	Expected ROI (feet)	System Manifold
1159-SVE-01*	4	8-16	0.020	17.61	50	Leg S1
1159-SVE-02*	4	14-24	0.020	24.97	50	Leg S2
1159-SVE-03	4	4.5-7.5	0.020	8	40	Leg S1
1159-SVE-04	4	5-8	0.020	8.5	50	Leg S1
1159-SVE-05	4	5-8	0.020	8.5	50	Leg S1
1159-SVE-06	4	7-15	0.020	15.5	50	Leg S1
1159-SVE-07	4	7-10	0.020	10.5	50	Leg S1
1159-SVE-08	4	7-10	0.020	10.5	50	Leg S1
1159-SVE-09	4	7-10	0.020	10.5	50	Leg S1
1159-SVE-10	4	8-12	0.020	12.5	50	Leg S1
1159-SVE-11	4	9-18	0.020	18.5	50	Leg S2
1159-SVE-12	4	9-18	0.020	18.5	50	Leg S2
1159-SVE-13	4	9-18	0.020	18.5	50	Leg S2
1159-SVE-14	4	7-10	0.020	10.5	50	Leg S2
1159-SVE-15	4	7-10	0.020	10.5	50	Leg S2

Notes:
* Existing SVE wells
All wells will be constructed using Schedule 40 polyvinyl chloride risers and well screens.

2.3.3 Baseline Soil Sampling

In order to establish baseline site conditions and better evaluate remediation system performance at Site 1159, additional soil sampling will be conducted from varying depths during treatment well installation. Field screening using an OVA/FID TVA-1000 will be conducted during AAS treatment well installation. Soil samples will be collected during SVE treatment well installation based on identified zones of interest from the screening results of the AAS system borings. Samples for laboratory analyses will be collected from selected locations per, Chapter 62-770.200 FAC. Soil samples will be analyzed for TRPH (Florida Residual petroleum Organic [FL-PRO] method), TRPH speciation (Total Petroleum Hydrocarbon Criteria Working Croup [TPHCWG] method), volatile organic compounds [VOCs] (SW-846 Method 8260B), lead (SW-846 6010B), and PAHs (SW-846 Method 8310).

A shallow subsurface sample will be collected at each SVE boring location (anticipated to be 6 to 8 feet bls) along with a sample from the zone exhibiting the highest FID response within the vadose zone interval. A third sample may be collected at each boring, from another vadose zone interval near the capillary fringe or within the saturated zone if the zone of highest FID response occurs beneath the water table. All sampling intervals will be ultimately determined by the CH2M HILL Geologist and project team based on results of the PID/FID screening of AAS wells, lithologic determinations, or other boring-specific reasons.

2.3.4 Follow-up Soil Sampling

A follow-up soil sampling event will be completed after asymptotic system performance has been achieved. Additional soil sampling will be conducted to determine if smear zone concentrations indicate LNAPL presence and/or to evaluate the effectiveness of the treatment system to source contamination. The additional soil sampling is anticipated to be completed approximately 1 year after system start-up.

Sampling will be completed by direct push technology (DPT) methods and will be collocated with baseline soil sampling intervals for comparison of concentrations. Up to 20 soil samples will be collected from selected locations per Chapter 62-770.200 FAC. Soil samples will be analyzed for TRPH (FL-PRO), TRPH speciation (TPHCWG), VOCs (SW-846 Method 8260B), lead (SW-846 6010B), and PAHs (SW-846 Method 8310).

2.3.5 Surveying

A Florida registered surveyor will survey new treatment well locations relative to local benchmarks that reference to North American Datum (NAD). If no local benchmark can be established, the top of casing of monitoring well MW-1 will be assigned an arbitrary elevation of 30 feet msl and be used as an arbitrary benchmark. Horizontal control surveying (X-, Y-coordinates) will be performed at the ground surface of each sampling location. Vertical control surveying (Z-coordinate) will be performed on the monitoring wells at the top of casing and the ground surface referencing the North American Vertical Datum (NAVD).

2.4 AAS System Components

The AAS compressors will be selected to produce design airflow and pressure and will be equipped with variable frequency drive units and motors to allow for maximum adjustability. The compressor motors and associated electrical equipment will be designed for a non-hazardous atmosphere. The airflow rate to each AAS well has been reduced from 30 standard cubic feet per minute (scfm) to 20 scfm. Based on system cycling, the total air flow from the AAS compressor will be 350 scfm at a maximum pressure of 25 pounds per square inch gauge (psig). The pressure rating for the AAS system is designed at 25 psig to push the air through the equipment, instruments, field piping, and the approximately 30-foot water column.

To avoid damaging the field piping, compressor discharge will be routed through heat exchangers in order to reduce the compressor discharge air temperature to approximately 100°F to 110°F. In order to extend the durability of the system's mechanical components and minimize the impact of noise pollution on the adjacent campgrounds, the AAS compressors will be housed inside a structurally reinforced and insulated enclosure.

2.5 SVE System Components and Off-Gas Treatment

The SVE vacuum blowers will be selected to extract design airflow and vacuum and will be equipped with variable frequency drive (VFD) drive units and motors to allow for maximum adjustability. The blower motors and associated electrical equipment will be

designed for Class 1 Division 1, Group D hazardous atmosphere. It is anticipated that the SVE off-gas will be near 25 percent of the LEL; therefore, explosion-proof motors and spark-proof blowers will be specified. It is anticipated that multiple vacuum blowers will be necessary to produce the desired design parameters. The use of multiple blowers in conjunction with VFDs will increase the overall operational flexibility of the SVE system.

The SVE system optimization includes a reduction in the total number of SVE wells, which reduces the total design extraction air flow rate. The total number of SVE wells has been reduced to 15 (13 new SVE wells and 2 existing SVE wells) in order to focus vapor capture from the areas where the AAS system is operating, areas where LNAPL persists, and areas where contaminant concentrations exceed the FDEP SCTLs, as presented in Chapter 62-770, FAC. Design air extraction from this system will be 600 scfm at 100 inches H_2O vacuum. This is approximately 1.7 times the proposed maximum AAS injection rate. The vacuum rating for the SVE system is designed to extract the off-gas from each soil vapor extraction well, through the field piping, equipment, instruments, and through the off-gas treatment.

Due to the combined effects of the shallow water table at Site 1159 and suction from the SVE blowers, it is possible that excess moisture could enter the system and collect in the SVE moisture separator(s). Collection and disposal of the unknown quantities of water could present significant problems in maintaining system effectiveness. To minimize any potential adverse effects on treatment system operation, moisture separators will be installed between the SVE lines and the blowers to remove water from the off-gas air stream prior to processing through the SVE blowers.

The moisture separators will be equipped with effluent pumps, which will operate using high, medium, and low level float switches installed within each moisture separator. Pumps will activate when water levels inside the moisture separators reach the medium-level switch and will automatically turn off when the low-level switch is triggered. The high-level switch will be wired to the control panel to turn the entire system off if triggered by a high water level in the moisture separator.

The SVE moisture separator effluent pump discharge lines will be manifolded together, and the water removed from the soil-gas by the SVE system moisture separators will initially be containerized and tested for lead and petroleum constituents to determine the proper disposal method. Potential disposal methods include onsite discharge, approved disposal at an offsite facility, or discharge to the local publicly-owned treatment works.

Initial influent total petroleum hydrocarbon (TPH) concentrations from the SVE systems are expected to exceed the FDEP limit of 13.7 pounds per day; therefore, off-gas treatment will be provided using a thermal oxidizer with catalytic option. Due to the presence of tetraethyl lead (TEL) in the AVGAS, it is likely that lead-oxide particulates will be generated during the combustion process inside the thermal oxidizer.

Reported TEL values in AVGAS range from 0.56 to 1.12 grams Pb per liter [0.005 to 0.009 pounds TEL (as Pb) per gallon] (Chevron, 2000) to greater than 4 grams TEL (as Pb) per gallon (EPA, 2002). Based on the original volume estimate (TtNUS, September 2002) of 242,000 gallons of AVGAS released at Site 1159, potentially 300 to 2,100 pounds of TEL (as Pb) exists in the treatment zone, and could be entrained in the SVE system off-gas and released to the atmosphere.

The site-specific concentrations at which the TEL will be extracted from the vadose zone are unknown at this time; therefore, lead emissions estimates from an AVGAS-contaminated site at Hickam Air Force Base in Oahu, Hawaii, were used in conjunction with design flow rates to estimate the approximate off-gas treatment system emissions at OLF Bronson. Lead emissions from the Hickam AFB site were observed to be 2.162 milligrams per cubic meter (mg/m^3)(CH2M HILL, 2000). Using this lead concentration, the estimated annual emissions for OLF Bronson Site 1159 would be between 21 and 135 pounds per year, depending on operational flow rates (design flow or maximum flow); this estimate falls below the 500 pounds Pb per year limit established in Chapter 62-210 FAC.

The lead emissions may present a potential risk to human health and the environment. As a precaution, additional influent sampling, off-gas sampling, and ambient air monitoring will be conducted during system startup and routine operations (if startup observations show that it is necessary) to determine the actual mass of lead particulates being generated by the off-gas treatment system and to track TPH emissions. Additionally, air modeling may be conducted to determine the extent of lead particulate dispersion and assess potential effects of lead deposition to areas adjacent to the site. If the concentrations of TEL exceed the Occupational Safety and Health Administration (OSHA) general industry permissible exposure limit of 0.075 mg/m^3 as lead, then off-gas treatment system optimization will be performed to reduce the emitted concentrations. If optimization efforts do not successfully reduce the lead concentrations, additional off-gas treatment may be required.

Initial system startup activities will consist of an SVE-only startup during which the SVE and off-gas system operation will be initiated and optimized. Once stable SVE operations have been achieved (i.e., flow rates balanced, TPH off-gas effluent emissions are maintained below 13.7 pounds per day, and lead emissions are below 1.37 pounds per day or up to 500 pounds per year of Pb), the SVE system legs may be cycled based upon field and analytical observations obtained during the initial startup, including off-gas influent concentrations and emissions. Once startup activities are completed (AAS/SVE/off-gas), the SVE system will continue to operate until the cumulative removal curve approaches an asymptotic slope, or lead emissions reach 500 pounds within a 1-year period.

Once soil gas removal rates fall below 13.7 pounds per day as TPH, the off-gas treatment system will be removed and the soil-gas will be vented directly to the atmosphere, with approval from the FDEP. Off-gas sampling and ambient air monitoring (if necessary based on startup observations) will be continued to confirm TPH and lead emissions in order to ensure that human health and the environment are protected and that regulatory emissions criteria are met. The frequency and duration of the continuing off-gas sampling and ambient air monitoring is subject to change (with concurrence from the FDEP), based on the air sampling analytical results.

In order to extend the durability of the system's mechanical components and minimize the impact of noise pollution on the adjacent campgrounds, the SVE vacuum blowers, moisture separators, and components will be housed inside a structurally reinforced and insulated enclosure wired for explosive atmospheres.

2.6 Process Instrumentation and System Controls

The AAS/SVE system at Site 1159 will be equipped with a PLC and control panel(s) that will be mounted inside the AAS trailer. A preliminary process and instrumentation diagram is included in the system design drawings in Appendix E.

The remediation system controls for the AAS, SVE, and off-gas treatment systems will have HAND, OFF, and AUTO switches. The remediation system will operate with the AAS, SVE and off-gas systems running in the AUTO mode. Under no circumstances will the AAS system operate in the AUTO mode without the SVE/off-gas systems being operational. The SVE and off-gas systems will startup first, followed by the AAS system, ensuring that the SVE and off-gas systems will be operating and extracting from the vadose zone soils prior to the AAS system starting up. The HAND function will allow for temporary operations of the components for trouble-shooting and short-term operations for conducting system testing.

At a minimum, the system control panel will alarm if the following conditions occur:

- Power failure
- SVE motor failure
- AAS motor failure
- Heat exchanger failure
- LEL shutdown AAS trailer
- LEL shutdown SVE trailer
- Moisture separator high-level shutdown
- SVE compressor high temperature shutdown
- AAS pipe high temperature shutdown (post heat exchanger)
- AAS enclosure high temperature shutdown
- SVE enclosure high temperature shutdown

The thermal/catalytic oxidizer control panel will alarm if the following conditions occur:

- System runs out of fuel
- SVE shutdown
- Power loss shutdown
- Low flow shutdown
- Burner high temperature shutdown
- Catalyst high temperature shutdown (if operating in catalytic mode)
- Catalyst high pressure shutdown (if operating in catalytic mode)
- Flame safe guard (FSG) shutdown
- Combustion blower overload
- Combustion blower failure

The AAS/SVE system controller may be connected to a telemetry unit/auto-dialer device that will allow for system checks from an offsite location. Additionally, if used, the telemetry unit/auto-dialer device will alert the user if system shutdowns have occurred. At a minimum, the following instruments will be wired to the system PLC:

- Temperature gauges on the AAS post heat exchanger discharge
- Pressure gauges on the AAS compressor discharge

- Vacuum gauges on the SVE blower intake
- Level switches on the moisture separators
- AAS compressor motors
- SVE blower motors
- LEL sensors/meters in the AAS and SVE process enclosures
- Oxidizer temperature gauges/sensors
- Oxidizer FSG sensor
- Oxidizer auto dilution valve

The AAS compressor motor(s), AAS heat exchanger motor(s), SVE blower motors, effluent pump motor(s), and thermal oxidizer combustion blower will all be equipped with hour meters to track actual hours of operation for maintenance purposes, calculating system performance efficiency, and for calculating mass removal.

2.7 System Enclosure

The AAS enclosure, SVE enclosure, and off-gas treatment system will be set up inside a system enclosure in the general location depicted on Figures 2-3 and 2-4. The system enclosures and oxidizer will be grounded and anchored at this location. A minimum 8-foot tall privacy fence will be built around the equipment to protect the system trailers and to further reduce the noise impacts on the adjacent campground.

2.8 Aquifer and Vadose Zone Monitoring System

Saturated zone monitoring points (SZMPs), vadose zone monitoring points (VZMPs), and existing groundwater monitoring wells will be used in order to assess the effects of the AAS/SVE system on the saturated zone and vadose zone.

2.8.1 AAS Monitoring System

Three additional SZMPs and select existing groundwater monitoring wells at Site 1159 screened in both the vadose and saturated zones will be used to monitor DO and water levels. Wells that are entirely screened below the water table will be used to monitor saturated zone pressures. Because only three wells onsite are screened completely below the water table, additional monitoring points (SZMPs) must be installed in order to better evaluate airflow through the saturated zone. Proposed construction details of these monitoring points are included with the design drawings in Appendix E and their proposed locations are shown on Figure 2-3. Actual locations will be finalized in the field based on rig access.

2.8.2 SVE Monitoring System

Existing groundwater monitoring wells at Site 1159 screened in the vadose zone will be used to monitor soil gas concentrations (percent oxygen [% O_2], VOCs, percent LEL [% LEL], percent carbon dioxide [% CO_2], and percent methane [% CH_4]) and pressure/vacuum. Additional VZMPs may be installed to evaluate ROI. Vacuum readings will be used to evaluate SVE influence within the vadose zone. Soil gas monitoring will also be conducted at each SVE well line to evaluate hydrocarbon concentrations in order to optimize system performance. Proposed construction details of these monitoring points are included with the design drawings in Appendix E and their proposed locations are shown on Figure 2-4.

2.9 System Operation and Maintenance

O&M for the AAS/SVE system at Site 1159 is comprised of three phases of operations: startup operations, long-term operations, and site closure. These phases, along with additional site investigation activities, are discussed in the following sections.

2.9.1 Startup Operations

Startup includes the period from preconstruction to approximately 1 to 2 months after the system is turned on. The purpose of startup is to thoroughly evaluate baseline soil gas concentrations, determine off-gas treatment effectiveness, and establish optimal system operational parameters (flows per well, maximum extraction vacuums/pressures, and radius of influence). The baseline vapor and soil concentrations will be compared to all system operations data to evaluate the system's effectiveness in addressing the contamination present in both the vadose zone and saturated zone.

2.9.2 Former Fuel Pipeline Evaluation

In addition to conducing additional soil sampling activities at the site, CH2M HILL will conduct a literature search to determine if fuel lines were properly abandoned. If no record of fuel line abandonment is found, CH2M HILL will propose an investigation to rule out the existence of a continuing source in the area.

2.9.3 Monitoring Well Abandonment

Two monitoring wells,MW-29 and MW-30, will be abandoned as part of the field mobilization. These wells do not offer representative groundwater samples since they are installed in a retention pond which drains Bronson Road and the adjacent area. The wells are constructed from Schedule 40 PVC and have stick-up surface completions. A new well, MW-77, would replace the wells on the upgradient side of the retention pond between monitoring wells MW-08 and MW-67. Table 2-3 shows the construction completion information for these two wells.

All abandonment of monitor wells will be performed in accordance with state and local laws and regulations. If slurry is used, a mud balance and/or Marsh Funnel will be used to ensure that the density (pounds per gallon) of the abandonment mud mixture conforms to the manufacturer's specification. All abandoned monitor wells will be checked 24 to 48 hours after mud/solid bentonite emplacement to determine whether curing is occurring properly. More specific curing specifications or quality assurance checks may be recommended by the manufacturer and will be followed. Additionally, if significant settling has occurred, a sufficient amount of mud/solid bentonite will be added to attain its initial level. These slurry/solid bentonite curing checks and any addition of mud/solid bentonite will be recorded in the field logs.

TABLE 2-3
Well Completion Details
Site 1159, OLF Bronson, NAS Pensacola, Florida

Monitoring Well ID	Northing (NAD)	Easting (NAD)	Well Diameter (inches)	Total Well Depth (feet bls)
1159-MW-29	515261.84	1046428.24	2	14.50
1159-MW-30	515298.63	1046410.39	2	14.50

ID Identification
NAD North American Datum
bls below land surface

2.9.4 Additional Monitoring Well Installation

CH2M HILL recommends installing four additional shallow monitoring wells (MW-76, -77, -78, and -79). These wells will be installed using Rotasonic drilling techniques in order to:

- Delineate the northwestern extent of groundwater contamination (north of MW-72).
- Provide better resolution to track the northern extent of the source area plume between MW-71 and MW-44.
- Provide a point of compliance well upgradient of the retention pond to replace MW-29 and MW-30.
- Provide a clean, upgradient well to 1159-MW-62.

The well borings will be continuously cored and screened using a FID-equipped TVA 1000. The well will be constructed using Schedule 40 PVC with a 10-foot, 0.010-inch slot screen. Screen placement will vary based on well location due to topographic changes at the site. Table 2-4 summarizes the monitoring well construction details. Proposed monitoring well locations are shown on Figure 2-5. All new well locations will be developed prior to sampling. Development will occur no sooner than 24 hours after the completion of the well installation. Additional monitoring wells or piezometers may be installed based on field observations. All drill cuttings will be containerized in 55-gallon drums or roll-off containers for transportation and disposal.

TABLE 2-4
Proposed Monitoring Well Construction Details
Site 1159, OLF Bronson, NAS Pensacola, Florida

Monitoring Well ID	Screen Interval (feet bls)	Total Depth (feet bls)
1159-MW-76	6-16	16.5
1159-MW-77	6-16	16.5
1159-MW-78	12-22	22.5
1159-MW-79	8-18	18.5

ID Identification
bls below land surface

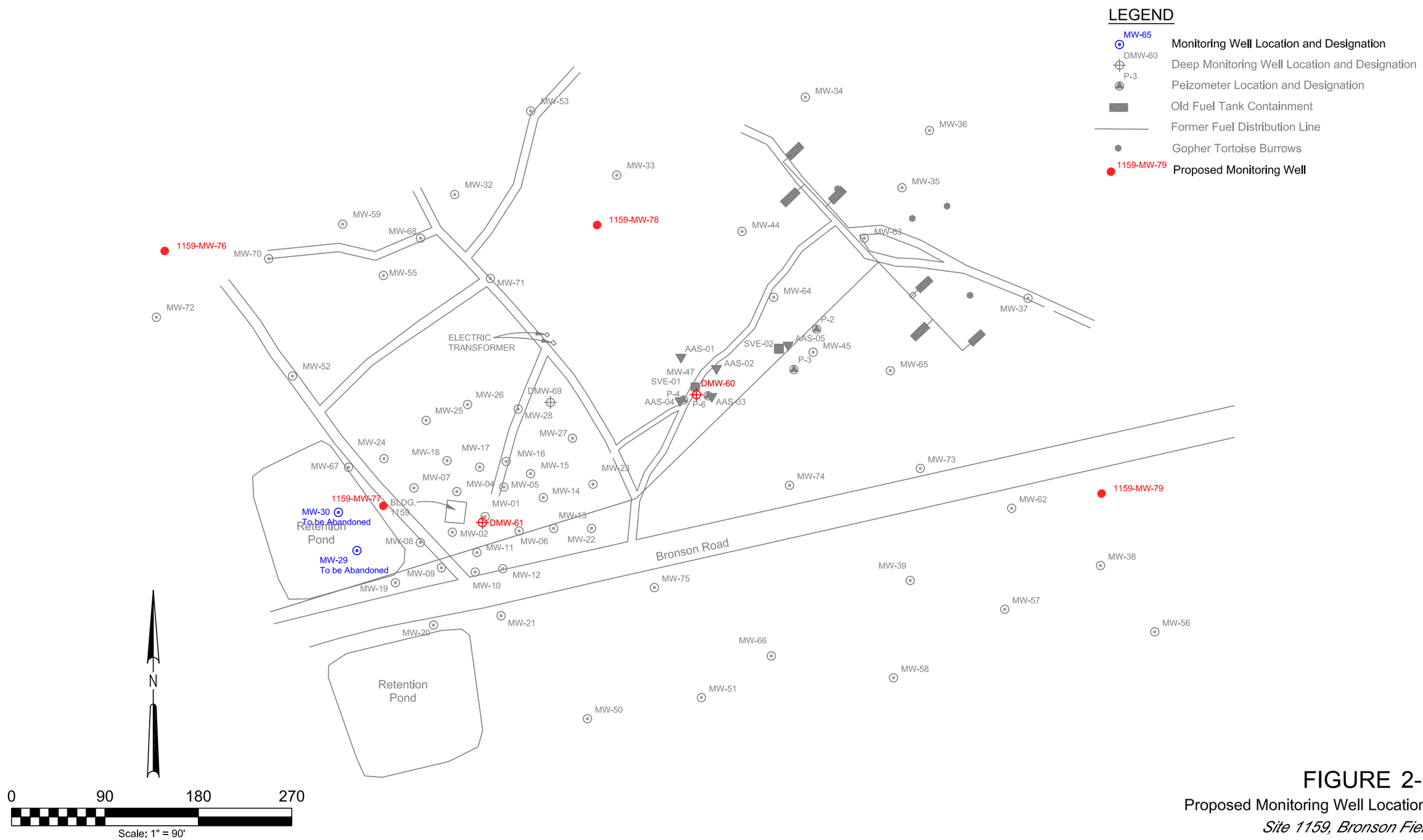

FIGURE 2-5

Proposed Monitoring Well Locations

Site 1159, Bronson Field

CH2MHILL

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2.9.5 Startup Groundwater Sampling

Once the system installation has been completed, groundwater samples will be collected and analyzed to establish baseline dissolved phase contamination conditions and to establish data trends. These data will also be used to monitor the remediation system's effectiveness. The baseline sampling plan is included in Table 2-5. The wells in this table have been classified into the three treatment zones based on historical data, but those classifications may change pending the results of the soil analytical samples collected during treatment well installation activities.

TABLE 2-5
Baseline Groundwater Sampling Plan
Site 1159, OLF Bronson, NAS Pensacola, Florida

Location	TRPH (FL-PRO)	VOCs (SW-846 8260B)	PAHs (SW-846 8310)	Lead (SW-846 6010B)	NAIPs
Source Zone Wells					
MW-45	X	X	X	X	X
MW-47	X	X	X	X	X
MW-62	X	X	X	X	X
MW-64	X	X	X	X	
MW-65	X	X	X	X	X
MW-71	X	X	X	X	X
MW-73	X	X	X	X	X
MW-74	X	X	X	X	
Transitional Zone Wells					
MW-01	X	X	X	X	X
MW-16	X	X	X	X	
MW-21	X	X	X	X	
MW-22	X	X	X	X	
MW-28	X	X	X	X	X
MW-38	X	X	X	X	
MW-39	X	X	X	X	
MW-55	X	X	X	X	X
MW-70	X	X	X	X	
MW-75	X	X	X	X	
Point of Compliance Zone Wells					
Upgradient					
MW-37	X	X	X	X	
MW-38	X	X	X	X	
MW-63	X	X	X	X	X
MW-79[A]	X	X	X	X	X
Sidegradient					
MW-32	X	X	X	X	
MW-44	X	X	X	X	
MW-59	X	X	X	X	
MW-78[A]	X	X	X	X	

TABLE 2-5
Baseline Groundwater Sampling Plan
Site 1159, OLF Bronson, NAS Pensacola, Florida

Location	TRPH (FL-PRO)	VOCs (SW-846 8260B)	PAHs (SW-846 8310)	Lead (SW-846 6010B)	NAIPs
		Downgradient			
MW-19	X	X	X	X	
MW-20	X	X	X	X	
MW-52	X	X	X	X	
MW-67	X	X	X	X	
MW-72	X	X	X	X	
MW-76[A]	X	X	X	X	X
MW-77[A]	X	X	X	X	
DMW-60	X	X	X	X	X
DMW-61	X	X	X	X	

Notes:
[A] Proposed new wells
NAIPs include ferrous iron (ASTM 3500D), sulfate (EPA 300), total alkalinity (EPA 310.1), nitrate (EPA 353.2), and methane (RSK-175). Carbon dioxide (RSK-175, ASTM 1945 or equivalent), ethane (RSK-175), ethane (RSK-175), may also be analyzed.

NAIP Natural Attenuation Indicator Parameters
FL-PRO Florida Petroleum Residual Organic
PAHs polycyclic aromatic hydrocarbons
SW solid waste
TRPH total recoverable petroleum hydrocarbons
VOCs volatile organic compounds

2.9.6 System Startup Monitoring

After system installation activities have been completed, the system will be turned on to perform operational tests. The startup sequence will consist of an SVE-only startup (to include off-gas treatment) and an AAS/SVE startup (to include off-gas treatment). An AAS-only startup is not recommended for health and safety reasons, due to the reported historical free product, recently observed quantities of free product, and groundwater contaminant concentrations.

The purpose of the SVE/off-gas treatment evaluation is to conduct system monitoring activities (soil gas field screening, air sampling, and system parameters measurements [flow, vacuum, ROI]) in order to understand and optimize operations. Once the SVE and off-gas treatment systems have been evaluated and optimized, the AAS system will be started in concert with the SVE/off-gas treatment system and optimized in order to maximize treatment of both saturated zone and vadose zone.

SVE-only Startup

During the SVE-only startup phase, the SVE blowers will be turned on (along with the off-gas treatment system) and system parameters will be monitored in order to determine the system effects on the vadose zone, establish baseline removal flow rates, establish and define ROI, quantify mass removal, and assess/define off-gas treatment efficiency. The SVE system will be initially set to process 100 percent ambient air using manual dilution valves.

The off-gas treatment system will be started up and SVE blower vacuums, flow rates, operating temperatures, and discharge pressures will be monitored to establish operational capacity under open flow conditions. Once the operational capacity has been defined under open flow conditions, the manual dilution valves will be closed, and the well lines will be opened in order to begin extracting from the vadose zone. Based on the field observations and analytical results obtained during the August 2004 soil-gas field screening, a staged SVE-only startup will be necessary to avoid exceeding the 13.7 pounds per day FDEP emissions criteria for TPH. Specific system startup procedures will be pursuant to the manufacturer's instructions and field observations obtained at the time of startup.

Soil gas parameters will be measured at the combined oxidizer influent line and at the oxidizer stack. An FID will be used to screen the samples from the influent line and effluent stack in order to calculate the oxidizer destruction efficiency and respective emissions rates. Air samples will also be collected for laboratory analysis. Representative vadose zone monitoring points will be used to monitor the SVE effects and to determine actual ROI for the system wells. A preliminary list of VZMPs is presented in Table 2-6. VZMPs could include monitoring wells for which well screens are not fully submerged. Flow rates will be adjusted to approximately 40 scfm at each SVE well. Soil gas parameters will be measured at each of the SVE well lines to establish operational trends. Table 2-7 lists the parameters that will be measured and recorded, as well as equipment that will be used for the readings.

TABLE 2-6
Preliminary SVE System Monitoring Locations
Site 1159, OLF Bronson, NAS Pensacola, Florida

Monitoring Point ID	Total Depth (feet bls)	Top of Screen (feet bls)	Bottom of Screen (feet bls)	Vacuum/ Pressure	Soil Gas
1159-MW-26	14.50	4.00	14.00	X	X
1159-MW-28	14.50	4.00	14.00	X	X
1159-MW-32	18.50	8.00	18.00	X	X
1159-MW-33	29.50	19.00	29.00	X	X
1159-MW-38	24.50	14.00	24.00	X	X
1159-MW-39	19.50	9.00	19.00	X	X
1159-MW-44	30.50	20.00	30.00	X	X
1159-MW-45	27.50	17.00	27.00	X	X
1159-MW-47	22.50	12.00	22.00	X	X
1159-MW-56	25.50	15.00	25.00	X	X
1159MW-57	22.50	12.00	22.00	X	X
1159-MW-59	17.50	7.00	17.00	X	X
1159-MW-64	No Data	No Data	No Data	X	X
1159-MW-65	No Data	No Data	No Data	X	X
1159-MW-68	No Data	No Data	No Data	X	X
1159-MW-76	16.5	6	16	X	X
1159-MW-77	16.5	6	16	X	X
1159-MW-78	22.5	12	22	X	X
1159-MW-79	18.5	8	18	X	X

Soil Gas readings include VOCs (using an FID) % LEL, %CH_4, %CO_2, and %O_2

TABLE 2-7
SVE System Monitoring Parameters
Site 1159, OLF Bronson, NAS Pensacola

System Parameter	Equipment Used	Measurement Purpose
Mechanical System Parameters		
System Operation Hours	Hour meters	Track system performance, determine system run times, track mass removal, determine dates/times of shutdowns
SVE Blower Vacuum	Vacuum Gauge	Determine blower performance
SVE Blower Discharge Temperature	Bimetal Thermometer	Determine blower performance
SVE Well Temperature/ Extraction Vacuum/ Differential Pressure	Pitot Tube, Magnahelic Gauge Box, Thermometer	Calculate flow rate from each well in order to calculate mass loading rate to the treatment system as well as overall system mass removal
Oxidizer Dilution Blower Flow	Magnahelic Gauge Box/Flow Meter	Track oxidizer dilution air intake for emissions calculations
Oxidizer Operating Temperatures	Thermocouples	Track and establish oxidizer thermal mode operating parameters with influent loading concentrations
Oxidizer Effluent VOCs	Air Sampling Pump, FID/PID	Track oxidizer performance and estimate daily emissions rates
Oxidizer Effluent Lead	Air Sampling Pump, Glass Fiber Filters	Track oxidizer performance and estimate daily emissions rates
Oxidizer Effluent $\%O_2$, $\%CH_4$, $\%CO_2$, %CO, %LEL	Air Sampling Pump, 3L Tedlar Bags, GEM 2000	Track oxidizer performance/destruction efficiency
In-Situ Parameters		
$\%CH_4$, $\%CO_2$, %LEL	Air Sampling Pump, 3L Tedlar Bags, GEM 2000	Track in-situ biological activity in the treatment area and system capture effectiveness
$\%O_2$	Air Sampling Pump, 3L Tedlar Bags, and GEM 2000	Track in-situ biological activity in the treatment area and track system aeration effectiveness
VOCs	FID/PID, Air Sampling Pump, and 3L Tedlar Bags	Track VOC concentrations with time to evaluate system performance
Wellhead Vacuum/Pressure	Magnahelic Gauge Box	Determine SVE/AAS system ROI
Analytical Air Samples	Air Sampling Pump/ 1L Tedlar Bags	Calculate emissions and track system mass removal

PID photoionization detector
FID flame ionization detector

Analytical air samples will be collected at select locations and analyzed for BTEX/MTBE/TPH-G by EPA-Part 60 Appendix A, Reference Method 18 to quantify the mass removal and assess oxidizer treatment efficiency in maintaining emissions below the regulatory limit of 13.7 pounds per day. Additionally, lead concentrations will be analyzed using EPA method IO-3.4, Determination of Metals Captured on Glass Fiber Filter, and analyzed by inductively coupled plasma (ICP). Glass filters will be certified by the laboratory/manufacturer to be constructed of quartz or glass fiber containing less than 1.3 micrograms per square inch ($\mu g/in^2$) of each metal to be measured. Analytical results provided by the manufacturer stating metals content of the filters will be acceptable. Additionally, samples from the influent may be analyzed using National Institute for Occupational Safety and Health (NIOSH) Method 2533 and personal monitoring equipment will be analyzed using NISOH Method 7105 (ICP).

During this initial SVE startup, the system will be inspected for any accumulation of water in the moisture separators. Due to the shallow groundwater table at Site 1159, moisture accumulation could be significant. As described previously, the combined effluent from the moisture separator effluent pumps will be discharged to land surface in the area exhibiting the most elevated levels of groundwater contamination nearest the treatment system enclosure.

The data collected during the SVE-only startup will be evaluated to determine the system performance in extracting vapors from the vadose zone and determine the off-gas treatment system destruction efficiency and lead emissions rates. Once evaluation of the SVE-only startup is complete and the system has been optimized, startup operations will continue.

AAS/SVE Combined Startup

Once the SVE system performance has been evaluated and operational parameters have been optimized, the AAS system will be started up in a similar manner. With the SVE and off-gas system operational, the AAS system will be brought online with the valves to all the AAS wells closed and the manual by-pass valves 100 percent open. Open flow conditions will be assessed for the AAS compressors and their respective heat exchangers. System pressures, temperatures, and airflow rates will be monitored to determine maximum blower capacities under open flow conditions.

Once open flow conditions have been assessed for the AAS system, the valves to the AAS wells will be opened, and the bypass valves will be slowly closed to force air through the field piping network and into the AAS treatment wells. The pressures and airflow rates will be monitored to ensure that flow is being distributed evenly to all the AAS wells (approximately 20 scfm each) and that airflow is being distributed into the saturated zone. Select monitoring points will be used to monitor AAS system performance. Wellhead pressures, DO, and water levels at each monitoring well will be measured and recorded in order to establish operational ROI for the AAS system wells. Additional adjustments will be made to the AAS well lines in order to attain equal flow to each AAS well.

Once AAS flow rates have been adjusted, the parameters listed in Table 2-8 will be measured and recorded. Note that SVE parameters will also be recorded to determine the effects of the AAS system operating in conjunction with the SVE system. The frequency of

these measurements will be determined by the field engineer but, at a minimum, will be monitored on a weekly basis for the first month of operation, and then monthly thereafter.

TABLE 2-8
AAS/SVE System Monitoring Parameters
Site 1159, OLF Bronson, NAS Pensacola, Florida

System Parameter	Equipment Used	Measurement Purpose
Mechanical System Parameters		
System Operation Hours	Hour meters	Track system performance, determine system run times, track mass removal, determine dates/times of shutdowns
AAS Compressor Discharge Pressure	Pressure Gauge	Track AAS compressor performance
AAS Compressor Discharge Temperature	Bimetal Thermometer	Track AAS compressor performance
AAS Compressor Discharge Flow rate	Flow Meter	Track AAS compressor performance
AAS Heat Exchanger Discharge Temperature	Bimetal Thermometer	Track heat exchanger efficiency in reducing AAS discharge temperatures to acceptable limits for system field piping
AAS Heat Exchanger Discharge Pressure	Pressure Gauge	Track head loss across the heat exchanger in order to determine if leaks are present and monitor performance
AAS Well Temperature/Injection Pressure/Differential Pressure	Pitot Tube, Magnahelic Gauge Box, Thermometer	Calculate flow rate to each well in order maintain even treatment across the AAS zone of influence
SVE Blower Vacuum	Vacuum Gauge	Determine blower performance
SVE Blower Discharge Temperature	Bimetal Thermometer	Determine blower performance
SVE Well Temperature/Extraction Vacuum/Differential Pressure	Pitot Tube, Magnahelic Gauge Box, Thermometer	Calculate flow rate from each well in order to calculate mass loading rate to the treatment system as well as overall system mass removal
Oxidizer Dilution Blower Flow	Magnahelic Gauge Box/Flow Meter	Track oxidizer dilution air intake flow rate for emissions calculations
Oxidizer Operating Temperatures	Thermocouples	Track and establish oxidizer thermal mode operating parameters with influent loading concentrations
Oxidizer Effluent VOCs	Air Sampling Pump, FID/PID	Track oxidizer performance and estimate daily emissions rates
Oxidizer Effluent Lead	Air Sampling Pump, Glass Fiber Filters	Track oxidizer performance and estimate daily emissions rates
Oxidizer Effluent $\%O_2$, $\%CH_4$, $\%CO_2$, %CO, %LEL	Air Sampling Pump, 3L Tedlar Bags, GEM 2000	Track oxidizer performance/destruction efficiency
In-Situ Parameters		
$\%CH_4$, $\%CO_2$, %LEL	Air Sampling Pump, 3L Tedlar Bags, GEM 2000	Track in-situ biological activity in the treatment area and system capture effectiveness

TABLE 2-8
AAS/SVE System Monitoring Parameters
Site 1159, OLF Bronson, NAS Pensacola, Florida

System Parameter	Equipment Used	Measurement Purpose
Mechanical System Parameters		
Dissolved Oxygen	Dissolved Oxygen Meter	Track AAS ROI and biological activity
Water Levels	Water Level Indicator	Track AAS system ROI
$\%O_2$	Air Sampling Pump, 3L Tedlar Bags, and GEM 2000	Track in-situ biological activity in the treatment area and track system aeration effectiveness
VOCs	FID/PID, Air Sampling Pump, and 3L Tedlar Bags	Track VOC concentrations with time to evaluate system performance
Wellhead Vacuum/Pressure	Magnahelic Gauge Box	Determine AAS/SVE system ROI
Analytical Air Samples	Air Sampling Pump/ 1L Tedlar Bags	Calculate emissions and track system mass removal

PID photoionization detector
FID flame ionization detector

2.9.7 Environmental Startup Sampling

Startup sampling will be divided into field screening and analytical measurements. The field screening measurements will track soil gas concentrations, off-gas vapor stream concentrations, DO concentrations, and groundwater level measurements. Analytical measurements will measure BTEX/MTBE/TPH-G/Pb concentrations in the system off-gas. Combined oxidizer influent and oxidizer effluent air samples will be collected daily for the first week, weekly for the first month and monthly thereafter.

2.10 Long-Term Operations and Maintenance

Routine long-term system O&M will involve measuring and recording the AAS/SVE/ off-gas treatment system parameters specified in Table 2-8 weekly for the first month of operations and then monthly thereafter. The main system parameters (flow rates, pressure/vacuum, temperatures, and operational hours) will be measured and recorded on a weekly basis. Additional long-term O&M requirements are listed in Table 2-9.

TABLE 2-9
Long-term O&M Procedures
Site 1159, OLF Bronson, NAS Pensacola, Florida

Parameter	Monitoring Frequency	Purpose
Site-Wide Water Level Measurements	Quarterly	Track site-wide water levels
Groundwater Sampling (BTEX, TRPH, PAHs, and Lead)	Quarterly for the first year, semiannually thereafter (pending data evaluation)	Track contaminant concentrations over time to evaluate system performance
Soil Sampling (BTEX, TRPH, TRPH Specification, PAHs, and Lead)	Based on vapor monitoring and groundwater data trends. Subsequent soil sampling will be conducted at locations adjacent to the original baseline boring locations. Frequency will be determined at the time decision criteria have been reached per decision logic.	Track system performance in remediating soil contamination
Main System Parameters (Run-time Hours, Vacuums/Pressures, Temperatures, and Flow Rates)	Weekly	Track system performance, determine time schedules for regular maintenance
AAS/SVE Well Parameters (Flows, Pressures/Vacuums, Temperatures, Off-gas Parameters)	Monthly	Track system performance at all system wells for the first 6 months, operational adjustments may be recommended based upon system treatment progress
Air Sampling From SVE Influent and Oxidizer Effluent (Laboratory Analysis for BTEX/MTBE/TPH-G/Pb)	Monthly	Track mass removal, oxidizer destruction efficiency, and document compliance with max daily emission rates
System Component Maintenance (SVE, AAS, and Off-gas Systems and Components)	According to manufacturer recommendations	Maintain equipment in proper working condition to extend life of mechanical components

Pursuant to Chapter 62-770.700 (4) FAC, quarterly groundwater sampling will be required for the first year of operation to monitor the treatment system effectiveness at reducing the groundwater contaminant concentrations and to track the contaminant plume dynamics. Table 2-10 outlines the groundwater sampling plan for Site 1159. The sampling plan may change based upon changing site conditions and remediation system treatment progress.

Air sampling from the SVE/off-gas system is required to ensure that the system is not emitting more than 13.7 pounds per day of TPH and 500 pounds per year of Pb emissions to the atmosphere. Air sampling also provides information for calculating and tracking total mass removed by the SVE system, as wells as quantifying oxidizer destruction efficiency.

Periodic maintenance will be required on all system components to ensure that the equipment remains operational.

TABLE 2-10
Routine O&M Sampling Plan
Site 1159, OLF Bronson, NAS Pensacola, Florida

Location	Sampling Frequency		TRPH[B] (FL-PRO)	VOCs (SW-846 8260B)	PAHs[B] (SW-846 8310)	Lead (SW-846 6010B)	NAIPs[B]
	Quarterly	Semiannual					
Source Zone Wells							
MW-45	X	X	X	X	X	X	X
MW-47	X	X	X	X	X	X	X
MW-62	X	X	X	X	X	X	X
MW-64	X	X	X	X	X	X	
MW-65	X	X	X	X	X	X	X
MW-71	X	X	X	X	X	X	X
MW-73	X	X	X	X	X	X	X
MW-74	X	X	X	X	X	X	
Transitional Zone Wells							
MW-01		X	X	X	X	X	X
MW-16		X	X	X	X	X	
MW-21		X	X	X	X	X	
MW-22		X	X	X	X	X	
MW-28		X	X	X	X	X	X
MW-38		X	X	X	X	X	
MW-39		X	X	X	X	X	
MW-55	X	X	X	X	X	X	X
MW-70	X	X	X	X	X	X	
MW-75		X	X	X	X	X	
Point of Compliance Zone Wells							
Upgradient							
MW-37		X	X	X	X	X	
MW-38		X	X	X	X	X	
MW-63		X	X	X	X	X	X
MW-79[A]	X	X	X	X	X	X	X
Sidegradient							
MW-32		X	X	X	X	X	
MW-44		X	X	X	X	X	
MW-59		X	X	X	X	X	
MW-78[A]	X	X	X	X	X	X	
Downgradient							
MW-19		X	X	X	X	X	
MW-20		X	X	X	X	X	
MW-52		X	X	X	X	X	
MW-67		X	X	X	X	X	
MW-72		X	X	X	X	X	
MW-76[A]	X	X	X	X	X	X	X

TABLE 2-10
Routine O&M Sampling Plan
Site 1159, OLF Bronson, NAS Pensacola, Florida

Location	Sampling Frequency		TRPH[B] (FL-PRO)	VOCs (SW-846 8260B)	PAHs[B] (SW-846 8310)	Lead (SW-846 6010B)	NAIPs[B]
	Quarterly	Semiannual					
MW-77[A]	X	X	X	X	X	X	
Deep							
DMW-60	X	X	X	X	X	X	X
DMW-61		X	X	X	X	X	

[A] Proposed new wells
[B] Parameters will be sampled during semiannually
NAIPs include ferrous iron (ASTM 3500D), sulfate (EPA 300), total alkalinity (EPA 310.1), nitrate (EPA 353.2), and methane (RSK-175). Carbon dioxide (RSK-175, ASTM 1945 or equivalent), ethane (RSK-175), ethane (RSK-175), may also be analyzed.
FL-PRO Florida Petroleum Residual Organic

2.11 Site Cleanup and Restoration

Disturbed areas will be repaired or rebuilt to return to conditions that existed prior to the initiation of work. All debris resulting from site cleanup activities will be managed as described in Section 4.0 Waste Management Plan.

2.12 Decontamination and Demobilization

Personnel and equipment will be decontaminated prior to leaving the site in accordance with the HSP (Appendix C). Equipment will be properly decontaminated to remove all contamination, which may be associated with the equipment as a result of the scope of work activities. All debris and rinsate generated by the treatment activities will be properly containerized, sampled and analyzed, and disposed offsite as specified in Section 4.0 Waste Management Plan.

3.0 Sampling and Analysis Plan

This Sampling and Analysis Plan (SAP), describes CH2M HILL's tasks and responsibilities with respect to the sampling and analysis associated with the work effort described in Section 2.0 Execution and Remediation Plan. CH2M HILL intends this document to be a site-specific guide for use by the field team while performing the project-required sampling and analysis. Any changes to the activities described in this SAP must be documented as an addendum to this SAP and approved by the Project Manager and Project Chemist.

Samples will be collected in accordance with EPA Region IV Environmental Investigative Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), November 2001 and FDEP SOPs for Field Activities, DEP-SOP-001/01, February 1, 2004.

The sampling team will be qualified under the Navy Installation Restoration Chemical Data Quality Manual (IRCDQM), 1999 sampling requirements.

A Navy, U.S. Army Corps of Engineers (USACE)-, or Air Force Center for Engineering and the Environment (AFCEE) - and FDEP-approved laboratory will be used for all sample analyses.

3.1 Data Quality Levels for Measurement Data

The data quality levels for each sampling task are listed in Table 3-1. The sampling events, sampling and analytical requirements, and the required level of quality and data packages are listed in Table 3-2. The quantitation, project action, accuracy, precision, and completeness limits by which the data will be evaluated will be provided by the selected laboratory and approved by CH2M HILL's Project Chemist.

TABLE 3-1
Data Quality Levels
Site 1159, OLF Bronson, NAS Pensacola, Florida

Sampling Activity	Data Quality Level Category
Subsurface Soil Investigations (onsite)	Screening
Soil Sampling (off site laboratory analyses)	Definitive
Monitoring well screening (onsite including temperature, pH, conductivity, turbidity)	Screening
Monitor Well Sampling (offsite laboratory analyses)	Definitive
Air Sampling (onsite)	Screening
Air Sampling (offsite laboratory analyses)	Definitive
Waste Characterization of the contaminated soils and aqueous waste (offsite Laboratory analyses)	Definitive

TABLE 3-2
Sampling and Analytical Summary
Site-1159, OLF Bronson, NAS Pensacola, Florida

Sample Task	Sample Point	Matrix	Sampling Frequency	Approx. Sample No	Sampling Method	Sampling Equipment	TAT	DQO Level/ Data Package Reqmnt	Required Analysis	Analytical Method	Holding Time	Sample Preserv	Containers
Groundwater Sampling													
Baseline Groundwater Sampling	MW-01,16, 19, 20, 21, 22, 28, 32, 37, 38, 39, 44, 45, 47, 52, 55, 59, 62, 63, 64, 65, 67, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, DMW-60, 61	Water	Baseline	34 + 3 Dup + 1 MS/MSD =39 Total Samples	Grab	Peristaltic Pump; Teflon Tubing (low flow technique)	14 days	DQO Level IV, CH2M HILL Level C	VOCs	8260B	14 days	HCl pH< 2; Cool to 4°C	(3) 40-ml vial
									PAH	8310	7 days ext; 40 days analysis	Cool to 4°C	(2) 1-L amber glass
									TRPH	FL-PRO	7 days ext; 40 days analysis	H2SO4 pH<2; Cool to 4°C	(2) 1-L amber glass
									Lead	6010B	6 months	HNO3 pH<2; Cool to 4°C	(1) 500-ml HDPE
Natural Attenuation Indicator Parameters (NAIPs)	MW-01, 28, 45, 47, 55, 62, 63, 65, 71, 73, 76, 79, DMW-60 (see Table 2-5)	Water	Baseline	13 + 1 Dup + 1 MS/MSD =16 Total Samples	Grab	Peristaltic Pump; Teflon Tubing (low flow technique)	14 days	DQO Level IV, CH2M HILL Level C	Methane, Ethane, Ethene, CO_2	RSK-175	14 days	Cool to 4°C	(1) 250-ml HDPE
									Nitrate	EPA 300.0, 354.1	48 hours	Cool to 4°C	(1) 250-ml HDPE
									Total Alkalinity	EPA 310.2	14 days	Cool to 4°C	(1) 250-ml HDPE
									Sulfate	EPA 300.0, 375.2	28 days	Cool to 4°C	(1) 250-ml HDPE

TABLE 3-2
Sampling and Analytical Summary
Site-1159, OLF Bronson, NAS Pensacola, Florida

Sample Task	Sample Point	Matrix	Sampling Frequency	Approx. Sample No	Sampling Method	Sampling Equipment	TAT	DQO Level/ Data Package Reqmnt	Required Analysis	Analytical Method	Holding Time	Sample Preserv	Containers
									Ferrous Iron	ASTM 3500D	ASAP (24 hours)	Cool to 4°C	(2) 40-ml Amber Vials
Quarterly Groundwater Sampling	MW-45, 47, 55, 62, 64, 65, 70, 71, 73, 74, 76, 77, 78, 79, DMW-60	Water	Quarterly for first year (1st & 3rd Qtrs)	15 + 1 Dup = 16 Total Samples	Grab	Peristaltic Pump; Teflon Tubing (low flow technique)	14 days	DQO Level IV, CH2M HILL Level C	VOCs	8260B	14 days	HCl pH< 2; Cool to 4°C	(3) 40-ml vial
									PAH	8310	7 days ext; 40 days analysis	Cool to 4°C	(2) 1-L amber glass
									TRPH	FL-PRO	7 days ext; 40 days analysis	H2SO4 pH<2; Cool to 4°C	(2) 1-L amber glass
									Lead	6010B	6 months	HNO3 pH<2; Cool to 4°C	(1) 500-ml HDPE
Natural Attenuation Indicator Parameters (NAIPs)	MW-45, 47, 55, 62, 65, 71, 73, 76, 79, DMW-60 (see Table 2-10)	Water	Quarterly for first year (1st & 3rd Qtrs)	10 + 1 Dup + 1 MS/MSD = 13 Total Samples	Grab	Peristaltic Pump; Teflon Tubing (low flow technique)	14 days	DQO Level IV, CH2M HILL Level C	Methane, Ethane, Ethene, CO_2	RSK-175	14 days	Cool to 4°C	(1) 250-ml HDPE
									Nitrate	EPA 300.0, 354.1	48 hours	Cool to 4°C	(1) 250-ml HDPE

TABLE 3-2
Sampling and Analytical Summary
Site-1159, OLF Bronson, NAS Pensacola, Florida

Sample Task	Sample Point	Matrix	Sampling Frequency	Approx. Sample No	Sampling Method	Sampling Equipment	TAT	DQO Level/ Data Package Reqmnt	Required Analysis	Analytical Method	Holding Time	Sample Preserv	Containers
									Total Alkalinity	EPA 310.2	14 days	Cool to 4°C	(1) 250-ml HDPE
									Sulfate	EPA 300.0, 375.2	28 days	Cool to 4°C	(1) 250-ml HDPE
									Ferrous Iron	ASTM 3500D	ASAP (24 hours)	Cool to 4°C	(2) 40-ml Amber Vials
Semiannual Groundwater Sample	MW-01, 16, 19, 20, 21, 22, 28, 32, 37, 38, 39, 44, 45, 47, 52, 55, 59, 62, 63, 64, 65, 67, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, DMW-60, 61	Water	Semi-Annual for first year (2nd & 4th Qtrs)	34 + 3 Dup + 1 MS/MSD = 39 Total Samples	Grab	Peristaltic Pump; Teflon Tubing (low flow technique)	14 days	DQO Level IV, CH2M HILL Level C	VOCs	8260B	14 days	HCl pH< 2; Cool to 4°C	(3) 40-ml vial
									PAH	8310	7 days ext; 40 days analysis	Cool to 4°C	(2) 1-L amber glass
									TRPH	FL-PRO	7 days ext; 40 days analysis	H2SO4 pH<2; Cool to 4°C	(2) 1-L amber glass
									Lead	6010B	6 months	HNO3 pH<2; Cool to 4°C	(1) 500-ml HDPE
Natural Attenuation Indicator Parameters (NAIPs)	MW-01, 28, 45, 47, 55, 62, 63, 65, 71, 73, 76, 79, DMW-60 (see Table 2-10)	Water	Semi-Annual for first year (2nd & 4th Qtrs)	13 + 1 Dup + 1 MS/MSD = 16 Total Samples	Grab	Peristaltic Pump; Teflon Tubing (low flow technique)	14 days	DQO Level IV, CH2M HILL Level C	Methane, Ethane, Ethene, CO_2	RSK-175	14 days	Cool to 4°C	(1) 250-ml HDPE

TABLE 3-2
Sampling and Analytical Summary
Site-1159, OLF Bronson, NAS Pensacola, Florida

Sample Task	Sample Point	Matrix	Sampling Frequency	Approx. Sample No	Sampling Method	Sampling Equipment	TAT	DQO Level/ Data Package Reqmnt	Required Analysis	Analytical Method	Holding Time	Sample Preserv	Containers
									Nitrate	EPA 300.0, 354.1	48 hours	Cool to 4°C	(1) 250-ml HDPE
									Total Alkalinity	EPA 310	14 days	Cool to 4°C	(1) 250-ml HDPE
									Sulfate	EPA 300.0, 375	28 days	Cool to 4°C	(1) 250-ml HDPE
									Ferrous Iron	ASTM 3500D	ASAP (24 hours)	Cool to 4°C	(2) 40-ml Amber Vials
	Pre-Equipment Blank	Water	1 per 10 samples		Prepared in Field	Analyte-free water	14 days	DQO Level IV, CH2M HILL Level C	VOCs	8260B	14 days	HCl pH< 2; Cool to 4°C	(3) 40-ml vial
									PAH	8310	7 days ext; 40 days analysis	Cool to 4°C	(2) 1-L amber glass
									TRPH	FL-PRO	7 days ext; 40 days analysis	HCl pH<2; Cool to 4°C	(1) 1-L amber glass
									Lead	6010B	6 months	HNO3 pH<2; Cool to 4°C	(1) 500-ml HDPE
	Post-Equipment Blank								Methane, Ethane, Ethene, CO_2	RSK-175	14 days	Cool to 4°C	(1) 250-ml HDPE
									Nitrate	EPA 300.0, 354.1	48 hours	Cool to 4°C	(1) 250-ml HDPE

TABLE 3-2
Sampling and Analytical Summary
Site-1159, OLF Bronson, NAS Pensacola, Florida

Sample Task	Sample Point	Matrix	Sampling Frequency	Approx. Sample No	Sampling Method	Sampling Equipment	TAT	DQO Level/ Data Package Reqmnt	Required Analysis	Analytical Method	Holding Time	Sample Preserv	Containers
									Total Alkalinity	EPA 310	14 days	Cool to 4°C	(1) 250-ml HDPE
									Sulfate	EPA 300.0, 375	28 days	Cool to 4°C	(1) 250-ml HDPE
									Ferrous Iron	ASTM 3500D	ASAP (24 hours)	Cool to 4°C	(2) 40-ml Amber vial
Aqueous Waste Characterization	Decon and GW Purge Water	Water	1 per 10 drums	10	Grab	Peristaltic Pump; Teflon Tubing	14 days	DQO Level III, CH2M HILL Level B	VOCs	8260B	14 days	HCl pH< 2; Cool to 4°C	(3) 40-ml vial
									SVOCs	8270C	7 days ext; 40 days analysis	Cool to 4°C	(5) 1L amber glass
									Pesticides	8081A	7 days ext; 40 days analysis	Cool to 4°C	
									Herbicides	8151A	7 days ext; 40 days analysis	Cool to 4°C	
									Ignitability	1010A/1020 B	ASAP	Cool to 4°C	
									Reactivity	SW-846 Chapter 7.3.3.2	ASAP	Cool to 4°C	
									Corrosivity	9040C	ASAP	Cool to 4°C	
									TAL Metals	6010B/7470 A	6 months; Hg - 28 days	HNO3 pH< 2; Cool to 4°C	(1) 500ml HDPE

TABLE 3-2
Sampling and Analytical Summary
Site-1159, OLF Bronson, NAS Pensacola, Florida

Sample Task	Sample Point	Matrix	Sampling Frequency	Approx. Sample No	Sampling Method	Sampling Equipment	TAT	DQO Level/ Data Package Reqmnt	Required Analysis	Analytical Method	Holding Time	Sample Preserv	Containers
	Trip Blank	Water	1 per cooler containing volatile samples	1	Prepared by Lab	N/A	14 days	DQO Level IV, CH2M HILL Level C	VOCs	8260B	14 days	HCl pH< 2; Cool to 4°C	(2) 40-ml vial
Soil Sampling													
Soil Sampling	Baseline Soil Sampling (Quick turnaround time required for VOCs and TRPH)	Soil	Initial	10+ 1 dupe+ MS/MSD = 12 total samples	Grab (VOC only) Composite	SS Split Spoon	3 days	DQO Level IV, CH2M HILL Level C DQO Level IV, CH2M HILL Level C	VOCs	8260B	48 hours	2 vials 5-ml H2O; 1 vial 5-ml Methanol Cool to 4°C	(3) 40-ml vial (1) 2-oz. jar
							14 day		PAH	8310	14 days ext; 40 days analysis	Cool to 4°C	(1) 4-oz. jar
							5-7 days		TRPH	FL-PRO	14 days ext; 40 days analysis	Cool to 4°C	(1) 4-oz. jar
							14 day		TPH Speciation	TPHCWG	14 days	Cool to 4°C	(1) 4-oz. jar
							14 day		Lead	6010B	6 months	Cool to 4°C	(1) 4-oz. jar

TABLE 3-2
Sampling and Analytical Summary
Site-1159, OLF Bronson, NAS Pensacola, Florida

Sample Task	Sample Point	Matrix	Sampling Frequency	Approx. Sample No	Sampling Method	Sampling Equipment	TAT	DQO Level/ Data Package Reqmnt	Required Analysis	Analytical Method	Holding Time	Sample Preserv	Containers
	Baseline Soil Sampling	Soil	Initial	35 + 4 dup +2 MS/MSD = 44 Total Samples	Grab	SS Split Spoon	14 days	DQO Level IV, CH2M HILL Level C	VOCs	8260B	48 hours	2 vials 5-ml H2O; 1 vial 5-ml Methanol Cool to 4°C	(3) 40-ml vial
					Composite				VOCs (percent moisture)	8260B	48 hours	Cool to 4°C	(1) 2-oz. jar
									PAH	8310	14 days ext; 40 days analysis		(1) 4-oz. jar
									TRPH	FL-PRO	14 days ext; 40 days analysis		(1) 4-oz. jar
									TPH Speciation	TPHCWG	14 days		(1) 4-oz. jar
									Lead	6010B	6 months		(1) 4-oz. jar
	Pre-Equipment Blank	Water	1 per 10 samples	5	Prepared in Field	Analyte-free water	14 days	DQO Level IV, CH2M HILL Level C	VOCs	8260B	14 days	HCl pH< 2; Cool to 4°C	(3) 40-ml vial
									PAH	8310	7 days ext; 40 days analysis	Cool to 4°C	(2) 1-L amber glass
									TRPH	FL-PRO	7 days ext; 40 days analysis	H2SO4 pH<2; Cool to 4°C	(2) 1-L amber glass

TABLE 3-2
Sampling and Analytical Summary
Site-1159, OLF Bronson, NAS Pensacola, Florida

Sample Task	Sample Point	Matrix	Sampling Frequency	Approx. Sample No	Sampling Method	Sampling Equipment	TAT	DQO Level/ Data Package Reqmnt	Required Analysis	Analytical Method	Holding Time	Sample Preserv	Containers
									Lead	6010B	6 months	HNO3 pH<2; Cool to 4°C	(1) 500 ml HDPE
	Post-Equipment Blank	Water	1 per 10 samples	5	Prepared in Field	Analyte-free water	14 days	DQO Level IV, CH2M HILL Level C	VOCs	8260B	14 days	HCl pH< 2; Cool to 4°C	(2) 40-ml vial
									PAH	8310	7 days ext; 40 days analysis	Cool to 4°C	(2) 1-L amber glass
									TRPH	FL-PRO	7 days ext; 40 days analysis	HCl pH<2; Cool to 4°C	(2) 1-L amber glass
									Lead	6010B	6 months	HNO3 pH<2; Cool to 4°C	(1) 500 ml HDPE
	Trip Blank	Water	1 per cooler containing volatile samples	4	Prepared by Lab	N/A	14 days	DQO Level IV, CH2M HILL Level C	VOCs	8260B	14 days	HCl pH< 2; Cool to 4°C	(2) 40-ml vial

TABLE 3-2
Sampling and Analytical Summary
Site-1159, OLF Bronson, NAS Pensacola, Florida

Sample Task	Sample Point	Matrix	Sampling Frequency	Approx. Sample No	Sampling Method	Sampling Equipment	TAT	DQO Level/ Data Package Reqmnt	Required Analysis	Analytical Method	Holding Time	Sample Preserv	Containers
Soil Sampling	Confirmation Soil Sampling (Standard TAT)	Soil	Once	15+ 2 field duplicates+ MS/MSD = 18 samples	Grab (VOC only) Composite	SS Split Spoon	3 days	DQO Level IV, CH2M HILL Level C DQO Level IV, CH2M HILL Level C	VOCs	8260B	48 hours	2 vials 5-ml H2O; 1 vial 5=ml Methanol Cool to 4°C	(3) 40-ml vial (1) 2-oz. jar
							14 day		PAH	8310	14 days ext; 40 days analysis	Cool to 4°C	(1) 4-oz. jar
							5-7 days		TRPH	FL-PRO	14 days ext; 40 days analysis	Cool to 4°C	(1) 4-oz. jar
							14 day		TPH Speciation	TPHCWG	14 days	Cool to 4°C	(1) 4-oz. jar
							14 day		Lead	6010B	6 months	Cool to 4°C	(1) 4-oz. jar
	Pre-Equipment Blank	Water	1 per 10 samples	2	Prepared in Field	Analyte-free water	14 days	DQO Level IV, CH2M HILL Level C	VOCs	8260B	14 days	HCl pH< 2; Cool to 4°C	(3) 40-ml vial
									PAH	8310	7 days ext; 40 days analysis	Cool to 4°C	(2) 1-L amber glass
									TRPH	FL-PRO	7 days ext;	H2SO4 pH<2;	(2) 1-L amber glass

TABLE 3-2
Sampling and Analytical Summary
Site-1159, OLF Bronson, NAS Pensacola, Florida

Sample Task	Sample Point	Matrix	Sampling Frequency	Approx. Sample No	Sampling Method	Sampling Equipment	TAT	DQO Level/ Data Package Reqmnt	Required Analysis	Analytical Method	Holding Time	Sample Preserv	Containers
											40 days analysis	Cool to 4°C	
									Lead	6010B	6 months	HNO3 pH<2; Cool to 4°C	(1) 500 ml HDPE
	Post-Equipment Blank	Water	1 per 10 samples	2	Prepared in Field	Analyte-free water	14 days	DQO Level IV, CH2M HILL Level C	VOCs	8260B	14 days	HCl pH< 2; Cool to 4°C	(2) 40-ml vial
									PAH	8310	7 days ext; 40 days analysis	Cool to 4°C	(2) 1-L amber glass
									TRPH	FL-PRO	7 days ext; 40 days analysis	HCl pH<2; Cool to 4°C	(2) 1-L amber glass
									Lead	6010B	6 months	HNO3 pH<2; Cool to 4°C	(1) 500 ml HDPE
	Trip Blank	Water	1 per cooler containing volatile samples	3	Prepared by Lab	N/A	14 days	DQO Level IV, CH2M HILL Level C	VOCs	8260B	14 days	HCl pH< 2; Cool to 4°C	(2) 40-ml vial

TABLE 3-2
Sampling and Analytical Summary
Site-1159, OLF Bronson, NAS Pensacola, Florida

Sample Task	Sample Point	Matrix	Sampling Frequency	Approx. Sample No	Sampling Method	Sampling Equipment	TAT	DQO Level/ Data Package Reqmnt	Required Analysis	Analytical Method	Holding Time	Sample Preserv	Containers
Soil Waste Characteri-zation	Soil Cuttings	Soil	1 per 500 tons	2	Grab	TerraCore Sampler or equivalent SS Spoon/Bowl	14 days 14 days	DQO Level III, CH2M HILL Level B	TCLP VOCs	1311/8260B	48 hours	2 vials 5-ml H2O; 1 vial 5-ml Methanol ; cool to 4°C	(3) 40-ml vial
									TCLP Semi-volatiles	1311/8270 C	14 days ext; 40 days analysis	Cool to 4°C	(1) 16-oz. jar
					Composite				TCLP Pesticides	1311/8081A	7 days ext; 40 days analysis	Cool to 4°C	
									Herbicides	1311/8151A	7 days ext; 40 days analysis	Cool to 4°C	
									Ignitability	1010/1020	ASAP	Cool to 4°C	
									Reactivity	SW-846 Chapter 7.3.3.2	ASAP	Cool to 4°C	
									Corrosivity	9045B	ASAP	Cool to 4°C	
									TAL TCLP Metals	6010B/7470 A	6 months	HNO3 pH< 2; Cool to 4°C	

DQO	data quality objective	ml	milliliter	SVE	soil vapor extraction	MTBE	methyl tert butyl ether
ºC	degrees centigrade	QC	quality control	VOC	volatile organic compound	TRPH	total recoverable petroleum hydrocarbon
TAT	turnaround time	L	liter	BTEX	benzene, toluene, ethyl benzene, and xylenes	EPA	U.S. Environmental Protection Agency
HCl	hydrochloric acid	N/A	not applicable	PAH	polycyclic aromatic hydrocarbon	FL-PRO	Florida Petroleum Residual Organics

3.2 Sampling Objectives

The sampling objectives for this project will be as follows:

- Collect soil samples to establish baseline site conditions and better evaluate remediation system performance followed by confirmation soil sampling (pending site operational status based on site-specific decision logic) to track system performance and evaluate site exit strategy
- Collect baseline groundwater samples to monitor the presence of free product and assess the current extent of the COCs
- Collect SVE air samples to record emissions and monitor system parameters
- Perform quarterly water level monitoring for the first year and semiannually thereafter
- Collect samples for waste characterization of contained soil cuttings
- Collect samples for waste characterization of water used in equipment decontamination, sampling and well development

3.3 Soil Sampling and Subsurface Soil Screening

AAS treatment wells will be installed using Rotasonic drilling techniques. The borings will be continuously cored to terminal depth. Soil samples will be continuously collected and logged to the completion depth from each of the borings, as directed by the CH2M HILL onsite Geologist. Additionally, a PID/FID will be used to screen the soil samples for volatile concentrations.

Once AAS well installation is completed by Rotasonic methods, a DPT rig with functionality for hollow stem auger (HSA) will install SVE wells. Based on field screening with the FID, soil samples will be collected at high concentration intervals at the discretion of the onsite Geologist using a split spoon sampling device. Up to 45 soil samples (plus QC samples) will be collected from the 13 SVE treatment wells and submitted to an offsite laboratory for chemical analysis in accordance with Table 3-2. Samples will be collected in accordance with FDEP-SOP-001/01 FS 3000 Soil, February 1, 2004.

The maximum total depth for AAS borings is estimated to be up to 54 feet bls. SVE borings will reach a maximum of 18 feet bls. The average depth to groundwater is approximately 12 feet, and groundwater flow is generally to the west-southwest.

The borings will be completed in an order determined by previous sampling data gaps and decision logic represented in the RAP Addendum (CH2M HILL, 2007). Distinct lithologic zones will be selected and their estimated target depths identified.

Soil samples will be described by the CH2M HILL Geologist for grain size, mineralogy, color, moisture content, odor, and structure. Boring locations and general information will be recorded in the Field Logbook. Detailed boring logs will be maintained by CH2M HILL.

Headspace Screening

Headspace field screening (see field screening procedures below) will be conducted on soil samples collected from the rotosonic core samples (extruded into bags) at approximately every 2 vertical feet during drilling.

The following procedures will be performed to screen soil samples for organic content (VOCs).

1. Calibrate the PID/FID per the manufacturer's procedures.
2. Wear nitrile gloves for dermal protection and to reduce cross-contamination.
3. Record sample interval, date, and time in Field Logbook.
4. **Quickly** fill the glass jars at least one-third full with desired soil interval using a clean, stainless steel sampling spoon. Seal jars using aluminum foil and the screw caps, label the two quart-sized glass mason jars with the sample interval and a waterproof pen, and set aside out of the sun and protected from the environment.
5. Visually and physically characterize the soil. Document soil lithology in Field Logbook.
6. Allow the soil in the jars to reach "room temperature" or warmer [20 degrees Celsius [°C] (68°F) to 32°C (90°F)].
7. While the PID/FID organic vapor analyzer is running, insert the sampling probe through the foil-wrapped lid of the first jar after the temperature has equilibrated (typically after 5 minutes).
8. Record the highest reading on the gauge. If using a PID, record the reading in the Field Logbook as the VOC measurement for that sample. If using an FID, record the **unfiltered measurement**. If using an FID and unfiltered reading > 0, proceed to Step 9.
9. Attach an activated charcoal filter onto the sample probe. However, make sure that the charcoal filter capacity has not been exceeded, as described in Step 13.
10. While the FID is running, insert the probe with the attached charcoal filter through the foil-wrapped lid of the second jar.
11. Record the highest reading; this is the amount of methane present.
12. Subtract the methane reading from the unfiltered reading for the **total corrected VOC measurement**.
13. Confirm that the charcoal filter capacity has not been exceeded:

    Step 1: With the FID on and properly calibrated, obtain a source of volatile organic vapors (e.g., permanent marker pen).

    Step 2: Introduce the probe end of the FID to the source of volatile organic vapors, allow the instrument to provide a measurement of vapor concentration, and record concentration.

    Step 3: Connect charcoal filter to end of FID probe. Repeat Step 2. If the FID indicates a value greater than zero (or background), then remove and replace the activated

charcoal in the filter. Repeat Step 2 to ensure that the new charcoal is preventing vapor breakthrough.

3.4 Groundwater Sampling

Groundwater levels will be measured in monitoring well prior to groundwater sampling. The data generated from this event will be used to generate a current potentiometric map for the shallow zone of the site and to assess the current extent of LNAPL present at the site.

3.4.1 Water-level Measurements

Water levels will be measured using an electronic sensor with tape graduated in 0.01 feet. Measurements will be recorded as depth to water or free product from the mark on the top of the well casing. Well number, date and time of measurement, and depth to water will be recorded in the field logbook.

3.4.2 Well Purging

Monitoring wells will be purged using a peristaltic pump and dedicated Teflon® tubing and using low-flow/low-stress purging techniques. Low-flow sampling is a monitoring well purging and sampling method that induces laminar (non-turbulent) flow in the immediate vicinity of the sampling pump intake, thus drawing groundwater directly from the sampled aquifer horizontally through the well screen, and into the sampling device. This results in the collection of groundwater from a discrete portion of the well screen at a rate that closely replicates the natural recharge of groundwater from the formation into the well screen. Low flow sampling purge rates are approximately 0.1 to 0.5 liters/minute.

Monitoring the water level within the well is essential to determine stabilization during low flow purging. Drawdown should be less than 0.1 meters (0.3 feet). These low-flow rates minimize disturbance in the screened aquifer, resulting in: 1) minimal production of artificial turbidity and oxidation; 2) minimal mixing of chemically distinct zones; 3) minimal loss of VOCs; and 4) collection of representative samples while minimizing purge volume. While the well is being purged, field parameters are monitored at the wellhead, typically at 3- to 5-minute intervals using a flow-through cell. See Appendix F for low-flow groundwater sampling procedures.

3.4.3 Collecting Samples from Monitoring Wells

Unlike conventional well purging, when using low flow methodology, the removal of three well volumes is not required. Stabilization shall be defined as follows for three successive readings:

- Temperature ± 3°C
- pH ± 0.1 units
- Specific conductivity (conductance) ± 3 percent
- Turbidity ± 10 percent
- DO ± 10 percent

If these parameters do not stabilize, the sample will be collected after five standard well volumes have been removed (via conventional purging rates and methods), and the

anomalous parameters will be brought to the field team lead's attention and documented. Field equipment will be calibrated in accordance with manufacturer's instructions.

Low-flow sampling will use small positive-displacement pumps (geopumps). Samples to be analyzed for volatile or gaseous constituents shall not be withdrawn with pumps or at flow rates that degas the samples. Water quality indicator parameters will be monitored and recorded during low-flow sampling using an in-line flow-through cell. Before collecting groundwater samples, the sampler will don clean, phthalate-free protective gloves. Sampling equipment should be constructed of inert material, precluding alteration of analyte concentrations caused by sorption, desorption, degradation, or corrosion. Viton®, Tygon®, silicon, and neoprene should not be components of sampling equipment that come into contact with the groundwater sample. Sampling equipment will be decontaminated upon completion of sampling activities. Dedicated tubing should be used and the tubing replaced in the pump head for each well.

Containers will be quickly and adequately sealed; container rims and threads should be clean before tightening lids; and unless otherwise specified, Teflon®-lined screw lids should be used to seal the jar. Sample containers will be properly labeled. The samples will be immediately packed on ice and submitted to an offsite laboratory for chemical analysis in accordance with Table 3-2. Samples will be collected in accordance with FDEP-SOP-001/01, February 1, 2004.

3.5 Solid Waste Disposal Characterization

Solid wasted generated from Site 1159 will be in the form of soil removed during well installation and soil sample collection. The soil will be containerized in roll-off boxes, sampled and submitted to an offsite Navy-, USACE-, or AFCEE-approved laboratory for analysis for the parameters listed in Table 3-2. Disposal soil samples will be collected from each container.

3.5.1 Procedure for Collecting Volatile Fractions

Characterization samples will be collected from the roll-off boxes prior to disposal. One composite sample will be collected per container or as required by the disposal facility. A minimum of five grabs per roll-off will be composited to characterize the material for disposal. The five locations will be selected such that each location is representative of approximately one-fifth of the volume to be disposed. The samples will generally be collected as follows:

1. Choose five random points within the roll-off box prior to sampling.
2. At each of the five points, collect grab samples by performing the following steps:
   - Auger down to a depth that is approximately one-half the depth of the soil staged.
   - Collect a single grab sample set using the TerraCore (or equivalent) device (5 gram soil aliquot per sampling container; three 40-ml VOC vials, one with 5-ml methanol and two with 5 ml deionized water) for the volatiles sample.
   - Continue to collect more sample into a stainless steel bowl.

3. Homogenize the five grab samples by the quartering techniques using the stainless steel spoon.
4. Fill the appropriate sample jar approximately three-fourths full with the homogenized sample.
5. Close the jars, label and package the sample for shipment to the laboratory.

Navy Level III Quality Control and CH2M HILL Level C package will be required along with appropriate Quality Control samples for the required waste characterization and incidental waste stream samples.

3.5.2 Procedure for Collecting Non-Volatile Samples

1. From five randomly selected sample locations, collect several spoonfuls of the soil into a stainless steel bowl.
2. Homogenize the samples by the quartering techniques using the stainless steel spoon.
3. Fill the appropriate sample jars completely full with the homogenized sample
4. Close the jar, label, and package the sample for shipment to the laboratory.

3.5.3 Decontamination and Purge Water Sampling

Decontamination water and any water from well installation and development will be contained in 55-gallon drums, poly tanks, bulk containers or frac tanks. The samples will be collected in the following manner and analyzed in accordance with Table 3-2.

1. Using a bailer, dip jar, or peristaltic pump, collect a water sample from its containment.
2. The sample containers for volatile analyses will be filled first. The 40-ml vials will be filled so that there is no headspace in each vial.
3. The sample containers for the remaining analyses will then be filled.
4. Label and package the samples for shipment to the laboratory.

A CH2M HILL Level C data package will be required along with appropriate QC samples for required analyses. All analytical data will be submitted by both hard copy and electronic files.

3.6 Sample Documentation

A sample label shall be affixed on each individual sample container. Clear tape should be placed over each label to prevent the labels from tearing off, falling off, being smeared and to prevent loss of information on the label. The following information shall be recorded with a waterproof marker on each label:

- Project name
- Project number
- Sample identification or number

- Date and time of sample collection (24-hour clock)
- Sampler's name or initials
- Sample preservatives (if applicable)
- Analyses to be performed on the sample (specifically for the specific container and preservatives – typically for water samples only). This shall be identified by the method number (or name if the number is not known).

These labels may be obtained from the analytical laboratory or printed from a computer onto adhesive labels.

For samples intended for chemical analysis, sample custody procedures shall be followed through sample collection, transfer, analysis and final sample disposal to ensure that the integrity of the samples are maintained. Custody of samples shall be maintained in accordance with the sample custody procedures described below.

A sample is considered to be in custody if:

- It is on one's actual physical possession or view.
- It is in one's physical possession and has not been tampered with (i.e., it is under lock or official seal).
- It is retained in a secured area with restricted access.
- It is placed in a container and secured with an official seal such that the sample cannot be reached without breaking the seal.

Sampling documentation will include the following:

- Numbered Chain-of-Custody (COC) Reports
- Sample Log Book and/or field data sheet which includes the following information:
  - Name of laboratories and contacts to which the samples were sent, turnaround time (TAT) requested, and data results, when possible
  - Termination of a sample point or parameter and reasons
  - Unusual appearance or odor of a sample
  - Measurements, volume of flow, temperature, and weather conditions
  - Additional samples and reasons for obtaining them
  - Levels of protection used (with justification)
  - Meetings and telephone conversations held with the Southern Division, NTR, regulatory agencies, project manager, or supervisor
  - Details concerning any samples split with another party
  - Details of QC samples obtained
  - Sample collection equipment and containers, including their serial or lot numbers Details of QC samples obtained
  - Field analytical equipment, and equipment utilized to make physical measurements will be identified
  - Calculations, results, and calibration data for field sampling, field analytical, and field physical measurement equipment
  - Property numbers of any sampling equipment used, if available
  - Sampling station identification
  - Date and Time of sample collection
  - Description of the sample location
  - Description of the sample
  - Sampler(s)' name(s) and company
  - How the sample was collected
  - Diagrams of processes
  - Maps/sketches of sampling locations
  - Weather conditions that may affect the sample (e.g., rain, extreme heat or cold, wind, etc.)
  - Sample Labels

- Custody Seals (minimum of two on each shipping container)

3.7 Sample Nomenclature

All samples and field quality control will be designated a unique sample identification. The sample identification procedure will be implemented for the following types of environmental samples collected.

- Waste Characterization Samples and Incidental Wastestream Samples
  - CTO Number-Location-Environmental Media-Month and Date-Year
  - Environmental Media: S (Soil), SL (Sludge), SW (Surface Water), GW (Groundwater), WW (Wastewater), and A (Air)
  - Month and Date: Four digit number representing the month and date (e.g., 0402 is April 2)
  - Year: Last two digits of the calendar year (e.g., 07 is the calendar year 2007)
  - Confirmation Samples: CTO Number-Location-Environmental Media-Month and Date-Year
- Monitoring Well Samples
  - CTO Number-Monitoring Well Location-Q #-Year
  - Q #: Represents the quarter number in the calendar year (e.g., fourth quarter is Q4)

An example of the monitoring well sample identification protocol is a quarterly sampling event conducted at a site with an air sparge system that has been in operation since November 1997. The sample event, conducted under CTO No. 0002, included a sample collected from groundwater monitoring well MW-1 in May 2007. This example has the following identification number: 071-MW1-Q2-07.

Treatment System Samples:

- CTO Number-Equipment Location-Influent or Effluent-Media-Month and Date-Year-Number of Months of Treatment System Operation (if applicable)
- Equipment Location: air stripper (ASl), activated carbon adsorption units (ACA), oil/water separator (OWS), soil vapor extraction blower (SVE), monitoring well (MW), and recovery trench (RT). This list may be modified based on site-specific project locations. If required, the work plan addenda will document the site-specific treatment system sample locations.
- Influent or Effluent: Influent to the specific equipment or treatment system location where the sample is collected will be designated by the letter I. Effluent from the specific equipment or treatment system location where the sample is collected will be designated by the letter E.

An example of the treatment system sample identification protocol is an air quality sample collected under CTO No. 0071 from the soil vapor extraction blower effluent on June 2, 2007.

The air sparge and soil vapor extraction system has been in operation since November 2006. This example would have the following identification number: 071-SVE-E-A-0602-07-07.

3.8 Cross-Contamination Minimization

Cross-contamination is the introduction of contaminants into the sample through the sampling and/or sample-handling procedures. It can cause an otherwise representative sample to become non-representative. The most important means of minimizing cross-contamination are as follows:

- Sampling expendables, i.e., sample gloves, pipettes, string, dip jars, etc., must not be reused. Used expendables should be labeled so they are not confused with non-contaminated trash
- Minimum contact should be made between the sampler and the sample medium. For example, a sampler should not walk across a contaminated area and then take a surface soil sample where [he/she] has just stepped.
- Sample collection activities should proceed progressively from the least contaminated area to the most contaminated area
- Sampling equipment should be constructed of Teflon®, stainless steel, or glass that been properly pre-cleaned for collecting samples. Equipment constructed of plastic or PVC should not be used to collect samples for trace organic analyses.
- Any tools used in sampling must be carefully decontaminated prior to first use and after each sample.

Activities that could contaminate samples are prohibited in the sample handling and preparation area. These activities and the possible contaminants include:

- Smoking – PAHs
- Spraying for insects – pesticides, oils, solvents
- Spraying for weeds – herbicides, oils, solvents
- Refueling –BTEX, hydrocarbons
- Painting and paint stripping – solvents

3.9 Field Quality Control

Field duplicate samples and equipment blank samples will be collected at a minimum frequency of 10 percent times the total number of samples collected for an analysis and rounded to the nearest whole number. Equipment blanks will be collected at a minimum of 5 percent of the total number of samples collected for an analysis and rounded to the nearest whole number. One trip blank sample will be provided at a frequency of one per sample cooler containing volatile samples. Matrix spike/matrix spike duplicates (MS/MSD) will be required at a frequency of one per sample event or a minimum of 5 percent of the total number of samples collected for an analysis and rounded to the nearest whole number. Quantity and frequency are detailed in Table 3-2.

3.10 Analytical Methods

Samples will be collected for analytical methods summarized in Table 3-2.

Preliminary analytical results will be faxed to Bethany Garvey at the following fax number per the turnaround times listed in Table 4-2 from day of sample receipt. The final hardcopy data and electronic file will be delivered to Kama White within 14 days of sample receipt.

Bethany Garvey
Laboratory Coordinator
CH2M HILL
1000 Abernathy Road, Suite 1600
Atlanta, GA 30328
770-604-9182 ext. 54124
Efax: 678-579-8176
bgarvey@ch2m.com

Kama White
CH2M HILL
1000 Abernathy Road, Suite 1600
Atlanta, GA 30328
(770) 604-9182 ext 54385
kwhite@ch2m.com

4.0 Waste Management Plan

The scope of this waste management plan addresses the management and disposal requirements for wastes generated during site remediation activities at Site 1159, OLF Bronson. It is anticipated that the following wastes and materials will be generated during these activities:

- Recovered LNAPL
- Contaminated water from groundwater sampling, well installation and well development
- Uncontaminated soil from system installation and other field activities
- Petroleum contaminated soil cuttings
- Sampling-related waste including, but not limited to sampling tubing, gloves, and protective clothing.
- Wastewater from decontamination activities
- Clean and uncontaminated construction debris. (Debris includes discarded materials generally considered to be not water-soluble. Debris includes, but is not limited to, concrete, asphalt material, pipe, and materials used in decontamination, e.g., plastic sheeting, sampling materials and personal protective clothing.)

4.1 Waste Characterization

Wastes will be characterized and managed according to Section 4.0 Sampling and Analysis Plan. Waste characterization information typically will be included on a waste profile form provided by the offsite facility. CH2M HILL will provide analytical data from the most recent characterization sampling and analysis event. However, in some cases, facilities that are permitted to accept a specific waste material might require specific or additional analyses to evaluate the waste stream before acceptance.

It is assumed that petroleum-contaminated media (i.e., soil cuttings or groundwater) that fail the Toxicity Characteristic test for the organic compounds associated with the D018 through D043 waste codes is not hazardous waste because it is a result of UST petroleum cleanup activities (40 Code of Federal Regulation [CFR] 261.4(b)(10)).

Waste characterization information for wastes will be documented on a waste profile form provided by the offsite treatment or disposal facility as part of the waste acceptance process. An approved copy of the waste profile will be received prior to offsite transportation of the material. If generator certification and/or signature are required, NAS Pensacola personnel will provide.

The waste profile typically requires the following information:

- Generator (Navy) information including name, address, contact, and phone number
- Site name including street/mailing address
- Activity generating waste (e.g., petroleum cleanup)
- Source of contamination
- Historical use for area
- Waste composition (95 percent soil, 5 percent debris)
- Physical state of waste (e.g., solid, liquid, etc.)
- Applicable hazardous waste codes

A facility approved copy of the waste profile will be received prior to scheduling of offsite transportation of the waste.

4.2 Waste Management

4.2.1 Waste Storage Time Limit

Hazardous wastes may only be accumulated for 90 days after the first date of generation. Additionally, as required under FAC 62-770, petroleum-contaminated soil (including excessively contaminated soil) will not be stored or stockpiled onsite for more than 60 days. However, petroleum-contaminated soil (including excessively contaminated soil) may be containerized in watertight drums and stored onsite for 90 days, after which time proper treatment or proper disposal of the contaminated soil will occur. Other wastes will be removed from the site as soon as possible. The date of generation (or accumulation start date) is the day that a waste is first placed in a container (drum or roll-off), tank, or stockpile.

4.2.2 Labels

The labeling of waste containers will be in accordance with 49 CFR 172, 173 and 178. Labels will include the type of waste, location from which the waste was generated, and accumulation start date.

Waste labels will include the following information, as applicable for the type of waste:

- "Analysis Pending" or "Waste Material" - Temporary pre-printed or handwritten label will include the accumulation start date. Once analytical results are reviewed and the waste characterized, the label will be replaced with appropriate final label (i.e., "Hazardous Waste" or "Non-Hazardous Waste").

- "Hazardous Waste" - Pre-printed hazardous waste labels with the following information:

  - Accumulation start date
  - Generator Name:
  - USEPA ID number:
  - Waste codes
  - Manifest number (for containers of less than 110-gallon capacity)

- "Non-Hazardous Waste" - Preprinted labels with the following information:
  - Accumulation start date
  - Generator name:
  - USEPA ID number:
  - Waste-specific information (e.g., contaminated soil)

Waste materials that will be recycled (e.g., scrap metal) or reclaimed (e.g., recovered fuel that can be burned for energy recovery), and that are exempt from waste management requirements, will be labeled accordingly. For example, containers or tanks of recovered petroleum that will be burned will have labels identifying the contents as "Recovered Petroleum" or equivalent.

Where applicable, the major hazards (e.g., flammable, oxidizer, and carcinogen) will be included on the label.

4.2.3 General Waste Management Requirements

Hazardous wastes will be segregated from non-hazardous wastes. Additionally, incompatible wastes (e.g., flammable and corrosive wastes) will be segregated. Wastes of the same matrix, contamination, and the same source may be aggregated to facilitate storage and disposal.

Wastes will be accumulated in an area identified or approved by the Navy. If an accumulation area is not designated, CH2M HILL will accumulate hazardous wastes in an area that is not accessible to the general public, and that can be secured.

Waste accumulation areas will contain appropriate emergency response equipment. The HSP (Appendix C) identifies the specific emergency response procedures and equipment. Waste accumulation areas will include fire extinguishers (in areas where wastes are known or suspected to be flammable or ignitable), decontamination equipment, and an alarm system (if radio equipment is not available to all staff, including subcontractors, working in accumulation area). Spill control equipment (e.g., sorbent pads) will be available in the waste accumulation areas, and where liquids are transferred from one vessel to another.

All containers will be inspected upon arrival at the site for equipment in disrepair and any contamination or contents. If container contains waste upon arrival or is in disrepair, it will be immediately rejected and documented.

Solid and liquid wastes will be containerized and the containerized wastes will be stored in accordance with all applicable rules and regulations until treated and/or disposed of offsite. Solid and liquid wastes will be disposed of at offsite facilities approved to receive the wastes. Documentation of the transport and disposal of wastes offsite will be provided.

Soil and Solid Waste

Following the completion of work, sample(s) from the soil cuttings generated during drilling will be collected by CH2M HILL to characterize the solid waste for offsite transport and disposal. The samples will be sent to an offsite laboratory and analyzed using EPA SW-846 procedures for Toxic Characteristic Leaching Procedure (TCLP) VOCs, TCLP semivolatile organic compounds (SVOCs), TCLP metals, TCLP pesticides, TCLP herbicides,

polychlorinated biphenyls (PCBs), Reactivity/Corrosivity/Ignitability (RCI), and TRPH. Analytical Methods are included in Section 4.0 Sampling and Analysis Plan.

Liquid Waste

Liquid wastes may be generated from well installation, well development and decontamination activities. CH2M HILL will collect representative samples of the liquid wastes for waste characterization. The samples will be sent to an offsite laboratory and analyzed using EPA SW-846 procedures for RCI, VOCs, SVOCs, pesticides, herbicides, metals, and TRPH. Analytical methods are included in Section 3.0 Sampling and Analysis Plan.

Drums/Small Containers

The following requirements apply to drums and small containers:

- Drums and small containers of hazardous waste will be transported to the temporary accumulation areas on wood pallets and will be secured together with non-metallic banding.
- Drums will be inspected and inventoried upon arrival onsite for signs of contamination and/or deterioration.
- Adequate aisle space (e.g., 30 inches) will be provided for containers such as 55-gallon drums to allow the unobstructed movement of personnel and equipment. A row of drums should be no more than two drums wide.
- Each drum will be provided with its own label, and labels will be visible.
- Drums will remain covered except when removing or adding waste to the drum. Covers will be properly secured at the end of each workday.
- Drums will be disposed of with the contents. If the contents are removed from the drums for offsite transportation and treatment or disposal, the drums will be decontaminated prior to re-use or before leaving the site.
- Drums containing liquids or hazardous waste will be provided with secondary containment.

Tanks

- Tanks will be inspected upon arrival onsite for signs of deterioration and contamination. Any tank arriving onsite with contents will be rejected.
- Tanks will be provided with covers and secondary containment.
- Only non-stationary tanks (such as a cargo tank or other wheeled tank) will be used to accumulate hazardous waste.
- Each tank will be labeled.

Roll-off Boxes

- Roll-off boxes will be inspected upon arrival on-site. Any roll-off container arriving with contents will be rejected.
- Roll-off boxes for hazardous or "excessively contaminated" soil will be provided with covers and disposable liners. Liners will be disposed of as contaminated debris.
- When not in use, securely fastened covers will be installed on all roll-off boxes.
- Old labels will be removed and a new, appropriate label applies as discussed above
- Roll-off containers will be inspected by the transporter after removal of the liner and decontaminated in the event of evidence of liner failure.

Soil Stockpiles

- Stockpiles of contaminated soil will be located near the excavation areas and within an area of existing contamination.
- Stockpiles will be provided with liner, cover, and perimeter berm to prevent release or infiltration of liquids.
  - Minimum 10- and 6-mil polyethylene sheeting will be used for liners and covers, respectively.
  - The perimeter berm will be constructed of clean materials (e.g., hay bales under the liner) and allow for collection of any free liquids draining from the stockpile.
  - Accumulated free liquids will be pumped-out to a container or tank.
- Covers and perimeter berms will be secured in-place when not in use and at the end of each workday, or as necessary to prevent wind dispersion or run-off from major precipitation events.
- Construction materials for the stockpiles that contact contaminated soil will be disposed of as contaminated debris.
- Accumulation start dates will be recorded on a log or a sign located at the stockpile.

Construction Waste/Debris Stockpiles

Where appropriate, construction debris, waste or scrap equipment may be accumulated in stockpiles. These stockpiles will be managed in such a manner as to maintain good housekeeping, and to prevent the spread of contamination.

- Contaminated debris stockpiles will be provided with containment as indicated for soil stockpiles. Damaged or leaking equipment will be placed in containers, and may not be stored in storage piles.
- Uncontaminated or decontaminated debris stockpiles or intact equipment should be placed on a liner. These piles will be covered as necessary to prevent storm water run-on and run-off.

4.2.4 Inspection of Waste Storage Areas

Waste accumulation areas will be inspected for malfunctions, deterioration, discharges, and leaks that could result in a release. At least weekly, containers, tanks and roll-off containers will be inspected for leaks, signs of corrosion, or signs of general deterioration.

Deficiencies observed or noted during inspection will be documented and rectified immediately. Appropriate measures may include transfer of waste from leaking container to new container, replacement of liner or cover, or repair of containment berm.

If operations are suspended for more than 7 days, the regulatory compliance manager will be contacted and alternate inspection arrangements will be made. Prior to demobilization, all wastes will be removed from the site.

Inspections will be recorded in the daily Quality Control Report and include any deficiencies and how issue was rectified. Copies of the report will be maintained onsite, and available for review.

4.3 Transportation

Each transportation vehicle and load of waste will be inspected before leaving the site. The quantities of waste leaving the site will be recorded. A contractor licensed for commercial transportation will transport non-hazardous wastes. For hazardous waste, the transporter will have an EPA Identification number, and will comply with transportation requirements outlined in 49 CFR 171-179 (Department of Transportation) and 40 CFR 263.11 and 263.31 (Hazardous Waste Transportation). A copy of the documentation indicating that the selected transporter has appropriate licenses will be received prior to transport of any waste material.

4.3.1 Shipping Documentation

Prior to offsite disposal of any waste, CH2M HILL will provide the Navy with a waste approval package for each waste stream. This package shall include a waste profile naming the U.S. Navy as the generator of the waste, analytical summary table(s) applicable to the waste, LDR notification for any hazardous wastes, a completed waste manifest; end any other applicable information necessary for the Navy to complete its review of the disposal package and signature as the generator.

The signed profile will then be submitted to the disposal facility for acceptance approval. Once the approval letter is received from the disposal facility, transportation can be scheduled.

Each load of waste material will be manifested prior to leaving the site. At a minimum, the manifest form will include the following information:

- Generator information including name, address, contact, and phone number, EPA ID number
- Transporter information including name, address, contact and phone number, EPA ID number

- Facility information including name, address, phone number, EPA ID number
- Site name including street/mailing address
- U.S DOT Proper Shipping Name (e.g., Hazardous Waste Solid, n.o.s., 9, UN 3077, PG III (D008))
- Type and number of container
- Quantity of waste (volumetric estimate)
- CTO or job number
- Profile number
- 24 hour emergency phone number

Additionally, each shipment of waste will also have a weight ticket. A Land Disposal Restriction (LDR) Notification/Certification is also required for hazardous wastes. This form also requires the generator signature and submission to the disposal facility.

The generator (Navy) and the transporter must sign the manifest prior to the load of waste leaving the site. A copy of the manifest with generator and transporter signatures will be retained on site and included with the daily Quality Control Report. The original final facility-signed manifest will be returned to the address of the generator. The facility will provide a copy of this final facility-signed manifest to CH2M HILL for the final report. The final report will include copies of the facility signed manifest, haul ticket, LDR (if applicable), and the Certificate of Disposal/Destruction/Recycle.

If the signed hazardous waste manifest from the designated offsite facility is not received within 35 days, CH2M HILL will contact the transporter or the designated facility to determine the status of the waste. If the signed hazardous waste manifest has not been received within 45 days, CH2M HILL, in coordination with the Navy, will issue an "Exception Report" to the state of Florida, as required under 40 CFR 262.42.

4.3.2 Transporter Responsibilities

The transporter will be responsible for weighing loads at a certified scale. For each load of material, weight measurements will be obtained for each full and empty container, dump truck, or tanker truck. Disposal quantities will be based on the difference of weight measurements between the full and empty container, dump truck, or tanker truck. Weights will be recorded on the waste manifest. The transporter will provide copies of weight tickets with the final manifest to CH2M HILL.

The transporter will observe the following practices when hauling and transporting wastes offsite:

- Minimize impacts to general public traffic.
- Repair road damage caused by construction and/or hauling traffic.
- Cleanup material spilled in transit.

- Line and cover trucks/trailers used for hauling contaminated materials to prevent releases and contamination.
- Decontaminate vehicles prior to re-use, other than hauling contaminated material.
- Seal trucks transporting liquids.

No wastes from other project sites will be combined with wastes from this site.

4.4 Disposal of Waste Streams

Offsite treatment or disposal facilities will use the waste profile and supporting documentation (e.g., analytical data) to determine if they will accept a waste. Recovered petroleum will be recycled and/or used for energy recovery, whenever possible. Otherwise, recovered petroleum will be characterized and disposed as a solid waste.

- Any waste that is classified as hazardous will be sent to an offsite permitted, Resource Conservation and Recovery Act (RCRA) Subtitle C Treatment, Storage, and Disposal (TSD) facility.
- Non-hazardous wastes will be disposed at an offsite RCRA Subtitle D facility permitted to receive such wastes.
- Aqueous wastes (i.e., groundwater) will be discharged to a POTW pending approval of the POTW, or disposed offsite at a facility permitted to accept the waste.
- Uncontaminated construction debris may be sent to municipal landfills, or landfills designated for construction/demolition debris.

The treatment or disposal facility will be responsible for providing a copy of the final waste manifest and for a certificate of treatment or disposal for each load of waste received.

4.5 Transportation and Disposal Log

The T&D Log is used to track waste from generation to final disposition. Wastes will be logged into the T&D Log the day waste is generated and placed into containers. Transportation of wastes will be inventoried the day of transportation from the site using the T&D Log. Final disposal will be documented on the T&D Log using the Certificate of Disposal or other documentation describing the final disposition of the material. The T&D Log is provided in Appendix G.

4.6 Records/Reporting

The following records and documents will be maintained:

- Transportation and offsite disposal records, including:
  - Profiles and associated characterization data
  - Manifests, LDR notifications/certifications, bills of lading, and other shipping records
  - Offsite facility waste receipts, certificates of disposal/destruction
- Training records
- Inspection records

CH2M HILL will maintain MSDSs for chemicals and/or hazardous materials brought onsite, including the MSDSs for chemicals brought onsite by subcontractors.

5.0 Environmental Protection Plan

The Environmental Protection Plan of the Basewide Work Plan (CH2M HILL, 2000) addresses general procedures that will be implemented to prevent pollution and protect the environment. The purpose of this plan is to provide specific requirements/procedures to protect the environment during soil remediation activities at Outlying Landing Field Bronson.

5.1 Regulatory Drivers

All solid/hazardous waste and media will be characterized and managed according to the requirements of Chapter 62-730 FAC, Hazardous Waste Regulations. Management of petroleum contaminated wastes will comply with the provisions of Chapter 62-770 FAC, Petroleum Contamination Site Cleanup Criteria, as appropriate.

5.2 Spill Prevention and Control

The provisions for spill prevention and control establish minimum site requirements. Subcontractors are responsible for spill prevention and control related to their operations. Subcontractors written spill prevention and control procedures must be consistent with this plan. All spills will be reported to the CH2M HILL site superintendent and/or project manager. Refer to the HSP (Appendix C) for emergency response procedures and further reporting requirements.

All fuel, chemical, and waste storage areas will be properly protected from on- and offsite vehicle traffic. All tanks (including fuel storage and waste storage) must be equipped with secondary containment. These tanks must be inspected daily for signs of leaks. Accumulated water must be inspected daily for signs of contamination (e.g., product sheen, discoloration, and odor) before being discarded. Fire protection provisions outlined in the Health and Safety Plan must be adhered to.

Chemical products must be properly stored, transferred, and used. Should chemical product use occur outside areas equipped with spill control materials, adequate spill control materials must be maintained at the local work area.

5.3 Spill Containment and Control

Spill control materials will be maintained in the support zone, at fuel storage and dispensing locations, and at waste storage areas. Incidental spills will be contained with sorbent and disposed of properly. Spilled materials must be immediately contained and controlled. Spill response procedures include:

5. Immediately warn any nearby workers and notify supervisor.
6. Assess the spill area to ensure that it is safe to respond.

7. Evacuate area if spill presents an emergency.
8. Ensure any nearby ignition sources are immediately eliminated.
9. Stop source of spill.
10. Establish site control for spill area.
11. Contain and control spilled material through use of sorbent booms, pads, or other material.
12. Use proper personal protective equipment (PPE) in responding to spills.

5.4 Spill Clean-up and Removal

All spilled material, contaminated sorbent, and contaminated media will be cleaned up and removed as soon as possible. Contaminated spill material will be contained, labeled, and properly stored until the material is disposed. Contaminated spill material will be managed as waste and disposed according to applicable, federal, state, and local requirements. In the event of a hazardous substance spill or release, the CH2M HILL Site Superintendent will immediately notify the NAS Pensacola Quarterdeck and follow the NAS Pensacola Spill Response Procedures.

5.5 Endangered Species Protection

The Florida Fish and Wildlife Conservation Commission maintains the state list of animals designated as endangered, threatened, or species of special concern. Two active gopher tortoise (*Gopherus* polyphemus) burrows, which are listed as a Species of Special Concern, have been identified at Bronson Field. One burrow is located approximately 50-feet from the edge of the plume and the other approximately 100 feet. These burrows are clearly marked by the Navy using PVC pipe to prevent disturbance. However, no signs are posted and vehicle and foot traffic by guests and maintenance crews is evident in this area.

5.6 Erosion Control

Throughout the duration of this project, it is anticipated that less than 1 acre will be disturbed; therefore, coverage under FDEP's Generic Permit for Stormwater Discharge from Large and Small Construction Activities is not required. Erosion and sediment controls will be installed prior to, and maintained during land disturbing activities.

During remediation activities that have the potential to disturb the land, CH2M HILL will adhere to the following practices:

- The smallest practical area will be disturbed.
- Trees outside the excavation area will be protected from any construction activity. No ropes, cables, or guy lines will be fastened or attached to any existing trees.
- Temporary erosion and sediment controls will be used to prevent sediment from discharging to any ponds or wetland areas. Structural controls may include the use of

straw bales, silt fences, earth dikes, drainage swales, sediment traps, and sediment basins.

Material staging areas will be properly barricaded for containment and to control run-off.

6.0 Quality Control Plan

This Quality Control Plan details the quality administrators and the project organization for the work to be completed at Site 1159 – Outlying Landing Field Bronson, NAS Pensacola. Specifically, this plan addresses the construction inspections associated with remediation objectives for this site.

The Submittal Register included in Appendix H, documents submittals in accordance with CH2M HILL's Revised Contract Management Plan (CH2M HILL, 2003). CH2M HILL, the Navy, or others will approve submittals as identified in the Submittal Register. Approved submittals will be distributed by CH2M HILL to the appropriate Navy personnel (CO, Resident Officer in Charge of Construction [ROICC] (in duplicate), etc.), the project site, and to the project file.

6.1 QC Organization

The overall responsibility for implementation and enforcement of the Quality Control Plan is assigned to the Project Manager and Project QC Manager. Designated qualified individuals will assume execution responsibility for this plan. These individuals may include the Site Superintendent, Site H&S Specialist, and Project QC Manager. The CH2M HILL Program QC Manager has responsibility for verification of the effectiveness of the project's QC system.

The project organization chart (Figure 6-1) depicts the chain-of-command for this CTO and the individuals responsible for executing the work as indicated. Individual roles and responsibilities of CTO personnel are summarized in Table 6-1.

6.2 Outside Organizations

CH2M HILL assumes overall responsibility for conformance of subcontracted materials and services with quality requirements. However, it is the responsibility of the subcontractors to plan, manage, and accomplish the work in accordance with the project-specific plans, specifications, and local, state, and federal regulations.

Subcontractors report directly to the Site Superintendent and are responsible for completion of the project-specific activities assigned. Subcontractors are also responsible for reporting to the Site Superintendent, who consults with the Project QC Manager about quality issues. Subcontractors verify that their construction activities and materials comply with the requirements of the project-specific plans and specifications. Subcontractors include those organizations providing materials or services to the project. The subcontractors anticipated for this project are:

- System installation and testing services
- Drilling services
- Field piping services
- Waste transportation services

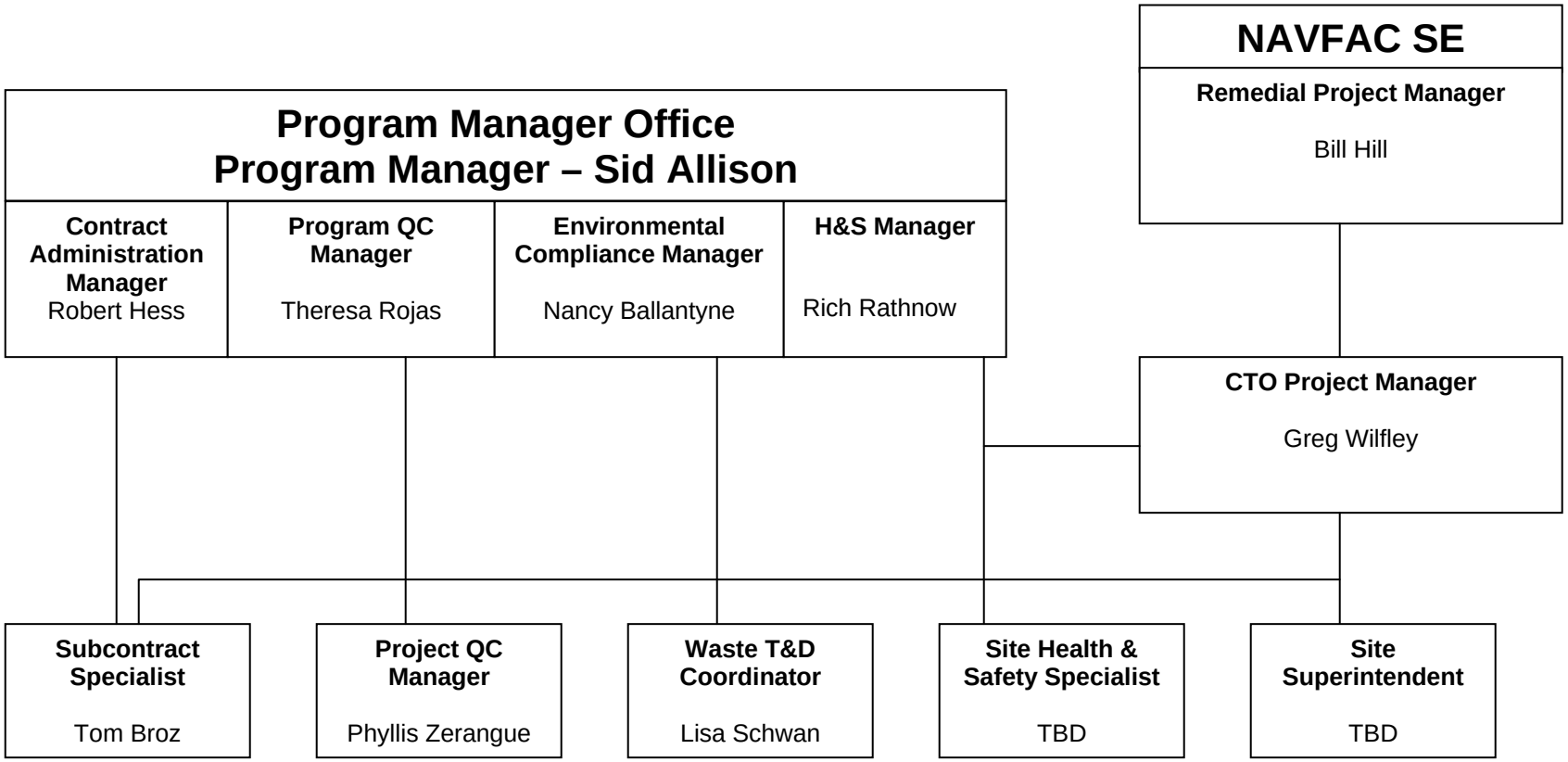

Figure 6-1
Project Organization Chart

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TABLE 6-1
Roles, Responsibilities, and Authorities of Key Project Personnel

Role	Responsibility	Authority
Project Manager	• Communication with NAVFAC SE RPM • Management and Technical Direction of work • Overview subcontractor performance • Select project staff • Develop project Work Plan and supporting plans • Meet Performance Objectives • Prepare status reports	• Approve subcontractor selection • Approve invoices to Southern Division • Approve CTO baseline schedule • Stop work at the site for any reason • Approve payment to vendors and suppliers • Approve payment to subcontractors
Site Superintendent	• Responsible for all site activities • Provide direction to subcontractors • Act for Project Manager • Provide daily status reports • Prepare CTO Work Plan • Conduct daily safety meetings • Review subcontractor qualifications • Stop work for unsafe conditions or practices • Monitor and oversee subcontractor compliance with scope of work • Review requests for changes in scope of work • Review technical qualifications of subcontractors • Prepare Field Change Requests	• Stop work for subcontractors • Approve corrective action for site work-arounds • Approve materials and labor costs for site operations • Resolve subcontractor interface issues • Approve daily and weekly status reports • Approve Field Change Requests below ceiling amount
Transportation and Disposal Coordinator	• Develop site specific procedures for transport and disposal practices • Plan and coordinate the transport and disposal of waste • Review subcontractor qualifications • Audit Transportation and Disposal (T&D) subcontractors compliance with contract requirements	• Approve subcontractors daily report of waste material removed from the site • Approve corrective action plans from T&D subcontractor
Project Assistant	• Maintain CTO files and correspondence • Coordinate CTO schedule and monitor deliverables • Maintain change management records • Maintain Action Tracking System log	• Submit Action Tracking System log • Assign correspondence log numbers
Project QC Manager/ QC Inspector(s)	• Monitor and report on subcontractor quality and quantities • Audit subcontractors offsite fabrication • Maintain Submittal Register • Participate in Continuous Improvement Team • Stop work for non-compliant operations • Maintain Lessons Learned Log	• Stop work for non-compliant operations • File daily quantities report • File Lessons Learned Log Sheet • Approve resumption of work for resolved quality issues

TABLE 6-1
Roles, Responsibilities, and Authorities of Key Project Personnel

Role	Responsibility	Authority
Site Health and Safety Specialist	• Monitor and report on subcontractor safety and health performance • Record and report safety statistics • Conduct needed site safety and health orientation • Maintain Environmental Log • Stop work for unsafe practices or conditions	• Stop work for unsafe practices or conditions • Approve subcontractor site specific health and safety plan • Set weekly safety objectives • Approve resumption of work for resolved safety issues
Subcontract Specialist	• Prepare bid packages • Purchase disposable materials • Maintain subcontract log	

6.3 Submittal Procedures and Initial Submittal Register

CH2M HILL will implement a submittal process for submittals to the Navy. Each submittal will include a transmittal form, properly identifying each submittal. The Project QC Manager is responsible for the completeness and accuracy of the submittals and will be assisted in this task by the Project Manager.

The Project QC Manager will review submittal packages in detail for completeness and compliance with contract requirements for documentation. Exceptions will be noted and expressly stated. This procedure will ensure that field data are adequate for their intended use and meet the contract requirements. Each member of the project QC team in the chain of command is responsible for preparation and review of pertinent QC material and field log documents.

For deliverables, the Project QC Manager will complete his/her review and submit the information to the Project Manager. Following a final review by the Project Manager, applicable data and information relating to the submittals will be forwarded to the Navy. The Project Manager has the authority to sign submittals and present them to the Navy or reject the documents and have them returned to the project team or Subcontractor for revision.

The Submittal Register included in Appendix H, documents submittals in accordance with the CH2M HILL/NAVFAC SE contract. CH2M HILL, the Navy, or others as appropriate will approve submittals as identified in the Submittal Register. All approved submittals will be distributed by CH2M HILL to the Navy representative, the project site, and the project file.

6.4 Testing Plan and Log

Site investigation field-testing will be performed in accordance with the CTO project work plan. The CTO QC Plan Addendum will include provisions to assure that all data collected is of known quality and meets project requirements. The PM and QCM will review this section of the CTO QC Plan Addendum.

Tests may be needed to verify conformance of an item to specified requirements and to demonstrate that the item will perform satisfactorily in service. Tests may also be required to verify techniques for waste minimization or disposal. Such tests will be planned and executed in accordance with the requirements and acceptance criteria of applicable design or other pertinent technical documents.

A Testing Plan and Log, included in Appendix H, will be used to record results of field testing. The Testing Plan and Log will be updated as testing is performed and new testing is identified and scheduled.

6.5 Procedures to Complete Rework Items

A rework item list will be developed and maintained at the site by the Project QC Manager. The list is intended to identify and record the status of those items of work that have been deemed as not satisfying contract requirements. The Contractor QC Report includes provisions for reporting rework items identified during initial and follow-up phases of QC inspections. Rework items identified as a consequence of testing and inspections will be discussed during meetings, at which time, resolution of the nonconformance will be planned and agreed upon.

6.6 Documentation Procedures

As an element to the project quality system, CH2M HILL will deliver the following documentation during this project at a minimum:

- Contractor Quality Control Report
- Contractor Production Report
- Preparatory Phase Checklist
- Initial Phase Checklist
- Field Test Reports
- Monthly Summary Report of Field Tests
- Testing Plan and Log
- Rework Item List
- QC Meeting Minutes
- QC Certifications
- Waste Tracking Log

The documentation will typically be submitted as attachments to the Contractor Quality Control Report.

6.7 Construction Inspections

The Project QC Manager will perform inspections of the materials/equipment and overall work activities. The inspections are performed to ensure safe, efficient, high quality work is performed, while meeting the objectives and requirements of the plans and specifications.

6.8 Definable Features of Work

The project tasks for this CTO are grouped into definable features of work, which are work activities that are significant enough to warrant distinct plans and specifications. The definable features of work for this project are:

- Mobilization and Site Preparation
- Treatment Well and Monitoring Well Installation
- Field Piping/Trenching
- System Installation
- Surveying
- Sampling (aqueous, solid, air, waste)
- System Startup and O&M
- Waste Management
- Cleanup and Site Restoration
- Decontamination and Demobilization

The definable features of work will be inspected in accordance with the three phases of control. The three phases include Preparatory, Initial, and Follow-up. An overview of the inspection provisions is outlined in the subsections that follow.

6.8.1 Mobilization and Site Preparation

As part of the mobilization activity, a pre-construction meeting will be held to review project scope, schedule, communications, and field documentation and reporting. The meeting will verify that site preparation provisions, such as permitting/approvals; utility clearances; demarcation of the work zones; staging of equipment and material; stormwater runoff and erosion controls; as well as other devices to be used at the site, are in place to begin the field activities. Additionally, equipment and materials will be verified functional and in good operational condition prior to starting the field work.

Preparatory Phase

The preparatory phase will include a review of the relevant activity hazard analyses (AHAs), communications matrix, project schedule, submittal status, work zone layout, and confirmation that appropriate materials and equipment are available. A dig permit is in place. Personnel training and medical clearance records will be reviewed.

Initial Phase

Inspections will be made as necessary to ensure construction limits are defined, utilities marked, and material staged in the designated areas. Additionally, equipment will be inspected for operability and proper function. Deficient equipment will not be permitted to operate.

Follow-up Phase

The Project QC Manager will provide continuous oversight of the site preparation activities to verify that the work is completed in accordance with the requirements provided in this work plan addendum. Deficiencies will be documented and corrected.

Task	Inspection Details
Pre-Construction Meeting	• Verify training and medical clearance • Verify Dig Permit in place • Verify designated locations of equipment layout and material staging • Discuss maintaining mark-up drawings and recording field data
Site Preparation	• Review pre-construction and construction quality control submittals to ensure they are approved • Review personnel certifications and licenses for performing particular work • Confirm that field equipment is properly setup and calibrated and in operational condition • Confirm that the materials and equipment are stored properly in accordance with the work plan addendum • Review site security measures • Discuss construction schedule • Ensure the erosion controls are installed properly • Review the H&S plan and PPE requirements • Ensure MSDSs are onsite

6.8.2 Treatment Well and/or Monitoring Installation

Preparatory Phase

The preparatory inspection for treatment well and/or monitoring well installation activities will include review of the construction drawings, the site-specific work plan, and specifications, verifying the submittal approval, confirming qualifications and schedule of the well driller, verifying that appropriate materials are present, and confirming that the appropriate equipment and geologists and/or technicians are available to complete the work.

Initial Phase

Prior to the treatment well and/or monitor well installation activities, the Project QC Manager will complete an initial inspection of the augers to verify that they have been properly decontaminated. The locations of the treatment wells and monitoring wells will be shown on the site plan provided in the work plan. Deficiencies will be documented and corrected as necessary.

Follow-up Phase

A geologist or other approved technical representative and the Project QC Manager will be responsible for oversight of well installation activities. Oversight activities will include verification that the work is being completed according to the technical specifications and the well details provided on the construction drawings. Attention will be placed on total well and screen depth, well materials, and filter pack materials and depths. The Project QC Manager will verify that the installation procedures are completed in accordance with the requirements provided in the work plan, technical specifications, and the well details provided on the construction drawings. Deficiencies will be documented and corrected as necessary.

Task	Inspection/Control
Well Drilling	Confirm that necessary permits, applications, and other required documents have been obtained. Confirm the monitoring well installation location. Confirm that drilling conforms to state and local regulations. Confirm that oversight is provided by a Florida registered geologist or engineer. Confirm that proper decontamination procedures are used. Confirm that the boring is the correct size and depth. Confirm that the well has been developed in accordance with this Work Plan Addendum. Confirm that appropriate drilling activity records are kept.
Well Construction	Confirm that no glue, solvents, or pipe dope is used in the well casing construction. Confirm that new, unused PVC is used for the well casing and an appropriate slot size is used for the screen. Confirm that well screen is placed in correct interval. Confirm that the appropriate filter pack and seal is used. Confirm that the appropriate flush-to-ground well head completion is installed. Confirm that appropriate well construction records are kept.
Well Development	Confirm that development is completed between 24 and 48 hours after construction. Confirm that the number of well volumes of groundwater specifiied in this Work Plan Addundum are removed from the well and pH, temperature, specific conductance, and turbidity have stabilized.
Decontamination and Investigation Derived Waste (IDW) Disposal	Confirm that soil cuttings, purged groundwater, and sampling equipment IDW are disposed according to this Work Plan Addendum. Confirm that sampling equipment is decontaminated or disposed of properly.

6.8.3 Field Piping/Trenching

Preparatory Phase

The preparatory phase for the installation of the pipe and utility trenches will include a review of the site plan, construction drawings, work plan, technical specifications, submittal status, confirmation of appropriate materials and construction equipment, worker qualifications and availability, and equipment availability.

Initial Phase

Initial inspections of the pipe trench will be completed when a representative portion of the trench has been excavated. The Project QC Manager will verify that the depth and slope are being maintained according to the construction drawings and technical specifications.

Follow-up Phase

The Project QC Manager will provide oversight during trench and piping installation activities. The Project QC Manager or Site Superintendent will document the length, depth, and location of the trench, pipe placement, and bedding and cover material in the trench. Daily observation will verify compliance with the construction drawings and technical specifications. Fill activities will be inspected to verify proper placement, soil loading, and compaction, where necessary. The Project QC Manager will conduct inspections to verify that the work, pipe materials, and associated equipment are in accordance with the

construction drawings, the requirements provided in the work plan, and technical specifications. Deficiencies will be documented and corrected.

6.8.4 System Installation

Remediation Enclosure Installation

The remediation system enclosure(s) will be constructed following construction of the foundation pads.

Preparatory Phase

The preparatory phase will include a review of the plans and specifications, review of the work plan, submittal status, confirmation of appropriate materials and equipment, worker qualifications and availability, and equipment availability. A project engineer will visit the manufacturer facility to inspect the equipment prior to shipping to the site.

Initial Phase

Upon arrival at the site, the Project QC Manager will perform an inspection to ensure that the equipment and enclosures have not been damaged during shipping and note deviations from the construction drawings, the site-specific work plan addendum, and specifications and any deficiencies in materials or equipment.

Follow-up Phase

The Project QC Manager will provide continuous oversight of remediation enclosure installation to verify that the work is completed in accordance with the construction drawings, the requirements provided in the work plan, and specifications. Daily observation will verify compliance with the technical specifications. Deficiencies will be noted and corrected.

Equipment Installation

Installation of free product, groundwater, and/or soil treatment equipment will include the electrical and utility connection of the required treatment equipment and associate appurtenances. Depending on the project requirements this could include vapor extraction blower(s), moisture separator, condensation storage tank, aerator, liquid-phase carbon vessels, oil/water separator, free-product storage tank, air compressor, sump pumps, equalization tank, horizontal air compressor storage tank, pneumatic pump installation, and controls. The environmental remediation treatment equipment will be mounted at the appropriate locations on the concrete foundations within the remediation enclosure location.

Preparatory Phase

The preparatory phase will include a review of the construction drawings and the work plan, technical specifications, submittal status, confirmation of appropriate materials and treatment equipment, worker qualifications and availability, and equipment availability.

Initial Phase

Multiple inspections will be required during installation of the equipment. The initial inspection of the treatment equipment installation activities will be initiated following

installation of the remediation enclosure(s) and completed when a representative portion of the equipment has been placed on the slab and connected to the proper utilities. The installation will include the plumbing and electrical connections. The Project QC Manager will perform the inspections and note deviations from the design drawings, the work plan, and specifications and deficiencies in equipment.

Follow-up Phase

The Project QC Manager will provide continuous oversight of the treatment equipment placement, piping, and utility connection activities to verify that the work is completed in accordance with the construction drawings, work plan requirements, and technical specifications. Deficiencies will be noted and corrected.

6.8.5 Surveying

A professional land surveyor registered in the State of Florida will conduct surveying. The registered land surveyor will survey site features and monuments to create a site layout map capturing significant site features. The Project QC Manager is responsible for verifying conformance of coordinate tolerances with the technical specifications.

All survey data must conform to the Tri-Service Spatial Data Standards (TSSDS). These standards shall be applied on all deliverables involving site investigation, site assessment, site verification, remedial investigation, and confirmation sampling activities. Horizontal controls for graphic and non-graphic information are Mercator Projection, GRS 80, State Plane Coordinate System, North American Datum 1983, Lambert Zones 1 through 6 (or appropriate zone for region to be mapped), feet. Vertical controls are Mean Sea Level, North American Vertical Datum 1988.

Task	Procedures/Construction Details
Surveying	• Surveyor qualifications / license (Florida -registered professional land surveyor) • Verification of existing monuments and structures • Instrument calibration and accuracy • Surveying tolerances (horizontal, vertical, contours) (Horizontal controls Mercator Projection, GRS 80, State Plane Coordinate System, North American Datum 1983, Lambert Zones 1-6 (or appropriate zone for region to be mapped)(Vertical controls mean Sea Level, North American Vertical Datum, 1988) • Reference to applicable plane coordinates and vertical datum, information collected in English units (Tri-Service Spatial Data Standards) • Location and layout of the monitoring well, structure locations, and buried utilities • Electronic and hard copy data deliverables

6.8.6 Sampling and Analysis

Sampling and analysis procedures are prepared based on standard protocols established by CH2M HILL and include sampling techniques, frequency, and associated equipment.

Preparatory Phase

The preparatory stage for sample collection activities includes a review of the technical specifications and sampling procedures provided in the work plan, verifying acceptance of the selected laboratory, and confirming that the appropriate equipment and materials are available to complete the sampling activities.

Initial Phase

Waste characterization and incidental waste stream samples will be collected and analyzed at an approved laboratory in accordance with requirements outlined in the work plan or sampling and analysis plan. Sample collection activities including proper chain-of-custody documentation will follow the protocols outlined in the work plan or sampling and analysis plan. Procedures for the collection of pre-excavation, groundwater monitoring well, treatment system, and confirmation samples will be outlined in the work plan.

Follow-up Phase

Sample collection locations and activities will be properly documented throughout each environmental restoration project. Analytical reports from the approved laboratory will be reviewed for accuracy and quality. If required, data validation information from the laboratory will be reviewed to verify discrepancies in the analytical data. CH2M HILL personnel will review and tabulate laboratory data and field sampling results.

Task	Procedures/Construction Details
Field Sampling	• Appropriate sampling equipment and proper decontamination • Document pertinent sampling location information • Acquire copy of offsite laboratory certification • Verify appropriate facilities and testing equipment are available and comply with testing standards • Verify the field instruments are calibrated in accordance with manufacturers' recommendations • Verify recording forms, including all of the test documentation requirements, have been prepared and are accurate and complete

6.8.7 System Startup and O&M

Each treatment system will be started, operated, and maintained for a period required in the CTO. Collection of treatment system and groundwater monitoring well samples from specified locations will be conducted as specified in the work plan. An operation and maintenance manual will be prepared by the equipment manufacturer that documents the required sample collection protocol, system start-up conditions, normal operating conditions, and troubleshooting guides.

Preparatory Phase

Prior to system start-up, the specifications, submittal status, and manufacturer's operating instructions will be reviewed by the Project QC Manager and other site personnel. Start-up will not begin until equipment tests have been completed. Equipment testing will consist of operating the equipment under free flow, atmospheric conditions: SVE will pull 100% from ambient air and AAS will discharge to ambient.

Initial Phase

The initial phase will be completed by the Project QC Manager once start-up has commenced. The Project QC Manager will inspect for gauge and flow readings, leaks, equipment malfunctions, and other deficiencies. Deficiencies will be corrected during start-up activities.

Follow-up Phase

Technical personnel performing operation and maintenance activities will provide oversight of the system operation and collect any necessary treatment system and groundwater monitoring well samples from the groundwater and/or soil remediation system(s). Deficiencies will be documented and corrected. Technical personnel will abide by the operation and maintenance schedule and complete the required activities as specified in the Operation and Maintenance Manual. At the completion of operation and maintenance activities, the treatment system will be turned over to the owner for operation. An operation and maintenance manual, prepared by CH2M HILL will be provided. The Project QC Manager and technical personnel will verify that the system is operating in accordance with the technical specifications.

6.8.8 Waste Management

Liquid and solid wastes may be generated from remediation. These wastes will be characterized, managed, transported, and disposed of in accordance with the SAP and Waste Management Plan of this work plan addendum.

Preparatory Phase

The preparatory phase for transportation and disposal of waste streams includes a review of the disposal facility qualifications; transportation schedule for hauling material offsite; and confirming that the appropriate equipment and materials are available to commence the work activity. Prior to any work, the relevant AHAs will be reviewed and discussed. Temporary storage containers will be inspected prior to acceptance onto the project and labeled.

Initial Phase

This phase includes inspecting the waste transport vehicles prior to accepting on the job. Information provided on the waste manifest must be verified as complete and accurate including, but not limited to, generator name, address and signature, date, type of material being hauled, designated recycling or treatment facility, and volume and/or weight of material. Any discrepancies on waste manifest documents will be corrected.

Follow-up Phase

This phase includes verifying that the designated disposal facility has accepted the waste material at the facility and has sent the required completed manifest to the generator or the generator's technical representative. A field logbook and an electronic log of transportation and disposal shipments will be maintained. Waste storage areas will be visually inspected on a daily basis for releases or signs of corrosion, deterioration, or other conditions. These results of all inspections will be recorded.

Task	Inspections/Details
Waste Management	• Verify qualifications of transporters and disposal facilities • Check manifests • Maintain T&D log • Inspect waste transport vehicles routinely • Inspect waste containers and storage areas on a daily basis

6.8.9 Cleanup and Site Restoration

Disturbed areas will be repaired or rebuilt to return to conditions that existed prior to the initiation of work. All debris resulting from site cleanup activities will be managed as described in Section 0.0 Waste Management Plan.

Preparatory Phase

The project team will review the AHAs associated with the backfill and site restoration activities, inspect the equipment to ensure it is in good working condition and suitable for the work, confirm that it has been adequately decontaminated prior to initiating these activities, review the plan for performing the work, and discuss outstanding items that may affect the start of excavation.

Initial Phase

This phase consists of review of the initial work activities to asses whether the work meets the objectives of the work plan addendum. The Project QC Manager will ensure: the backfill material is properly compacted and suitable for the intended purpose; the sod used as part of the site restoration meets the specifications; final grades match the surrounding area and promote good drain; and proper documentation for these activities is maintained.

Follow-up Phase

This phase includes the verification backfill and site restoration activities performed are acceptable. Inspections will be performed routinely as determined by the Project QC Manager; deficiencies will be documented and corrected immediately. Near completion of the field activities, a pre-final inspection will be coordinated with the RPM.

Inspections will include, but are not limited to the following:

Task	Inspection/Construction Control
Backfill	• Monitor backfill placement and compaction activities. • Verify lift thickness of backfill material. • Verify final grades meet the specifications
Site Restoration	• Verify sod meet specifications • Inspect erosion control measures • Document and correct deficiencies

6.8.10 Decontamination and Demobilization

Equipment utilized to perform intrusive work will be decontaminated in accordance with the provisions of the site-specific Health and Safety Plan. Pre-final inspection for cleanliness will be performed by the Site Geologist and the Site Health and Safety Specialist.

Equipment and personnel will demobilize from the site following the completion of the work activities identified in this Work Plan Addendum. The Project QC Manager will verify that the objectives of associated drilling activities have been met. A final inspection will be conducted to verify completion of all project activities. Findings, should any be identified, will be tracked, resolved, and documented during a final site walk-through inspection.

Preparatory Phase

The preparatory phase will include a review of decontamination procedures, the Health and Safety Plan, and relevant AHAs, and site drawings and maps to ensure all data has been captured. Additionally, deliverable requirements will be reviewed and action dates will be established.

Initial Phase

The site superintendent will perform inspections to confirm that the objectives of the decontamination activities have been met and that the rework items, if any, have been completed to the satisfaction of CH2M HILL and the Navy.

Follow-up Phase

The Project QC Manager will provide continuous oversight of the decontamination and demobilization to verify that the work is completed in accordance with the requirements provided in this work plan addendum. Deficiencies will be noted and corrected.

Task	Procedures/Construction Details
Demobilization	• Pre-final site inspection and develop punch-list items • Inspect work areas to ensure all temporary facilities, equipment and resources are safely removed from the site • Completion inspection when work is substantially complete • Punch lists on outstanding items • Project housekeeping and final project cleaning • Final Site Inspections • Orderly Site Demobilization • Compilation of Site Records & Documents • Complete Resolution of Punch-list items

7.0 References

ACFEE. 1995. Draft Test Plan and Technical Protocol for a Field Treatability Test for POL Free Product Recovery - Evaluating the Feasibility of Traditional and Bioslurping Technologies. Brooks AFB, Texas. January.

Battelle. 1996. Best Practices Manual for Bioslurping for Naval Facilities Engineering Service Center, Port Hueneme, California. June.

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CH2M HILL. 2004. *Remedial Action Plan Addendum Site 1159-Outlying Landing Field Bronson, Naval Air Station Pensacola.* December.

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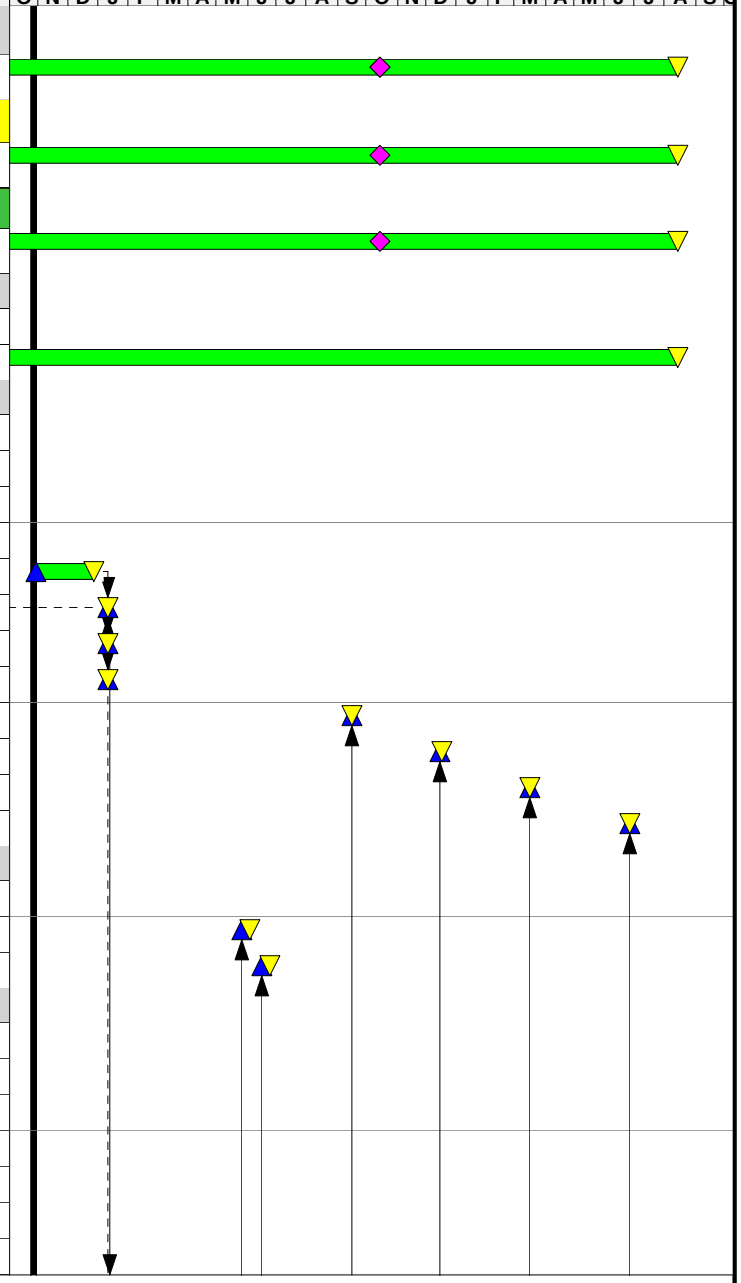
Tetra Tech NUS, Inc. September 2002. Remedial Action Plan For Site 1159, Outlying Landing Field Bronson, Pensacola, Florida.

U.S. Geological Survey (USGS). 7.5-Minute Quadrangle Map for Lillian, Alabama-Florida. 1987.

Appendix A

Project Schedule

Activity ID	WBS CHARGE #	% Comp	Activity Description	Orig Dur	Rem Dur	Early Start	Early Finish
CTO #0071 - NAS Pensacola, FL							
Subtotal		39		1,531	456	08AUG03A	13AUG09
PHASE 3							
Subtotal		39		1,531	456	08AUG03A	13AUG09
PHASE 3 - SITE 1159							
Subtotal		39		1,531	456	08AUG03A	13AUG09
PROJECT MANAGEMENT							
B898220101	98.22.01.01	100	Project Management - Site 1159	771	0	08AUG03A	27NOV06A
B898220102	99.22.01.01	25	Project Management -Site 1159	671	456	27NOV06A	13AUG09
MOBILIZATION & PREPARATORY WORK							
B832010300		100	System Optimization Study	34	0	30MAY06A	17JAN07A
B898010291	98.01.02.91	100	CCI Mobilization - Site 1159	1	0	27NOV06A	27NOV06A
B832010310	32.01.03.30	100	RAP Addendum	20	0	17JAN07A	11JUL07A
B832010315		100	RAP Addendum Approval	20	0	12JUL07A	08AUG07A
B832010396	32.01.03.96	0	Gopher Tortoise Permit	40	40	29OCT07	26DEC07
B832010292	32.01.02.92	0	Subcontractor Mobilization	1	1	11JAN08	11JAN08
B832221209	32.22.12.09	0	Subcontractor's P&P Bond	1	1	11JAN08	11JAN08
B898010292	99.01.02.91	0	CCI Mobilization - Site 1159	1	1	11JAN08	11JAN08
B832010291	32.01.02.91	0	Mobilization of Sampling Crew	1	1	15SEP08	15SEP08
B832010293	32.01.02.91	0	Mobilization of Sampling Crew	1	1	15DEC08	15DEC08
B832010294	32.01.02.91	0	Mobilization of Sampling Crew	1	1	16MAR09	16MAR09
B832010295	32.01.02.91	0	Mobilization of Sampling Crew	1	1	26JUN09	26JUN09
ENGINEERING, SURVEY & QC							
B898220426	98.22.04.26	100	Project QA/QC Audit - Site 1159	5	0	27NOV06A	27NOV06A
B898220427	99.22.04.26	0	Project QA/QC Audit - Site 1159	5	5	27MAY08	02JUN08
B832210606	32.21.06.06	0	As-Built Survey	5	5	17JUN08	23JUN08
MONITORING, SAMPLING, TEST & ANALYSIS							
B832020490	32.02.04.90	100	DPT Well Installation	10	0	06APR04A	19APR04A
B832020492	32.02.04.92	100	HSA Well Installation	5	0	06APR04A	12APR04A
B832020590	32.02.05.90	100	GW Sampling & Analysis	10	0	23AUG04A	27AUG04A
B832020592	32.02.05.92	100	Aquifer Sampling & Analysis	3	0	23AUG04A	25AUG04A
B832021106	32.02.11.06	100	Data Collection Tests	3	0	23AUG04A	25AUG04A
B832029090	32.02.90.90	100	Recovery Well Test	7	0	23AUG04A	31AUG04A
B832029092	32.02.90.92	100	Bail Down Test	4	0	23AUG04A	26AUG04A



Start Date 03AUG98
Finish Date 13AUG09
Data Date 27OCT07
Run Date 15NOV07 14:44

Early Bar
Progress Bar
Critical Activity

NFAC - CO71

Sheet 1 of 2

CTO #0071 - NAS Pensacola, FL
CTO COMPLETION SCHEDULE
NAVY RAC SOUTHERN DIVISION

CH2MHILL

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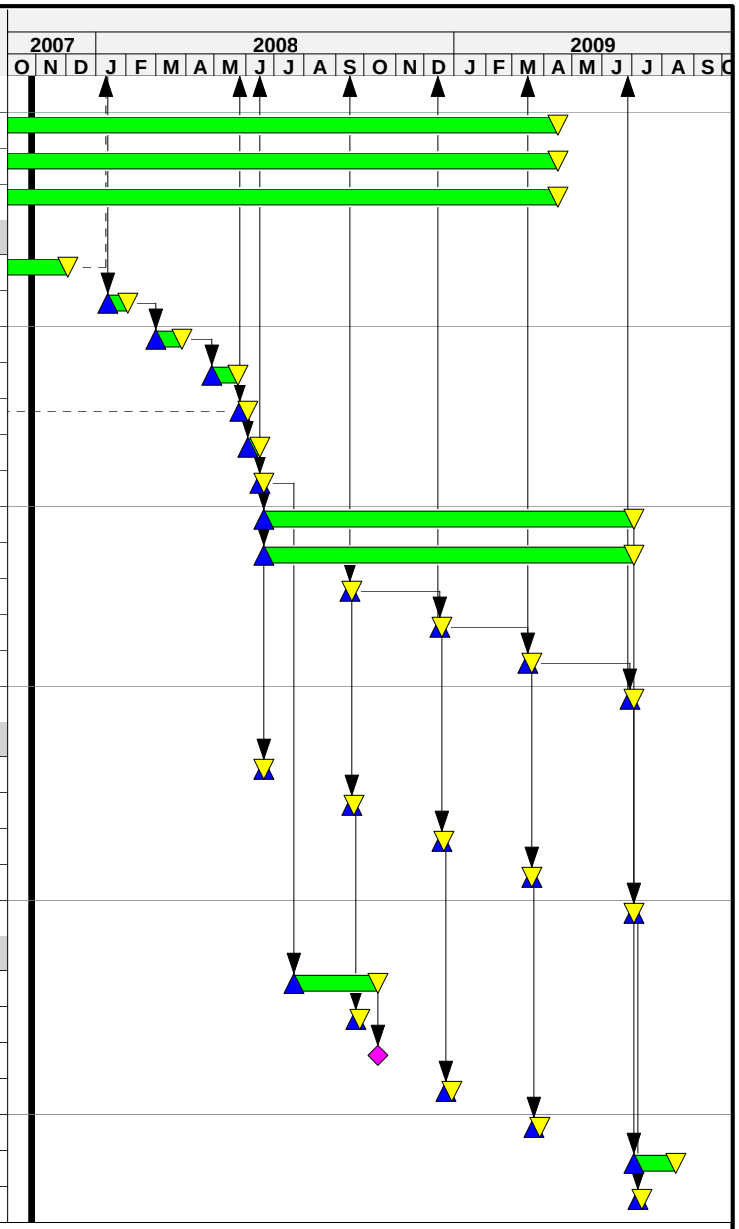
Activity ID	WBS CHARGE #	% Comp	Activity Description	Orig Dur	Rem Dur	Early Start	Early Finish
B832029094	32.02.90.94	100	Bioslurping Test	12	0	23AUG04A	23AUG04A
B832020905	32.02.09.05	25	Waste Characterization	499	372	27AUG04A	15APR09
B832021490	32.02.14.90	25	Independent Data Validation	499	372	27AUG04A	15APR09
B832021491	32.02.14.91	25	Data Evaluation & Management	499	372	27AUG04A	15APR09
PHYSICAL TREATMENT							
B832139090	32.13.90.90	0	Bioslurping Procurement	60	24	08AUG07A	03DEC07
B832139092	32.13.90.92	0	Well Installation	15	15	14JAN08	01FEB08
B832139094	32.13.90.94	0	Collection System	20	20	03MAR08	28MAR08
B832139096	32.13.90.96	0	Treatment System	20	20	28APR08	23MAY08
B832139290	32.13.92.90	0	Baseline Sampling	5	5	27MAY08	02JUN08
B832139291	32.13.92.91	0	System Start-Up	10	10	03JUN08	16JUN08
B832139292	32.13.92.92	0	Start-Up Sampling	3	3	17JUN08	19JUN08
B832139295	32.13.92.95	0	System O&M	262	262	20JUN08	01JUL09
B832139296	32.13.92.96	0	System Monitoring	262	262	20JUN08	01JUL09
B832139297	32.13.92.97	0	GW Monitoring	3	3	16SEP08	18SEP08
B832139298	32.13.92.97	0	GW Monitoring	3	3	16DEC08	18DEC08
B832139299	32.13.92.97	0	GW Monitoring	3	3	17MAR09	19MAR09
B832139300	32.13.92.97	0	GW Monitoring	3	3	29JUN09	01JUL09
DEMOBILIZATION							
B898210590	99.21.05.90	0	CCI Demobilization - Site 1159	1	1	20JUN08	20JUN08
B832210591	32.21.05.91	0	Demobe of Sampling Crew	1	1	19SEP08	19SEP08
B832210592	32.21.05.91	0	Demobe of Sampling Crew	1	1	19DEC08	19DEC08
B832210593	32.21.05.91	0	Demobe of Sampling Crew	1	1	20MAR09	20MAR09
B832210594	32.21.05.91	0	Demobe of Sampling Crew	1	1	02JUL09	02JUL09
POST CONSTRUCTION							
B832210605	32.21.06.05	0	Construction Documentation Report	60	60	21JUL08	13OCT08
B832210607	32.21.06.07	0	Quarterly Report	5	5	22SEP08	26SEP08
B832210610		0	Submit Construction Documentation Report	0	0		13OCT08
B832210608	32.21.06.07	0	Quarterly Report	5	5	22DEC08	29DEC08
B832210611	32.21.06.07	0	Quarterly Report	5	5	23MAR09	27MAR09
B832210609	32.21.06.09	0	O&M Manual	30	30	02JUL09	13AUG09
B832210612	32.21.06.07	0	Quarterly Report	5	5	06JUL09	10JUL09



Appendix B

FDEP SOPs for Trimming Trees

CIR853

Pruning Landscape Trees and Shrubs[1]

Edward F. Gilman and Robert J. Black[2]

Pruning is the removal of plant parts, typically shoots, branches, fronds and flowers to improve health, control growth or influence fruiting, flowering or appearance. Roots can also be pruned and removed if they circle close to or are resting against the trunk. Pruning should be a routine part of home-ground maintenance and not delayed until the landscape is overgrown. Overgrown plants can be tall and leggy with little foliage close to the ground, and cannot be pruned to desired size in a single pruning without severely damaging the plants. These plants should be pruned back gradually over a period of several years.

The objective of this document is to present pruning techniques for Florida trees, shrubs and palms. The need for pruning, timing, types of pruning, tree pruning, shrub pruning and tools are discussed separately. Specific examples will support the pruning concepts.

Minimize Pruning Needs with Proper Plant Selection

Proper tree selection at the nursery can eliminate early pruning requirements (Figure 1). Defects such as clustered branches can begin in the nursery and they should be corrected there. Shade trees should meet Florida #1 standards or better, and have one dominant trunk. Those with more than one trunk will have to be pruned soon after planting.

Why Prune?

Proper plant selection can eliminate much of the pruning requirements in today's landscapes. Unfortunately, plants are frequently placed in the landscape according to their current size and shape, not the size which the plant is likely to attain in five or more years. The homeowner or landscape manager soon finds it necessary to clip or prune plants frequently to keep them within bounds. For instance, frequent pruning is assured when photinia shrubs are selected as foundation plants, since this plant can quickly grow to 25-30' tall. Utilizing a low-growing, compact shrub in such a location would greatly reduce or eliminate required pruning. It is less time

1. This document is Circular 853 (MG087), Environmental Horticulture Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. This document supersedes The Woody Ornamentalist, Vol. 14, No. 7 (published July 1989) and Special Series #2, SS-ORH-902, both titled Pruning Ornamental Trees and Shrubs. This information supports Environmental Landscape Management, i.e., landscape design and management for environmental horticulture. Publication date: June 1990. Reviewed: August 1994. Revised June 2005.

2. Edward F. Gilman, professor; Robert J. Black, professor emeritus, Environmental Horticulture Department, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville FL 32611. For more information, contact your county Cooperative Extension Service office.

The Institute of Food and Agricultural Sciences (IFAS) is an Equal Opportunity Institution authorized to provide research, educational information and other services only to individuals and institutions that function with non-discrimination with respect to race, creed, color, religion, age, disability, sex, sexual orientation, marital status, national origin, political opinions or affiliations. U.S. Department of Agriculture, Cooperative Extension Service, University of Florida, IFAS, Florida A. & M. University Cooperative Extension Program, and Boards of County Commissioners Cooperating. Larry Arrington, Dean

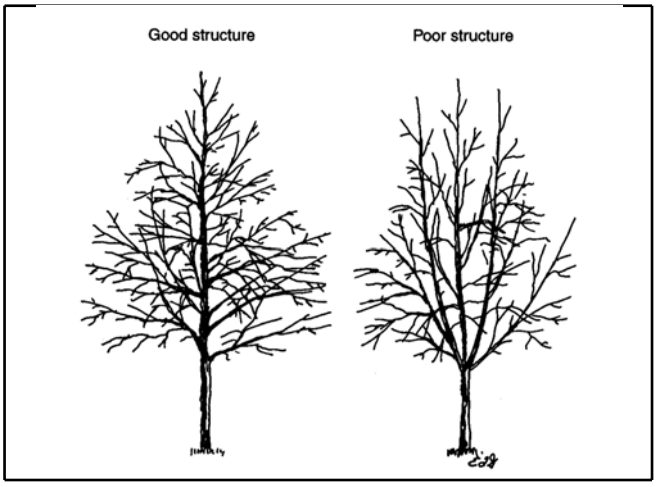


Figure 1. High quality medium and large-maturing shade trees have one dominant leader (left), whereas poor quality trees have several codominant stems (right).

consuming and less costly to select and install the proper sized plant than to choose one which will require frequent, timely pruning. Ask your nurseryman or consult a reliable source for growth rate and size of desirable plant species. If a plant needs to be pruned several times each year to control size, it may be the wrong species for that location. Many prunings can be eliminated by proper plant selection and this can save space in landfills by reducing the volume of yard waste.

Plants may be pruned for a number of reasons. Determine why you are pruning a plant before beginning.

Maintain or Improve Health or Vigor

Removal of dead, dying or damaged branches and diseased and insect infested plant parts is an effective way to limit the spread of decay, disease and insects to other portions of the plant or to neighboring plants. For example, if several branch tips are infested with aphids or scale, prune and discard the affected shoots. This can be an effective alternative to spraying insecticides if the infestation is small and localized. Weekly checking is often necessary to detect a disease or an infestation in the early stages.

Control Plant Size and Form

A common objective of pruning is to maintain or develop a desired size or form. However, this can be largely eliminated by installing the proper species or cultivar and by not over fertilizing. Many compact and dwarf shrubs are now available at retail garden centers. Selective pruning can shape plants or produce either a thin or thick canopy. A thinner canopy edge will allow more light penetration and help keep interior leaves on the plant. Root pruning can be used to slow plant growth, producing a more compact plant. Prune one half the root system, wait 4-6 weeks, then prune the other half. Root pruning should be scheduled so roots will be watered thoroughly to keep the soil moist for 4-6 weeks following root pruning.

Training Young Plants

There are several reasons to train plants. Pruning young trees so they have good branch structure can dramatically influence their long-term health, function and longevity. Snipping branch ends on young shrubs encourages branching and fullness, which are frequently desirable characteristics of landscape plants.

Branch spacing and arrangement and the ultimate structural strength and safety of a tree can be controlled by selectively removing or shortening branches on a young plant (Figure 2).

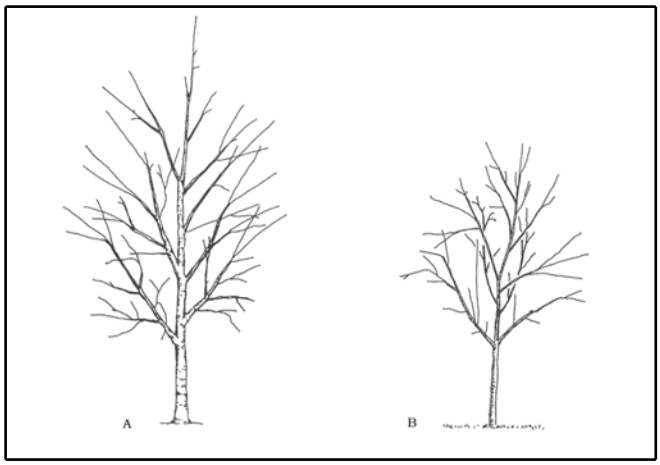


Figure 2. (A) Desirable form and branching pattern on a young, large-sized shade tree such as live oak, mahogany, or southern magnolia. Major limbs are spaced apart along the trunk, not clustered at the same point on the trunk. (B) Desirable form on a young, small-sized patio tree such as dogwood, trumpet tree, or frangipani. Major limbs can be spaced closer together on the trunk.

Encourage only one central trunk to develop by removing or reducing the length of competing, upright trunks or branches (Figure 3).

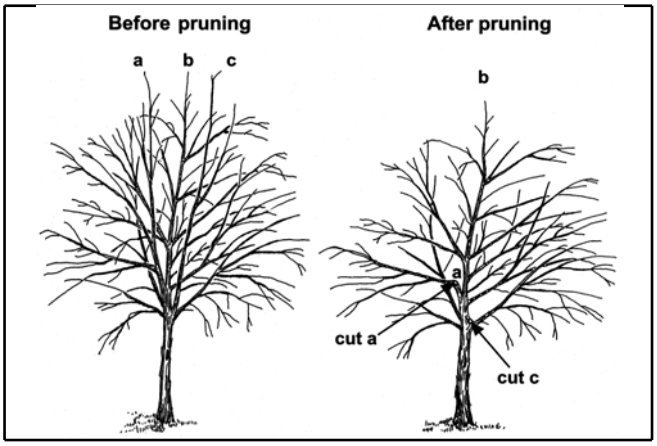


Figure 3. Reduce the length of (subordinate) leader a using a reduction cut to encourage leader b to grow faster. Remove leader c back to the trunk. After pruning, the tip of leader b should be much higher than the tops of all other stems. This technique will help leader b become the dominant trunk by slowing growth on competing leaders and allowing more sunlight to reach b. In most cases on large-maturing trees, branches in the lower 15 to 20 feet of the tree should be kept smaller than half the trunk diameter using this technique. Those same branches should not be allowed to grow up into the tree to become a permanent part of the canopy. Notice that branches are spaced along the trunk.

This should begin within the first 2-3 years after planting. Tree training continues for 20 or more years on large-maturing species. Frequent light prunings several times each year encourage faster growth and prevent undesirable sprouting compared to one heavy pruning each year. Pruning trees every year or two results in a nicer tree than waiting 4 or 5 years in between pruning sessions. In all but the highest maintenance landscapes, do not attempt to dramatically alter the natural form; instead, choose a species which has more of a natural tendency to grow into the desired form. For example, a river birch, red maple or tabebuia would be better suited as a shade tree in a narrow vertical space than would live oak.

Plants can be pruned into different shapes such as balls, squares, rectangles or animal figures to create special effects. This practice (topiary) has become popular in recent years, but plants pruned in this manner become focal points and should be used sparingly in most landscapes. Topiaries can be grown by planting a small-leaved plant such as boxwood, yaupon holly or natal plum and training the plant into a specific form. Another technique utilizes a wire mesh frame which is packed tightly with sphagnum moss. Appropriate plant species including begonias, ivy and creeping fig can be planted in the sphagnum, forming a fully grown topiary in several months to two years.

The practice of growing plants against a wall (espalier) or on a trellis requires frequent pinching and pruning. Plants trained in this manner are specimen plants and not all plants are adaptable to this pruning technique. Pyracantha, sea grape, *Fatshedra*, magnolia, yaupon holly, loquat and others make excellent espalier plants.

Plants which many consider as large shrubs such as photinia, wax myrtle and pittosporum can be trained into small trees by gradually removing over a period of 1-3 years, all the foliage and small branches from the lower portion of one or more stems. Small branches left along the lower trunk will build trunk caliper and create a sturdier tree. The longer they remain on the trunk, the thicker and stronger the trunk becomes.

Influence Flowering and Fruit Production

Larger fruit on certain species can be produced by selectively removing flowers or developing fruits. Those remaining will be larger. Light pruning helps to maintain annual flowering and fruiting on fruit trees. Severe pruning on plants which flower on current season's growth such as crape myrtle will generally stimulate vegetative growth and produce fewer, but larger flower clusters. Pinching new vegetative growth during the growing season will stimulate growth of lateral shoots which on species which flower terminally (e.g. azalea, cassia, crape myrtle) will increase the number of blossoms produced. Remove developing seed heads on crape myrtle to promote a second and perhaps a third flower display.

Safety Pruning

The manner in which stems are attached to each other and to the trunk influences the structural strength of the tree. Remove branches with bark inclusions having narrow V-shaped crotches in favor of wider-angled U-shaped crotches (Figure 4).

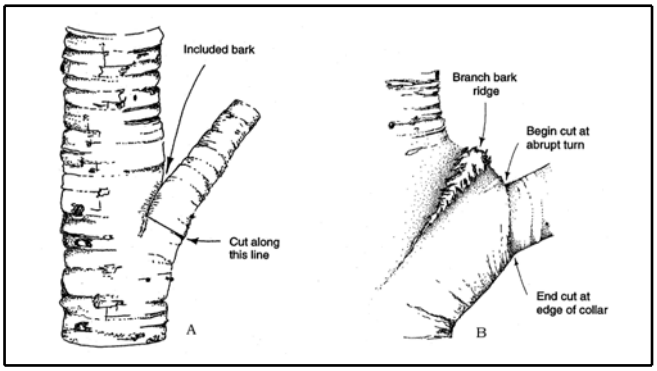


Figure 4. (A) Remove or reduce limbs with bark inclusions. They are poorly attached to the tree and can split from the tree as they grow older. Included bark is bark that is squeezed between stems. The union of the two stems appears as a "V." (B) Retain limbs with raised bark at the union of the stems. The crotch between these stems appears as a "U" and represents a strong union between stems.

Large decayed, broken, cracked or poorly attached tree limbs should be recognized and promptly removed by a professional before they fall. Remove dead branches and branch stubs since they can lead to serious trunk decay (Figure 5). Periodic tree inspection by a professionally trained tree specialist (arborist) can help prevent these situations from developing into unsafe conditions.

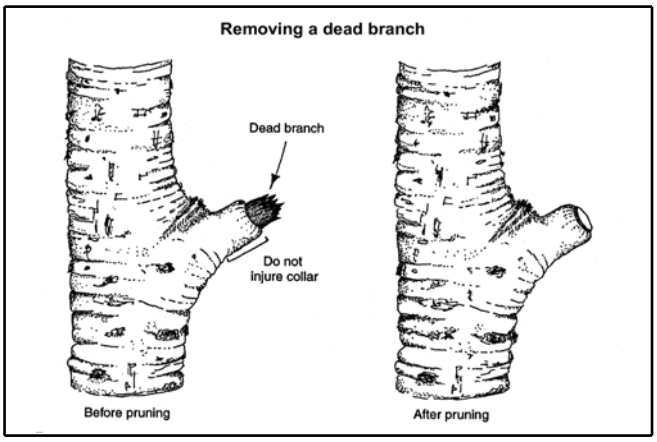


Figure 5. Proper removal of a dead branch. Do not cut into the swollen collar growing around the dead branch. This will injure the trunk, since the collar is composed of trunk tissue.

Rejuvenate Old Plants

Sometimes a shrub which is not growing well despite receiving adequate light, water and nutrients can be invigorated or "shocked" into growing by severe pruning. Typically, the plant either dies or begins growing vigorously in response to this drastic treatment.

Pruning at Transplanting

Shoot pruning for the purpose of compensating for root loss at transplanting is not recommended. Prune only to remove dead, diseased, crossed, rubbing or broken branches. About one year after transplanting, begin pruning to develop appropriate form and structure.

When to Prune

Trees and shrubs can be lightly pruned anytime. To minimize reduction of next year's flowers, prune spring-flowering plants such as azaleas, spireas, trumpet trees and dogwoods in late spring before the flower buds set for the next season (Table 1). These plants set their flower buds on the previous season's growth and the buds over winter on this older growth. For example, dogwoods and azaleas form flower buds in July for the following year's flower display. Pruning or pinching between the end of the flower display and late spring would not reduce the number of flower buds set. Pinching the new shoots on azalea anytime from several weeks after they begin elongating through May will encourage lateral branching. Each of these laterals is likely to develop a flower bud. Thus the pinched plant produces many more flowers the following year, than an unpinched plant (Figure 6). Pruning between July and the flower display would remove flower buds and reduce the flower display but should not affect the health of the plant.

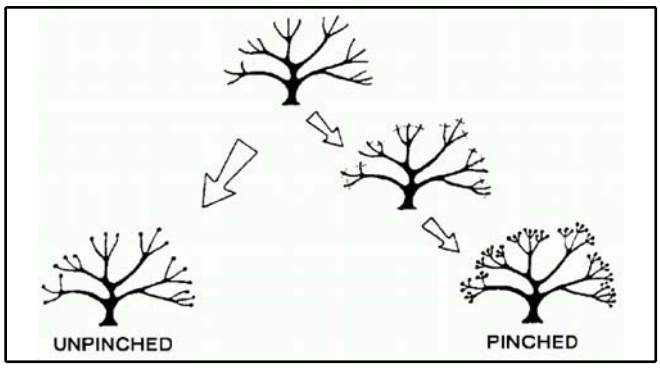


Figure 6. Pinching new spring or early summer growth on plants which flower on subsequent shoot growth will encourage more flower bud formation for next year's flower display. Azalea respond well to pinching.

Plants that produce flowers on current season's growth such as abelia, crape myrtle, hibiscus and rose are usually pruned while dormant or just before the spring growth flush (Table 2). Developing shoots can be pinched to encourage lateral branching which will enhance the flower display. Moderate to severe pruning may encourage production of fewer but larger blossoms or blossom clusters.

It is best to prune trees such as oaks, mahogany, black olives, hickory, and other large shade trees during the dormant season or just following a growth flush. They can be pruned at other times, but avoid pruning when trees are emerging from dormancy or entering dormancy.

Most evergreens such as podocarpus, jasmines, holly, boxwood, ligustrum, juniper and wax myrtle can be pruned anytime. Terminal growth of pines can be controlled by removing one-half of the candle in the spring just prior to needle expansion (Figure 7). This encourages new bud formation at the pinch, slows growth on the pinched branch and creates a more compact plant. New buds will not form behind pruning cuts made into older wood.

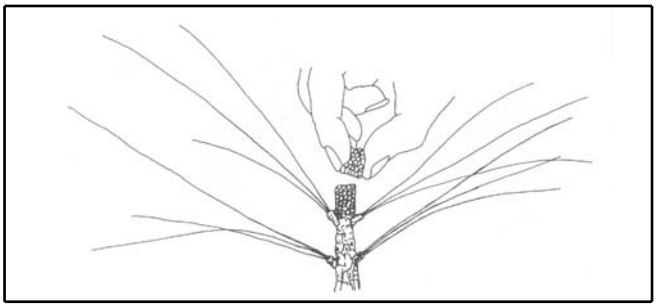


Figure 7. Prune pines by pinching one-half of the candle, or new shoot, before the needles elongate.

To encourage rapid shoot development and greatest overall plant growth, prune just prior to the first spring growth flush. To retard growth for maximum dwarfing effect, prune just after each growth flush. Late summer pruning may stimulate an additional flush of shoot growth on species which flush several times each year. These shoots could be damaged by an early frost.

Closure of pruning wounds on most trees and shrubs should be most rapid if pruning is conducted just before, or immediately following the spring growth flush. This is desirable because a closed wound is more aesthetically pleasing, and insects, diseases and decay organisms are discouraged from entering the plant. Late fall and early winter pruning can stimulate new growth, particularly during a mild period during the winter. These succulent stems are not cold hardy and can be easily damaged, even by a light frost. Low winter temperatures can also cause cambium damage near pruning cuts, even if growth is not stimulated by pruning. This is particularly true of plants which are marginally hardy. If in doubt about cold susceptibility, it is best to delay heavy pruning to just before growth begins in the spring.

Some trees such as birch, maple, dogwood, elm and walnut bleed sap from pruned wounds if they are pruned during late winter or early spring. This "bleeding" is not harmful to the tree, but the dripping sap is often objectionable. Trees which show this tendency should be pruned in late fall or early winter.

Pruning Techniques

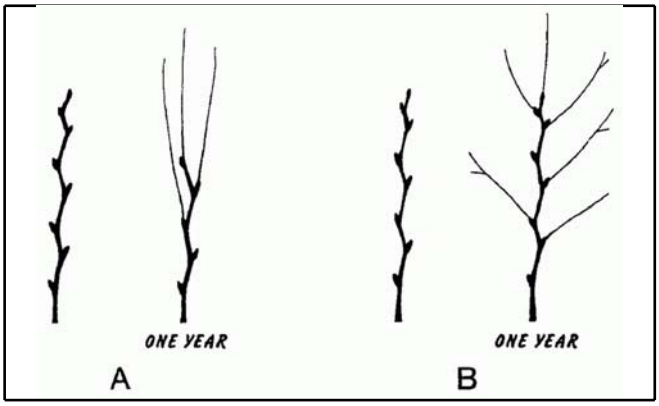


Figure 8. (A) Heading a young unbranched shoot will force two to four buds back from the cut into vigorous upright growth. Undesireable multiple leaders with included bark will develop on trees from this type of pruning, so it is not recommended; however, properly placed, these cuts can create and maintain a nicely formed shrub. (B) Growth from an unpruned shoot will be more typical of the natural form and more uniformly distributed along the stem. Note the horizontal branching habit.

Heading (Figure 8) is the selective cutting of terminal ends of twigs or young branches back to an axillary bud or node. This technique produces a shorter shrub. However, new growth is typically vigorous and upright, developing from two to several buds just behind the pruning cut. The new foliage may be so thick that it shades the lower growth forming a top-heavy plant. This can be avoided in

shrubs by heading shoots to several different heights (Figure 9).

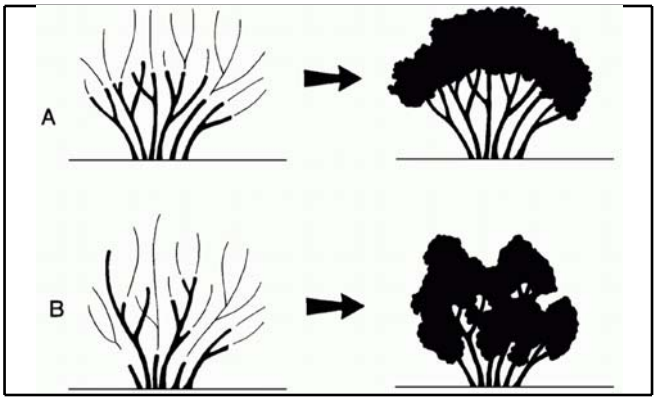


Figure 9. Heading shrubs is cutting back terminal shoots to a bud or node. (A) Heading all shoots to the same height produces a leggy, top-heavy shrub. (B) Heading shoots to several different levels poduces a more natural, fuller-looking shrub.

Heading (stubbing) trees is rarely warranted in landscape sites. Never "hat-rack" a landscape tree, i.e., cut all branches back to about the same length without regard for their location (Figure 10).

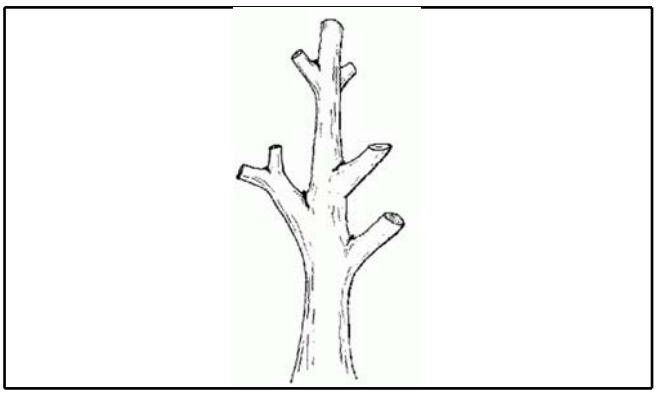


Figure 10. Never "hat-rack" a tree by heading back all branches to an indiscriminate location.

This type of pruning has no place in horticulture and is not recommended. When heading trees or shrubs, make the cut on a slight slant 1/4 inch above a healthy bud (Figure 11). The bud should be facing the direction preferred for new growth.

Thinning (Figure 12) is the complete removal of branches back to lateral branches, the main trunk, or in shrubs, to the ground. Thinning gives a plant an open appearance and can encourage new growth inside the crown depending on how the plant is thinned. If thinning is heavy, interior sprouts will develop. If the plant is lightly thinned, interior shoots

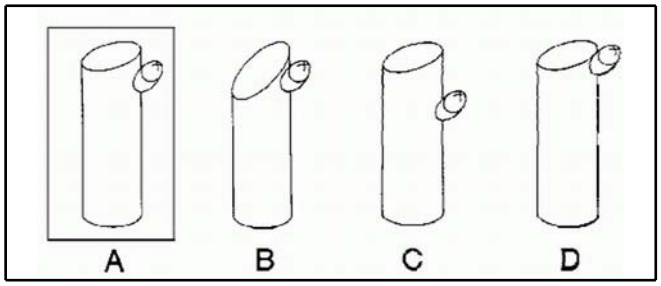


Figure 11. Proper pruning angle. "A" is a correct cut, "B" is too slanted, "C" is too far from the bud, "D" is too close to the bud.

are not likely to develop. This technique is used primarily on shrubs to make the canopy appear more open and see through. It contrasts to hedging or heading to the same spot on all branches which gives a shrub a manicured, controlled appearance. Trees can be thinned to increase light penetration, encouraging turf and shrub growth beneath the tree. Trees with properly thinned crowns also resist wind damage better than unpruned trees. This is a specialized technique best performed by a professional arborist. Removing live branches from mature trees can cause stress on the tree and harm it. Consider other alternatives first.

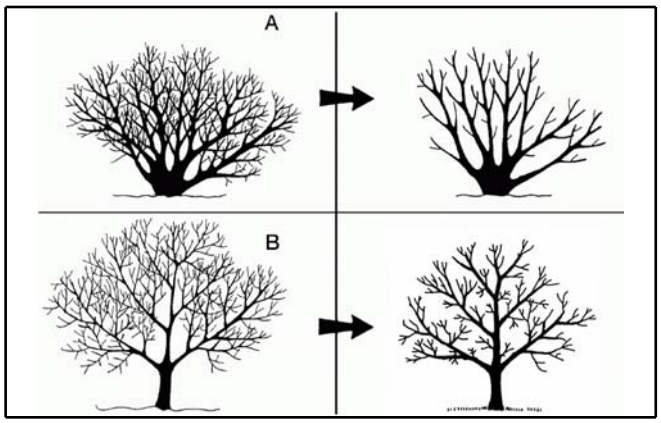


Figure 12. (A) Thinning shrubs is the complete removal of branches back to a lateral or the main trunk, or to the ground. (B) Proper thinning of shade trees removes branches at the edge of the canopy to create an open canopy.

Pruning Shrubs

The first step in pruning a shrub is to remove all dead, diseased, or injured branches. Pruning shears and saws can be dipped in a weak alcohol solution (1 part to 9 parts water) to prevent spread of disease between plants. Remove branches that cross or touch each other and those which look out of place. If the

shrub is still too dense or large, remove some of the oldest branches. Head back excessively long branches to a bud or lateral branch that is 6 to 12 inches below the desirable plant height. If the shrub is 2 to 3' too tall, heading (Figure 9) and thinning (Figure 12) may be desirable. Cut each branch separately to different lengths with hand pruners. This will maintain a neat informal shrub with a natural shape. Plants sheared into various geometric shapes produce a formality not suitable for many modern, natural landscapes. See the following section on hedge pruning for a discussion of formal pruning.

A properly pruned shrub is a work of art and beauty and does not look as if it has been pruned. Pruning cuts should not be visible, but located inside the plant, covered up by remaining foliage.

Rejuvenation of Shrubs

Rejuvenation is a drastic method of pruning old shrubs that have become much too large or have a large amount of non-flowering wood. On single-stem shrubs such as ligustrum and gardenia, rejuvenation is carried out over a period of 2-3 years by severe thinning out to the basic limb framework (Figure 13). One-third to one-half of the old growth is removed each year.

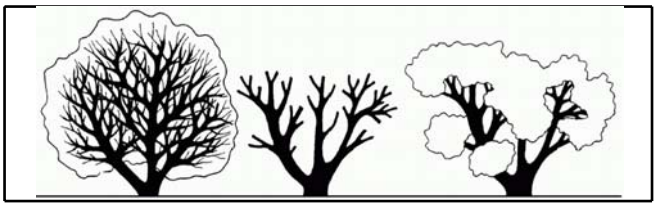


Figure 13. Rejuvenation on single stem shrubs is carried out by pruning much of the older branches and stems back to the basic framework.

Multiple stem shrubs are rejuvenated by cutting back all stems at ground level over a period of 3 years (Figure 14). Remove 1/3 of the old, mature stems the first year. The second year remove 1/2 of the remaining old stems and head back long shoots growing from the previous year's pruning cuts. The third season remove the remaining old wood and head back the long new shoots.

The best time for rejuvenation is in late winter or early spring, just before growth begins. Large, old shrubs should not be rejuvenated during late summer,

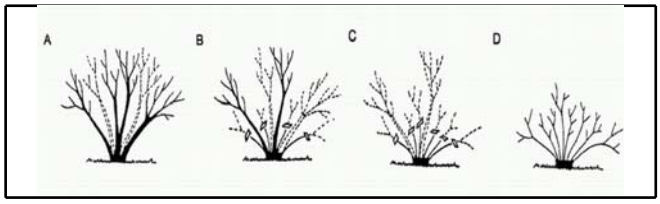


Figure 14. Rejuvenation of multiple stem shrubs. (A) First year, remove 1/3 of old, mature stems near ground level. (B) Second year, remove 1/2 of the remaining old stems and head back long regenerated shoots from last year's growth. (C) Third year, remove the remaining old stems and head back the long new shoots. (D) Growth at the end of the third season (rejuvenated shrub).

as new growth will be stimulated and possibly killed by cold weather in the winter.

Pruning cane-type shrubs such as nandina and mahonia is best done on a 2 or 3-year cycle. The tallest canes are pruned to a stub 3"-6" above the soil line during the first spring, just as growth begins. By the second spring, last year's medium sized canes have grown to become tall canes and should be cut back to a 3" stub. Canes from the first year's pruning have already begun to grow and are one to three feet tall by now. In the third spring, the canes which were the shortest in the first spring are now fairly tall and can be cut back. In this way, there is always foliage near the ground and the shrubs can be kept from becoming leggy. Cut nandina canes generally will not flower during the growing season following pruning.

Pruning Trees

First, prune out dead, diseased or broken twigs and branches. After studying the tree form, select the best spaced and positioned permanent branches and remove or shorten others on young trees. Permanent branches should be spaced between 6-24 inches apart on the trunk, depending on the ultimate mature size of the tree. For trees that remain small at maturity, 6" spacing is adequate; whereas, for oaks and other large shade trees, 18-24" spacing is best (Figure 15). Next, remove fast growing suckers at the base of and along the trunks. Sprouts along branches should be left intact in most cases. They typically indicate a struggling tree attempting to grow its way to health.

Trees should be pruned to one dominant leader (stem) after locating the straightest and best leader to retain (Figure 3 and Figure 17).

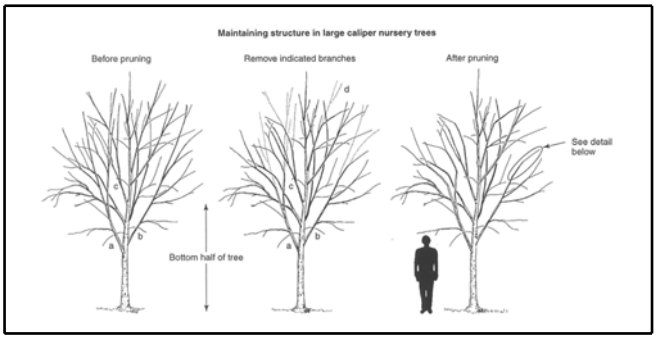


Figure 15. Shorten limbs a, b, and c because they are growing into the upper third of the canopy and they originate from the bottom half of the tree (left). Most, if not all, of these shortened limbs will eventually be removed from the tree as it grows in the landscape. They were shortened using reduction cuts (center). If the lateral branch left after making a reduction cut is too long, also shorten the lateral branch with a reduction cut (bottom detail). This essentially results in making two reduction cuts to accomplish subordination of a limb. Branch d was shortened because it was forming a codominant stem in the upper canopy (center).

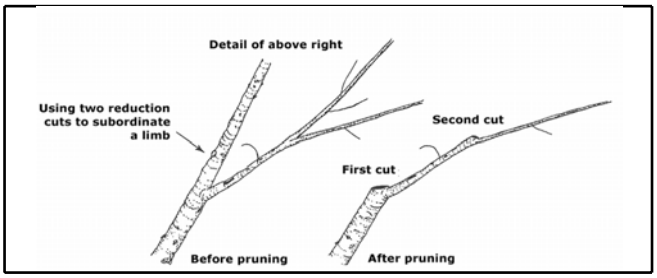


Figure 16.

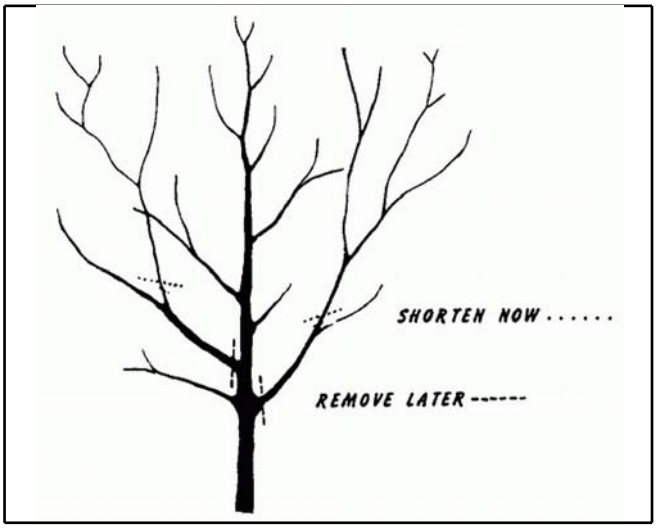


Figure 17. In forming the tree over a two-year period, remove lateral branches that grow upright. They will compete with the leader and form a weak, multiple-leadered tree.

Most shade trees can be grown in this form when they are young, but the growth habit of some species will change to a multi-leader spreading form as they mature. There should be no narrow forks or branches leaving the trunk at an acute angle (Figure 18). If there are, then reduce their length cutting back to a lateral branch at least half the diameter of the removed stem. Reduce length of stems and branches with bark inclusions (Figure 17).

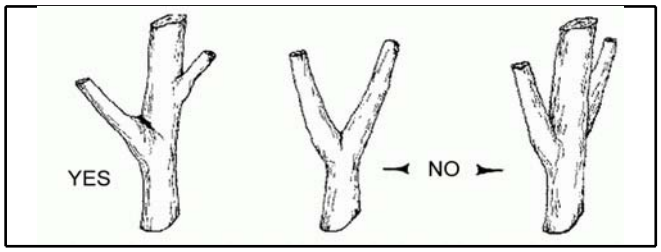


Figure 18. Branches that are small in relation to the trunk are well attached (left). Those that are the same size are not as well attached (center and right). Forked trunks can be dangerous. One of the forks should be reduced in length.

Removing Large Tree Branches

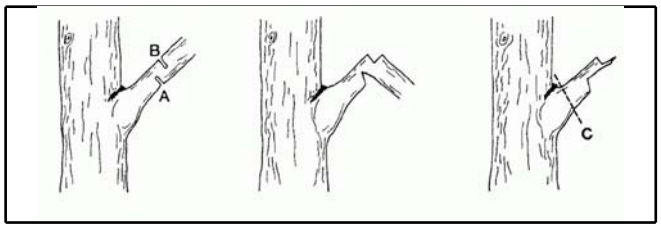


Figure 19. Removing a tree branch over 1 1/2" diameter. First cut at "A" until saw binds, then cut at "B" 2-4" beyond "A" until the branch falls, then cut at "C", outside of the branch collar (see Figure 19).

Large branches that are too heavy to be held with your hand (those 1-1/2" or larger in diameter) require three separate cuts to prevent trunk bark stripping. The first cut is made on the lower side of the branch about 15 inches away from the trunk and as far up through the branch as possible before the branch weight binds the saw (Figure 19). The second cut is made downward from the top of the branch a few inches from the first cut to cause the limb to split cleanly between the two cuts without tearing the bark. The remaining stub is easily supported with one hand while it is cut from the tree. This cut should begin on the outside of the branch bark ridge and end just outside of the trunk collar swelling on the lower side of the branch (Figure 20). This is usually

accomplished by cutting at a right angle to the top of the branch. In this way, only branch tissue is cut, and there is no damage to the trunk.

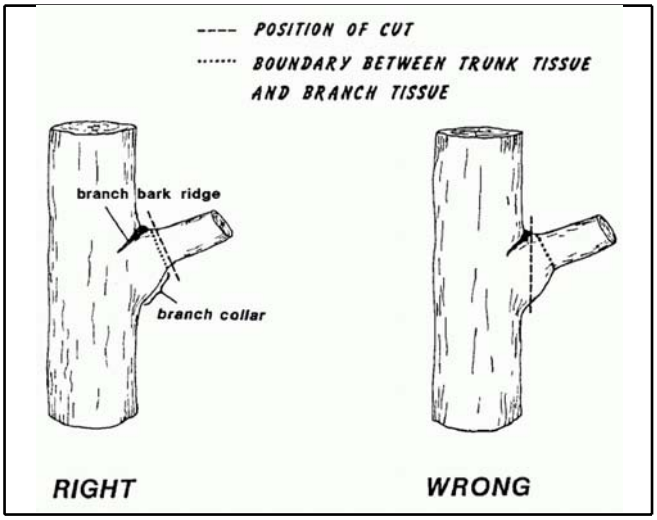


Figure 20. Correct and incorrect final pruning cut. All branches, large and small, should be cut in this manner. Do not cut into the branch collar. It is trunk wood and the trunk can decay if this tissue is damaged. Begin the cut on the outside of the branch bark ridge. This ridge is usually rough and always darker than the surrounding bark and is fairly obvious on most species. Angle the cut so it ends just beyond the swelling (branch collar) beneath the branch. If this swelling is not obvious, then place the cut at a right angle to the top of the branch.

The old practice had been to make the final cut flush with the trunk. Research has conclusively shown that this causes extensive trunk decay because wood is cut which is actually part of the trunk. Flush cuts should never be made since they injure the trunk.

Removing branches more than about 8" in diameter can result in trunk decay. Consider shortengin the branch instead back to a live lateral branch half the diameter of the cut.

Thinning the Canopy

Removing more than about 10% of live foliage from a mature tree can cause stress on the tree. To thin the canopy, remove 1/2-inch to 1-inch diameter stems from the edge of the canopy. Never clean out the interior of the tree by removing all of the small diameter branches attached to main branches and trunk (Figure 21).

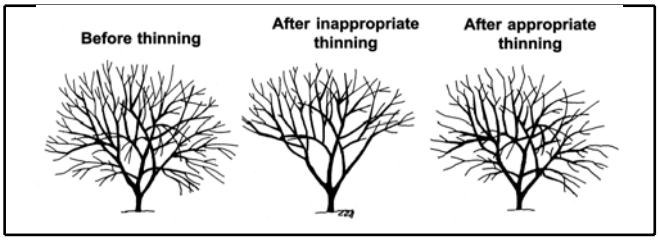


Figure 21. Inappropriate thinning leaves branches only at the edge of the crown (center). This situation can leave trees more vulnerable to wind damage and other stresses. Appropriate thinning (right) leaves live branches distributed all along limbs by removing live branches primarily from the edge of the crown.

Wound Dressing

Painting wounds with tree wound dressing was standard practice. The recommendation was to paint wounds with a quality tree wound dressing to protect the cut surface from wood rotting organisms and checking (cracking) upon drying. Research has shown, however, that wound dressings do not prevent decay. Upon exposure to the sun, the protective coating often cracks, allowing moisture to enter the cracks and accumulate in pockets between the wood and the wound covering. This situation may be more inviting to wood rotting organisms than one with no wound cover, but in situations where aesthetics are important, the practice may be justified if a light coat is applied.

Pruning Palms

Care must be taken when pruning palms not to cut or otherwise injure the terminal bud or the whole tree will die. Removing green fronds is not needed (Figure 22).

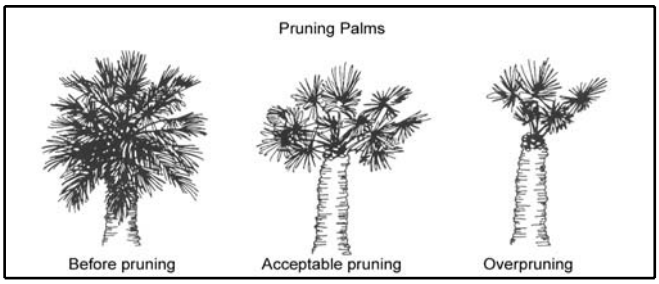


Figure 22. It is rarely necessary to remove green leaves from a palm. However, if you wish to do so, only remove those drooping below an imaginary horizontal line drawn through the bottom of the canopy (center). Growth will be slowed and the palm can be damaged and attract pests and diseases when green leaves are removed from above this imaginary line (right).

Old leaves that persist on palms such as the Washington palm can be removed, as they often harbor insects and rodents and may become a fire hazard.

When palms with large, heavy fronds such as the Royal palm shed their heavy leaves, they can damage property and injure people. If they are growing where falling leaves may be hazardous, remove leaves before they drop.

Large fruits of coconut palms can be dangerous to pedestrians and automobiles passing beneath the palm. Prevent formation of fruits by removing the flower stalks. Flower stalks on christmas palm and others can be left on the palm to take advantage of the ornamental characteristics of the fruit.

Hedge Pruning

The method of pruning hedges depends on the type of hedge desired. Informal hedges generally consist of a row of closely planted shrubs which are allowed to develop into their natural shape. Annual pruning consists of thinning and heading just enough to maintain desired height and width.

The desired appearance of a formal hedge is a hard outline of foliage from the top of the hedge to the ground. Two important factors to remember when pruning formal hedges are (1) hedges should be clipped while the new growth is green and succulent and (2) plants should be trimmed so the base of the hedge is wider than the top (Figure 23). Hedges pruned with a narrow base will lose lower leaves and branches because of insufficient light. This condition will worsen with age resulting in sparse growth at ground level and an unattractive hedge which does not give desired privacy.

Flowering hedges grown formally should be sheared after they have bloomed since more frequent shearing reduces number of blooms. If the blooms are of secondary importance, pruning may be conducted at any time.

Pruning Tools

Basic tools used in pruning are hand pruner, loppers, hedge shears and saws (Figure 24). Hand pruners are used for small branch and twig cleanup, pruning saws for larger branches and hedge shears to trim closely clipped formal hedges only. Both shears and saws are available on poles which are handy to prune difficult to reach branches. Loppers should not be used for pruning on live shrubs and trees since they damage the collar on the trunk.

Tools should be kept sharp for easier cutting without injuring surrounding tissue. Injured tissues are susceptible to disease and decay, which can lead to long-term health problems for the plant.

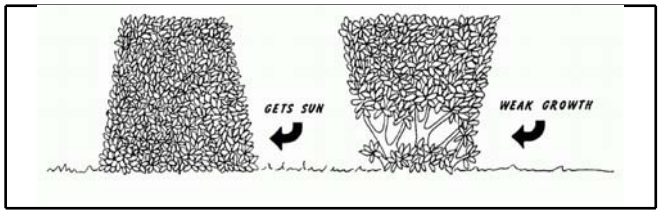


Figure 23. Plants pruned as a solid hedge should be wider at the bottom than the top.

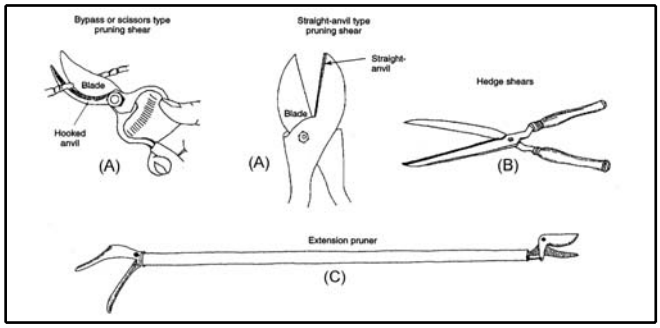


Figure 24. Pruning tools. (A) Hand pruners are used to cut branches less than 1/4 inch in diameter. (B) Hedge shears are used to shear formal hedges. (C) Extension pruners can reach higher.

Table 1. Winter and spring flowering plants which can be pruned after flowering but before flower buds form for next year's show.*

Shrubs	
azaleas	spireas
some hydrangea	Indian hawthorn
banana shrub	wisteria
camellia	star and saucer magnolia
Trees	
dogwoods	redbud
fringe tree	magnolias
african tulip-tree	

* The only effect from pruning at other times is a reduction in the number of flower buds.

Table 2. Plants producing flowers on current season's growth which can be pruned during the dormant season.*

Shrubs	
allamanda	plumbago
abelia	thryllis
hibiscus	golden dew-drop
oleander	bouganvillea
rose	vitex
Trees	
frangipani	acacia
bottle brush	golden rain tree
cassia	princess-flower
royal poinciana	crape myrtle
jacaranda	

* Structural pruning to correct forks and multiple stems can be done at any time.

Appendix C

Health and Safety Plan

Health and Safety Plan
Site Characterization for Site 1159
Outlying Landing Field Bronson

Naval Air Station Pensacola
Pensacola, Florida

Contract No. N62467-98-D-0995
Contract Task Order No. 0071

Revision 00

Submitted to:

U.S. Naval Facilities
Engineering Command
Southern Division

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November 2007

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3 Chemical-Specific Training Form
4 Emergency Contacts
5 Activity Hazard Analysis Form
6 Project Activity Self-Assessment Checklists/Permits
7 Incident Reporting Forms
8 Material Safety Data Sheets

Acronyms

°F	degrees Fahrenheit
AHA	Activity Hazard Analysis
ALARA	as low as reasonably achievable
APR	air-purifying respirator
ATL	Atlanta
CCI	CH2M HILL Constructors, Inc.
CNS	central nervous system
CPR	cardiopulmonary resuscitation
CTO	Contract Task Order
dBA	decibel A-rated
DOT	Department of Transportation
DPT	direct-push technology
FA	first aid
FFWCC	Florida Fish and Wildlife Conservation Commission
FID	flame ionization detector
GFCI	ground fault circuit interrupter
HAS	Hollow stem auger
HAZCOM	hazard communication
HR	heart rate
HSM	Health and Safety Manager
HSP	Health and Safety Plan
IDLH	immediately dangerous to life and health
IDW	investigation-derived waste
lb	pound
LEL	lower explosive limit
LNAPL	Light non-aqueous phase liquid
mg/m^3	milligrams per cubic meter
MSDS	Material Safety Data Sheet
mW/cm^2	milliwatt per square centimeter
NAS	Naval Air Station
NAVFAC	U.S. Naval Facilities Engineering Command
NDG	nuclear density gauge
NPDES	National Pollutant Discharge Elimination System
NSC	National Safety Council
OSHA	Occupational Safety and Health Administration
OWS	oil/water separator
PAHs	polycyclic aromatic hydrocarbons
PAPR	powered air-purifying respirator
PDF	personal flotation device
PID	photoionization detector
POTW	publicly owned treatment works
PPE	personal protective equipment
ppm	parts per million
RMSF	Rocky Mountain Spotted Fever

SAR	supplied-air respirator
SCBA	self-contained breathing apparatus
SHSS	Site Health and Safety Specialist
SOP	standard of practice
STEL	short-term exposure limit
SZ	support zone
TBD	to be determined
TMCC	truck-mounted crash cushion
TRPH	total recoverable petroleum hydrocarbons
TSDF	treatment, storage, and disposal facility
VOCs	volatile organic compounds

This Health and Safety Plan (HSP) 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 Health and Safety Specialist (SHSS) is to be familiar with these SOPs and the contents of this plan. CH2M HILL personnel and subcontractors must sign Attachment 1.

1.0 Project Information and Description

Project No: Contract Task Order (CTO) No. 0071

Client: Southern Division, U.S. Navy Facilities Engineering Command (NAVFAC)

Project/Site Name: Naval Air Station (NAS) Pensacola, Pensacola Florida

Site Address: Pensacola Florida

CCI Project Manager: Greg Wilfley

CCI Office: Atlanta, Georgia (ATL)

Date Health And Safety Plan Prepared: September 2007

Date(s) of Site Work: October 2007 to October 2008

Site Background and Setting The objective of the remedial activities being performed by CH2M HILL under this CTO includes the continued performance of groundwater monitoring. In that CTO, in-situ landfarming of residual petroleum contaminated soil in four former fire training burn pits was performed. Initial baseline sampling of existing monitoring wells and thereafter-periodic sampling, with associated reports was also completed. Documentation of the progression of biodegradation of the contaminants of concern in the former burn pit soil, and attainment of the soil cleanup goals was accomplished. Finally, upon attainment of remediation clean-up goals, the site was restored to meet surrounding conditions and specifications.

Description of Specific Tasks to be Performed: The scope of work that will be conducted at Site 1159 will be used to complete the design of the selected remedial alternative, free phase product recovery via bioslurping and groundwater pump and treat. The scope of work includes the following tasks:

Full-scale remediation system installation and O&M entails the following field tasks:

- Mobilization and Site Setup
- Site Preparation
- Treatment Wells and System Field Piping/Soil Sampling
- AAS System Components Installation
- SVE System Components and Off-Gas Treatment Installation
- Process Instruments and System Controls Installation
- System Enclosure Installation
- Aquifer and Vadose Zone Monitoring System
- System Operation & Maintenance/Air and Groundwater Sampling
- Air, Soil and Water Sampling
- Site Cleanup and Restoration
- Decontamination and Demobilization

2.0 Tasks to be Performed Under this Plan

Refer to project documents (i.e., Work Plan) for detailed task information. Tasks other than those listed below require an approved amendment or revision to this plan before tasks begin.

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. **Prior approval from the Health and Safety Manager (HSM) is required before these tasks are conducted on regulated hazardous waste sites**.

3.0 Hazard Control

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 SHSS for clarification.

The health and safety hazards posed by field activities have been identified for each project activity, and is provided in this section.

Activity Hazard Analysis (AHA) will be prepared before beginning each project activity posing H&S hazards to project personnel using the AHA form provided in Attachment 5 as a guide. The AHA will identify the work tasks required to perform each activity, along with potential H&S hazards and recommended control measures for each work task. In addition, a listing of the equipment to be used to perform the activity, inspection requirements and training requirements for the safe operation of the equipment listed must be identified.

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.

Project-activity self-assessments checklist will be completed weekly by the SHSS during the course of the project, completing the applicable checklist depending on the work performed at the time on the project.

3.1 Project-Specific Hazards

3.1.1 Drilling Safety

- The drill rig is not to be operated in inclement weather.
- The driller is to verify that the rig is properly leveled and stabilized before raising the mast.
- Personnel should be cleared from the sides and rear of the rig before the mast is raised.
- The driller is not to drive the rig with the mast in the raised position.
- The driller must check for overhead power lines before raising the mast. A minimum distance of 15 feet between mast and overhead lines (<50 kV) is recommended. Increased separation may be required for lines greater than 50 kV.

- Personnel should stand clear before rig startup.
- The driller is to verify that the rig is in neutral when the operator is not at the controls.
- Become familiar with the hazards associated with the drilling method used (cable tool, air rotary, hollow-stem auger, etc.).
- Do not wear loose-fitting clothing, watches, etc., that could get caught in moving parts.
- Do not smoke or permit other spark-producing equipment around the drill rig.
- The drill rig must be equipped with a kill wire or switch, and personnel are to be informed of its location.
- Be aware and stand clear of heavy objects that are hoisted overhead.
- The driller is to verify that the rig is properly maintained in accordance with the drilling company's maintenance program.
- The driller is to verify that all machine guards are in place while the rig is in operation.
- The driller is responsible for housekeeping (maintaining a clean work area).
- The drill rig should be equipped with at least one fire extinguisher.

If the drill rig comes into contact with electrical wires and becomes electrically energized, do not touch any part of the rig or any person in contact with the rig, and stay as far away as possible. Notify emergency personnel immediately

3.1.2 Welding/cutting with compressed Gas Cylinders

(Reference CH2M HILL, SOP HS-22, *Welding and Cutting*)

- Complete hot work permit.
- Wear appropriate personal protective equipment.
- Remove or combustible materials in the immediate hot work area.
- Station fire watch with fire extinguisher.
- Valve caps must be in place when cylinders are transported, moved, or stored.
- Cylinder valves must be closed when cylinders are not being used and when cylinders are being moved.
- Cylinders must be secured in an upright position at all times.
- Cylinders must be positioned to avoid being struck or knock over; coming in contact with electrical circuits or extreme heat sources; and shielded from welding and cutting operations.
- Cylinders must be secured on a cradle, basket or pallet when hoisted; they may not be hoisted by choker slings.

3.1.3 Working around material handling equipment

- Never approach operating equipment from the rear. Always make positive contact with the operator, and confirm that the operator has stopped the motion of the equipment.

- Never approach the side of operating equipment; remain outside of the swing and turning radius.
- Maintain distance from pinch points of operating equipment.
- Because heavy equipment may not be equipped with properly functioning reverse signal alarms, never turn your back on any operating equipment.
- Never climb onto operating equipment or operate contractor/subcontractor equipment.
- Never ride contractor/subcontractor equipment unless it is designed to accommodate passengers; equipped with firmly attached passenger seat.
- Never work or walk under a suspended load.
- Never use equipment as a personnel lift; do not ride excavator buckets or crane hooks.
- Always stay alert and maintain a safe distance from operating equipment, especially equipment on cross slopes and unstable terrain.

3.1.4 Excavation/Trenching Activities

(Reference CH2M HILL, SOP HS-32, *Excavation and Trenching*)

- CH2M HILL personnel must notify and be granted authorization from the excavation competent person prior to entering any excavation. CH2M HILL personnel must follow all excavation/trenching requirements established by the competent person.
- The competent person must inspect the trench and/or excavation everyday and after everyday hazard increasing event. Documentation of this inspection must be maintained onsite at al times.
- Excavations must be protected from cave-ins by adequate protective systems unless the excavation is less than 5 feet in depth and a competent person determines there is no indication of cave-in or the excavation is made entirely in stable rock that is not fractured.
- Prior to excavating/trenching at a location, buried utilities in the area must be identified; refer to Section 3.2.11 "Procedures for Locating Buried Utilities".
- CH2M HILL personnel must not enter any excavation where protective systems are deficient at any time, for any reason. The competent person must be notified of such conditions.
- Refer to CH2M HILL SOP HS-32 "Excavations and Trenching" for more specific details on excavation requirements.

3.1.5 Operating Heavy Equipment

(Reference CH2M HILL, SOP HS-27, *Earthmoving Equipment*)

- CH2M HILL authorizes only those employees qualified by training or previous experience to operate material handling equipment.
- Equipment must be checked at the beginning of each shift to ensure the equipment is in safe operating condition and free of apparent damage. The check should include: service brakes, parking brakes, emergency brakes, tires, horn, back-up alarm, steering mechanism, coupling devices, seat belts and operating controls. All defects will be

corrected before the equipment is placed in service. Documentation of this inspection must be maintained onsite at all times.

- Equipment must be on a stable foundation such as solid ground or cribbing; outriggers are to be fully extended.
- Equipment must not be used to lift personnel; loads must not be lifted over the heads of personnel.
- Equipment, or parts thereof, which are suspended must be substantially blocked or cribbed to prevent shifting before personnel are permitted to work under or between them. All controls will be in a neutral position, with the motors stopped and brakes set.
- Equipment which is operating in reverse must have a reverse signal alarm distinguishable from the surrounding noise or a signal person when the operators view is obstructed.
- When equipment is used near energized powerlines, the closest part of the equipment must be at least 10 feet from the powerlines < 50 kV. Provide an additional 4 feet for every 10 kV over 50 kV. A person must be designated to observe clearances and give timely warning for all operations where it is difficult for the operator to maintain the desired clearance by visual means. All overhead powerlines must be considered to be an energized until the electrical utility authorities indicate that it is not an energized line and it has been visibly grounded.
- Underground utility lines must be located before excavation/trenching begins; refer to Section 3.2.11 "Procedures for Locating Buried Utilities."
- Operators loading/unloading from vehicles are responsible for seeing that vehicle drivers are in the vehicle cab or in a safe area.
- The parking brake will be set whenever equipment is parked, wheels must be chocked when parked on inclines.
- When not in operation, the blade/bucket must be blocked or grounded; the master clutch must be disengaged when the operator leaves the cab. When equipment is unattended, power must be shut off, brakes set, blades/buckets landed and shift lever in neutral.

3.2 General Hazards

3.2.1 General Practices and Housekeeping

(Reference CH2M HILL- SOP HS-20, *General Practices*)

- Site work should be performed during daylight hours whenever possible. Work conducted during hours of darkness require enough illumination intensity to read a newspaper without difficulty.
- Good housekeeping must be maintained at all times in all project work areas.
- Common paths of travel should be established and kept free from the accumulation of materials.
- Keep access to aisles, exits, ladders, stairways, scaffolding, and emergency equipment free from obstructions.

- Provide slip-resistant surfaces, ropes, and/or other devices to be used.
- Specific areas should be designated for the proper storage of materials.
- Tools, equipment, materials, and supplies will be stored in an orderly manner.
- As work progresses, scrap and unessential materials must be neatly stored or removed from the work area.
- Containers should be provided for collecting trash and other debris and will be removed at regular intervals.
- All spills will be quickly cleaned up. Oil and grease will be cleaned from walking and working surfaces.

3.2.2 Hazard Communication

(Reference CH2M HILL-SOP HS-05, *Hazard Communication)*

The SHSS is to perform the following:

- Complete an inventory of chemicals brought on site by CH2M HILL using Attachment 2.
- Confirm that an inventory of chemicals brought on site by CH2M HILL subcontractors is available.
- Request or confirm locations of Material Safety Data Sheets (MSDSs) from the client, contractors, and subcontractors for chemicals to which CH2M HILL employees potentially are exposed.
- Before or as the chemicals arrive on site, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, and store properly.
- Give employees required chemical-specific HAZCOM training using Attachment 3.
- Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

3.2.3 Shipping and Transportation of Chemical Products

(Reference CH2M HILL's *Procedures for Shipping and Transporting Dangerous Goods)*

Chemicals brought to the site might be defined as hazardous materials by the U.S. Department of Transportation (DOT). All staff who ship the materials or transport them by road must receive CH2M HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. Contact the HSM or the Equipment Coordinator for additional information.

Proper lifting techniques must be used when lifting any object. These include:

- Plan storage and staging to minimize lifting or carrying distances.
- Split heavy loads into smaller loads.
- Use mechanical lifting aids whenever possible.

- Have someone assist with the lift -- especially for heavy or awkward loads.
- Make sure the path of travel is clear prior to the lift.

3.2.4 Fire Prevention

(Reference CH2M HILL- SOP HS-22, *Fire Prevention*)

- Fire extinguishers will be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 feet. When 5 gallons or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 feet. Extinguishers must:
  - be maintained in a fully charged and operable condition,
  - be visually inspected each month, and
  - undergo a maintenance check each year.
- The area in front of extinguishers must be kept clear.
- Post "Exit" signs over exiting doors, and post "Fire Extinguisher" signs over extinguisher locations.
- Combustible materials stored outside should be at least 10 feet from any building.
- Solvent waste and oily rags must be kept in a fire resistant, covered container until removed from the site.
- Flammable/combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.

3.2.5 Electrical

(Reference CH2M HILL-SOP HS-23, *Electrical*)

- Only qualified personnel are permitted to work on unprotected energized electrical systems.
- Only authorized personnel are permitted to enter high-voltage areas.
- Do not tamper with electrical wiring and equipment unless qualified to do so. All electrical wiring and equipment must be considered energized until lockout/tagout procedures are implemented.
- Inspect electrical equipment, power tools, and extension cords for damage prior to use. Do not use defective electrical equipment, remove from service.
- All temporary wiring, including extension cords and electrical power tools, must have ground fault circuit interrupters (GFCIs) installed.
- Extension cords must be:
  - equipped with third-wire grounding.
  - covered, elevated, or protected from damage when passing through work areas.
  - protected from pinching if routed through doorways.
  - not fastened with staples, hung from nails, or suspended with wire.

- Electrical power tools and equipment must be effectively grounded or double-insulated UL approved.
- Operate and maintain electric power tools and equipment according to manufacturers' instructions.
- Maintain safe clearance distances between overhead power lines and any electrical conducting material unless the power lines have been de-energized and grounded, or where insulating barriers have been installed to prevent physical contact. Maintain at least 10 feet from overhead power lines for voltages of 50 kV or less, and 10 feet plus ½ inch for every 1 kV over 50 kV.
- Temporary lights will not be suspended by their electric cord unless designed for suspension. Lights will be protected from accidental contact or breakage.
- Protect all electrical equipment, tools, switches, and outlets from environmental elements.

3.2.6 Stairways and Ladders

(Reference CH2M HILL-SOP HS-25, *Stairways and Ladders*)

- Stairway or ladder is generally required when a break in elevation of 19 inches or greater exists.
- Personnel should avoid using both hands to carry objects while on stairways; if unavoidable, use extra precautions.
- Personnel must not use pan and skeleton metal stairs until permanent or temporary treads and landings are provided the full width and depth of each step and landing.
- Ladders must be inspected by a competent person for visible defects prior to each day's use. Defective ladders must be tagged and removed from service.
- Ladders must be used only for the purpose for which they were designed and will not be loaded beyond their rated capacity.
- Only one person at a time will climb on or work from an individual ladder.
- User must face the ladder when climbing; keep belt buckle between side rails
- Ladders will not be moved, shifted, or extended while in use.
- User must use both hands to climb; use rope to raise and lower equipment and materials
- Straight and extension ladders must be tied off to prevent displacement
- Ladders that may be displaced by work activities or traffic must be secured or barricaded
- Portable ladders must extend at least 3 feet above landing surface
- Straight and extension ladders must be positioned at such an angle that the ladder base to the wall is one-fourth of the working length of the ladder

- Stepladders are to be used in the fully opened and locked position
- Users are not to stand on the top two steps of a stepladder; nor are users to sit on top or straddle a stepladder
- Fixed ladders > 24 feet in height must be provided with fall protection devices.
- Fall protection should be considered when working from extension, straight, or fixed ladders greater than 6 feet from lower levels and both hands are needed to perform the work, or when reaching or working outside of the plane of ladder side rails.

3.2.7 Heat Stress

(Reference CH2M HILL- SOP HS-09, *Heat and Cold Stress*)

- Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50ºF to 60ºF should be available. Under severe conditions, drink one to two cups every 20 minutes, for a total of 1 to 2 gallons per day. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.
- Acclimate yourself by slowly increasing workloads (e.g., do not begin with extremely demanding activities).
- Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency.
- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.
- Avoid direct sun whenever possible, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods.
- Provide adequate shelter/shade to protect personnel against radiant heat (sun, flames, hot metal).
- Maintain good hygiene standards by frequently changing clothing and showering.
- Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should consult the SHSS to avoid progression of heat-related illness.

Symptoms and Treatment of Heat Stress

	Heat Syncope	Heat Rash	Heat Cramps	Heat Exhaustion	Heat Stroke
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure.	Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours.	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure; oral temperature normal or low	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.
Treatment	Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.	Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.	Remove to cooler area. Rest lying down. Increase fluid intake.	Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.	Cool rapidly by soaking in cool– but not cold– water. Call ambulance, and get medical attention immediately!

Monitoring Heat Stress

These procedures should be considered when the ambient air temperature exceeds 70ºF, the relative humidity is high (>50 percent), or when workers exhibit symptoms of heat stress.

The heart rate (HR) should be measured by the radial pulse for 30 seconds, as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 100 beats/minute, or 20 beats/minute above resting pulse. If the HR is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same. If the pulse rate still exceeds 100 beats/minute at the beginning of the next rest period, the work cycle should be further shortened by 33 percent. The procedure is continued until the rate is maintained below 100 beats/minute, or 20 beats/minute above resting pulse.

3.2.8 Cold Stress

(Reference CH2M HILL- SOP HS-09, *Heat and Cold Stress*)

- Be aware of the symptoms of cold-related disorders, and wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in cool weather.
- Consider monitoring the work conditions and adjusting the work schedule using guidelines developed by the U.S. Army (wind-chill index) and the National Safety Council (NSC).
- Wind-Chill Index is used to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For those reasons, it should only be used as a guideline to warn workers when they are in a situation that can cause cold-related illnesses.

- NSC Guidelines for Work and Warm-Up Schedules can be used with the wind-chill index to estimate work and warm-up schedules for fieldwork. The guidelines are not absolute; workers should be monitored for symptoms of cold-related illnesses. If symptoms are not observed, the work duration can be increased.
- Persons who experience initial signs of immersion foot, frostbite, hypothermia should consult the SHSS to avoid progression of cold-related illness.
- Observe one another for initial signs of cold-related disorders.
- Obtain and review weather forecast – be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation.

Symptoms and Treatment of Cold Stress

	Immersion (Trench) Foot	Frostbite	Hypothermia
Signs and Symptoms	Feet discolored and painful; infection and swelling present.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Treatment	Seek medical treatment immediately.	Remove victim to a warm place. Re-warm area quickly in warm–but **not** hot–water. Have victim drink warm fluids, but **not** coffee or alcohol. Do not break blisters. Elevate the injured area, and get medical attention.	Remove victim to a warm place. Have victim drink warm fluids, but **not** coffee or alcohol. Get medical attention.

3.2.9 Compressed Gas Cylinders

- Valve caps must be in place when cylinders are transported, moved, or stored.
- Cylinder valves must be closed when cylinders are not being used and when cylinders are being moved.
- Cylinders must be secured in an upright position at all times.
- Cylinders must be shielded from welding and cutting operations and positioned to avoid being struck or knocked over; contacting electrical circuits; or exposed to extreme heat sources.
- Cylinders must be secured on a cradle, basket, or pallet when hoisted; they may not be hoisted by choker slings.

3.2.10 Procedures for Locating Buried Utilities

- Where available, obtain utility diagrams for the facility.
- Review locations of sanitary and storm sewers, electrical conduits, water supply lines, natural gas lines, and fuel tanks and lines.
- Review proposed locations of intrusive work with facility personnel knowledgeable of locations of utilities. Check locations against information from utility mark-out service.

- Where necessary (e.g., uncertainty about utility locations), excavation, trenching, or drilling of the upper depth interval should be performed manually
- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon).
- When the client or other onsite party is responsible for determining the presence and locations of buried utilities, the SHSS should confirm that arrangement.

3.3 Biological Hazards and Controls

3.3.1 Snakes

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical attention immediately. DO NOT apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake: note color, size, patterns, and markings.

3.3.2 Poison Ivy and Poison Sumac

Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas. Become familiar with the identity of these plants. Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.

3.3.3 Ticks

Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch in size. Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into boots; spray **only outside** of clothing with permethrin or permanone and spray skin with only DEET; and check yourself frequently for ticks.

If bitten by a tick, grasp it at the point of attachment and carefully remove it. After removing the tick, wash your hands and disinfect and press the bite areas. Save the removed tick. Report the bite to human resources. Look for symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme: a rash might appear that looks like a bullseye with a small welt in the center. RMSF: a rash of red spots under the skin 3 to 10 days after the tick bite. In both cases, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, seek medical attention.

3.3.4 Bees and Other Stinging Insects

Bee and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and

inform the SHSS and/or buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; seek medical attention if a reaction develops.

3.3.5 Bloodborne Pathogens

(Reference CH2M HILL- SOP HS-36, *Bloodborne Pathogens*)

Exposure to bloodborne pathogens may occur when rendering first aid or CPR, or when coming into contact with landfill waste or waste streams containing potentially infectious material. Exposure controls and personal protective equipment (PPE) are required as specified in CH2M HILL SOP HS-36, *Bloodborne Pathogens*. Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.

3.4 Radiological Hazards and Controls

Refer to CH2M HILL's *Corporate Health and Safety Program, Program and Training Manual,* and *Corporate Health and Safety Program, Radiation Protection Program Manual*, for standards of practice in contaminated areas.

3.5 Chemical Hazards

The following describes the chemical hazards posed by remedial activities at the project. Chemical contaminants of concern (COC), along with their maximum concentration in soil/groundwater, the applicable exposure limit/IDLH and symptoms of exposure are listed in Table 3-1.

3.6 Potential Routes of Exposure

- **Dermal:** Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 5.
- **Inhalation:** Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 5 and 6, 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).

TABLE 3-1
Contaminants of Concern
(Refer to Project Files for more detailed contaminant information)

Contaminant	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Arsenic	0.01 mg/m^3	5 Ca	Ulceration of nasal septum, respiratory irritation, dermatitis, gastrointestinal disturbances, peripheral neuropathy, hyperpigmentation	NA
Benzene	1 ppm	500 Ca	Eye, nose, skin, and respiratory irritation; headache; nausea; dermatitis; fatigue; giddiness; staggered gait; bone marrow depression	9.24
2-Butanone (Methyl Ethyl Ketone, MEK)	200 ppm	3,000	Eye, skin, and nose irritation; headache; dizziness; vomiting; dermatitis	9.54
Cadmium	0.005 mg/m^3	9 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
Carbon Tetrachloride	2 ppm	200 Ca	Central nervous system (CNS) depression, nausea, vomiting, eye and skin irritation, liver and kidney injury, drowsiness, dizziness	11.47
Chlordane	0.5 mg/m^3	100 Ca	Blurred vision, confusion, ataxia, delirium, coughing, abdominal pain, nausea, vomiting, diarrhea, irritability, tremors anuria	UK
Chlorobenzene	10 ppm	1,000	Skin, eye, and nose irritation; drowsiness; uncoordination; CNS depression	9.07
Chloroform	2 ppm	500 Ca	Dizziness, mental dullness, nausea, confusion, disorientation, headache, fatigue, eye and skin irritation, anesthesia, enlarged liver	11.42
Chromium (as Cr(II) & Cr(III))	0.5 mg/m^3	25	Irritated eyes, sensitization dermatitis, histologic fibrosis of lungs	NA
Chromium (hexavalent)	0.01 mg/m^3	15 Ca	Irritated respiratory system, nasal septum perforation, liver and kidney damage, leucytosis, leupen, monocytosis, eosinophilla, eye injury, conjunctivitis, skin ulcer, sensitization dermatitis	NA
Cobalt (Metal, Dusts, and Fumes)	0.05 mg/m^3	20	Coughing, difficulty breathing, wheezing, decreased pulmonary function, diffuse nodule fibrosous, dermatitis, respiratory hypersensitivity, asthma	NA
Cresol (all isomers of 2-, 3-, & 4-methylphenol)	5 ppm	250	Eye, skin, and mucous membrane irritant; CNS effects including confusion, depression, and respiratory failure; difficulty breathing; irregular rapid respiration; weak pulse; eye and skin burns; dermatitis; lung, liver, kidney, and pancreas damage	8.98

TABLE 3-1
Contaminants of Concern
(Refer to Project Files for more detailed contaminant information)

Contaminant	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
DDT	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
Dibutylphthalate (DBP)	5 mg/m^3	4,000	Eye, upper respiratory system, and stomach irritant	UK
o-Dichlorobenzene (1,2-Dichlorobenzene)	25 ppm	200	Nose and eye irritation, liver and kidney damage, skin blisters	9.06
p-Dichlorobenzene (1,4-Dichlorobenzene)	10 ppm	150 Ca	Headache, eye irritation, nausea, vomiting, swelling periorbital, profus rhinitis, jaundice, cirrhosis	8.98
1,1-Dichloroethane	100 ppm	3,000	CNS depression, skin irritation; liver, kidney, and lung damage	11.06
1,2-Dichloroethane (Ethylene Dichloride)	1 ppm	50 Ca	CNS depression, nausea, vomiting, dermatitis, eye irritation, liver, kidney, and CNS damage; corneal opacity	11.05
Bis-(2-ethylhexyl)phthalate (DEHP, DOP)	5 mg/m^3	5,000 Ca	Eye and mucous membrane irritant	UK
Endosulfan	0.1 mg/m^3	NL	Irritated skin, nausea, confusion, agitation, flushing, dry mouth, tremor, convulsion, headache	UK
Ethyl Benzene	100 ppm	800	Eye, skin, and mucous membrane irritation; headache; dermatitis; narcotic; coma	8.76
Lead	0.05 mg/m^3	100	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
Mercury	0.05 mg/m^3	10	Skin and eye irritation, cough, chest pain, difficult breathing, bronchitis, pneumontitis, tremors, insomnia, irritability, indecision, headache, fatigue, weakness, GI disturbance	
Naphthalene	10 ppm	250	Eye irritation, headache, confusion, excitement, nausea, vomiting, abdominal pain, bladder irritation, profuse sweating, dermatitis, corneal damage, optical neuritis	8.12
PCBs (Limits as Aroclor 1254)	0.5 mg/m^3	5 Ca	Eye and skin irritation, acne-form dermatitis, liver damage, reproductive effects	UK
PNAs (Limits as Coal Tar Pitch)	02 mg/m^3	80 Ca	Dermatitis and bronchitis	UK
1,1,2,2-Tetrachloroethane (Tetrachlorethane)	1 ppm	100 Ca	Nausea, vomiting, abdominal pain, finger tremors, jaundice, hepatitis, liver tenderness, monocytosis, kidney damage, dermatitis	11.10

TABLE 3-1
Contaminants of Concern
(Refer to Project Files for more detailed contaminant information)

Contaminant	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Tetrachloroethylene (PCE)	25 ppm	150 Ca	Eye, nose, and throat irritation; nausea; flushed face and neck; vertigo; dizziness; sleepiness; skin redness; headache; liver damage	9.32
1,1,2-Trichloroethane	10 ppm	100 Ca	Eye and nose irritation, CNS depression, liver damage, dermatitis	11.00
Trichloroethylene (TCE)	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
Toluene	50 ppm	500	Eye and nose irritation, fatigue, weakness, confusion, dizziness, headache, dilated pupils, excessive tearing, nervousness, muscle fatigue, paresthesia, dermatitis, liver and kidney damage	8.82
Xylenes	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
Vinyl Chloride	1 ppm	NL Ca	Weakness, abdominal pain, gastrointestinal bleeding, enlarged liver, pallor or cyanosis of extremities	9.99
Vinylidene Chloride (1,1-dichloroethylene)	1 ppm	NL Ca	Eye, skin, and throat irritation; dizziness; headache; nausea; difficult breathing; liver and kidney dysfunction; pneumonitis	10.0

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.

4.0 Project Organization and Personnel

4.1 CH2M HILL Employee Medical Surveillance and Training

(Reference CH2M HILL- SOPs HS-01, *Medical Surveillance*, and HS-02, *Health and Safety Training)*

The employees listed 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 "SHSS" have completed a 12-hour site safety coordinator course, and have documented requisite field experience. An SHSS 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-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	SHSS/FA-CPR
Greg Wilfley	ATL	Project Manager	
Rich Rathnow	ORO	HSM	SC-HW, SC-C, FA; CPR
Scott Dunbar	ATL	SHSS/Site Superintendent	SC-HW, SC-C, FA; CPR

4.2 Field Team Chain of Command and Communication Procedures

4.2.1 Client

Contact Name: Jimmy Jones COTR
Phone: 843/820-5544
Facility Contact Name: Mark Shull
Phone: 850-452-4616, ext. 129

4.2.2 CH2M HILL

Program Manager: Scott Newman/ATL
Project Manager: Greg Wilfley/ATL
Health and Safety Manager: Richard Rathnow/KNV
Site Superintendent: TBD
Site Health and Safety Specialist: TBD

The CH2M HILL project manager (PM) is responsible for providing adequate resources (budget and staff) for project-specific implementation of the HS&E management process. The PM has overall management responsibility for the tasks listed below. The PM may explicitly delegate specific tasks to other staff, as described in sections that follow, but retains ultimate responsibility for completion of the following in accordance with this SOP:

- Include standard terms and conditions, and contract-specific HS&E roles and responsibilities in contract and subcontract agreements (including flow-down requirements to lower-tier subcontractors)
- Select safe and competent subcontractors by:
  - obtaining, reviewing and accepting or rejecting subcontractor pre-qualification questionnaires
  - ensuring that acceptable certificates of insurance, including CH2M HILL as named additional insured, are secured as a condition of subcontract award
  - including HS&E submittals checklist in subcontract agreements, and ensuring that appropriate site-specific safety procedures, training and medical monitoring records are reviewed and accepted prior to the start of subcontractor's field operations
- Maintain copies of subcontracts and subcontractor certificates of insurance (including CH2M HILL as named additional insured), bond, contractors license, training and medical monitoring records, and site-specific safety procedures in the project file accessible to site personnel
- Provide oversight of subcontractor HS&E practices per the site-specific safety plan
- Ensure that the overall, job-specific, HS&E goals are fully and continuously implemented

The CH2M HILL Navy RAC H&S Manager is responsible for:

- Review and accept or reject subcontractor pre-qualification questionnaires that fall outside the performance range delegated to the Contracts Administrator (KA)
- Review and accept or reject subcontractor training records and site-specific safety procedures prior to start of subcontractor's field operations
- Support the SHSS's oversight of subcontractor (and lower-tier subcontractors) HS&E practices.

The SHSS is responsible for verifying that the project is conducted in a safe manner including the following specific obligations:

- Verify these HSP are current and amended when project activities or conditions change
- Verify CH2M HILL site personnel and subcontractor personnel read these FSI and sign Attachment 1 "Employee Signoff Form" prior to commencing field activities

- Verify CH2M HILL site personnel and subcontractor personnel have completed any required specialty training (e.g., fall protection, confined space entry) and medical surveillance.
- Verify compliance with the requirements of these FSI and applicable subcontractor health and safety plan(s)
- Act as the project "Hazard Communication Coordinator."
- Act as the project "Emergency Response Coordinator."
- Post OSHA job-site poster; the poster is required at sites where project field offices, trailers, or equipment-storage boxes are established; posters can be obtained by calling 800/548-4776 or 800/999-9111
- Verify that safety meetings are conducted and documented in the project file initially and as needed throughout the course of the project (e.g., as tasks or hazards change)
- Verify that project H&S forms and permits, found in Attachment 7, are being used as outlined in Section 2
- Perform oversight and/or assessments of subcontractor HS&E practices per the site-specific safety plan and verify that project activity self-assessment checklists, found in Attachment 6, are being used.
- Verify that project files available to site personnel include copies of executed subcontracts and subcontractor certificates of insurance (including CH2M HILL as named additional insured), bond, contractors license, training and medical monitoring records, and site-specific safety procedures prior to start of subcontractor's field operations
- Coordinate with the HS&E manager regarding CH2M HILL and subcontractor operational performance, interfaces
- Ensure that the overall, job-specific, HS&E goals are fully and continuously implemented

The training required for the SHSS is as follows:

- SHSS 10-hour course
- OHSA 10-hour course for Construction
- First Aid and CPR
- Relevant Competent Person Courses (excavation, confined space, scaffold, fall protection, etc.)

The SHSS is responsible for contacting the Site Superintendent and Project Manager. In general, the Project Manager will contact the client. The Health and Safety Manager should be contacted as appropriate.

4.2.3 CH2M HILL Subcontractors

(Reference CH2M HILL- SOP HS-55, *Subcontractor, Contractor, and Owner*)

Certain subcontractors (drilling, remedial and construction contractors) are required to be pre-qualified for safety by completing the Subcontractor Safety Performance Questionnaire. The subcontractors listed above are covered by this HSP. 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 by following the Subcontractor Safety Procedure Criteria specific to their work.

Subcontractors are also required to prepare Activity Hazard Analysis before beginning each activity posing H&S hazards to their personnel using the AHA form provided in Attachment 5 as a guide. The AHA will identify the principle steps of the activity, potential H&S hazards for each step and recommended control measures for each identified hazard. In addition, a listing of the equipment to be used to perform the activity, inspection requirements and training requirements for the safe operation of the equipment listed must be identified.

Subcontractors must comply with the established health and safety plan(s). The CH2M HILL SHSS 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 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 SHSS 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 SHSS 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 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.

5.0 Personal Protective Equipment

(Reference CH2M HILL- SOP HS-07, *Personal Protective Equipment*, HS-08, *Respiratory Protection*)

Personal Protective equipment (PPE) specifications are listed in Table 5-1.

TABLE 5-1
PPE Specifications[a]

Task	Level	Body	Head	Respirator [b]
General site entry Surveying Oversight of remediation and construction	D	Work clothes; steel-toe, leather work boots; work glove.	Hardhat [c] Safety glasses Ear protection [d]	None required
Surface water sampling Aquifer testing Sediment sampling Surface soil sampling Hand augering Geoprobe boring Piezometer installation	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
Groundwater sampling 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
Test pit excavation 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]
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

[a] Modifications are as indicated. CCI will provide PPE only to CCI 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 SHSS.
[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.

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 SHSS qualified at that level is present. PPE levels may be upgraded for the following reasons:

- 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 6) exceeded

PPE levels may be downgraded for the following reasons:

- 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

6.0 Air Monitoring/Sampling

(Reference CH2M HILL- SOP HS-06, *Air Monitoring)*

6.1 Air Monitoring Specifications

Air monitoring specifications are listed in Table 6-1.

TABLE 6-1
Air Monitoring Specifications

Instrument	Tasks	Contaminant Concentration	Action Levels[a]	Frequency [b]	Calibration
PID: OVM with 10.6eV lamp or equivalent	All intrusive and potentially contaminated liquid exposure situations	0-5 ppm 5-10 ppm >10 ppm	Level D Level C Contact HSM	Initially and periodically during task	Daily
CGI: MSA model 260 or 261 or equivalent		0-10% : 10-25% LEL: >25% LEL:	No explosion hazard Potential explosion hazard Explosion hazard; evacuate or vent	Continuous during advancement of boring or trench	Daily
O_2Meter: MSA model 260 or 261 or equivalent		>25%[c] O_2: 20.9%[c] O_2: <19.5%[c] O_2:	Explosion hazard; evacuate or vent Normal O_2 O_2 deficient; vent or use SCBA	Continuous during advancement of boring or trench	Daily
Dust Monitor: Miniram model PDM-3 or equivalent		mg/m^3 mg/m^3	Level D Level C	Initially and periodically during tasks	Zero Daily
Detector Tube: Drager benzene specific 0.5/c (0.5 to 10 ppm range) with pre-tube, or equivalent		<0.5 ppm 0.5-1 ppm >1 ppm	Level D Level C Level B	Initially and periodically when PID/FIB >1 ppm	Not applicable
Colormetric Tube: Drager vinyl chloride specific (0.5 to 30 ppm range) with pre-tube, or equivalent		<0.5 ppm 0.5 ppm	Level D Level B	Initially and periodically when PID/FID >1 ppm	Not applicable
Radiation Meter [d]: Ludlum Model 2 with GM probe model 44-9, or equivalent		Background: >3x Background: >2 mR/Hr:	Continue work Consult RHM Establish REZ	Initially, periodically, and at end of task	Daily
Nose-Level Monitor [e]:		<85 dB(A) 85-120 dB(A) 120 dB(A)	No action required Hearing protection required Stop; re-evaluate	Initially and periodically during task	Daily

[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 SHSS; 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 O_2 is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O_2 action levels apply only to ambient working atmospheres, and not to confined-space entry. More-stringent percent LEL and O_2 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.

6.2 Calibration Specifications

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

Air Monitoring equipment calibration specifications are listed in Table 6-2.

TABLE 6-2
Air Monitoring Equipment Specifications

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
FID: OVA	100 ppm methane	3.0 ± 1.5	100 ppm	1.5 lpm reg T-tubing
FID: TVA 1000	100 ppm methane	NA	100 ppm	2.5 lpm reg T-tubing
Dust Monitor: Miniram-PDM3	Dust-free air	Not applicable	0.00 mg/m^3 in "Measure" mode	Dust-free area OR Z-bag with HEPA filter
CGI: MSA 260, 261, 360, or 361	0.75% pentane	N/A	50% LEL ± 5% LEL	1.5 lpm reg direct tubing

6.3 Air Sampling

Sampling, in addition to real-time monitoring, may be required by other OSHA regulations where there may be exposure to certain contaminants. Air sampling typically is required when site contaminants include lead, cadmium, arsenic, asbestos, and certain volatile organic compounds. Contact the HSM immediately if these contaminants are encountered.

Results must be sent immediately to the HSM. Regulations may require reporting to monitored personnel.

7.0 Decontamination

(Reference CH2M HILL- SOP HS-13, *Decontamination*)

The SHSS must establish and monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SHSS. The SHSS must ensure that procedures are established for disposing of materials generated on the site.

7.1 Decontamination Specifications

Decontamination specifications are listed in Table 7-1.

TABLE 7-1
Decontamination Specifications

Personnel	Sample Equipment	Heavy Equipment
• Boot wash/rinse • Glove wash/rinse • Outer-glove removal • Body-suit removal • Inner-glove removal • Respirator removal • Hand wash/rinse • Face wash/rinse • Shower ASAP • Dispose of PPE in municipal trash, or contain for disposal • Dispose of personnel rinse water to facility or sanitary sewer, or contain for offsite disposal	• Wash/rinse equipment • Solvent-rinse equipment • Contain solvent waste for offsite disposal	• Power wash • Steam clean • Dispose of equipment rinse water to facility or sanitary sewer, or contain for offsite disposal

7.2 Diagram of Personnel-Decontamination Line

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SHSS should establish areas for eating, drinking, and smoking. Contact lenses are not permitted in exclusion or decontamination zones.

Figure 7-1 illustrates a conceptual establishment of work zones, including the decontamination line. Work zones are to be modified by the SHSS to accommodate task-specific requirements.

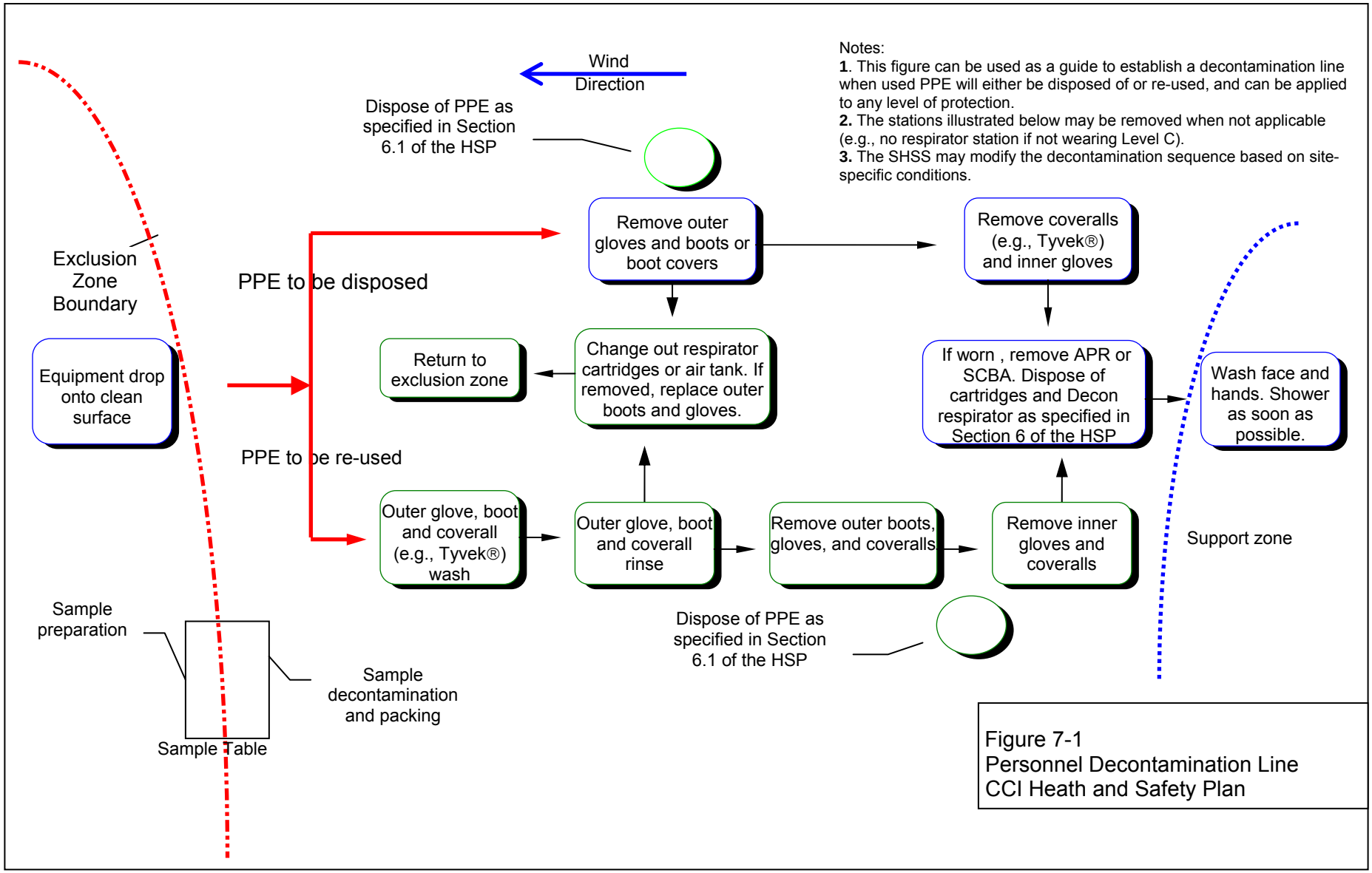


Figure 7-1
Personnel Decontamination Line
CCI Heath and Safety Plan

8.0 Spill-Containment Procedures

Sorbent material will be maintained in the support zone. Incidental spills will be contained with sorbent and disposed of properly.

9.0 Site Control Plan

9.1 Site Control Procedures

(Reference CH2M HILL- SOP HS-11, *Site Control)*

- The SHSS will conduct a site safety briefing (see below) before starting field activities or as tasks and site conditions change.
- Topics for briefing on site safety: general discussion of Health and Safety Plan, site-specific hazards, locations of work zones, PPE requirements, equipment, special procedures, emergencies.
- The SHSS records attendance at safety briefings in a logbook and documents the topics discussed.
- Post the OSHA job-site poster in a central and conspicuous location in accordance with CH2M HILL- SOP HS-71, OSHA Postings.
- Establish support, decontamination, and exclusion zones. Delineate with flags or cones as appropriate. Support zone should be upwind of the site. Use access control at entry and exit from each work zone.
- Establish onsite communication consisting of the following:
  - Line-of-sight and hand signals
  - Air horn
  - Two-way radio or cellular telephone if available
- Establish offsite communication.
- Establish and maintain the "buddy system."
- Initial air monitoring is conducted by the SHSS in appropriate level of protection.
- The SHSS is to conduct periodic inspections of work practices to determine the effectiveness of this plan – refer to Sections 2 and 3. Deficiencies are to be noted, reported to the HSM, and corrected.

9.2 Hazwoper Compliance Plan

(Reference CH2M HILL- SOP HS-19, *Site-Specific Written Safety Plans)*

Certain parts of the site work are covered by state or federal Hazwoper standards and therefore require training and medical monitoring. Anticipated Hazwoper tasks might occur consecutively or concurrently with respect to non-Hazwoper tasks. Non-Hazwoper-trained personnel also must be trained in accordance with all other state and federal OSHA requirements.

- In many cases, air sampling, in addition to real-time monitoring, must confirm that there is no exposure to gases or vapors before non-Hazwoper-trained personnel are allowed on the site, or while non-Hazwoper-trained staff are working in proximity to Hazwoper activities. Other data (e.g., soil) also must document that there is no potential for exposure. The HSM must approve the interpretation of these data.
- When non-Hazwoper-trained personnel are at risk of exposure, the SHSS must post the exclusion zone and inform non-Hazwoper-trained personnel of the:
  - nature of the existing contamination and its locations
  - limitations of their access
  - emergency action plan for the site
- Periodic air monitoring with direct-reading instruments conducted during regulated tasks also should be used to ensure that non-Hazwoper-trained personnel (e.g., in an adjacent area) are not exposed to airborne contaminants.
- When exposure is possible, non-Hazwoper-trained personnel must be removed from the site until it can be demonstrated that there is no longer a potential for exposure to health and safety hazards.
- Remediation treatment system start-ups: Once a treatment system begins to pump and treat contaminated media, the site is, for the purposes of applying the Hazwoper standard, considered a treatment, storage, and disposal facility (TSDF). Therefore, once the system begins operation, only Hazwoper-trained personnel (minimum of 24 hours of training) will be permitted to enter the site. All non-Hazwoper-trained personnel must not enter the TSDF area of the site.

10.0 Emergency Response Plan

(Reference CH2M HILL- SOP HS-12, *Emergency Response*)

10.1 Pre-Emergency Planning

The SHSS performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with CH2M HILL onsite parties, the facility, and local emergency-service providers as appropriate.

- Review the facility emergency and contingency plans where applicable.
- Determine what onsite communication equipment is available (e.g., two-way radio, air horn).
- Determine what offsite communication equipment is needed (e.g., nearest telephone, cell phone).
- Confirm and post emergency telephone numbers, evacuation routes, assembly areas, and route to hospital; communicate the information to onsite personnel.
- Field Trailers: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Review changed site conditions, onsite operations, and personnel availability in relation to emergency response procedures.
- Where appropriate and acceptable to the client, inform emergency room and ambulance and emergency response teams of anticipated types of site emergencies.
- Designate one vehicle as the emergency vehicle; place hospital directions and map inside; keep keys in ignition during field activities.
- Inventory and check site emergency equipment, supplies, and potable water.
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, and releases.
- Rehearse the emergency response plan before site activities begin, including driving route to hospital.
- Brief new workers on the emergency response plan.

The SHSS will evaluate emergency response actions and initiate appropriate follow-up actions.

10.2 Emergency Equipment and Supplies

The SHSS should mark the locations of emergency equipment on the site map and post the map. Emergency equipment is listed in Table 10-1.

TABLE 10-1
Emergency Equipment

Emergency Equipment and Supplies	Location
20 LB (or two 10-lb) fire extinguisher (A, B, and C classes)	Support Zone/Heavy Equipment
First aid kit	Support Zone/Field Vehicle
Eye Wash	Support & Decon Zone/Field Vehicle
Potable water	Support & Decon Zone/Field Vehicle
Bloodborne-pathogen kit	Support Zone/Field Vehicle
Additional equipment (specify):	

10.3 Incident Reporting, Investigation and Response

According to Southern Division, NAVFAC Incident Reporting requirements, all incidents involving personal injury, and property damage greater than $1,000 incidents involving CH2M HILL or subcontractor project personnel must be reported to Southern Division, NAVFAC within 24 hours of incident occurrence. As such, the Site Manager must report the following incident information to the HSM immediately after incident occurrence:

- Date and time of mishap
- Project name and project number
- Name and worker classification
- Extent of known injuries
- Level of medical attention
- Injury cause

According to CH2M HILL requirements, all personal injuries, near-misses, or property damage incidents require involving CH2M HILL or subcontractor project personnel must be reported immediately to the HSM. An incident investigation will be performed and submitted to the HSM within 24 hours of incident occurrence by the completing the Incident Report, Near Loss Investigation and Root Cause Analysis provided in Attachment 7.

In fires, explosions, or chemical releases, actions to be taken include the following:

- Shut down CH2M HILL operations and evacuate the immediate work area.
- Notify appropriate response personnel.
- Account for personnel at the designated assembly area(s).
- Assess the need for site evacuation, and evacuate the site as warranted.

Instead of implementing a work-area evacuation, note that small fires or spills posing minimal safety or health hazards may be controlled.

10.4 Emergency Medical Treatment

The procedures listed below may also be applied to non-emergency incidents. CH2M HILL and employee injuries and illnesses (including overexposure to contaminants) must be reported to their respective Human Resource contacts in Attachment 4. If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact either the CH2M HILL medical consultant, depending on whose employee is injured. During non-emergencies, follow these procedures as appropriate.

- Notify appropriate emergency response authorities listed in Section 10.8 (e.g., 911).
- The SHSS will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Prevent further injury.
- Initiate first aid and CPR where feasible.
- Get medical attention immediately.
- Perform decontamination where feasible; lifesaving and first aid or medical treatment take priority.
- Make certain that the injured person is accompanied to the emergency room.
- When contacting the medical consultant, give your name and telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.
- Report incident as outlined in Section 10.7.

10.5 Evacuation

- Evacuation routes and assembly areas (and alternative routes and assembly areas) are specified on the site map.
- Evacuation route(s) and assembly area(s) will be designated by the SHSS before work begins.
- Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation.
- The SHSS and a "buddy" will remain on the site after the site has been evacuated (if safe) to assist local responders and advise them of the nature and location of the incident.
- The SHSS will account for all personnel in the onsite assembly area.
- A designated person will account for personnel at alternate assembly area(s).
- The SHSS will write up the incident as soon as possible after it occurs and submit a report to the Corporate Director of Health and Safety.

10.6 Evacuation Signals

Evacuation signals are listed in Table 10-2.

TABLE 10-2
Evacuation Signals

Signal	Meaning
Grasping throat with hand	Emergency-help me.
Thumbs up	OK; understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

10.7 Incident Notification and Reporting

- Upon any project incident (fire, spill, injury, near miss, death, etc.), immediately notify the PM and HSM. Call emergency beeper number if HSM is unavailable.
- For CH2M HILL work-related injuries or illnesses, contact the respective Human Resources contact listed in Attachment 4. For CH2M HILL incidents the HR administrator will complete an Incident Report Form (IRF). IRF must be completed within 24 hours of incident.
- For CH2M HILL subcontractor incidents, complete the Subcontractor Accident/Illness Report Form and submit to the HSM.
- Notify and submit reports to client as required in contract.

11.0 Approval

This site-specific Health and Safety Plan has been written for use by CCI only. CCI 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.

11.1 Original Plan

Written By: Rich Rathnow **Date:** November 2007

Approved By: Rich Rathnow **Date:** November 2007

11.2 Revisions

Revisions Made By: **Date:**

Revisions Approved By: **Date:**

Attachment 1

Employee Signoff Form

EMPLOYEE SIGNOFF FORM

- The CCI project employees and subcontractors listed below have been provided with a copy of this HSP, have read and understood it, and agree to abide by its provisions.

Project Name: **Project Number:**

EMPLOYEE NAME (Please print)	**EMPLOYEE SIGNATURE**	**COMPANY**	**DATE**

Attachment 2

Project-Specific Chemical Product Hazard Communication Form

Project-Specific Chemical Product Hazard Communication Form

This form must be completed prior to performing activities that expose personnel to hazardous chemicals products. Upon completion of this form, the SHSS will verify that training is provided on the hazards associated with these chemicals and the control measures to be used to prevent exposure to CCI and subcontractor personnel. Labeling and MSDS systems will also be explained.

Project Name: **Project Number:**

MSDSs will be maintained at the following location(s):

Hazardous Chemical Products Inventory

Chemical	Quantity	Location	MSDS Available	Container labels	
				Identity	Hazard
Methane	1 liter, compressed	Support Zone			
Isobutylene	1 liter, compressed	Support Zone			
Pentane	1 liter, compressed	Support Zone			
Hydrochloric acid	< 500 ml	Support Zone / sample bottles			
Nitric acid	< 500 ml	Support Zone / sample bottles			
Sulfuric Acid	< 500 ml	Support Zone / sample bottles			
Sodium hydroxide	< 500 ml	Support Zone / sample bottles			
Methanol	< 1 Gallon	Support/Decon Zones			
Hexane	< 1 Gallon	Support/Decon Zones			
pH buffers	< 500 ml	Support Zone			
MSA Sanitizer	< 1 liter	Support/Decon Zones			
Alconox/Liquinox	< 1liter	Support/Decon Zones			

Refer to SOP HS-05 *Hazard Communication* for more detailed information.

Attachment 3

Chemical specific Training Form

CHEMICAL-SPECIFIC TRAINING FORM

Location:	Project # :
HCC:	Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

The HCC will 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 will 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 CCI's written hazard communication program will be made available for employee review in the facility/project hazard communication file.

Attachment 4

Emergency Contacts

Emergency Contacts

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

Medical Emergency – 911
Facility Medical Response #:
Local Ambulance #:

CH2M HILL- Medical Consultant
Dr. Jerry H. Berke, M.D., M.P.H.
Health Resources
600 West Cummings Park, Suite 3400
Woburn, MA 01801-6350
1-781-938-4653
1-800-350-4511

Fire/Spill Emergency -- 911
Facility Fire Response #:
Local Fire Dept #:

Local Occupational Physician

Security & Police – 911
Facility Security #:
Local Police #:

Navy RAC Program Manager
Name: Scott Newman/ATL
Phone: 770/604/9182

Utilities Emergency
Water:
Gas:
Electric:

CH2M HILL Health and Safety Manager (HSM)
Name: Rich Rathnow/ORO
Phone: 865/483-9005 (Office); 865/607-6734 (Cell)
865/531-2933(Home)

Designated Safety Coordinator (SHSS)
Name: TBD
Phone:

CH2M HILL Regional Human Resources Department
Name: Nancy Orr/COR
Phone: 303/771-0900

Navy RAC Project Manager
Name: Greg Wilfley/ATL
Phone: 770/604-9182

CH2M HILL Corporate Human Resources Department
Name: John Monark/COR
Phone: 303/771-0900

Federal Express Dangerous Goods Shipping
Phone: 800/238-5355

Emergency Number for Shipping Dangerous Goods
Phone: 800/255-3924

CH2M HILL Worker's Compensation and Auto Claims
Sterling Administration Services
Phone: 800/420-8926 After hours: 800/497-4566

Report fatalities AND report vehicular accidents involving pedestrians, motorcycles, or more than two cars.

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

Facility Alarms:

Evacuation Assembly Area(s):

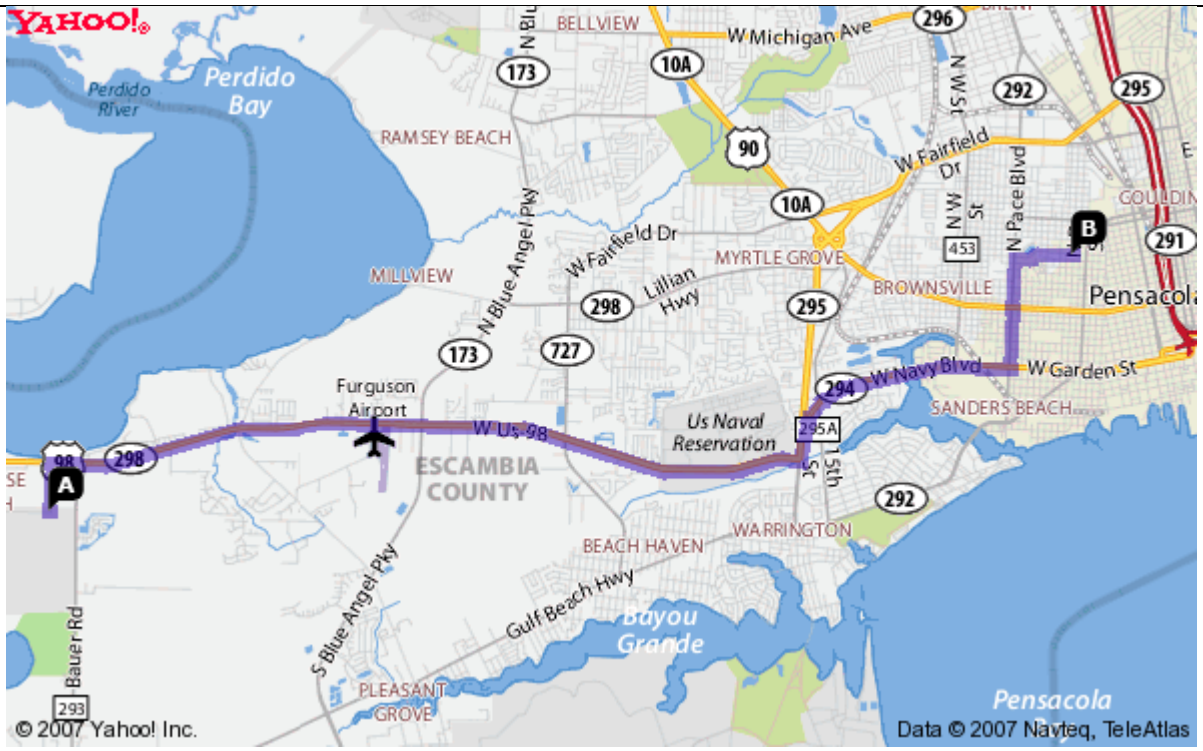
Facility/Site Evacuation Route(s):

Hospital Name/Address:
Baptist Hospital
1000 W. Moreno St.
Pensacola, FL 32501

Hospital Phone #:
(850) 434-4011

Directions to Hospital

From the site, turn right onto Lillian Hwy (US-98) and follow for approx. 8 miles. Turn left on N. Navy Blvd (begins as SR-295N and turns into US-98N) and follow for approx. 2.7 miles. Turn left to continue on US-98 (which will turn into N. Pace Blvd a.k.a SR-292) and follow for approx. 1 mile. Turn right on W. Blount St. and follow for approx. 0.2 miles. W. Blount St. will turn into W. Moreno St., continue to follow for approx. 0.4 miles and you will arrive at Baptist Hospital. Refer to next page for map.



Attachment 5

Activity Hazard Analysis Form

Activity Hazard Form

Activity:	**Date:**
	Project:
Description of the work:	**Site Supervisor:**
	Site Safety Officer:
	Review for latest use: Before the job is performed.

Work Tasks	Identify & Analyze the Hazards	Identify Hazard Controls

Work Tasks	Identify & Analyze the Hazards	Identify Hazard Controls

Equipment to be used	Inspection Requirements	Training Requirements

PRINT	SIGNATURE		
Supervisor Name:	_____	_____	Date/Time:_____
Safety Officer Name:	_____	_____	Date/Time:_____
Employee Name(s):	_____	_____	Date/Time:_____
	_____	_____	Date/Time:_____
	_____	_____	Date/Time:_____
	_____	_____	Date/Time:_____
	_____	_____	Date/Time:_____
	_____	_____	Date/Time:_____
	_____	_____	Date/Time:_____
	_____	_____	Date/Time:_____
	_____	_____	Date/Time:_____
	_____	_____	Date/Time:_____
	_____	_____	Date/Time:_____

Attachment 6

Project Activity Self-Assessment Checklists/Permits

- Waste Characterization, Sampling, and Analysis
- Drilling
- Hand and Power Tools
- Waste Sampling Analysis

CH2MHILL

H&S Self-Assessment Checklist - DRILLING

This checklist will be used by CH2M HILL personnel **only** and will 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).

SHSS may consult with drilling subcontractors when completing this checklist, but will not direct the means and methods of drilling operations nor direct the details of corrective actions. Drilling subcontractors will 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) will be corrected immediately or all exposed personnel will be removed from the hazard until corrected.

Completed checklists will 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 will 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	☐	☐	☐	☐
2. Personnel cleared during rig startup	☐	☐	☐	☐
3. Personnel clear of rotating parts	☐	☐	☐	☐
4. Personnel not positioned under hoisted loads	☐	☐	☐	☐
5. Loose clothing and jewelry removed	☐	☐	☐	☐
6. Personnel instructed not to approach equipment that has become electrically energized	☐	☐	☐	☐
7. Smoking is prohibited around drilling operation	☐	☐	☐	☐
8. Personnel wearing appropriate PPE, per HSP/FSI	☐	☐	☐	☐

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

SECTION 3

Complete this section for all items checked "No" in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: _____ Project Manager: _____

This checklist will be used by CH2M HILL personnel **only** and will 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 exposed to hand and power tool hazards and/or 2) CH2M HILL provides oversight of subcontractor personnel who are exposed to hand and power tool hazards.

SHSS or SHSS may consult with subcontractors when completing this checklist, but will not direct the means and methods of hand and power tool use nor direct the details of corrective actions. Subcontractors will 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) will be corrected immediately or all exposed personnel will be removed from the hazard until corrected.

Completed checklists will be sent to the HS&E Staff for review.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposure to hand and power tool hazards.
☐ Evaluate a CH2M HILL subcontractor's compliance with hand and power tool requirements.
Subcontractors Name: _____

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies will be brought to the immediate attention of the 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-50.

SECTION 1

	Yes	No	N/A	N/O
SAFE WORK PRACTICES (3.1)				
1. All tools operated according to manufacturer's instructions and design limitations.	☐	☐	☐	☐
2. All hand and power tools maintained in a safe condition and inspected and tested before use.	☐	☐	☐	☐
3. Defective tools are tagged and removed from service until repaired.	☐	☐	☐	☐
4. PPE is selected and used according to tool-specific hazards anticipated.	☐	☐	☐	☐
5. Power tools are not carried or lowered by their cord or hose.	☐	☐	☐	☐
6. Tools are disconnected from energy sources when not in use, servicing, cleaning, etc.	☐	☐	☐	☐
7. Safety guards remain installed or are promptly replaced after repair.	☐	☐	☐	☐
8. Tools are stored properly.	☐	☐	☐	☐
9. Cordless tools and recharging units both conform to electrical standards and specifications.	☐	☐	☐	☐
10. Tools used in explosive environments are rated for such use.	☐	☐	☐	☐
11. Knife or blade hand tools are used with the proper precautions.	☐	☐	☐	☐
12. Consider controls to avoid muscular skeletal, repetitive motion, and cumulative trauma stressors.	☐	☐	☐	☐

SECTION 2	Yes	No	N/A	N/O
GENERAL (3.2.1)				
13. PPE is selected and used according to tool-specific hazards anticipated.	☐	☐	☐	☐
14. Tools are tested daily to assure safety devices are operating properly.	☐	☐	☐	☐
15. Damaged tools are removed from service until repaired.	☐	☐	☐	☐
16. Power operated tools designed to accommodate guards have guards installed.	☐	☐	☐	☐
17. Rotating or moving parts on tools are properly guarded.	☐	☐	☐	☐
18. Machines designed for fixed locations are secured or anchored.	☐	☐	☐	☐
19. Floor and bench-mounted grinders are provided with properly positioned work rests.	☐	☐	☐	☐
20. Guards are provided at point of operation, nip points, rotating parts, etc.	☐	☐	☐	☐
21. Fluid used in hydraulic-powered tools is approved fire-resistant fluid.	☐	☐	☐	☐
ELECTRIC-POWERED TOOLS (3.2.2)				
22. Electric tools are approved double insulated or grounded and used according to SOP HS-23.	☐	☐	☐	☐
23. Electric cords are not used for hoisting or lowering tools.	☐	☐	☐	☐
24. Electric tools are used in damp/ wet locations are approved for such locations or GFCI installed.	☐	☐	☐	☐
25. Hand-held tools are equipped with appropriate on/off controls appropriate for the tool.	☐	☐	☐	☐
26. Portable, power-driven circular saws are equipped with proper guards.	☐	☐	☐	☐
ABRASIVE WHEEL TOOLS (3.2.3)				
27. All employees using abrasive wheel tools are wearing eye protection.	☐	☐	☐	☐
28. All grinding machines are supplied with sufficient power to maintain spindle speed.	☐	☐	☐	☐
29. Abrasive wheels are closely inspected and ring-tested before use.	☐	☐	☐	☐
30. Grinding wheels are properly installed.	☐	☐	☐	☐
31. Cup-type wheels for external grinding are protected by the proper guard or flanges.	☐	☐	☐	☐
32. Portable abrasive wheels used for internal grinding are protected by safety flanges.	☐	☐	☐	☐
33. Safety flanges are used only with wheels designed to fit the flanges.	☐	☐	☐	☐
34. Safety guards on abrasive wheel tools are mounted properly and of sufficient strength.	☐	☐	☐	☐
PNEUMATIC-POWERED TOOLS (3.2.4)				
35. Tools are secured to hoses or whip by positive means to prevent disconnection.	☐	☐	☐	☐
36. Safety clips or retainers are installed to prevent attachments being expelled.	☐	☐	☐	☐ 37.
Safety devices are installed on automatic fastener feed tools as required.	☐	☐	☐	☐
38. Compressed air is not used for cleaning unless reduced to < 30 psi, with PPE, and guarded.	☐	☐	☐	☐
39. Manufacturer's safe operating pressure for hoses, pipes, valves, etc. are not exceeded.	☐	☐	☐	☐
40. Hoses are not used for hoisting or lowering tools.	☐	☐	☐	☐
41. All hoses >1/2-inch diameter have safety device at source to reduce pressure upon hose failure.	☐	☐	☐	☐
42. Airless spray guns have required safety devices installed.	☐	☐	☐	☐
43. Blast cleaning nozzles are equipped with operating valves, which are held open manually.	☐	☐	☐	☐
44. Supports are provided for mounting nozzles when not in use.	☐	☐	☐	☐
45. Air receiver drains, handholes, and manholes are easily accessible.	☐	☐	☐	☐
46. Air receivers are equipped with drainpipes and valves for removal of accumulated oil and water.	☐	☐	☐	☐
47. Air receivers are completely drained at required intervals.	☐	☐	☐	☐
48. Air receivers are equipped with indicating pressure gauges.	☐	☐	☐	☐
49. Safety, indicating, and controlling devices are installed as required.	☐	☐	☐	☐
50. Safety valves are tested frequently and at regular intervals to assure good operating condition.	☐	☐	☐	☐

SECTION 2 (continued)

	Yes	No	N/A	N/O
LIQUID FUEL-POWERED TOOLS (3.2.5)				
51. Liquid fuel-powered tools are stopped when refueling, servicing, or maintaining.	☐	☐	☐	☐
52. Liquid fuels are stored, handled, and transported in accordance with SOP HS-21	☐	☐	☐	☐
53. Liquid fuel-powered tools are used in confined spaces in accordance with SOP HS-17.	☐	☐	☐	☐
54. Safe operating pressures of hoses, valves, pipes, filters, and other fittings are not exceeded.	☐	☐	☐	☐
POWDER-ACTUATED TOOLS (3.2.6)				
55. Only trained employee operates powder-actuated tools.	☐	☐	☐	☐
56. Powder-actuated tools are not loaded until just prior to intended firing time.	☐	☐	☐	☐
57. Tools are not pointed at any employee at any time.	☐	☐	☐	☐
58. Hands are kept clear of open barrel end.	☐	☐	☐	☐
59. Loaded tools are not left unattended.	☐	☐	☐	☐
60. Fasteners are not driven into very hard or brittle materials.	☐	☐	☐	☐
61. Fasteners are not driven into easily penetrated materials unless suitable backing is provided.	☐	☐	☐	☐
62. Fasteners are not driven into spalled areas.	☐	☐	☐	☐
63. Powder-actuated tools are not used in an explosive or flammable atmosphere.	☐	☐	☐	☐
64. All tools are used with correct shields, guards, or attachments recommended by manufacturer.	☐	☐	☐	☐
JACKING TOOLS (3.2.7)				
65. Rated capacities are legibly marked on jacks and not exceeded.	☐	☐	☐	☐
66. Jacks have a positive stop to prevent over-travel.	☐	☐	☐	☐
67. The base of jacks are blocked or cribbed to provide a firm foundation, when required.	☐	☐	☐	☐
68. Wood blocks are place between the cap and load to prevent slippage, when required.	☐	☐	☐	☐
69. After load is raised, it is cribbed, blocked, or otherwise secured immediately.	☐	☐	☐	☐
70. Antifreeze is used when hydraulic jacks are exposed to freezing temperatures.	☐	☐	☐	☐
71. All jacks are properly lubricated.	☐	☐	☐	☐
72. Jacks are inspected as required.	☐	☐	☐	☐
73. Repair or replacement parts are examined for possible defects.	☐	☐	☐	☐
74. Jacks not working properly are removed from service and repaired or replaced.	☐	☐	☐	☐
HAND TOOLS (3.2.8)				
75. Wrenches are not used when jaws are sprung to the point of slippage.	☐	☐	☐	☐
76. Impact tools are kept free of mushroomed heads.	☐	☐	☐	☐
77. Wooden handles of tools are kept free of splinters or cracks and are tightly fitted in tool.	☐	☐	☐	☐

SECTION 3

Complete this section for all items checked "No" in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: _____ Project Manager: _____

CH2MHILL

HS&E Self-Assessment Checklist—Waste Characterization, Sampling and Analysis

This checklist will be used by CH2M HILL personnel **only** and will 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 will be managing wastes generated on project sites and/or 2) CH2M HILL provides oversight of subcontractor personnel who are managing wastes generated at project sites.

The Safety Coordinator (SC) may consult with subcontractors when completing this checklist, but will not direct the means and methods of waste characterization, sampling and analysis operations nor direct the details of corrective actions. Subcontractors will 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) will be corrected immediately or all exposed personnel will be removed from the hazard until corrected.

Completed checklists will be sent to the HS&E Staff for review.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Person filling out checklist: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL compliance with its waste characterization, sampling and analysis standard (SOP-79).
☐ Evaluate a CH2M HILL subcontractor's compliance with the waste characterization, sampling and analysis standard and its requirements
Subcontractors Name: _____

Check "Yes" if an assessment item is complete/correct.

Check "No" if an item is incomplete/deficient. Deficiencies will be brought to the immediate attention of the 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-42.

	Yes	No	N/A	N/O
GENERAL WASTE CHARACTERIZATION INFORMATION (6.0)				
1. Personnel told not to sign waste documentation (e.g., manifests) unless specifically authorized by the client in writing.	☐	☐	☐	☐
2. Waste Management Plan developed and available to all project personnel (see HSE-78).	☐	☐	☐	☐
3. Waste characterized before it is generated.	☐	☐	☐	☐
4. Waste characterized by Client using generator information.	☐	☐	☐	☐
5. Waste volumes estimated.	☐	☐	☐	☐
6. Disposal facility sampling and analytical requirements identified.	☐	☐	☐	☐
7. Disposal facility evaluated (see HSE-78).	☐	☐	☐	☐
8. Waste stream characterization documented in project file.	☐	☐	☐	☐
IDENTIFY ANALYTICAL TEST METHODS (7.1)				
9. Nature and quantity of the waste determined.	☐	☐	☐	☐
10. Analyses required for transport, treatment, and disposal determined.	☐	☐	☐	☐
11. Detection limits identified.	☐	☐	☐	☐
12. Provide disposal facility with analytical results.	☐	☐	☐	☐
13. Analytical test methods identified.	☐	☐	☐	☐

	Yes	No	N/A	N/O
SAMPLING (7.2)				
14. Developed a sampling plan.	☐	☐	☐	☐
15. Field activities recorded in a logbook.	☐	☐	☐	☐
16. Exceptions to sampling plan documented in field logbook.				
17. Each container labeled with the project name, number, sample ID number, date and time,	☐	☐	☐	☐
18. The label on the container is covered with clear tape to prevent loss. collected sampler's name, sample preserves, analysis to be performed.	☐	☐	☐	☐
CHAIN OF CUSTODY (COC)				
19. Sample shipping containers sealed with two custody seals.	☐	☐	☐	☐
20. Custody seals placed over the left and rights sides of the container's cover (cooler).	☐	☐	☐	☐
21. Each seal signed and dated (with time).	☐	☐	☐	☐
22. Seals are covered with clear tape to prevent loss.	☐	☐	☐	☐
23. Custody seals placed on sample container immediately after collection.	☐	☐	☐	☐
24. Custody seals must be placed in a manner that they must be broken to open sample container.	☐	☐	☐	☐
25. The sample is in custody (in view or physical possession, it has not been tampered with, it is retained in a secured area with restricted access, it is placed in a container and secured with an official seal such that it cannot be reached without breaking the seal).	☐	☐	☐	☐
CHAIN OF CUSTODY FORM INSTRUCTIONS (7.2.5)				
26. Chain of Custody form completed per instructions	☐	☐	☐	☐
RECORDS (7.2.6)				
27. Original COC submitted to the lab along with final data packages.	☐	☐	☐	☐
28. Official copy of COC form sent to the project chemist and lab with sample shipment.	☐	☐	☐	☐
29. Changes to analytical requests on COC form or the PO made in writing to the lab.	☐	☐	☐	☐
30. A copy of written change sent to PM, lab, and placed in project files.	☐	☐	☐	☐
31. Reasons for change are included in sample log and project file.	☐	☐	☐	☐
32. Sample logbooks, sample logs, and COC forms sent to PM at completion of project activities.	☐	☐	☐	☐

Complete this section for all items checked "No" in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	**Corrective Action Planned/Taken**	**Date Corrected**

Auditor: ________________________________ Project Manager: ____________________________

Appendix A: Waste Characterization, Sampling and Analysis – USA

1.0 Introduction

This appendix provides federal requirements for projects conducted within the U.S. and its territories. Contact the regional ECC for specific state and local requirements.

2.0 Regulatory Review

The Resource Conservation and Recovery Act (RCRA, 40 CFR 258-279) regulates the generation, storage, transportation, treatment and disposal of solid and hazardous waste. States or local agencies may have hazardous waste requirements more restrictive than the Federal standard.

The Toxic Substances Control Act (TSCA, 40 CFR 761) regulates the manufacture, use, storage, treatment, and disposal of toxic substances, including PCBs. States or local agencies may have requirements more restrictive than the Federal standard.

The Clean Air Act (CAA, 40 CFR 61) regulates the emission of hazardous air pollutants, including asbestos and provides management standards to control emissions. States or local agencies may have requirements more restrictive than the Federal standard.

3.0 Responsibilities

3.1 Environmental Compliance Coordinator (ECC)

The ECC is responsible for providing resources to assist Project Managers to interpret environmental requirements and implement the policies and procedures in this appendix.

4.0 CH2M HILL Policy

It is CH2M HILL policy to manage wastes in compliance with applicable regulations. Since waste characterization is the client's legal responsibility, **CH2M HILL will not sign documentation (e.g., manifests) that suggests CH2M HILL is assuming the client's waste characterization responsibility.** If a client requests this service, the approval process described in the Hazardous Waste Policy for U.S. Projects (Attachment A-1) must be followed.

5.0 Definitions

5.1 Acute Hazardous Waste

Acute hazardous waste is designated with an "H" in the *Hazard Code* column in Tables 40 CFR 261.31 (F-list) and 261.33 (P-list).

5.2 Asbestos Containing Material (ACM)

ACM contains greater than 1 percent asbestos determined by polarized light microscopy.

5.3 Container
A container is any portable device in which a material is stored, transported, treated, disposed of, or otherwise handled. Containers include roll-off boxes, drums, and portable tanks.

5.4 Debris
Debris is any solid material exceeding a 60 mm particle size that is intended for disposal and that is a manufactured object, plant or animal matter, or natural geologic material.

5.5 EPA Identification Number
The EPA Identification Number is a unique number assigned by EPA or a state agency to a generator, transporter, and treatment, storage, or disposal facility that manages hazardous waste.

5.6 Environmental Media
Environmental media includes substances occurring in the natural environment, such as groundwater or soil.

5.7 Facility
A facility is all contiguous land, structures, appurtenances, and improvements on the land used for treating, storing, or disposing of hazardous waste. A facility may consist of several treatment, storage, or disposal operational units (e.g., one or more landfills, surface impoundments, or combinations of them).

5.8 Hazardous Waste
Hazardous waste is a solid waste that is not excluded from regulation and: 1) is listed as a hazardous waste, and/or 2) exhibits any of the characteristics of hazardous waste, i.e., ignitability, corrosivity, reactivity, and TCLP toxicity. States may have additional wastes or criteria for state-specific "hazardous" wastes.

5.9 Hazardous Waste Manifest
The hazardous waste manifest (Environmental Protection Agency (EPA) Form 8700-22) is the shipping document for tracking shipments of hazardous waste from the generator's facility to the final disposal facility. The manifest is originated and signed by the generator, and must also be signed by transporters and disposal facilities.

5.10 Munitions and Explosives
Munitions and explosives consist of various types of ordnance such as ammunition, ammunition components, chemical or biological warfare materials that have been abandoned, expelled from demolition pits or burning pads, lost, discarded, buried or fired. "Military munitions" are munitions and explosives that are or have been under the control of various federal agencies such as the DOE and DOD.

5.11 Polychlorinated Biphenyls (PCBs)
PCBs are chemicals in which the biphenyl molecule has been chlorinated and are commonly used in electrical equipment. PCBs may be regulated under TSCA, depending upon concentration.

5.12 Solid Waste
Solid waste is any discarded material regardless of physical state (solid, liquid, or containerized gases). Solid wastes are considered discarded if they are abandoned, recycled, or are inherently waste-like.

5.13 State-Regulated/Special/Industrial Wastes

State-regulated/special/industrial wastes are identified by state agencies for regulation separate from wastes identified by EPA.

5.14 Universal Waste

Universal wastes include batteries, agricultural pesticides, thermostats, and mercury-containing lamps. These wastes are subject to less stringent requirements than RCRA hazardous waste if they are managed in a regulation-specified manner.

5.15 Unexploded Ordnance (UXO)

UXO includes military munitions that have been primed, fuzed, armed, or otherwise prepared for action, and have been fired dropped, launched, projected or placed in such a manner as to constitute a hazard to operations, installation, personnel, or material and remain unexploded either by malfunction, design, or any other cause.

6.0 Waste Characterization

This section provides fundamental information on how to characterize wastes in accordance with RCRA, the Toxic Substance Control Act (TSCA), and other applicable laws and regulations. Consult your regional Environmental Compliance Coordinator for specific state and local requirements.

CH2M HILL may assist a client with waste characterization if specified in the project scope of work. The following procedures provide general information to assist with our limited scope. However, **CH2M HILL personnel must not sign documentation (such as manifests) that may indicate that CH2M HILL intends to assume the client's waste characterization responsibilities.** If a client requests this service, the approval process described in the Hazardous Waste Policy for U.S. Projects (Attachment A-1) must be followed.

6.1 Hazardous Waste Determination

Generators must determine if waste is hazardous by using process knowledge (e.g., historical data or information in MSDS) or testing the waste using standard EPA methods. With this information, a waste is characterized by asking the following questions:

- Is it a solid waste?
- Is it excluded?
- Is it a listed hazardous waste?
- Is it "contained in" environmental media or debris?
- Does it exhibit a hazardous characteristic?

Regulated wastes will carry a specific "waste code" for identification. Hazardous wastes are subject to strict management standards as discussed in HSE-80 (Hazardous Waste Management). The following sections discuss each question to characterize waste.

6.1.1 Is it a Solid Waste?

Almost everything is considered solid under RCRA, including liquids and compressed gases. Solid material becomes solid waste when it is discarded by being abandoned through accumulation, storage, disposal, or treatment or by being recycled.

6.1.2 Is it Excluded?

Some wastes are excluded from regulation as solid and hazardous waste. Solid waste exclusions are found in 40 CFR 261.4. Common solid waste exclusions include domestic sewage and industrial wastewater. Materials that are not solid waste *cannot* be hazardous waste.

Hazardous waste exclusions are found in 40 CFR 261.4. Common hazardous waste exclusions include mining overburden returned to the mine, and wastes from extraction or production of crude oil or natural gas. Evaluate all waste streams for a solid or hazardous waste exclusion and document all exclusions in the project file.

6.1.3 Is it Listed Hazardous Waste?

A solid waste is hazardous if it is included on one of three lists: F-list (40 CFR 261.31), K-list (261.32), and P- and U-lists (261.33). The lists are based on the source of the waste as shown in Table 6-1. Evaluate the source of all project waste streams to determine if a listed waste code applies. Document all waste code determinations in the project file.

Table 6-1 Listed Wastes

WASTE CODE	SOURCE OF WASTE	DESCRIPTION
F-list	Non-Specific Source	Generic wastes produced by any industrial manufacturing processes. Examples include spent solvents from degreasing.
K-list	Specific Source	Wastes from specifically identified industries. Examples include petroleum refining wastes or wood preserving wastes.
P- list (acutely hazardous) U-list (toxic)	Commercial Chemical Products	Pure chemical products or manufacturing intermediates listed in 40 CFR 261.33 or are the sole active ingredient in a mixture. Examples include MEK or TCE.

6.1.4 Is it "Contained-in" Environmental Media or Debris?

Environmental media and debris can become a hazardous waste if it "contains" (i.e., is contaminated) with a listed waste. Evaluate all project waste streams to determine if one of the following "contained-in" rules cause the waste stream to be regulated as a listed hazardous waste.

The "contained-in policy" regulates environmental media that contains listed hazardous waste. Environmental media is regulated as hazardous waste if it is contaminated with an F-, K-, P- or U-listed waste, regardless of the amount of contamination. The waste code can be removed from soil or groundwater by demonstrating that contamination is below health-based standards (e.g., following treatment) and obtaining a "contained-in decision" (also known as a "contained-out" decision) from the state or EPA. Document all determinations and contained-in decisions in the project file.

The "contained-in rule" (also known as the debris rule) applies to debris. It states that debris such as concrete, asphalt, or wood is regulated as hazardous waste if it contains listed hazardous waste. This determination can be removed through treatment to the alternative treatment standards for hazardous debris in 40 CFR 268.45. Treatment technologies include surface extraction such as pressure washing or spalling, depending upon the type of debris. Contact the regional ECC for assistance with "contained-in" rules.

6.1.5 Does it Exhibit a Hazardous Characteristic?

A solid waste is a hazardous waste if it exhibits the following four characteristics:

- Ignitability (D001)
- Corrosivity (D002)
- Reactivity (D003)
- Toxicity (D004-43)

Ignitable wastes (D001) are generally liquids with a flash point of less than 140 degrees F, such as mineral spirits. Other ignitable wastes are non-liquids that can cause fire under standard temperature and pressure, ignitable compressed gases, and ignitable oxidizers (chlorates).

Corrosive wastes (D002) are liquids with a pH < 2 or > 12.5, such as lead acid batteries, hydrochloric acid or sodium hydroxide. Soil cannot be a corrosive waste because it is not aqueous. Note however, that some states regulate corrosive solids.

Reactive wastes (D003) are wastes that are normally unstable and react violently such as a lithium sulfur dioxide battery, heated aerosol cans, or ordnance.

Toxic wastes are liquids or solids that contain a regulated amount of any one of 39 toxic compounds; the waste codes assigned to these compounds are D004 through D043. This determination is usually made by sampling and analysis using the Toxicity Characteristic Leaching Procedure (TCLP). Waste leachate concentrations exceeding the regulatory limits are assigned the corresponding D004 through D043 waste code(s). Table 6-2 lists the constituents applicable to the toxicity characteristic. Evaluate all project waste streams to determine if a D-code will apply.

Table 6-2 Toxicity Characteristic Criteria

Waste Code	Constituent	TCLP Maximum (mg/l)
D004	Arsenic	5.0
D005	Barium	100.0
D006	Cadmium	1.0
D007	Chromium (total)	5.0
D008	Lead	5.0
D009	Mercury	0.2
D010	Selenium	1.0
D011	Silver	5.0
	ides/Herbicides	
D012	Endrin	0.02
D013	Lindane	0.4
D014	Methoxychlor	10.0
D015	Toxaphene	0.5
D016	2,4-D	10.0
D017	2,4,5-TP Silvex	1.0
	s	
D018	Benzene	0.5
D019	Carbon tetrachloride	0.5
D020	Chlordane	0.03
D021	Chlorobenzene	100

D022	Chloroform	6.0
Waste Code	**Constituent**	**TCLP Maximum (mg/l)**
D023	o-Cresol*	200.0
D024	m-Cresol*	200.0
D025	p-Cresol*	200.0
D026	Cresols*	200.0
D027	1,4-Dichlorobenzene	7.5
D028	1,2-Dichloroethane	0.5
D029	1,1-Dichloroethylene	0.7
D030	2,4-Dinitrotoluene	0.13
D031	Heptachlor (and epoxide)	0.008
D032	Hexachlorobenzene	0.13
D033	Hexachlorobutadiene	0.5
D034	Hexachloroethane	3.0
D035	Methyl ethyl ketone	200.0
D036	Nitrobenzene	2.0
D037	Pentachlorophenol	100.0
D038	Pyridine	5.0
D039	Tetrachloroethylene	0.7
D040	Trichloroethylene	0.5
D041	2,4,5-Trichlorophenol	400.0
D042	2,4,6-Trichlorophenol	2.0
D043	Vinyl chloride	0.2

6.2 Underlying Hazardous Constituents

Wastes that are determined to be hazardous under Section 6.1 must also be evaluated for the presence of underlying hazardous constituents. These must be evaluated so that the waste can be fully treated to meet the Land Disposal Restrictions (LDRs, 40 CFR 268). The presence of underlying hazardous constituents can be determined through process knowledge, MSDS review, or sampling and analysis. Consult the regional ECC for assistance in determining if your project waste stream contains underlying hazardous constituents.

6.3 State-Specific Wastes

Many states have more stringent requirements than EPA and regulate additional wastes as hazardous or special wastes. Some examples include low-level PCB waste or petroleum-contaminated soil. Contact the regional ECC to evaluate state regulations and guidance to determine if project waste streams are regulated as state-specific wastes.

6.3 TSCA Waste Classification

PCB wastes are regulated under the Toxic Substances Control Act (TSCA, 40 CFR 761). As a general rule, if the concentration of PCBs in the waste is greater than 50 ppm, or if the original PCB source has a concentration greater than 50 ppm, the waste is regulated under TSCA. Refer to the PCB Management SOP (HSE-82) for more information.

6.4 Universal Waste Determination

Universal wastes include batteries, agricultural pesticides, thermostats, and mercury-containing lamps, and are regulated under 40 CFR 273. These wastes are subject to less stringent requirements than RCRA hazardous waste if they are managed in the regulatory specified manner. Refer to the Universal Waste SOP (HSE-83) for these requirements.

6.5 Asbestos

Asbestos is regulated under the Clean Air Act National Emission Standards for Hazardous Air Pollutants (NESHAPs). Waste asbestos or wastes containing asbestos must be removed, packaged, labeled and managed of in accordance with 40 CFR 61, Subpart M. Refer to the Asbestos SOP (HSE-42).

6.6 UXO/OEW

Unexploded ordnance/ordnance explosive waste (UXO/OEW) is regulated under RCRA. See the UXO/OEW SOP (HSE-91) for more information.

6.7 Radioactive Waste

If radioactive wastes will potentially be generated at a client site, contact the CH2M HILL Radioactive Waste Expert, Dave McCormack/SEA.

7.0 Waste Sampling and Analysis

This section identifies the requirements for sampling and analysis for wastes generated on U.S. projects. The following should be considered for sampling and analysis activities:

- Avoid resampling by evaluating regulatory and treatment, storage, or disposal facility (TSDF) requirements during project planning
- Ensure that test method detection levels meet regulatory limits
- Supplement laboratory testing with field test kits
- Use total constituent data where possible instead of TCLP to reduce costs
- Develop a sampling and analysis plan for the collection of representative samples

7.1 Identifying Analytical Test Methods

Potential analyses include:

- Totals
- TCLP
- Paint filter test
- Ignitability
- Corrosivity
- Reactivity
- PCBs

7.1.1 Waste Nature and Quantity

Under RCRA Land Disposal Restrictions (LDRs), underlying hazardous constituents must also be identified in a hazardous waste. Underlying hazardous constituents must also be treated to meet LDRs prior to land disposal. Therefore, any inquiries into the nature of the waste should identify underlying constituents that may not cause the waste to be hazardous. Also evaluate the waste to determine if listed hazardous waste is “contained-in” environmental media or debris (See Section 6.1.4). This determination can greatly effect the volume of hazardous waste generated.

7.1.2 Legal Requirements

RCRA requires that samples be representative of the waste stream. Representative sampling is easily accomplished in homogenous waste streams such as no-phase liquids. However, determining representative samples in a heterogeneous waste stream such as contaminated soil is more difficult. The following are EPA resources for determining representative sampling:

- Samplers and Sampling Procedures for Hazardous Waste Streams. 1980. U.S. EPA, Municipal Environmental Research Laboratory, Cincinnati, Ohio 45268, EPA-600/2-80-018. 70 pp. Publication is free. Order by calling EPA, Cincinnati Environmental Research Information Center (513) 569-7562.
- Sampling and Sampling Plans. Test Methods for Evaluating Solid Waste, Volume II: Field Manual, Physical/Chemical Methods, 3rd Edition, SW-846, Part III, Chapter 9, pp. 9-1 to 9-79. November 1986. EPA, Office of Solid Waste and Emergency Response, Washington, D.C. 20460.
- Characterization of Hazardous Waste Sites—A Methods Manual: Volume II. Available Sampling Methods, 2nd Edition. December 1984. EPA, Environmental Monitoring Systems Laboratory, Las Vegas, Nevada 89114, EPA 600/4-84-076.
- Characterizing Heterogeneous Wastes: Methods and Recommendations. February 1992. EPA, Office of Research and Development, Washington, D.C. 20460, EPA/600/R-92/033.

Commercial laboratories should be used for waste analyses. Field test kits may be used to minimize the cost of screening waste streams in the field. However, these *test kits should not be used as a sole source for hazardous waste determination*.

In some cases, total concentration analysis may be used to characterize a waste stream for the toxicity characteristic (D004-43) instead of running TCLP analysis. To use totals analysis, the waste must be entirely solid, or must contain less than 0.5 percent liquid. For ***solids*** with no liquid fraction, the TCLP leaches 100 grams of sample with 2,000 grams of leaching solution, providing a maximum of 20 times dilution of constituents in the sample. Therefore the conservative "20-Times" rule is to compare total constituent results to the TCLP regulatory limit times 20 to determine if the waste is hazardous. If less than 20x, the waste is below the regulatory limit, if above 20x, you must assume it is a hazardous waste for that constituent, or perform TCLP to make a final determination. For ***liquid*** wastes which have less than 0.5 percent solids, compare the results directly to the TC regulatory limit, with no multiplier. Note that for both liquids and solids, total constituent data can be more conservative than TCLP, especially for metals.

7.1.3 Detection Limits

Consult with the laboratory to identify the detection limits of the proposed test methods and compare them to the corresponding regulatory level, such as the TCLP limit. Although most detection limits will meet TCLP levels, some test methods cannot meet some regulatory levels, such as PCB concentrations in drinking water.

7.1.4 Disposal Facility Requirements

All facilities require waste characterization whether it be by analyses such as Toxicity Characteristic Leaching Procedure (TCLP) or by generator knowledge. Some facilities will also require additional analyses, such as total organic carbon (TOC) or chemical oxygen demand (COD), while others require testing only to meet certain permit requirements or no testing at all. Contact the proposed treatment/disposal facilities to determine their specific requirements.

Attachment A-1

HAZARDOUS WASTE POLICY for U.S. PROJECTS

Revision 2.0, January 1996

INTRODUCTION

This document presents the CH2M HILL policy for pursuing and performing projects involving hazardous and toxic wastes, and is effective on the date of issue. It applies to all projects involving the management or remediation of hazardous wastes or toxic substances that are governed by U.S. federal and state laws or regulations. This policy replaces the CH2M HILL, INC. policy issued in May 1993, and presents the prescribed process to follow for screening project opportunities involving hazardous or toxic materials. ***This policy is applicable to all project opportunities pursued or performed in all business groups.***

Properly done, hazardous and toxic waste work is challenging, profitable business and represents an investment in our firm's future success. Because this work can involve higher risks and exposures than most of our other work, we must use great care in marketing our services, screening potential projects, negotiating our contracts, and performing our work. We should accept only project work for which we are qualified and for which we have qualified and available people. We should not accept work for which the risks are too great. Most importantly, we must make sure that the health and safety of our employees is not compromised.

This policy represents a significant departure from its earlier versions. It reflects the competitive forces we encounter in the marketplace on a daily basis, and also considers the current legal and practice environment in which we pursue and perform project work involving hazardous and toxic materials. This hazardous waste policy makes the assignment of stewardship and the decision-making process for projects pursuit, except where special approval is required, similar to the decision-making process for pursuing other types of projects.

The policy requires careful screening of all opportunities involving hazardous or toxic materials. The screening process triggers one of several formal bid/no-bid or go/no-go assessments and assigns stewardship depending on the issues identified in the evaluation of the specific project opportunity.

PROJECTS REQUIRING SPECIAL APPROVAL

As a matter of policy, the following types of projects may not be undertaken without special approval as described below:

- **Hazardous Waste Generator or Transporter.** We will not accept projects or conduct tasks that will cause us to be classified as a generator or transporter of hazardous wastes. For example, we will not sign hazardous waste manifests.
- **Environmental Impairment Liability (EIL) Insurance Investigations.** We will not accept projects involving EIL investigations or assessments.
- **Standard Setting.** We will not accept projects that require us to certify, or to express an opinion regarding "safe" levels of contamination; i.e., we will not become "standard setters."

- **Asbestos Remediation Work.** We will not accept projects involving "stand-alone" asbestos remediation. We can accept assignments involving asbestos remediation that is performed by qualified subcontractors.

Special approval may be obtained from a team comprising the following people:

- A lawyer from the Legal & Insurance Department.
- The Regional Manager from the affected region.
- The Project Delivery Director or Director of Operations from the appropriate business group.
- If the project opportunity is from a multi-regional client, then the Operations Manager from the appropriate business group will be added to the special approval team.

If you have questions, or you need additional information, contact Dan Smith in the Legal & Insurance Department/COR ext. 2452, David Miller/COR ext. 2411, or Bill Dehn/FGL/COR ext. 2315.

Attachment 7

Incident Reporting Forms

- Incident Report Form
- Near Loss Investigation Form
- Root Cause Analysis Form

Incident Report Form

Fax completed form to:
425.462.5957
CH2M HILL Seattle Office
Attention: Corporate HS&E Department

Type of Incident (Select at least one)

- ☐ Injury/Illness
- ☐ Environmental/Permit Issue
- ☐ Property Damage
- ☐ Near Miss
- ☐ Spill/Release
- ☐ Other

General Information (Complete for all incident types)

Preparer's Name: _____ Preparer's Employee Number: _____
Date of Report: _____ Date of Incident: _____ Time of Incident: _____ am/pm

Type of Activity (Provide activity being performed that resulted in the incident)

- ☐ Asbestos Work
- ☐ Confined Space Entry
- ☐ Construction Mgmt- Haz Waste
- ☐ Construction Mgmt - Non-Haz Waste
- ☐ Demolition
- ☐ Drilling-Haz Waste
- ☐ Drilling-Non Haz Waste
- ☐ Drum Handling
- ☐ Electrical Work
- ☐ Excavation Trench-Haz Waste
- ☐ Excavation Trench-Non Haz
- ☐ Facility Walk Through
- ☐ General Office Work
- ☐ Keyboard Work
- ☐ Laboratory
- ☐ Lead Abatement
- ☐ Motor Vehicle Operation
- ☐ Moving Heavy Object
- ☐ Other (Specify) _____
- ☐ Process Safety Management
- ☐ Tunneling
- ☐ Welding
- ☐ Wetlands Survey
- ☐ Working from Heights
- ☐ Working in Roadways
- ☐ WWTP Operation

Location of Incident (Select one)

- ☐ Company Premises (CH2M HILL Office: _____)
- ☐ Field (Project #: _____ Project/Site Name: _____ Client: _____)
- ☐ In Transit (Traveling from: _____ Traveling to: _____)
- ☐ At Home

Geographic Location of Incident (Select region where the incident occurred)

- ☐ Northeast
- ☐ Southeast
- ☐ Northwest
- ☐ Southwest
- ☐ Corporate
- ☐ Canadian
- ☐ Asia Pacific
- ☐ Europe Middle East
- ☐ Latin America

If a CH2M HILL subcontractor was involved in the incident, provide their company name and phone number: _____

Describe the Incident (Provide a brief description of the incident): _____

_____

_____

Injured Employee Data (Complete for Injury/Illness incidents only)

If CH2M HILL employee injured

Employee Name: _____ Employee Number: _____

If CH2M HILL Subcontractor employee injured

Employee Name: _____ Company: _____

Injury Type

- ☐ Allergic Reaction
- ☐ Amputation
- ☐ Asphyxia
- ☐ Bruise/Contusion/Abrasion
- ☐ Burn (Chemical)
- ☐ Burn/Scald (Heat)
- ☐ Cancer
- ☐ Carpal Tunnel
- ☐ Concussion
- ☐ Cut/Laceration
- ☐ Dermatitis
- ☐ Dislocation
- ☐ Electric Shock
- ☐ Foreign Body in eye
- ☐ Fracture
- ☐ Freezing/Frost Bite
- ☐ Headache
- ☐ Hearing Loss
- ☐ Heat Exhaustion
- ☐ Hernia
- ☐ Infection
- ☐ Irritation to eye
- ☐ Ligament Damage
- ☐ Multiple (Specify) _____
- ☐ Muscle Spasms
- ☐ Other (Specify) _____
- ☐ Poisoning (Systemic)
- ☐ Puncture
- ☐ Radiation Effects
- ☐ Strain/Sprain
- ☐ Tendonitits
- ☐ Wrist Pain

Part of Body Injured

- ☐ Abdomen
- ☐ Ankle(s)
- ☐ Arms (Multiple)
- ☐ Back
- ☐ Blood
- ☐ Body System
- ☐ Buttocks
- ☐ Chest/Ribs
- ☐ Ear(s)
- ☐ Elbow(s)
- ☐ Eye(s)
- ☐ Face
- ☐ Finger(s)
- ☐ Foot/Feet
- ☐ Hand(s)
- ☐ Head
- ☐ Hip(s)
- ☐ Kidney
- ☐ Knee(s)
- ☐ Leg(s)
- ☐ Liver
- ☐ Lower (arms)
- ☐ Lower (legs)
- ☐ Lung
- ☐ Mind
- ☐ Multiple (Specify) _____
- ☐ Neck
- ☐ Nervous System
- ☐ Nose
- ☐ Other (Specify) _____
- ☐ Reproductive System
- ☐ Shoulder(s)
- ☐ Throat
- ☐ Toe(s)
- ☐ Upper Arm(s)
- ☐ Upper Leg(s)
- ☐ Wrist(s)

Nature of Injury

- ☐ Absorption
- ☐ Bite/Sting/Scratch
- ☐ Cardio-Vascular/Respiratory System Failure
- ☐ Caught In or Between
- ☐ Fall (From Elevation)
- ☐ Fall (Same Level)
- ☐ Ingestion
- ☐ Inhalation
- ☐ Lifting
- ☐ Mental Stress
- ☐ Motor Vehicle Accident
- ☐ Multiple (Specify) _____
- ☐ Other (Specify) _____
- ☐ Overexertion
- ☐ Repeated Motion/Pressure
- ☐ Rubbed/Abraded
- ☐ Shock
- ☐ Struck Against
- ☐ Struck By
- ☐ Work Place Violence

Initial Diagnosis/Treatment Date: _____

Type of Treatment

- ☐ Admission to hospital/medical facility
- ☐ Application of bandages
- ☐ Cold/Heat Compression/Multiple Treatment
- ☐ Cold/Heat Compression/One Treatment
- ☐ First Degree Burn Treatment
- ☐ Heat Therapy/Multiple treatment
- ☐ Multiple (Specify) _____
- ☐ Heat Therapy/One Treatment
- ☐ Non-Prescriptive medicine
- ☐ None
- ☐ Observation
- ☐ Other (Specify) _____
- ☐ Prescription- Multiple dose
- ☐ Prescription- Single dose
- ☐ Removal of foreign bodies
- ☐ Skin Removal
- ☐ Soaking therapy- Multiple Treatment
- ☐ Soaking Therapy- One Treatment
- ☐ Stitches/Sutures
- ☐ Tetanus
- ☐ Treatment for infection
- ☐ Treatment of 2nd /3rd degree burns
- ☐ Use of Antiseptics – multiple treatment
- ☐ Use of Antiseptics – single treatment
- ☐ Whirlpool bath therapy/multiple treatment
- ☐ Whirlpool therapy/single treatment
- ☐ X-rays negative
- ☐ X-rays positive/treatment of fracture

Number of days doctor required employee to be off work: _____
Number of days doctor restricted employee's work activity: _____
Equipment Malfunction : Yes ☐ No ☐ Activity was a Routine Task: Yes ☐ No ☐
Describe how you may have prevented this injury: _____
_____

Physician Information
Name: _____
Address: _____
City: _____
Zip Code: _____
Phone: _____

Hospital Information
Name: _____
Address: _____
City: _____
Zip Code: _____
Phone: _____

Property Damage (Complete for Property Damage incidents only)

Property Damaged: _____ Property Owner: _____
Damage Description: _____
Estimated Amount: $ _____

Spill or Release (Complete for Spill/Release incidents only)

Substance (attach MSDS): _____ Estimated Quantity: _____
Facility Name, Address, Phone No.: _____
Did the spill/release move off the property where work was performed?: _____
Spill/Release From: _____ Spill/Release To: _____

Environmental/Permit Issue (Complete for Environmental/Permit Issue incidents only)

Describe Environmental or Permit Issue: _____
Permit Type: _____
Permitted Level or Criteria (e.g., discharge limit): _____
Permit Name and Number (e.g., NPDES No. ST1234): _____
Substance and Estimated Quantity: _____
Duration of Permit Exceedence: _____

Verbal Notification (Complete for all incident types)(Provide names, dates and times)

CH2M HILL Personnel Notified: _____
Client Notified: _____

Witnesses (Complete for all incident types)

Witness Information (First Witness)
Name: _____
Employee Number (CH2M HILL):_____
Address: _____
City: _____
Zip Code:_____
Phone: _____

Witness Information (Second Witness)
Name: _____
Employee Number (CH2M HILL: _____
Address: _____
City: _____
Zip Code:_____
Phone :_____

Additional Comments:
_____
_____

NEAR LOSS INVESTIGATION FORM

Employer Information

Company Name: _____

Project Name: _____ Project Number: _____

Project Location: _____

CHIL Project? Yes ☐ No ☐

Task Location: _____

Job Assignment: _____ Business Group: _____

Preparer's Name: _____ Preparer's Employee Number: _____

Near Loss Incident Specific Information

Date of Incident: _____ Time of Incident: _____ a.m./p.m.

Location of incident:
☐Company premises ☐Field ☐In Transit ☐Other:_____

Address where the incident occurred: _____

Equipment Malfunction : Yes ☐ No ☐ Activity was a Routine Task: Yes ☐ No ☐

Describe any property damage: _____

Specific activity the employee was engaged in when the incident occurred:

_____

_____

All equipment, materials, or chemicals the employee was using when the incident occurred:

_____

_____

Describe the specific incident and how it occurred:

_____

_____

_____

_____

Describe how this incident may have been prevented:
_____
_____
_____

Contributing Factors (Describe in detail why incident occurred):
_____
_____
_____

Date employer notified of incident: _____ To whom reported: _____

NEAR LOSS INVESTIGATION FORM

Witness Information (First Witness)

Name: _____
Employee Number (for CH2M HILL employees):_____
Address: _____
City: _____
Zip Code : _____
Phone: _____

Witness Information (Second Witness)

Name: _____
Employee Number (for CH2M HILL employees): _____
Address: _____
City: _____
Zip Code: _____
Phone : _____

Additional information or
comments:_____
_____

Root Cause Analysis Form

Root Cause Analysis (RCA)

1. Lack of skill or knowledge
2. Lack of or inadequate operational procedures or work standards
3. Inadequate communication of expectations regarding procedures or work standards
4. Inadequate tools or equipment
5. Correct way takes more time and/or requires more effort
6. Short cutting standard procedures is positively reinforced or tolerated
7. Person thinks there is no personal benefit to always doing the job according to standards
8. Uncontrollable

RCA #	Solution(s): How to Prevent Loss From Occurring	RC[1]	CF[2]	Corrective Action Lead	Due Date	Completion Date	Date Verified

[1] RC = Root Cause; [2] CF = Contributing Factors (check which applies)

Investigation Team Members

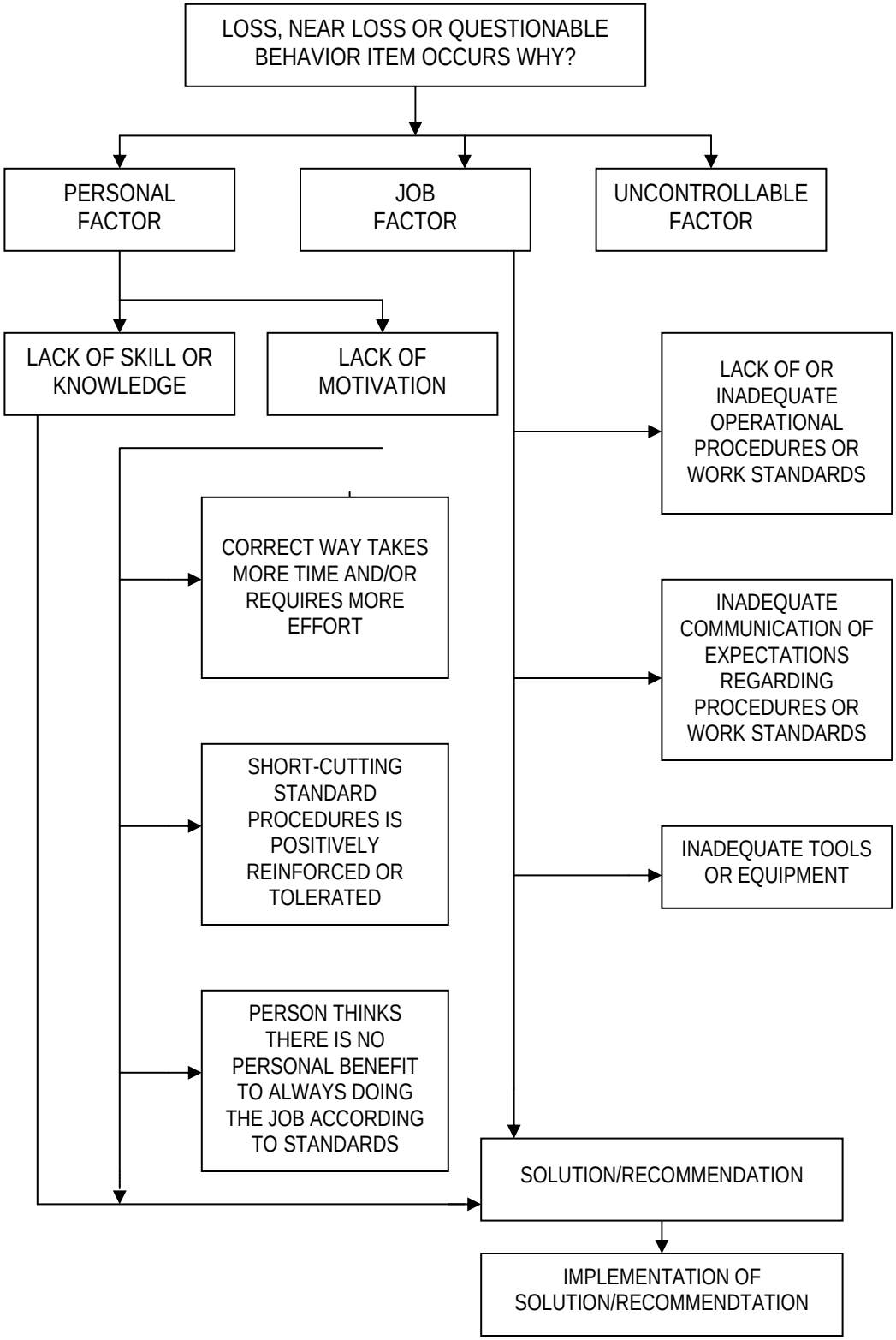
Name	Job Title	Date

Results of Solution Verification and Validation

Reviewed By

Name	Job Title	Date

Root Cause Analysis Flow Chart



Determination of Root Cause(s)

For minor losses or near losses the information may be gathered by the supervisor or other personnel immediately following the loss. Based on the complexity of the situation, this information may be all that is necessary to enable the investigation team to analyze the loss, to determine the root cause, and to develop recommendations. More complex situations may require the investigation team to revisit the loss site or re-interview key witnesses to obtain answers to questions that may arise during the investigation process.

Photographs or videotapes of the scene and damaged equipment should be taken from all sides and from various distances. This point is especially important when the investigation team will not be able to review the loss scene.

The investigation team must use the Root Cause Analysis Flow Chart to assist in identifying the root cause(s) of a loss. Any loss may have one or more "root causes" and "contributing factors". The "root cause" is the primary or immediate cause of the incident, while a "contributing factor" is a condition or event that contributes to the incident happening, but is not the primary cause of the incident. Root causes and contributing factors that relate to the *person* involved in the loss, his or her peers, or the supervisor should be referred to as "personal factors". Causes that pertain to the *system* within which the loss or injury occurred should be referred to as "job factors".

<u>Personal Factors</u>

- Lack of skill of knowledge
- Correct way takes more time and/or requires more effort
- Short-cutting standard procedures is positively reinforced or tolerated
- Person thinks that there is no personal benefit to always doing the job according to standards

<u>Job Factors</u>

- Lack of or inadequate operational procedures or work standards.
- Inadequate communication of expectations regarding procedures or standards
- Inadequate tools or equipment

The root cause(s) could be any one or a combination of these seven possibilities or some other "uncontrollable factor". In the vast majority of losses, the root cause is very much related to one or more of these seven factors. Uncontrollable factors should be used rarely and only after a thorough review eliminates "all" seven other factors.

Attachment 8

Material Safety Data Sheets

Appendix D

O_2/LEL Meter and FID Specifications

Product Overview
TVA1000B
Toxic Vapor Analyzer

The Only Portable Intrinsically Safe Dual PID/FID Analyzer

Analyze • Detect • Measure • Control™

Thermo
ELECTRON CORPORATION

Portable Toxic Vapor Analyzer

The TVA1000B is the only over-the-shoulder portable vapor analyzer that offers both PID (Photo Ionization Detection) and FID (Flame Ionization Detection) in a single, easy-to-use instrument. The ability to utilize both technologies in this field proven instrument provides benefits in reduced weight and a single user interface. The user can easily monitor and log inorganic and organic vapors simultaneously.

FID Detection

Users can measure a wide variety of organic vapors over an impressive dynamic range (0-50,000 ppm), monitoring some compounds that the PID will not detect. The flame ionization detector operates by breaking hydrocarbon bonds and is not limited by the ionization potential of the molecule.

Simultaneous FID/PID Detection

No other instrument offers both Photo Ionization and Flame Ionization Detection operating simultaneously in a single portable vapor analyzer. Dual detection eliminates the time, expense and trouble of purchasing and maintaining two separate analyzers.

With PID detection, the user has not only the ability to monitor for organic compounds, but also can detect many inorganic compounds. Some compounds detected by PID and not FID are ammonia, carbon disulfide, carbon tetrachloride, formaldehyde, and hydrogen sulfide. The PID also has the advantage of not requiring fuel or air to operate. In anaerobic environments, the TVA1000B PID can be used.

Applications

Fugitive Emissions Monitoring
The unique dual detector FID/PID design can handle a wide range of compound vapors present at processing plants. The TVA1000B will permit monitoring at lower ppm levels.

Emergency Response
For reliable measurements of hazardous spills or emissions, the TVA1000B responds quickly in an emergency. The ability to quickly detect the presence of "hot spots" is key to locating the source of the hazard.

Hazardous Waste Site Evaluation
The TVA1000B allows quick and easy identification of the hazard location and quantifies the level of contamination.

Underground Storage Tanks
The TVA1000B is a primary tool for determining if a UST is leaking and the extent of the contamination.

Industrial Hygiene
The TVA1000B can help you maximize the effectiveness of your plant ventilation system, and identifies trouble spots. Use it to survey ambient vapor levels in specific breathing zones or in general plant environments, and log for furthur follow-up action.

Natural Gas Leak Detection
The TVA1000B enables quick and easy detection of natural gas leaks.

Key Features

- Simultaneous FID/PID or Single FID detector(s)
- Portable and lightweight
- Multiple response factors and curves
- Multi-point calibration
- On-board datalogging
- 8 hour battery life

Probe Options

- *Standard Probe*
  Display measurement values on a 4-character LCD, with measurement units displayed on %, ppm, or ppb. Additionally, a bar graph indicator provides an indication of concentration level. Function keys allow selection of analyzer functions.
- *Enhanced Probe*
  Originally designed for Fugitive Emissions monitoring, the enhanced probe has a larger display area than the basic probe. This provides a display of up to 6 lines x 20 characters, plus a double height concentration value. It displays all the same information as the standard probe and has menu-driven access to many of the analyzer functions, allowing them to be easily initiated and/or changed at the probe.

TVA1000B Data Manager Accessory: Route Management Probe

Powerful field capabilities
The TVA1000B Data Manager allows users to modify or create route data in the field, eliminating the need for manual recording of data. This helps you comply with the electronic data storage requirements within most consent decrees. The new probe has a highly visible 360 degree LED with a pulsed rate linked to concentration.

The DataManager provides access to all of the features previously available only through the sidepack. Users can also easily search and navigate between tags in a route by simply entering the desired tag identifier.

Flexibility and control
The DataManager allows control of how data is viewed and accessed in the field. This allows the user to customize the view to best meet the monitoring needs at your facility, as each route may have different fields and screen displays. Fields may be designated as non-editable to enhance data integrity and database security.

An optional comment field allows the user to make electronic notes about each tag monitored. An alpha-numeric keypad makes data entry a snap.

Key Features for the DataManager

- Custom field labels for more clearly identified route information
- Definable screen layouts optimize user efficiency
- Pick lists lead to consistent data entry and minimize chance of data entry errors
- One button selections to access most commonly used functions
- New sample probe provides 360 degree visual indicator of concentration level
- Cable management system eliminates snagging sample line and electronic cable
- Existing TVA1000 units may be upgraded
- Enhanced filtering system removes dirt and water more efficiently.

Analyzer bag protects TVA1000 and may be used with standard shoulder strap or optional framed backpack

ThermoConnect Software

ThermoConnect enables users of the TVA1000B to transfer, display, analyze, and configure data from the instrument using a computer. ThermoConnect is windows based and facilitates the importing of data into other Windows based applications making it easier to retrieve logged data.

Added capability to maximize the TVA DataManager's features

ThermoConnect has been updated with a powerful new utility to create new route database template files. This utility allows you to easily build your own route database and design the screen appearance through a four-step process. Also, any existing route files in the old file format are still recognized by the TVA and may be upgraded to the new format.

Complete DataManager System

The **TVA1000B** is a benchmark for experience and reliability in Fugitive Emissions Monitoring

TVA1000B Technical Specifications

Safety certifications	FM (Class 1, Div. 1, Groups A,B,C&D Hazardous Location, Temp. Class T4) CENELEC (Div. 1, Zones I and II Group IIC, Hazardous Location, Temp. Class T4)*
Datalogging	Onboard
Readout	Bar graph & 4- digit LCD
Dynamic Range	0.5-2,000 ppm (PID) isobutylene; 0.5-50,000 ppm (FID) methane
Linear Range	0.5-500 ppm (PID) isobutylene; 0.5-10,000 ppm (FID) methane
Response Time	3.5 seconds
Minimum Detectable Limit	100 ppb benzene (PID); 300 ppb hexane (FID)
Alarms	Low, high, STEL
Sample Flow Rate	1,000 cc/min nominal
Power	Rechargeable NiCd Battery
Logging Capacity	800-18,000 points mode specific
Temperature Range	0-40°C (32°F - 104°F)
Fuel	None required (PID); 99.995% hydrogen (FID)
Portable Operation Time	8 hours (with reference operating conditions)
Approximate Mass	5.8 kg (13 pounds)
Nominal Dimensions	13.5 x 10.3 x 3.2 inches (343 x 262 x 81 mm)
Analog Output	0-2V dc
Repeatability	+/- 1% (PID); +/- 2% (FID)
Autoranging	Yes
Diagnostics	Yes

Other Available Options:	
Carrying Case	P/N CR012XL
Charcoal Filter	P/N 510095-1
FID Calibration Kit	P/N CR009UY
PID/FID Calibration Kit	P/N CR012UH

** Enhanced probe and DataManager not CENELEC certified as of publication date*

A world leader in high-tech instruments, Thermo Electron Corporation helps life science, laboratory, and industrial customers advance scientific knowledge, enable drug discovery, improve manufacturing processes, and protect people and the environment with instruments, scientific equipment and integrated software solutions.

Based in Waltham, Massachusetts, Thermo Electron has revenues of more than $2 billion, and employs approximately 11,000 people in 30 countries worldwide. For more information, visit www.thermo.com/ih

Lit: TVAMC703

Environmental Instruments
First Responder /
Industrial Hygiene Products
27 Forge Parkway
Franklin, MA
02038

Analyze • Detect • Measure • Control™
Thermo
ELECTRON CORPORATION

FLAME IONIZATION MONITOR

MicroFID

MicroFID

Detectable Compounds

Saturated Hydrocarbons - Methane, Ethane, Propane, n-Hexane

Aromatics - Benzene, Toluene, Naphthalene

Unsaturated Hydrocarbons -Acetylene, Ethylene, 1,3-Butadiene

Chlorinated Hydrocarbons- Vinyl Chloride, Chloroform, Trichloroethylene, Methylene Chloride

Ketones - Acetone, Methyl Ethyl Ketone, Methyl Isobutyl Ketone

Alcohols - Methanol, Ethanol, Isopropanol, n-Butanol

Please note: This list provides examples of the types of compounds detectable by the MicroFID. Please contact Photovac Technical Support for details on specific compound detection.

For further information on Photovac products, or to arrange a product demonstration, please contact a Photovac representative near you, email us at admin@photovac.com or contact Photovac, Inc.

Specifications

Size
43.4 cm (17.1“) long, 9.8 cm (3.85“) wide, 18.8 cm (7.4“) high

Weight
8.1 lb (3.7 kg)

Keypad
16-key, fixed function

Display
2-line, 16-character LCD with alphanumeric readout

Hydrogen Cylinder Discharge
Greater than 12 hours

Hydrogen Cylinder Capacity
9.2 liters

Battery Capacity
15 hours (snap-on replacement)

Serial Output
RS – 232, 1200-19200 baud with no parity, for tabular and graphic printouts and connection to a Windows® compatible computer.

Audio Output
On Alarm, LoBatt and NoFlm

Analog Output
0 to 1 volt full scale

Operating Temperature Range
41°F to 105°F (5°C to 45°C)

Operating Humidity
0-100% Relative Humidity (non-condensing)

Operating Concentration Range
0.5 PPM to 2000 PPM methane equivalent (Low Range)
10 PPM to 50,000 PPM methane equivalent (High Range)

Detection Limit
0.5 PPM methane

Accuracy
Methane (after calibration with zero air and 500 PPM methane gas): within ± 0.5 PPM or ± 10% of actual methane concentration (0.5 PPM to 2000 PPM range).

Response Time
Less than 3 seconds

Intrinsic Safety
Class I, Division 1, Groups A, B, C, & D
CENELEC Certified according to EN50021, EEx nA II T5, Demko No. 00Y127355X

PHOTOVAC, Inc.

PHOTOVAC, Inc. 176 Second Avenue | Waltham, MA 02451-1166 USA | Phone: 781-290-0777 Fax: 781-290-4884
PHOTOVAC Europa Bredabaan 885 | B-2170 Antwerp BELGIUM | Phone: +32-3-646-0456 Fax: +32-3-646-0095
visit us at www.Photovac.com

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MX792000

MultiRAE PLUS

One-to-Five Gas Monitor with VOC Detection

The MultiRAE PLUS is an extremely flexible one-to-five sensor instrument for use in confined space, emergency response, industrial hygiene, and many other monitoring applications. The MultiRAE is the only instrument available on the market today that can offer protection using both standard gas detection sensors for the detection of oxygen, combustible gas, and specific toxic gases, as well as an integrated Photo-Ionization Detector (PID) for the ultimate in broad-range toxic gas detection. The MultiRAE's versatility allows it to replace a wide range of monitors, saving training and maintenance costs. The MultiRAE is quickly and easily changed from a sophisticated technician instrument to a simple text or display only monitor. The same monitor can be used as a personal monitor, a hand-held sniffer, or as a continuous operational area monitor.

Advanced Features

- Rugged weather-proof composite case
- Visual alarm with flashing LED
- Automatic liquid trap protection for pump
- Any two plug-in "smart" toxic sensors:
  CO, H_2S, SO_2, NO, NO_2, Cl_2, HCN, NH_3, PH_3
- Programmable alarms can be changed on the MultiRAE or from easy-to-use Windows 3.1, 95, 98 and NT software
- Sample-draw over 100 feet (30m) horizontally and vertically
- Diffusion grill protected by Gortex™ moisture membrane
- Large digital display
- Loud audible alarm with varying tones for different alarm conditions and an optional remote vibration alarm for noisy areas
- Runs on alkalines, Ni-Cd batteries or continuously when plugged into charger or 12V automotive adapter
- Available as diffusion unit or with internal, sample-draw pump
- Deep-discharge battery option
- Easy one-button calibration with auto-zero capability

Applications

- Confined Space Entry
  - — Waste water treatment plants
  - — Shipyard and maritime confined spaces
  - — Land-fill operations
  - — Trenches, silos, railcars
  - — Sewers and manholes
- Refineries and petrochemical plants, including offshore drilling and plant shut-downs
- Power plants
- Pulp and paper industry
- Steel mills
- Soil, well, and water head-space analysis
- Aviation / wing tank entry

RAE Systems Inc.
1339 Moffett Park Drive • Sunnyvale, California 94089 USA
Tel: 408.752.0723 • Fax: 408.752.0724
Email: RaeSales@raesystems.com • www.raesystems.com

ISO 9001 CERTIFIED

AL001 Rev. 1-10/00

Specifications

Sensor Specifications

Gas Monitor	Range	Resolution	Response Time (t_{90})
Oxygen	0 ~ 30%	0.1%	15 seconds
Combustible gas	0 ~ 100% LEL	1%	15 seconds
VOCs	0 ~ 200 ppm	0.1 ppm	10 seconds
	200 ~ 2000 ppm	1 ppm	10 seconds
Carbon Monoxide	0 ~ 500 ppm	1 ppm	20 seconds
Hydrogen Sulfide	0 ~ 100 ppm	1 ppm	30 seconds
Sulfur Dioxide	0 ~ 20 ppm	0.1 ppm	15 seconds
Nitric Oxide	0 ~ 250 ppm	1 ppm	20 seconds
Nitrogen Dioxide	0 ~ 20 ppm	0.1 ppm	25 seconds
Chlorine	0 ~ 10 ppm	0.1 ppm	60 seconds
Hydrogen Cyanide	0 ~ 100 ppm	1 ppm	60 seconds
Ammonia	0 ~ 50 ppm	1 ppm	150 seconds
Phosphine	0 ~ 5 ppm	0.1 ppm	60 seconds

Detector Specifications

Size	4.65"L x 3.0"W x 1.9"H (11.8 cm x 7.6 cm x 4.8 cm)
Weight	16 oz with battery (454 g)
Detector	Protected catalytic bead for combustible gases Interchangeable electrochemical sensors for oxygen and toxic gases Photo-ionization detector for VOCs, 10.6 eV lamp standard
Battery	Rechargeable, 4.8 V, 1.4 Ah, Ni-Cd battery pack 4 AA alkaline battery adapter Field replaceable Smart battery charger: Up to 10 hours through built-in or external charger. Includes deep discharge option.
Operating Hours	10 hours continuous Unit will run and charge simultaneously
Display	2 line, 16 digit LCD with LED back light automatically in dim light or alarm condition
Keypads	1 operation key and 2 programming keys
Attachment	Wrist strap and high visibility rubber boot
Direct Readout	Instantaneous (up to 5) values: Oxygen as percentage by volume Combustible gas as percentage of lower explosion limit (LEL) Toxic gases and VOCs as parts per million by volume High and low values for all gases STEL and TWA values of toxic gases and VOCs Battery and shut down voltage Date, time, elasped time, temperature LEL/VOC scale (using correction factors)
Intrinisic Safety	UL, cUL Class 1, Division I, Group A, B, C, D EEx ia IIC T4
Alarm	90 dB buzzer and flashing red LED to indicate exceeded preset limits High - 3 beeps and flashes per second Low - 2 beeps and flashes per second STEL and TWA - 1 beep and flash per second Alarms latching with manual override or automatic reset Additional diagnostic alarm and display message for low battery and pump stall
Calibration	Two point field calibration for zero and span gas
Datalogging	20,000 points (64 hours, 5 channels at one minute intervals) download to PC with serial number of unit, user ID, site number, calibration date
Datalogging Interval	1 - 3600 seconds, programmable
Sampling Pump	Internal pump, flow rate 150 cc/min.
Temperature	-4° to 113° F (-20° to 45°C)
Humidity	0% to 95% relative humidity (non-condensing)

MultiRAE PLUS Accessories

Monitor only includes

- Monitor as specified
- Sensors as specified
- Shipping Case
- Carbon filters *(for units with CO)*
- Calibration adapter
- Quick reference guide
- Operation video *(as specified)*
- Operation and maintenance manual
- Rubber boot with belt-clip
- Alkaline battery adapter
- Rechargeable units additionally include:
  - Nickel-Cadium (Ni-Cd) battery
  - 120 V AC/DC Wall Adapter (if specified)
- Pumped units additionally include:
  - 10 Water trap filters
  - Inlet probe 3"
  - Water trap adapter

Monitor with Accessories Kit also includes:

- Hard transport case with pre-cut foam
- 15' (5 m) Teflon® tubing
- Constant flow hand pump *(for diffusion models)*
- Lamp Cleaning Kit

Optional Calibration Kit also include:

- Four-gas mix in a 34L cylinder; *(50% LEL, 20.9% O_2, 25 ppm Hydrogen Sulfide, 50 ppm Carbon Monoxide)*
- Calibration regulator (male) and tubing
- Isobutylene gas in a 34L cyclinder;
- Calibration regulator (female) and tubing

Datalogging Monitors also include:

- Software, ProRAE Suite Package for Windows™ 95, 98 & NT
- Computer Interface cable

Warranty: Lifetime on non-consuming components (per RAE Standard Warranty), 2 years for O_2, LEL, CO and H_2S sensors, 1 year all other sensors, 1 year pump, 1 year battery, 1 year for 10.6 eV PID lamp

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MultiRAE PLUS

VRAE

Hand Held 5 Gas Surveyor

VRAE is a hand held 1, 2, 3, 4 or 5 gas monitor with built-in sampling pump and optional data logging.

Sensors include new RAE dual range 0-100% Volume and 0-100% LEL, oxygen and three, smart, interchangeable toxic sensors or up to four smart, interchangeable toxic sensors may be added. The dual range combustible sensor can monitor explosive gases in an oxygen-free environment at percent by volume levels.

The internal pump automatically shuts off plus an alarm is activated, if the remote probe tubing crimps or water is sucked onto the field replaceable filter.

Toxic Sensors Include

- Carbon monoxide
- Hydrogen sulfide
- Sulfur dioxide
- Nitric oxide
- Nitrogen dioxide
- Chlorine
- Ammonia
- Hydrogen cyanide
- Phosphine

Features

- Large, alarm activated back light LCD display
- Visual alarm with flashing
- Large keys usable with gloved hand
- Rigid inlet probe
- 10 hours operation
- Sample collection port
- 16,000 data points download to PC
- Rubber boot

Special Points of Interest:

- Protected from portable radios
- Internal sample draw pump for quick response and remote sampling
- Smart battery charging with status indication and LED indicator
- Snap-in rechargeable NMH or alkaline battery pack
- 48 built-in correction factors for LEL sensor
- 4 toxic sensor version

Applications

- Refineries and petrochemical plants — confined space entry, hot work permits
- Utilities — cable vaults, transformer stations
- Waste water treatment plants — confined space entry
- Marine and off shore oil wells — testing of confined spaces
- Landfill operations — monitoring wells and confined spaces
- Food processing — refrigeration, decomposition, process off gasing, poultry farms
- Fire departments
- Confined Space Entry — trenches, silos, railcars

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Ch010 Rev. 3-2/99

RAE SYSTEMS

Specifications

Intrinsic Safety	UL Class 1, Division I, Group A,B,C,D cUL and EEx ia IiC T4 (Europe) PENDING
Size	8.3" (21 cm) L x 3.0" (7.6 cm) W x 1.9" (4.9 cm) H
Weight	20 oz (568 gm) with battery pack
Detector	Catalytic sensor for combustible gas. Thermal conductivity sensor for percentage volume combustible gas. Electrochemical sensors for oxygen and toxic gases
Battery	Rechargeable, snap-in, field replaceable 4.8V, 1.1Ah NMH battery pack, 4 AA alkaline battery adapter
Operating Hours	10 hours continuous
Battery Charging	10 hours charge through built-in charger or an external battery charger
Display	2 line by 16 digit LCD with LED back light automatically in dim light or alarm condition
Keypads	1 operation and 2 program keys
Direct Readout	Instantaneous (up to 5 values): • Oxygen as percentage by volume • Combustible gas as percentage by volume or percentage of lower explosion limit • Toxic gases as parts per million • High and low values for all gases • STEL, TWA for toxic gases • Battery and shut down voltage
Alarm	90 dB buzzer and flashing red LED to indicate exceeded preset alarms: • High — 3 beeps and flashes per second • Low — 2 beeps and flashes per second • STEL and TWA — 1 beep and flash per second Alarms latching with manual override or automatic reset Additional diagnostic alarm and display message for low battery and pump stall
Calibration	Two points field calibration of zero and span gas
Datalogging	16,000 points (53 hours, 5 channels at one minute intervals) down load to PC with serial number of unit, user ID, site ID and calibration date
Datalogging Interval	1 - 3,600 seconds, programmable
Sampling Pump	Internal pump, flow rate 400 cc/minute Automatic shut off at low flow condition
Temperature	-4°F to 113°F (-20°C to 40°C)
Humidity	0% to 95% relative humidity (non-condensing)

Gas	Nominal Range	Extended Range	Resolution	Response Time (t90)
Combustible	0 - 100% LEL		1%	15 sec
	0 - 100 VOL		1%	20 sec
Oxygen	0 - 30%		0.1%	15 sec
Carbon Monoxide	0 - 500 ppm	1500 ppm	1 ppm	40 sec
Hydrogen Sulfide	0 - 100 ppm	500 ppm	1 ppm	35 sec
Sulfur Dioxide	0 - 20 ppm	150 ppm	0.1 ppm	35 sec
Nitric Oxide	0 - 250 ppm	1000 ppm	1 ppm	30 sec
Nitrogen Dioxide	0 - 30 ppm	150 ppm	0.1 ppm	25 sec
Chlorine	0 - 10 ppm	30 ppm	0.1 ppm	60 sec
Hydrogen Cyanide	0 - 100 ppm	100 ppm	1 ppm	200 sec
Ammonia	0 - 50 ppm	200 ppm	1 ppm	150 sec
Phosphine	0 - 5 ppm	20 ppm	0.1 ppm	60 sec

Ordering Information

VRAE

Models 7800 & 7840

- VRAE unit with combustible, oxygen and up to 3 toxic sensors (7800) OR combustible, and up to 4 toxic sensors (7840)
- Rechargeable NMH battery pack
- AC/DC charging adapter
- Backup Alkaline battery adapter (accept 4 AA size alkaline)
- Inlet probe and water trap filter
- Operation and maintenance manual
- 2 year warranty for LEL / O2 / CO / H2S VRAE monitor

Accessories

- Confined space entry kit
- Calibration kits with gas cylinder, flow regulator and tubing
- ProRAE Suite Software and interface cable
- Automotive charging adapter
- Collapsible remote sampling probe
- Vibration alarm
- Additional sensors — contact the factory for details

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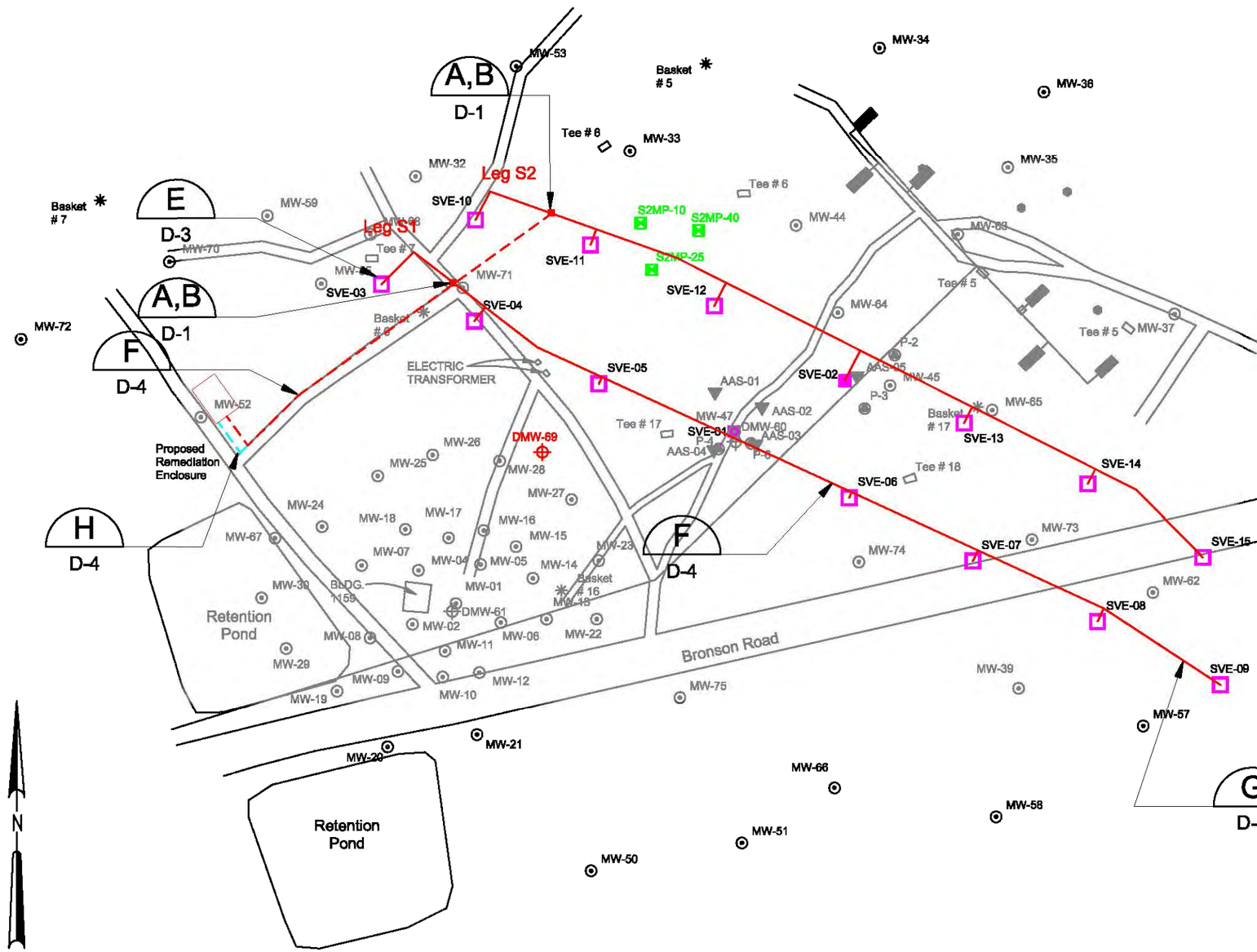
Appendix E

System Design Drawings



LEGEND

- MW-65 — Monitoring Well Location and Designation
- DMW-60 — Deep Monitoring Well Location and Designation
- P-3 — Peizometer Location and Designation
- S2MP-10 — Saturated Zone Monitoring Point
- Oak Tree
- Pine Tree
- Tent Platform
- Old Fuel Tank Containment
- Former Fuel Distribution Line
- Existing AAS Well Location
- Existing SVE Well Location
- Gopher Tortoise Burrows
- Proposed SVE Well
- Proposed SVE Mainline
- Proposed Electrical Conduit
- Proposed System Well Lines

Note:

1. Wells will have inndividual lines from wellhead to the corresponding vaults, but are shown as one on this figure for simplification.
2. For individual SVE Treatment well details please see Table 1, D-1.
3. Actual well depths will be determined in the field, based on actual surveyed location elevations.

DSGN	H.HERNANDEZ						
DR	D.T.HERR						
CHK	H.HERNANDEZ						
APVD	C.HOOD	NO.	DATE	REVISION	BY	APVD	

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OLF BRONSON FIELD SITE 1159
AAS/SVE SYSTEM DESIGN
N.A.S. PENSACOLA, FL.

DESIGN DRAWINGS

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DWG NO. C-1
DATE January 2007
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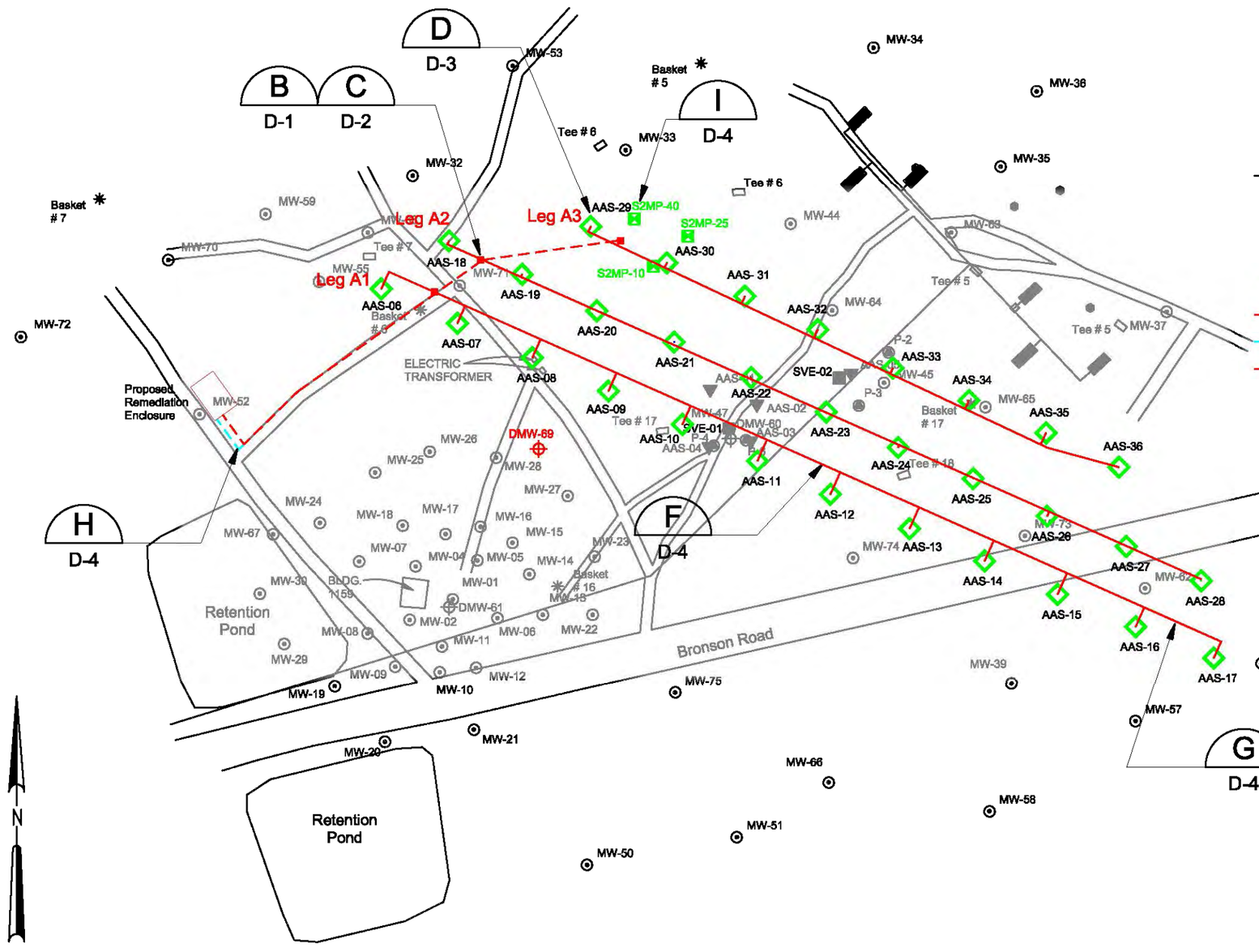

LEGEND

- MW-65 — Monitoring Well Location and Designation
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- P-3 — Peizometer Location and Designation
- S2MP-10 — Saturated Zone Monitoring Point
- Oak Tree
- Pine Tree
- Tent Platform
- Old Fuel Tank Containment
- Former Fuel Distribution Line
- Existing AAS Well Location
- Existing SVE Well Location
- Gopher Tortoise Burrows
- Proposed AAS Well
- Proposed SVE Mainline
- Proposed Electrical Conduit
- Proposed System Well Lines

Note:

1. Wells will have inndividual lines from wellhead to the corresponding vaults, but are shown as one on this figure for simplification.
2. For individual AAS Treatment well details please see Table 1, D-2.
3. Actual well depths will be determined in the field, based on actual surveyed location elevations.

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DR	D.T.HERR						
CHK	H.HERNANDEZ						
APVD	C.HOOD	NO.	DATE	REVISION	BY	APVD	

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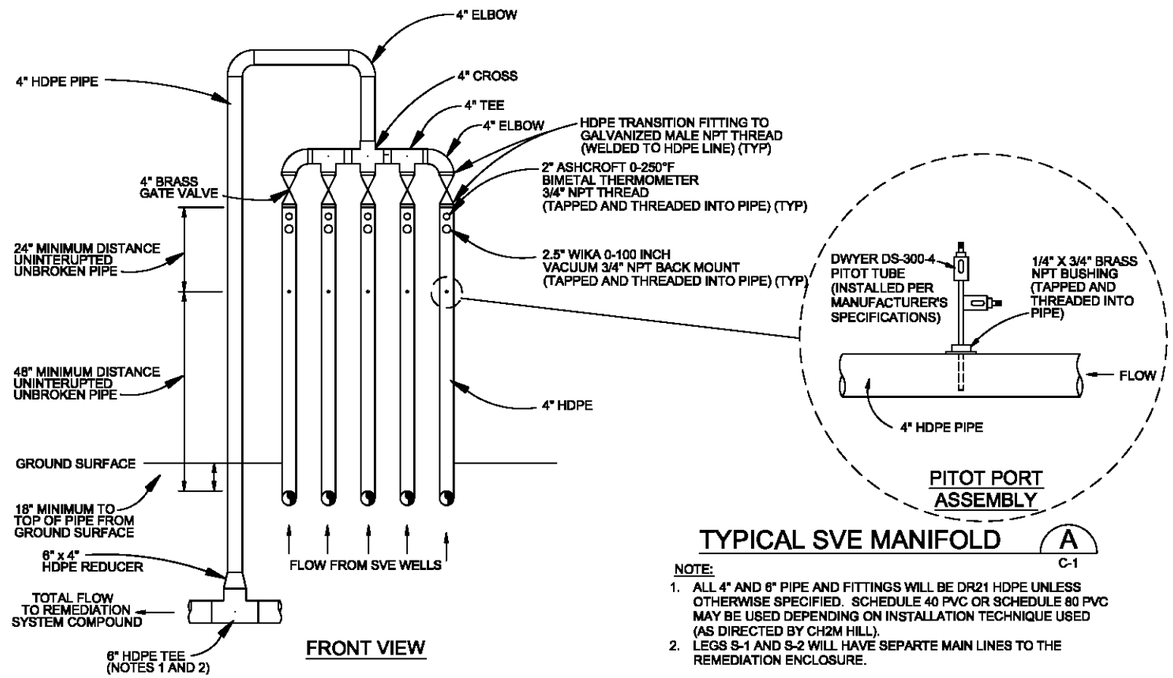
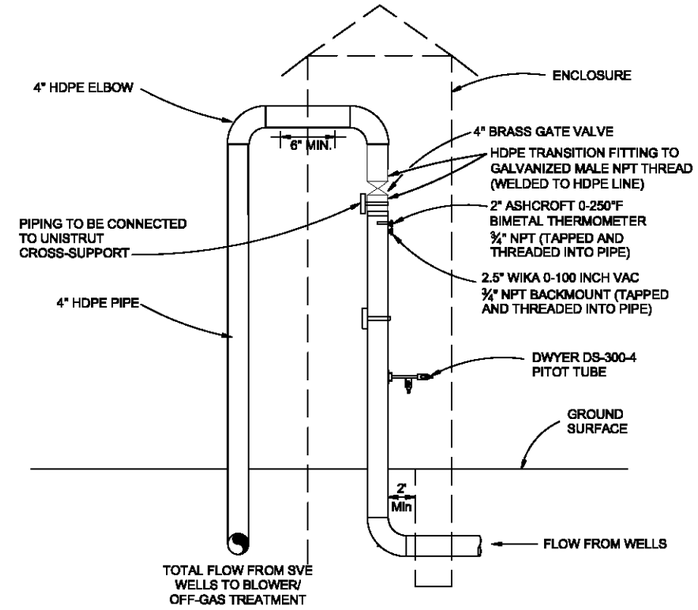


TYPICAL SVE MANIFOLD (A) C-1

NOTE:

1. ALL 4" AND 6" PIPE AND FITTINGS WILL BE DR21 HDPE UNLESS OTHERWISE SPECIFIED. SCHEDULE 40 PVC OR SCHEDULE 80 PVC MAY BE USED DEPENDING ON INSTALLATION TECHNIQUE USED (AS DIRECTED BY CH2M HILL).
2. LEGS S-1 AND S-2 WILL HAVE SEPARTE MAIN LINES TO THE REMEDIATION ENCLOSURE.



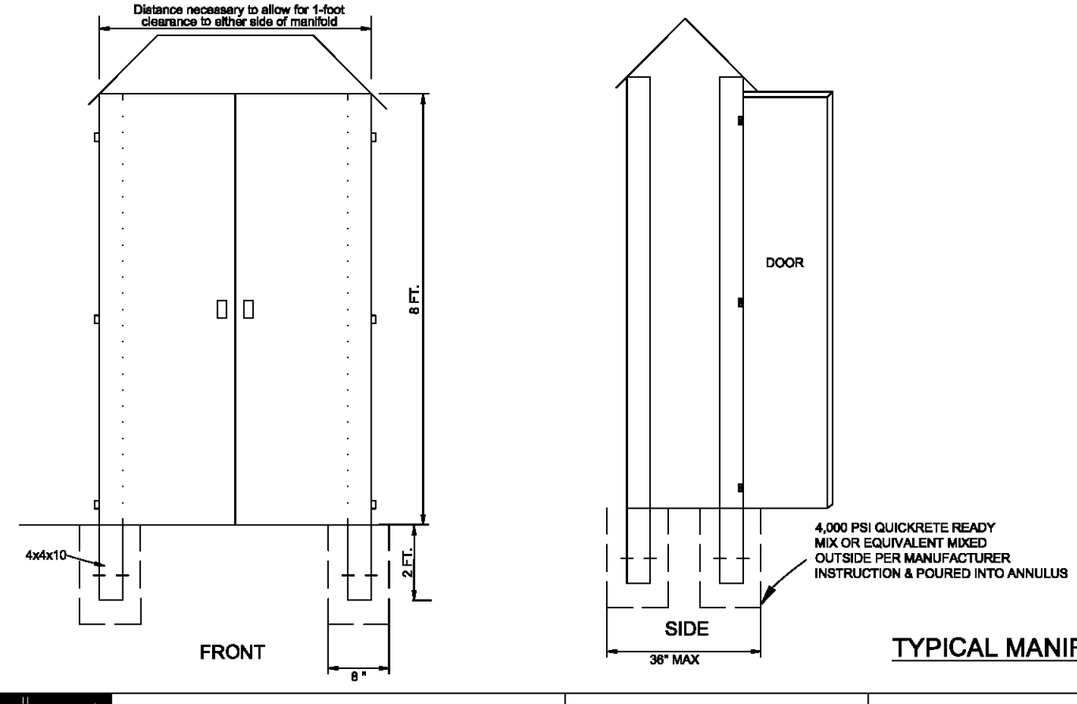
SIDE VIEW

Table 1

Treatment Well ID	Diameter	Screened Interval (ft bls)	Screen Size (inches)	Total Depth (ft bls)	System Manifold Connection
1159-SVE-01*	4	8-16	0.020	50	Leg S1
1159-SVE-02*	4	14-24	0.020	50	Leg S2
1159-SVE-03	4	4.5-7.5	0.020	40	Leg S1
1159-SVE-04	4	5-8	0.020	50	Leg S1
1159-SVE-05	4	5-8	0.020	50	Leg S1
1159-SVE-06	4	7-15	0.020	50	Leg S1
1159-SVE-07	4	7-10	0.020	50	Leg S1
1159-SVE-08	4	7-10	0.020	50	Leg S1
1159-SVE-09	4	7-10	0.020	50	Leg S1
1159-SVE-10	4	8-12	0.020	50	Leg S2
1159-SVE-11	4	9-18	0.020	50	Leg S2
1159-SVE-12	4	9-18	0.020	50	Leg S2
1159-SVE-13	4	9-19	0.020	50	Leg S2
1159-SVE-14	4	7-10	0.020	50	Leg S2
1159-SVE-15	4	7-10	0.020	50	Leg S2

* EXISTING SVE WELL

Note:
All wells will be constructed using flush-threaded, Schedule 40 polyvinyl chloride risers and well screens. Locations will be installed based upon field conditions during system installation.



TYPICAL MANIFOLD ENCLOSURE (B) C-1

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DR	D.T.HERR					
CHK	H.HERNANDEZ					
APVD	C. HOOD	NO.	DATE	REVISION	BY	APVD

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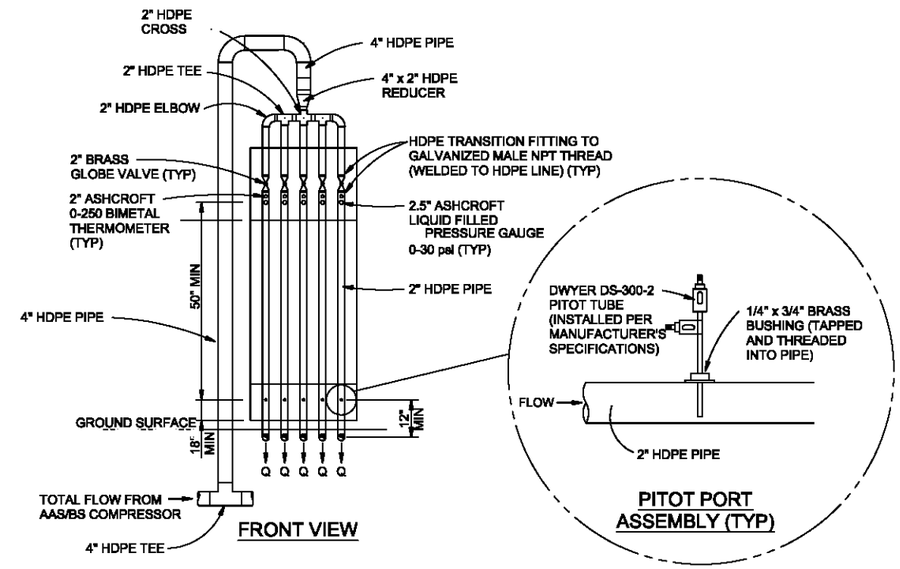
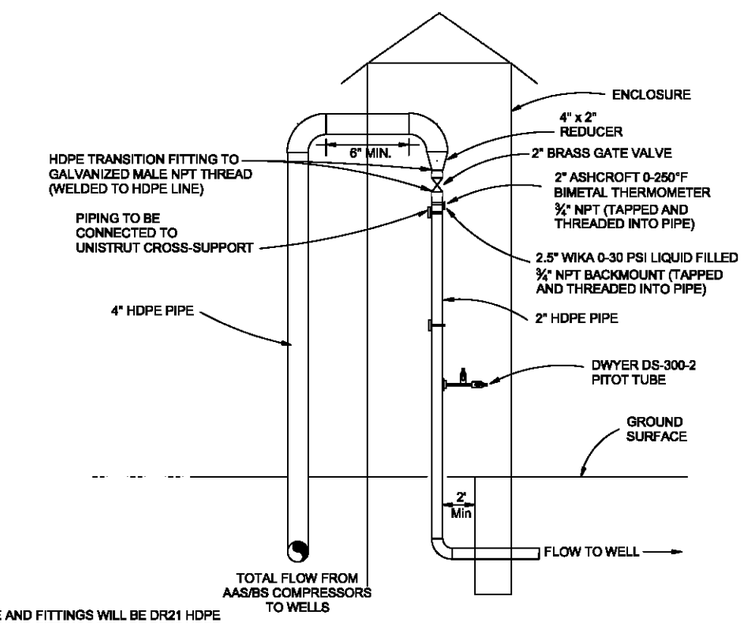
Table 2

Treatment Well ID	Diameter	Screened Interval (ft bls)	Screen Size (inches)	Total Depth (ft bls)	System Manifold Connection
1159-AAS-06	2	38-40	0.020	40.5	Leg A1
1159-AAS-07	2	38-40	0.020	40.5	Leg A1
1159-AAS-08	2	40-42	0.020	42.5	Leg A1
1159-AAS-09	2	42-44	0.020	44.5	Leg A1
1159-AAS-10	2	42-44	0.020	44.5	Leg A1
1159-AAS-11	2	44-46	0.020	46.5	Leg A1
1159-AAS-12	2	43-45	0.020	45.5	Leg A1
1159-AAS-13	2	43-45	0.020	45.5	Leg A1
1159-AAS-14	2	46-48	0.020	46.5	Leg A1
1159-AAS-15	2	46-48	0.020	46.5	Leg A1
1159-AAS-16	2	46-48	0.020	50.5	Leg A1
1159-AAS-17	2	46-48	0.020	48.5	Leg A1
1159-AAS-18	2	40-42	0.020	42.5	Leg A2
1159-AAS-19	2	40-42	0.020	42.5	Leg A2
1159-AAS-20	2	42-44	0.020	44.5	Leg A2
1159-AAS-21	2	42-44	0.020	44.5	Leg A2
1159-AAS-22	2	42-44	0.020	44.5	Leg A2
1159-AAS-23	2	42-44	0.020	44.5	Leg A2
1159-AAS-24	2	42-44	0.020	44.5	Leg A2
1159-AAS-25	2	40-42	0.020	42.5	Leg A2
1159-AAS-26	2	40-42	0.020	42.5	Leg A2
1159-AAS-27	2	46-48	0.020	48.5	Leg A3
1159-AAS-28	2	46-48	0.020	48.5	Leg A2
1159-AAS-29	2	52-54	0.020	54.5	Leg A3
1159-AAS-30	2	52-54	0.020	54.5	Leg A3
1159-AAS-31	2	52-54	0.020	54.5	Leg A3
1159-AAS-32	2	52-54	0.020	54.5	Leg A3
1159-AAS-33	2	52-54	0.020	54.5	Leg A3
1159-AAS-34	2	52-54	0.020	54.5	Leg A3
1159-AAS-35	2	52-54	0.020	54.5	Leg A3
1159-AAS-36	2	50-52	0.020	52.5	Leg A3

Note:
All wells will be constructed using flush-threaded, Schedule 40 polyvinyl chloride risers and well screens. Locations will be installed based upon field conditions during system installation. Existing AAS-04 will be connected to the Leg A3 manifold.





NOTE:
1. 4" PIPE AND FITTINGS WILL BE DR21 HDPE
   2" PIPE AND FITTINGS WILL BE DR17 HDPE
   SCHEDULE 40 PVC OR SCHEDULE 80 PVC MAY BE USED DEPENDING ON INSTALLATION TECHNIQUE USED (AS DIRECTED BY CH2M HILL)
2. ACTUAL NUMBER OF LINES WILL DIFFER PER MANIFOLD

TYPICAL AAS MANIFOLD (C / C-2)

DR H.HERNANDEZ						
CHK D.T.HERR						
APVD H.HERNANDEZ						
APVD C. HOOD	NO.	DATE	REVISION	BY	APVD	

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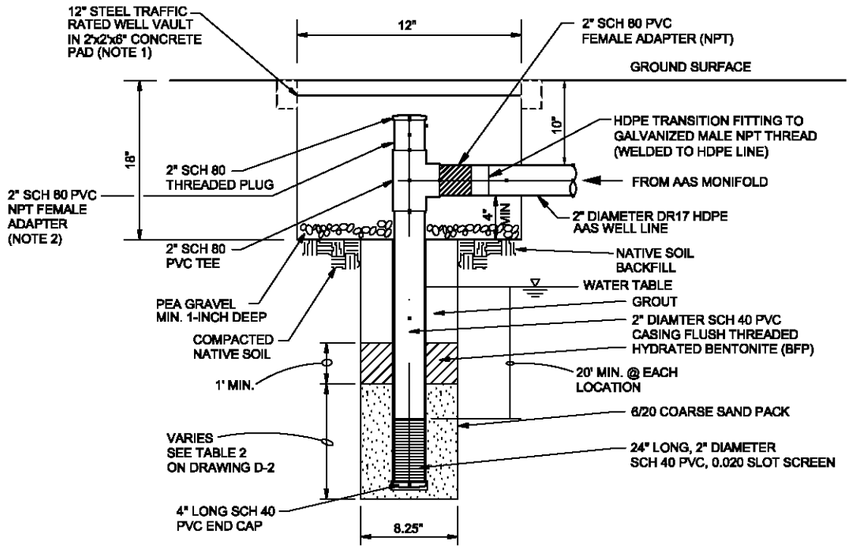
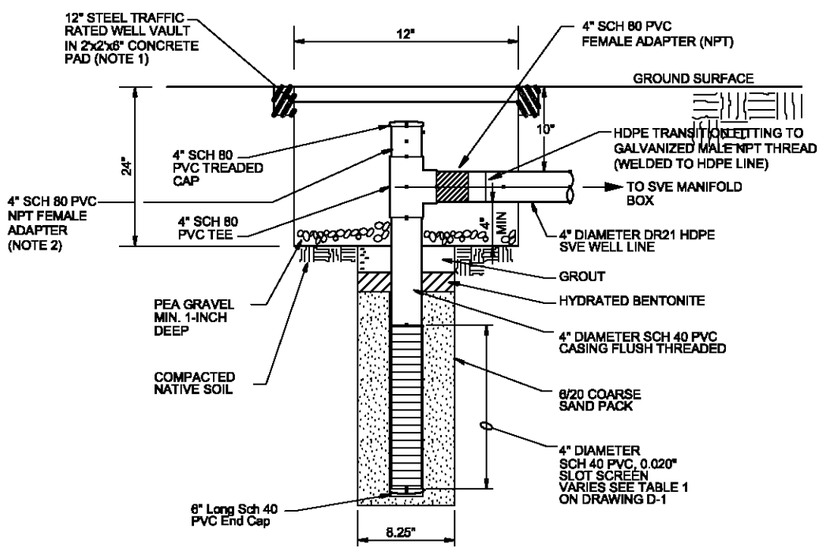


AAS WELL DETAIL (D)

NTS — C-2



4" SVE WELL DETAIL (E)

NTS — C-1

Notes for Details D, E, F AND G:

1. Well vault and cover shall be constructed of a traffic-rated material to be selected by the Subcontractor and approved by the Contractor.
2. Fittings used should allow for 2" unobstructed inside diameter. For AAS/BS wells and 4" unobstructed inside diameter for SVE wells.

DR	H.HERNANDEZ
CHK	D.T.HERR
APVD	H.HERNANDEZ
	C. HOOD

NO.	DATE	REVISION	BY	APVD

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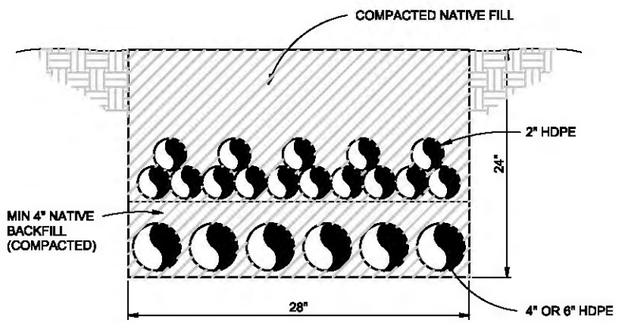
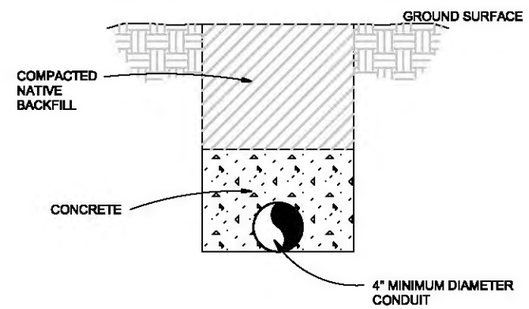


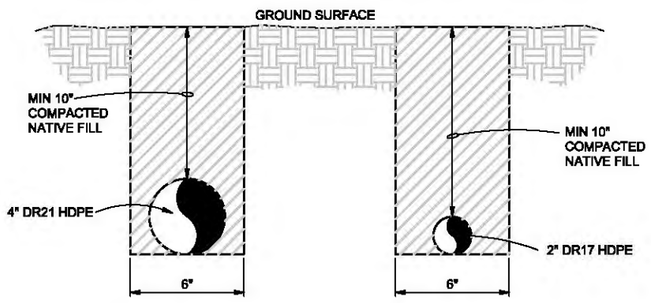
TYPICAL MAIN TRENCH (F) C-1 C-2



ELECTRICAL TRENCH (H) C-1 C-2

NOTE:

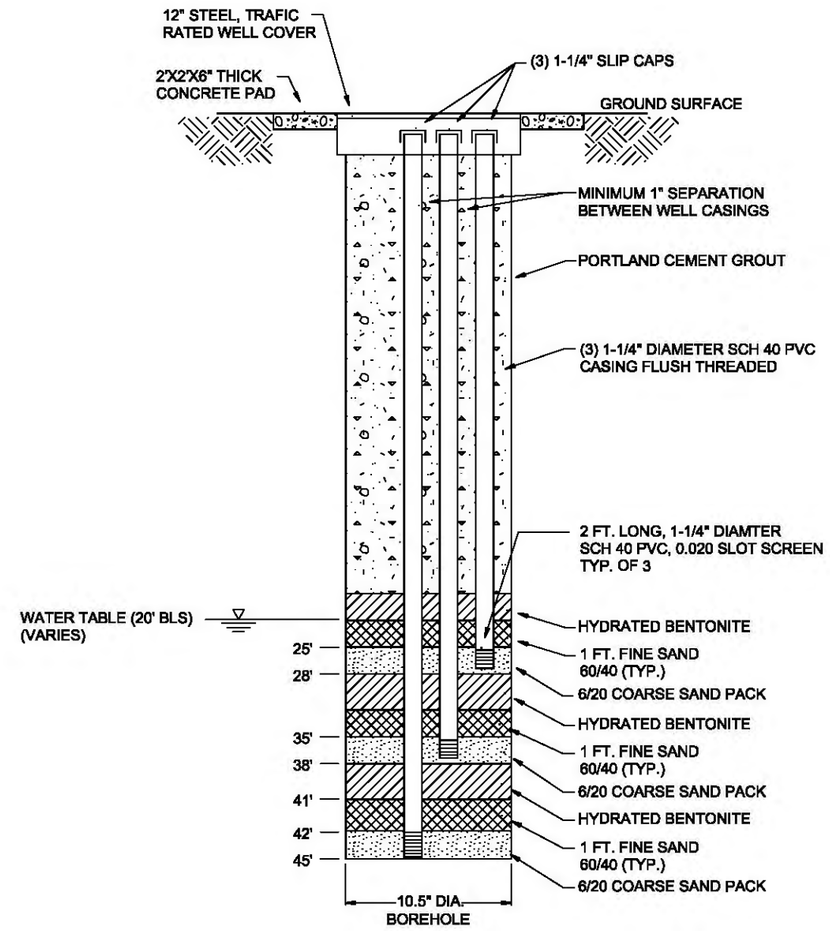
SUBCONTRACTOR SHALL BE RESPONSIBLE FOR COMPLYING WITH ALL APPLICABLE ELECTRICAL CODES.



SINGLE WELL LINE TRENCH (G) C-1 C-2

NOTE:

1. ALL DEBRIS, ROOTS, ROCKS MUST BE REMOVED FROM BACKFILL MATERIAL PRIOR TO REFILLING COMPACTING TRENCHES.
2. ALL 2" PIPE AND FITTINGS WILL BE DR17 HDPE UNLESS OTHERWISE SPECIFIED.
3. ALL 4" AND 6" PIPE AND FITTINGS WILL BE DR21 HPDE UNLESS OTHERWISE SPECIFIED. SCHEDULE 40 PVC OR SCHEDULE 80 PVC MAY BE USED DEPENDING ON INSTALLATION TECHNIQUE USED (AS DIRECTED BY CH2M HILL).



NESTED SATURATED ZONE MONITORING POINT (SZMP) DETAIL (I) C-2

NTS

NOTE:

WELL VAULT AND COVER SHALL BE CONSTRUCTED OF A TRAFFIC-RATED MATERIAL TO BE SELECTED BY THE SUBCONTRACTOR AND APPROVED BY THE CONTRACTOR.

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TRENCH LINE AND SZMP DESIGN DRAWINGS

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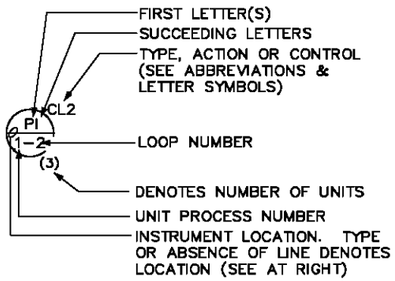
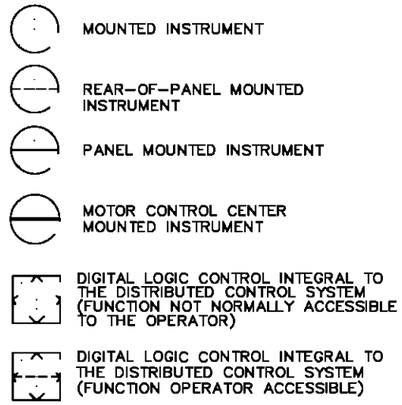
INSTRUMENT IDENTIFICATION

BUBBLE SYMBOL



INSTRUMENT LOCATION SYMBOL

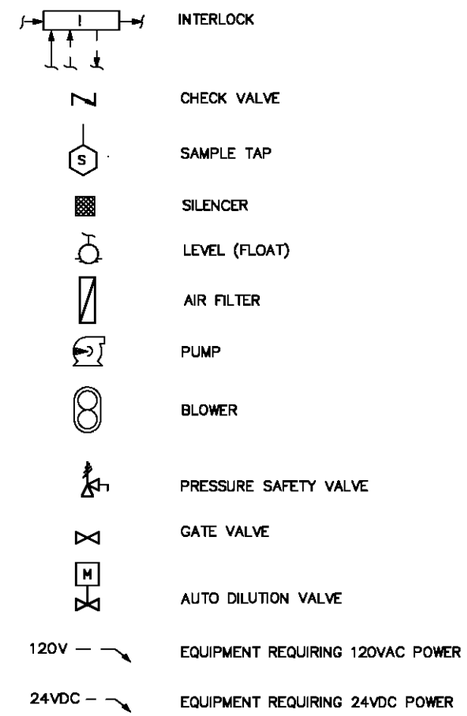


INSTRUMENT SOCIETY OF AMERICA TABLE (ISA)

LETTER	FIRST LETTER(S)		SUCCEEDING LETTERS		
	PROCESS OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS (*)		ALARM		
B	BURNER FLAME		USERS CHOICE (*)	USERS CHOICE (*)	USERS CHOICE (*)
C	CONDUCTIVITY			CONTROL	
D	DENSITY (S.G.)	DIFFERENTIAL			
E	VOLTAGE		PRIMARY ELEMENT		
F	FLOW RATE	RATIO			
G	GAUGE		GLASS	GATE	
H	HAND (MANUAL)				HIGH
I	CURRENT		INDICATE		
J	POWER	SCAN			
K	TIME OR SCHEDULE			CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOTION				MIDDLE
N	USERS CHOICE (*)		USERS CHOICE (*)	USERS CHOICE (*)	USERS CHOICE (*)
O	USERS CHOICE (*)		ORIFICE		
P	PRESSURE (OR VACUUM)		POINT (TEST CONNECTION)		
Q	QUANTITY OR EVENT (*)	INTEGRATE	INTEGRATE		
R			RECORD OR PRINT		
S	SPEED OR FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE (*)		MULTIFUNCTION (*)		
V	VISCOSITY			VALVE	
W	WEIGHT OR FORCE	WELL			
X	UNCLASSIFIED (*)		UNCLASSIFIED (*)	UNCLASSIFIED (*)	UNCLASSIFIED (*)
Y	USERS CHOICE (*)			RELAY OR COMPUTE (*)	
Z	POSITION			DRIVE, ACTUATE OR UNCLASSIFIED FINAL CONTROL ELEMENT	

(*) WHEN USED, EXPLANATION IS SHOWN ADJACENT TO INSTRUMENT SYMBOL. SEE ABBREVIATIONS AND LETTER SYMBOLS.

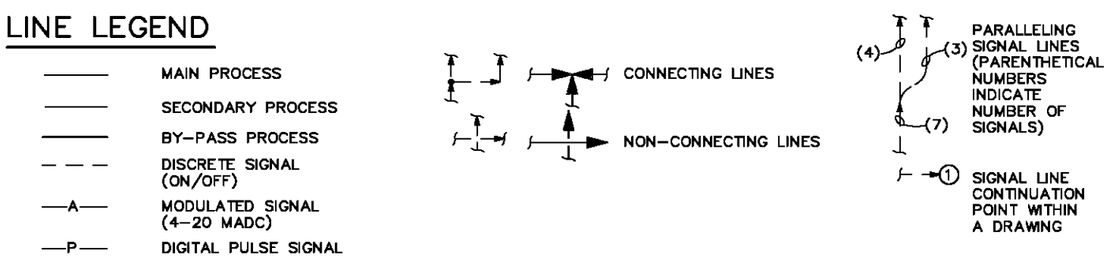
MISCELLANEOUS SYMBOLS



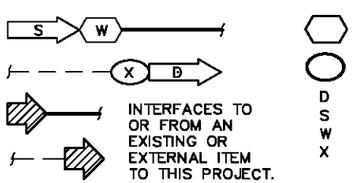
ABBREVIATIONS AND LETTER SYMBOLS

AAH	ANALYZER ALARM HIGH
AAHH	ANALYZER ALARM HIGH HIGH
AAS	AQUIFER AIR SPARGE
AE	ANALYZER ELEMENT
AIT	ANALYZER INDICATING TRANSMITTER
CP	CONTROL PANEL
FI	FLOW INDICATOR
FIT	FLOW INDICATING TRANSMITTER
HOA	HAND OFF AUTO
HS	HAND SWITCH
KM	HOUR METER
LAHH	LEVEL ALARM HIGH HIGH
LIH	LOWER EXPLOSIVE LIMIT ALARM HIGH
LIT	LOWER EXPLOSIVE LIMIT INDICATING TRANSMITTER
LSH	LEVEL SWITCH HIGH
LSHH	LEVEL SWITCH HIGH HIGH
LSL	LEVEL SWITCH LOW
OO	ON OFF
PI	PRESSURE INDICATOR
PIT	PRESSURE INDICATOR TRANSMITTER
QA	EVENT ALARM
QL	EVENT LIGHT
SS	START STOP
SVE	SOIL VAPOR EXTRACTION
TAH	TEMPERATURE ALARM HIGH
TAHH	TEMPERATURE ALARM HIGH HIGH
TSHH	TEMPERATURE SWITCH HIGH HIGH
TI	TEMPERATURE INDICATOR
TIT	TEMPERATURE INDICATING TRANSMITTER
VGAC	VAPOR – PHASE GRANULAR ACTIVATED CARBON

LINE LEGEND

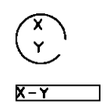


INTERFACE SYMBOLS



EQUIPMENT TAG NUMBERS

EQUIPMENT TYPE SYMBOLS
P = PUMP
T = TANK
M = MECHANICAL EQUIPMENT
Y: LOOP NUMBER



GENERAL NOTES

1. ■ – PROVIDED BY FIELD PIPING SUB-CONTRACTOR.
2. ◆ – PROVIDED BY AAS/SVE PROCESS EQUIPMENT SUBCONTRACTOR
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CHK	H.HERNANDEZ					
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PROCESS INSTRUMENTATION AND CONTROLS
INSTRUMENTATION AND CONTROL LEGEND

SHEET 7
DWG NO. I-1
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CP-1

PLC

I-3 3

SHUTDOWN

ON

HS 203 HQA

HS 204 HQA

HS 207 HQA

QL 206 OO

KM 206

QA 218 FAIL

QA 204 FAIL

QA 206 FAIL

LAHH 202

QA 202 FAIL

QA 203 FAIL

TAH 219

QA 219 FAIL

LAHH 200 FAIL

QA 200 FAIL

LIH 222

QA 222

HS SYSTEM OO

QL 204 OO

KM 204 HOURS

HS 208 HQA

QA 211 FAIL

LAHH 211

QL 220 OO

KM 220 HOURS

QA 205 FAIL

TAH 205

3 I-3, I-4

INTRINSIC SAFETY BARRIERS

QL 203 OO

KM 203 HOURS

QL 207 OO

KM 207 HOURS

HS 218 HQA

LSHH 200

LSH 200

LSL 200

ENCLOSURE VENT FAN M-218

OO HS 205 AUTO

KM 205 HOURS

QL 205

OFF-GAS FROM WELL LINE S1

FI 206

PI 208 VAC

TI 206

S 1

S 4

PI 212 VAC

TI 212

FI 212

MOISTURE SEPARATOR M-200

PI 214 VAC

VACUUM RELIEF VALVE

AIR FILTER

SVE BLOWER P-204

SILENCER

TI 216

PI 216

FI 216

S 6

LIT 219

TIT 219

LEL SENSOR

CHECK VALVE

PRESSURE RELIEF VALVE

TO ATMOSPHERIC DISCHARGE

TO ATMOSPHERIC DISCHARGE

DILUTION VALVE

SILENCER INTAKE FROM OUTSIDE OF ENCLOSURE

CHECK VALVE

EFFLUENT PUMP P-203

LSHH 202

LSH 202

LSL 202

SECONDARY OFF-GAS TREATMENT (OPTIONAL) M-221

OFF-GAS FROM WELL LINE S2

FI 209

PI 209 VAC

TI 209

S 2

S 5

PI 213 VAC

TI 213

FI 213

MOISTURE SEPARATOR M-202

PI 215 VAC

SVE BLOWER P-206

TI 217

PI 217

FI 217

S 7

S 8

S 9

CHECK VALVE

VACUUM RELIEF VALVE

AIR FILTER

SILENCER

PRESSURE RELIEF VALVE

LSHH 211

LSH 211

LSL 211

DILUTION AIR BLOWER

AIR FILTER

M

M

OFFGAS CONTROL SYSTEM

DILUTION AIR BLOWER INTAKE

PROPANE SUPPLY

EFFLUENT PUMP P-207

DILUTION VALVE

SILENCER INTAKE FROM OUTSIDE OF ENCLOSURE

TYPICAL SVE SYSTEM ENCLOSURE

SVE MS HOLDING TANK M-211

EFFLUENT PUMP P-220

NOTE:
ENCLOSURE VENT FAN MUST PROVIDE A MINIMUM OF 12 AIR EXCHANGES PER HOUR

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PROCESS INSTRUMENTATION AND CONTROLS

SVE SYSTEM
PROCESS AND INSTRUMENTATION DIAGRAM

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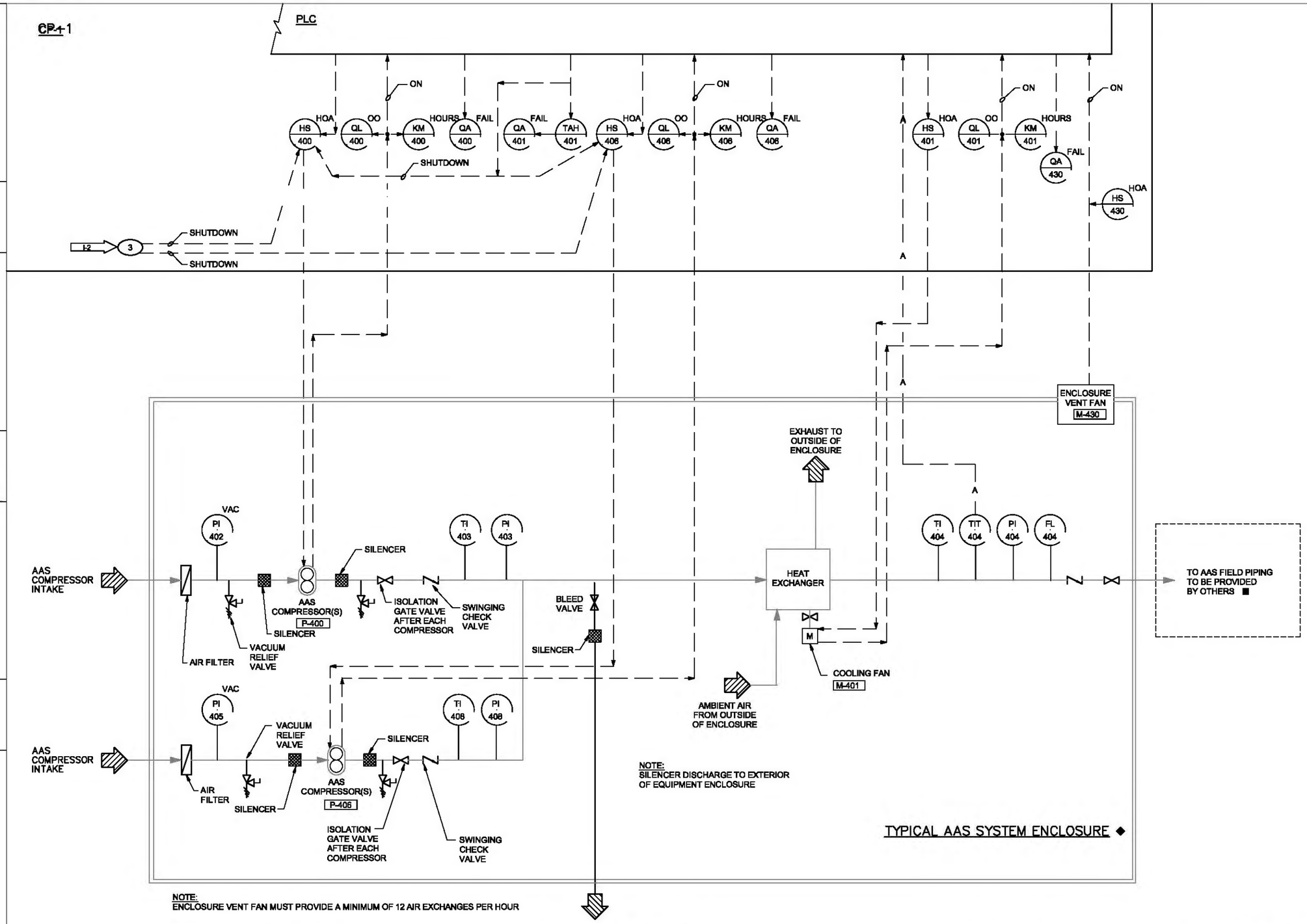

NOTE:
SILENCER DISCHARGE TO EXTERIOR OF EQUIPMENT ENCLOSURE

TYPICAL AAS SYSTEM ENCLOSURE ◆

NOTE:
ENCLOSURE VENT FAN MUST PROVIDE A MINIMUM OF 12 AIR EXCHANGES PER HOUR

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CHK	H. HERNANDEZ						
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PROCESS INSTRUMENTATION AND CONTROLS
AAS SYSTEM
PROCESS AND INSTRUMENTATION DIAGRAM

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Appendix F

Low Flow Groundwater Sampling Procedures

United States Environmental Protection Agency | Office of Research and Development | Office of Solid Waste and Emergency Response | EPA/540/S-95/504 April 1996

Ground Water Issue

LOW-FLOW (MINIMAL DRAWDOWN) GROUND-WATER SAMPLING PROCEDURES

by Robert W. Puls[1] and Michael J. Barcelona[2]

Background

The Regional Superfund Ground Water Forum is a group of ground-water scientists, representing EPA's Regional Superfund Offices, organized to exchange information related to ground-water remediation at Superfund sites. One of the major concerns of the Forum is the sampling of ground water to support site assessment and remedial performance monitoring objectives. This paper is intended to provide background information on the development of low-flow sampling procedures and its application under a variety of hydrogeologic settings. It is hoped that the paper will support the production of standard operating procedures for use by EPA Regional personnel and other environmental professionals engaged in ground-water sampling.

For further information contact: Robert Puls, 405-436-8543, Subsurface Remediation and Protection Division, NRMRL, Ada, Oklahoma.

I. Introduction

The methods and objectives of ground-water sampling to assess water quality have evolved over time. Initially the emphasis was on the assessment of water quality of aquifers as sources of drinking water. Large water-bearing units were identified and sampled in keeping with that objective. These were highly productive aquifers that supplied drinking water via private wells or through public water supply systems. Gradually, with the increasing awareness of subsurface pollution of these water resources, the understanding of complex hydrogeochemical processes which govern the fate and transport of contaminants in the subsurface increased. This increase in understanding was also due to advances in a number of scientific disciplines and improvements in tools used for site characterization and ground-water sampling. Ground-water quality investigations where pollution was detected initially borrowed ideas, methods, and materials for site characterization from the water supply field and water analysis from public health practices. This included the materials and manner in which monitoring wells were installed and the way in which water was brought to the surface, treated, preserved and analyzed. The prevailing conceptual ideas included convenient generalizations of ground-water resources in terms of large and relatively homogeneous hydrologic *units*. With time it became apparent that conventional water supply generalizations of *homogeneity* did not adequately represent field data regarding pollution of these subsurface resources. The important role of *heterogeneity* became increasingly clear not only in geologic terms, but also in terms of complex physical,

[1]National Risk Management Research Laboratory, U.S. EPA
[2]University of Michigan

Superfund Technology Support Center for Ground Water

National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
Robert S. Kerr Environmental Research Center
Ada, Oklahoma

Technology Innovation Office
Office of Solid Waste and Emergency Response, US EPA, Washington, DC

Walter W. Kovalick, Jr., Ph.D.
Director

chemical and biological subsurface processes. With greater appreciation of the role of heterogeneity, it became evident that subsurface pollution was ubiquitous and encompassed the unsaturated zone to the deep subsurface and included unconsolidated sediments, fractured rock, and *aquitards* or low-yielding or impermeable formations. Small-scale processes and heterogeneities were shown to be important in identifying contaminant distributions and in controlling water and contaminant flow paths.

It is beyond the scope of this paper to summarize all the advances in the field of ground-water quality investigations and remediation, but two particular issues have bearing on ground-water sampling today: aquifer heterogeneity and colloidal transport. Aquifer heterogeneities affect contaminant flow paths and include variations in geology, geochemistry, hydrology and microbiology. As methods and the tools available for subsurface investigations have become increasingly sophisticated and understanding of the subsurface environment has advanced, there is an awareness that in most cases a primary concern for site investigations is characterization of contaminant flow paths rather than entire aquifers. In fact, in many cases, plume thickness can be less than well screen lengths (e.g., 3-6 m) typically installed at hazardous waste sites to detect and monitor plume movement over time. Small-scale differences have increasingly been shown to be important and there is a general trend toward smaller diameter wells and shorter screens.

The hydrogeochemical significance of colloidal-size particles in subsurface systems has been realized during the past several years (Gschwend and Reynolds, 1987; McCarthy and Zachara, 1989; Puls, 1990; Ryan and Gschwend, 1990). This realization resulted from both field and laboratory studies that showed faster contaminant migration over greater distances and at higher concentrations than flow and transport model predictions would suggest (Buddemeier and Hunt, 1988; Enfield and Bengtsson, 1988; Penrose et al., 1990). Such models typically account for interaction between the mobile aqueous and immobile solid phases, but do not allow for a mobile, reactive solid phase. It is recognition of this third *phase* as a possible means of contaminant transport that has brought increasing attention to the manner in which samples are collected and processed for analysis (Puls et al., 1990; McCarthy and Degueldre, 1993; Backhus et al., 1993; U. S. EPA, 1995). If such a phase is present in sufficient mass, possesses high sorption reactivity, large surface area, and remains stable in suspension, it can serve as an important mechanism to facilitate contaminant transport in many types of subsurface systems.

Colloids are particles that are sufficiently small so that the surface free energy of the particle dominates the bulk free energy. Typically, in ground water, this includes particles with diameters between 1 and 1000 nm. The most commonly observed mobile particles include: secondary clay minerals; hydrous iron, aluminum, and manganese oxides; dissolved and particulate organic materials, and viruses and bacteria. These reactive particles have been shown to be mobile under a variety of conditions in both field studies and laboratory column experiments, and as such need to be included in monitoring programs where identification of the *total* mobile contaminant loading (dissolved + naturally suspended particles) at a site is an objective. To that end, sampling methodologies must be used which do not artificially bias *naturally* suspended particle concentrations.

Currently the most common ground-water purging and sampling methodology is to purge a well using bailers or high speed pumps to remove 3 to 5 casing volumes followed by sample collection. This method can cause adverse impacts on sample quality through collection of samples with high levels of turbidity. This results in the inclusion of otherwise immobile artifactual particles which produce an overestimation of certain analytes of interest (e.g., metals or hydrophobic organic compounds). Numerous documented problems associated with filtration (Danielsson, 1982; Laxen and Chandler, 1982; Horowitz et al., 1992) make this an undesirable method of rectifying the turbidity problem, and include the removal of potentially mobile (contaminant-associated) particles during filtration, thus artificially biasing contaminant concentrations low. Sampling-induced turbidity problems can often be mitigated by using low-flow purging and sampling techniques.

Current subsurface conceptual models have undergone considerable refinement due to the recent development and increased use of field screening tools. So-called hydraulic *push* technologies (e.g., cone penetrometer, Geoprobe®, QED HydroPunch®) enable relatively fast screening site characterization which can then be used to design and install a monitoring well network. Indeed, alternatives to conventional monitoring wells are now being considered for some hydrogeologic settings. The ultimate design of any monitoring system should however be based upon adequate site characterization and be consistent with established monitoring objectives.

If the sampling program objectives include accurate assessment of the magnitude and extent of subsurface contamination over time and/or accurate assessment of subsequent remedial performance, then some information regarding plume delineation in three-dimensional space is necessary prior to monitoring well network design and installation. This can be accomplished with a variety of different tools and equipment ranging from hand-operated augers to screening tools mentioned above and large drilling rigs. Detailed information on ground-water flow velocity, direction, and horizontal and vertical variability are essential baseline data requirements. Detailed soil and geologic data are required prior to and during the installation of sampling points. This includes historical as well as detailed soil and geologic logs which accumulate during the site investigation. The use of borehole geophysical techniques is also recommended. With this information (together with other site characterization data) and a clear understanding of sampling

objectives, then appropriate location, screen length, well diameter, slot size, etc. for the monitoring well network can be decided. This is especially critical for new in situ remedial approaches or natural attenuation assessments at hazardous waste sites.

In general, the overall goal of any ground-water sampling program is to collect water samples with no alteration in water chemistry; analytical data thus obtained may be used for a variety of specific monitoring programs depending on the regulatory requirements. The sampling methodology described in this paper assumes that the monitoring goal is to sample monitoring wells for the presence of contaminants and it is applicable whether mobile colloids are a concern or not and whether the analytes of concern are metals (and metalloids) or organic compounds.

II. Monitoring Objectives and Design Considerations

The following issues are important to consider prior to the design and implementation of any ground-water monitoring program, including those which anticipate using low-flow purging and sampling procedures.

A. Data Quality Objectives (DQOs)

Monitoring objectives include four main types: detection, assessment, corrective-action evaluation and resource evaluation, along with *hybrid* variations such as site-assessments for property transfers and water availability investigations. Monitoring objectives may change as contamination or water quality problems are discovered. However, there are a number of common components of monitoring programs which should be recognized as important regardless of initial objectives. These components include:

1) Development of a conceptual model that incorporates elements of the regional geology to the local geologic framework. The conceptual model development also includes initial site characterization efforts to identify hydrostratigraphic units and likely flow-paths using a minimum number of borings and well completions;

2) Cost-effective and well documented collection of high quality data utilizing simple, accurate, and reproducible techniques; and

3) Refinement of the conceptual model based on supplementary data collection and analysis.

These fundamental components serve many types of monitoring programs and provide a basis for future efforts that evolve in complexity and level of spatial detail as purposes and objectives expand. High quality, reproducible data collection is a common goal regardless of program objectives.

High quality data collection implies data of sufficient accuracy, precision, and completeness (i.e., ratio of valid analytical results to the minimum sample number called for by the program design) to meet the program objectives. Accuracy depends on the correct choice of monitoring tools and procedures to minimize sample and subsurface disturbance from collection to analysis. Precision depends on the repeatability of sampling and analytical protocols. It can be assured or improved by replication of sample analyses including blanks, field/lab standards and reference standards.

B. Sample Representativeness

An important goal of any monitoring program is collection of data that is truly representative of conditions at the site. The term *representativeness* applies to chemical and hydrogeologic data collected via wells, borings, piezometers, geophysical and soil gas measurements, lysimeters, and temporary sampling points. It involves a recognition of the statistical variability of individual subsurface physical properties, and contaminant or major ion concentration levels, while explaining extreme values. Subsurface temporal and spatial variability are facts. Good professional practice seeks to maximize representativeness by using proven accurate and reproducible techniques to define limits on the distribution of measurements collected at a site. However, measures of representativeness are dynamic and are controlled by evolving site characterization and monitoring objectives. An evolutionary site characterization model, as shown in Figure 1, provides a systematic approach to the goal of consistent data collection.

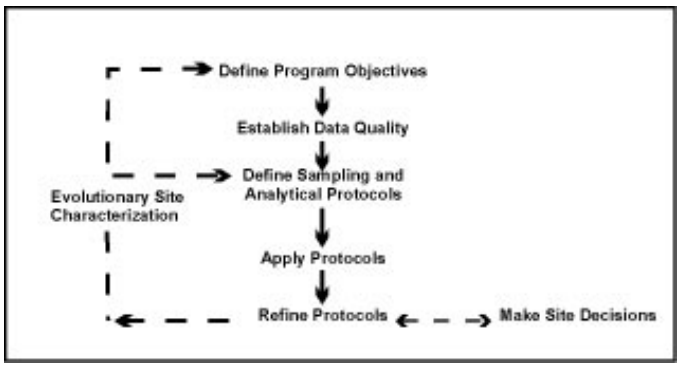

Figure 1. Evolutionary Site Characterization Model

The model emphasizes a recognition of the causes of the variability (e.g., use of inappropriate technology such as using bailers to purge wells; imprecise or operator-dependent methods) and the need to control avoidable errors.

1) Questions of Scale

A sampling plan designed to collect representative samples must take into account the potential scale of changes in site conditions through space and time as well as the chemical associations and behavior of the parameters that are targeted for investigation. In subsurface systems, physical (i.e., aquifer) and chemical properties over time or space are not statistically independent. In fact, samples taken in close proximity (i.e., within distances of a few meters) or within short time periods (i.e., more frequently than monthly) are highly auto-correlated. This means that designs employing high-sampling frequency (e.g., monthly) or dense spatial monitoring designs run the risk of redundant data collection and misleading inferences regarding trends in values that aren't statistically valid. In practice, contaminant detection and assessment monitoring programs rarely suffer these *over-sampling* concerns. In corrective-action evaluation programs, it is also possible that too little data may be collected over space or time. In these cases, false interpretation of the spatial extent of contamination or underestimation of temporal concentration variability may result.

2) Target Parameters

Parameter selection in monitoring program design is most often dictated by the regulatory status of the site. However, background water quality constituents, purging indicator parameters, and contaminants, all represent targets for data collection programs. The tools and procedures used in these programs should be equally rigorous and applicable to all categories of data, since all may be needed to determine or support regulatory action.

C. Sampling Point Design and Construction

Detailed site characterization is central to all decision-making purposes and the basis for this characterization resides in identification of the geologic framework and major hydro-stratigraphic units. Fundamental data for sample point location include: subsurface lithology, head-differences and background geochemical conditions. Each sampling point has a proper use or uses which should be documented at a level which is appropriate for the program's data quality objectives. Individual sampling points may not always be able to fulfill multiple monitoring objectives (e.g., detection, assessment, corrective action).

1) Compatibility with Monitoring Program and Data Quality Objectives

Specifics of sampling point location and design will be dictated by the complexity of subsurface lithology and variability in contaminant and/or geochemical conditions. It should be noted that, regardless of the ground-water sampling approach, few sampling points (e.g., wells, drive-points, screened augers) have zones of influence in excess of a few feet. Therefore, the spatial frequency of sampling points should be carefully selected and designed.

2) Flexibility of Sampling Point Design

In most cases *well-point* diameters in excess of 1 7/8 inches will permit the use of most types of submersible pumping devices for low-flow (minimal drawdown) sampling. It is suggested that *short* (e.g., less than 1.6 m) screens be incorporated into the monitoring design where possible so that comparable results from one device to another might be expected. *Short*, of course, is relative to the degree of vertical water quality variability expected at a site.

3) Equilibration of Sampling Point

Time should be allowed for equilibration of the well or sampling point with the formation after installation. Placement of well or sampling points in the subsurface produces some disturbance of ambient conditions. Drilling techniques (e.g., auger, rotary, etc.) are generally considered to cause more disturbance than *direct-push* technologies. In either case, there may be a period (i.e., days to months) during which water quality near the point may be distinctly different from that in the formation. Proper development of the sampling point and adjacent formation to remove fines created during emplacement will shorten this water quality *recovery* period.

III. Definition of Low-Flow Purging and Sampling

It is generally accepted that water in the well casing is non-representative of the formation water and needs to be purged prior to collection of ground-water samples. However, the water in the screened interval may indeed be representative of the formation, depending upon well construction and site hydrogeology. Wells are purged to some extent for the following reasons: the presence of the air interface at the top of the water column resulting in an oxygen concentration gradient with depth, loss of volatiles up the water column, leaching from or sorption to the casing or filter pack, chemical changes due to clay seals or backfill, and surface infiltration.

Low-flow purging, whether using portable or dedicated systems, should be done using pump-intake located in the middle or slightly above the middle of the screened interval. Placement of the pump too close to the bottom of the well will cause increased entrainment of solids which have collected in the well over time. These particles are present as a result of well development, prior purging and sampling events, and natural colloidal transport and deposition. Therefore, placement of the pump in the middle or toward the top of the screened interval is suggested. Placement of the pump at the top of the water column for sampling is only recommended in unconfined aquifers, screened across the water table, where this is the desired sampling point. Low-

flow purging has the advantage of minimizing mixing between the overlying stagnant casing water and water within the screened interval.

A. Low-Flow Purging and Sampling

Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface which can be affected by flow regulators or restrictions. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrological situation. The objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practical taking into account established site sampling objectives. Typically, flow rates on the order of 0.1 - 0.5 L/min are used, however this is dependent on site-specific hydrogeology. Some extremely coarse-textured formations have been successfully sampled in this manner at flow rates to 1 L/min. The effectiveness of using low-flow purging is intimately linked with proper screen location, screen length, and well construction and development techniques. The reestablishment of natural flow paths in both the vertical and horizontal directions is important for correct interpretation of the data. For high resolution sampling needs, screens less than 1 m should be used. Most of the need for purging has been found to be due to passing the sampling device through the overlying casing water which causes mixing of these stagnant waters and the dynamic waters within the screened interval. Additionally, there is disturbance to suspended sediment collected in the bottom of the casing and the displacement of water out into the formation immediately adjacent to the well screen. These disturbances and impacts can be avoided using dedicated sampling equipment, which precludes the need to insert the sampling device prior to purging and sampling.

Isolation of the screened interval water from the overlying stagnant casing water may be accomplished using low-flow minimal drawdown techniques. If the pump intake is located within the screened interval, most of the water pumped will be drawn in directly from the formation with little mixing of casing water or disturbance to the sampling zone. However, if the wells are not constructed and developed properly, zones other than those intended may be sampled. At some sites where geologic heterogeneities are sufficiently different within the screened interval, higher conductivity zones may be preferentially sampled. This is another reason to use shorter screened intervals, especially where high spatial resolution is a sampling objective.

B. Water Quality Indicator Parameters

It is recommended that water quality indicator parameters be used to determine purging needs prior to sample collection in each well. Stabilization of parameters such as pH, specific conductance, dissolved oxygen, oxidation-reduction potential, temperature and turbidity should be used to determine when formation water is accessed during purging. In general, the order of stabilization is pH, temperature, and specific conductance, followed by oxidation-reduction potential, dissolved oxygen and turbidity. Temperature and pH, while commonly used as purging indicators, are actually quite insensitive in distinguishing between formation water and stagnant casing water; nevertheless, these are important parameters for data interpretation purposes and should also be measured. Performance criteria for determination of stabilization should be based on water-level drawdown, pumping rate and equipment specifications for measuring indicator parameters. Instruments are available which utilize in-line flow cells to continuously measure the above parameters.

It is important to establish specific well stabilization criteria and then consistently follow the same methods thereafter, particularly with respect to drawdown, flow rate and sampling device. Generally, the time or purge volume required for parameter stabilization is independent of well depth or well volumes. Dependent variables are well diameter, sampling device, hydrogeochemistry, pump flow rate, and whether the devices are used in a portable or dedicated manner. If the sampling device is already in place (i.e., dedicated sampling systems), then the time and purge volume needed for stabilization is much shorter. Other advantages of dedicated equipment include less purge water for waste disposal, much less decontamination of equipment, less time spent in preparation of sampling as well as time in the field, and more consistency in the sampling approach which probably will translate into less variability in sampling results. The use of dedicated equipment is strongly recommended at wells which will undergo routine sampling over time.

If parameter stabilization criteria are too stringent, then minor oscillations in indicator parameters may cause purging operations to become unnecessarily protracted. It should also be noted that turbidity is a very conservative parameter in terms of stabilization. Turbidity is always the last parameter to stabilize. Excessive purge times are invariably related to the establishment of too stringent turbidity stabilization criteria. It should be noted that natural turbidity levels in ground water may exceed 10 nephelometric turbidity units (NTU).

C. Advantages and Disadvantages of Low-Flow (Minimum Drawdown) Purging

In general, the advantages of low-flow purging include:

- samples which are representative of the *mobile* load of contaminants present (dissolved and colloid-associated);
- minimal disturbance of the sampling point thereby minimizing sampling artifacts;
- less operator variability, greater operator control;

- reduced stress on the formation (minimal drawdown);
- less mixing of stagnant casing water with formation water;
- reduced need for filtration and, therefore, less time required for sampling;
- smaller purging volume which decreases waste disposal costs and sampling time;
- better sample consistency; reduced artificial sample variability.

Some disadvantages of low-flow purging are:

- higher initial capital costs,
- greater set-up time in the field,
- need to transport additional equipment to and from the site,
- increased training needs,
- resistance to change on the part of sampling practitioners,
- concern that new data will indicate a *change in conditions* and trigger an *action*.

IV. Low-Flow (Minimal Drawdown) Sampling Protocols

The following ground-water sampling procedure has evolved over many years of experience in ground-water sampling for organic and inorganic compound determinations and as such summarizes the authors' (and others) experiences to date (Barcelona et al., 1984, 1994; Barcelona and Helfrich, 1986; Puls and Barcelona, 1989; Puls et. al. 1990, 1992; Puls and Powell, 1992; Puls and Paul, 1995). High-quality chemical data collection is essential in ground-water monitoring and site characterization. The primary limitations to the collection of *representative* ground-water samples include: mixing of the stagnant casing and *fresh* screen waters during insertion of the sampling device or ground-water level measurement device; disturbance and resuspension of settled solids at the bottom of the well when using high pumping rates or raising and lowering a pump or bailer; introduction of atmospheric gases or degassing from the water during sample handling and transfer, or inappropriate use of vacuum sampling device, etc.

A. Sampling Recommendations

Water samples should not be taken immediately following well development. Sufficient time should be allowed for the ground-water flow regime in the vicinity of the monitoring well to stabilize and to approach chemical equilibrium with the well construction materials. This lag time will depend on site conditions and methods of installation but often exceeds one week.

Well purging is nearly always necessary to obtain samples of water flowing through the geologic formations in the screened interval. Rather than using a general but arbitrary guideline of purging three casing volumes prior to sampling, it is recommended that an in-line water quality measurement device (e.g., flow-through cell) be used to establish the stabilization time for several parameters (e.g. , pH, specific conductance, redox, dissolved oxygen, turbidity) on a well-specific basis. Data on pumping rate, drawdown, and volume required for parameter stabilization can be used as a guide for conducting subsequent sampling activities.

The following are recommendations to be considered before, during and after sampling:

- use low-flow rates (<0.5 L/min), during both purging and sampling to maintain minimal drawdown in the well;
- maximize tubing wall thickness, minimize tubing length;
- place the sampling device intake at the desired sampling point;
- minimize disturbances of the stagnant water column above the screened interval during water level measurement and sampling device insertion;
- make proper adjustments to stabilize the flow rate as soon as possible;
- monitor water quality indicators during purging;
- collect unfiltered samples to estimate contaminant loading and transport potential in the subsurface system.

B. Equipment Calibration

Prior to sampling, all sampling device and monitoring equipment should be calibrated according to manufacturer's recommendations and the site Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP). Calibration of pH should be performed with at least two buffers which bracket the expected range. Dissolved oxygen calibration must be corrected for local barometric pressure readings and elevation.

C. Water Level Measurement and Monitoring

It is recommended that a device be used which will least disturb the water surface in the casing. Well depth should be obtained from the well logs. Measuring to the bottom of the well casing will only cause resuspension of settled solids from the formation and require longer purging times for turbidity equilibration. Measure well depth after sampling is completed. The water level measurement should be taken from a permanent reference point which is surveyed relative to ground elevation.

D. Pump Type

The use of low-flow (e.g., 0.1-0.5 L/min) pumps is suggested for purging and sampling all types of analytes. All pumps have some limitation and these should be investigated with respect to application at a particular site. Bailers are inappropriate devices for low-flow sampling.

1) General Considerations

There are no unusual requirements for ground-water sampling devices when using low-flow, minimal drawdown techniques. The major concern is that the device give consistent results and minimal disturbance of the sample across a range of *low* flow rates (i.e., < 0.5 L/min). Clearly, pumping rates that cause minimal to no drawdown in one well could easily cause *significant* drawdown in another well finished in a less transmissive formation. In this sense, the pump should not cause undue pressure or temperature changes or physical disturbance on the water sample over a reasonable sampling range. Consistency in operation is critical to meet accuracy and precision goals.

2) Advantages and Disadvantages of Sampling Devices

A variety of sampling devices are available for low-flow (minimal drawdown) purging and sampling and include peristaltic pumps, bladder pumps, electrical submersible pumps, and gas-driven pumps. Devices which lend themselves to both dedication and consistent operation at definable low-flow rates are preferred. It is desirable that the pump be easily adjustable and operate reliably at these lower flow rates. The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and some volatiles loss. Gas-driven pumps should be of a type that does not allow the gas to be in direct contact with the sampled fluid.

Clearly, bailers and other *grab* type samplers are ill-suited for low-flow sampling since they will cause repeated disturbance and mixing of *stagnant* water in the casing and the *dynamic* water in the screened interval. Similarly, the use of inertial lift foot-valve type samplers may cause too much disturbance at the point of sampling. Use of these devices also tends to introduce uncontrolled and unacceptable operator variability.

Summaries of advantages and disadvantages of various sampling devices are listed in Herzog et al. (1991), U. S. EPA (1992), Parker (1994) and Thurnblad (1994).

E. Pump Installation

Dedicated sampling devices (left in the well) capable of pumping and sampling are preferred over <u>any</u> other type of device. Any portable sampling device should be slowly and carefully lowered to the middle of the screened interval or slightly above the middle (e.g., 1-1.5 m below the top of a 3 m screen). This is to minimize excessive mixing of the stagnant water in the casing above the screen with the screened interval zone water, and to minimize resuspension of solids which will have collected at the bottom of the well. These two disturbance effects have been shown to directly affect the time required for purging. There also appears to be a direct correlation between size of portable sampling devices relative to the well bore and resulting purge volumes and times. The key is to minimize disturbance of water and solids in the well casing.

F. Filtration

Decisions to filter samples should be dictated by sampling objectives rather than as a *fix* for poor sampling practices, and field-filtering of certain constituents should not be the default. Consideration should be given as to what the application of field-filtration is trying to accomplish. For assessment of truly dissolved (as opposed to operationally *dissolved* [i.e., samples filtered with 0.45 µm filters]) concentrations of major ions and trace metals, 0.1 µm filters are recommended although 0.45 µm filters are normally used for most regulatory programs. Alkalinity samples must also be filtered if significant particulate calcium carbonate is suspected, since this material is likely to impact alkalinity titration results (although filtration itself may alter the CO_2 composition of the sample and, therefore, affect the results).

Although filtration may be appropriate, filtration of a sample may cause a number of unintended changes to occur (e.g. oxidation, aeration) possibly leading to filtration-induced artifacts during sample analysis and uncertainty in the results. Some of these unintended changes may be unavoidable but the factors leading to them must be recognized. Deleterious effects can be minimized by consistent application of certain filtration guidelines. Guidelines should address selection of filter type, media, pore size, etc. in order to identify and minimize potential sources of uncertainty when filtering samples.

In-line filtration is recommended because it provides better consistency through less sample handling, and minimizes sample exposure to the atmosphere. In-line filters are available in both disposable (barrel filters) and non-disposable (in-line filter holder, flat membrane filters) formats and various filter pore sizes (0.1-5.0 µm). Disposable filter cartridges have the advantage of greater sediment handling capacity when compared to traditional membrane filters. Filters must be pre-rinsed following manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum of 1 L of ground water following purging and prior to sampling. Once filtration has begun, a filter cake may develop as particles larger than the pore size accumulate on the filter membrane. The result is that the effective pore diameter of the membrane is reduced and particles smaller than the stated pore size are excluded from the filtrate. Possible corrective measures include prefiltering (with larger pore size filters), minimizing particle loads to begin with, and reducing sample volume.

G. Monitoring of Water Level and Water Quality Indicator Parameters

Check water level periodically to monitor drawdown in the well as a guide to flow rate adjustment. The goal is minimal drawdown (<0.1 m) during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience. In-line water quality indicator parameters should be continuously monitored during purging. The water quality

indicator parameters monitored can include pH, redox potential, conductivity, dissolved oxygen (DO) and turbidity. The last three parameters are often most sensitive. Pumping rate, drawdown, and the time or volume required to obtain stabilization of parameter readings can be used as a future guide to purge the well. Measurements should be taken every three to five minutes if the above suggested rates are used. Stabilization is achieved after all parameters have stabilized for three successive readings. In lieu of measuring all five parameters, a minimum subset would include pH, conductivity, and turbidity or DO. Three successive readings should be within ± 0.1 for pH, ± 3% for conductivity, ± 10 mv for redox potential, and ± 10% for turbidity and DO. Stabilized purge indicator parameter trends are generally obvious and follow either an exponential or asymptotic change to stable values during purging. Dissolved oxygen and turbidity usually require the longest time for stabilization. The above stabilization guidelines are provided for rough estimates based on experience.

H. Sampling, Sample Containers, Preservation and Decontamination

Upon parameter stabilization, sampling can be initiated. If an in-line device is used to monitor water quality parameters, it should be disconnected or bypassed during sample collection. Sampling flow rate may remain at established purge rate or may be adjusted slightly to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Typically, flow rates less than 0.5 L/min are appropriate. The same device should be used for sampling as was used for purging. Sampling should occur in a progression from least to most contaminated well, if this is known. Generally, volatile (e.g., solvents and fuel constituents) and gas sensitive (e.g., Fe^{2+}, CH_4, H_2S/HS^-, alkalinity) parameters should be sampled first. The sequence in which samples for most inorganic parameters are collected is immaterial unless filtered (dissolved) samples are desired. Filtering should be done last and in-line filters should be used as discussed above. During both well purging and sampling, proper protective clothing and equipment must be used based upon the type and level of contaminants present.

The appropriate sample container will be prepared in advance of actual sample collection for the analytes of interest and include sample preservative where necessary. Water samples should be collected directly into this container from the pump tubing.

Immediately after a sample bottle has been filled, it must be preserved as specified in the site (QAPP). Sample preservation requirements are based on the analyses being performed (use site QAPP, FSP, RCRA guidance document [U. S. EPA, 1992] or EPA SW-846 [U. S. EPA, 1982]). It may be advisable to add preservatives to sample bottles in a controlled setting prior to entering the field in order to reduce the chances of improperly preserving sample bottles or introducing field contaminants into a sample bottle while adding the preservatives.

The preservatives should be transferred from the chemical bottle to the sample container using a disposable polyethylene pipet and the disposable pipet should be used only once and then discarded.

After a sample container has been filled with ground water, a Teflon™ (or tin)-lined cap is screwed on tightly to prevent the container from leaking. A sample label is filled out as specified in the FSP. The samples should be stored inverted at 4°C.

Specific decontamination protocols for sampling devices are dependent to some extent on the type of device used and the type of contaminants encountered. Refer to the site QAPP and FSP for specific requirements.

I. Blanks

The following blanks should be collected:

(1) field blank: one field blank should be collected from each source water (distilled/deionized water) used for sampling equipment decontamination or for assisting well development procedures.

(2) equipment blank: one equipment blank should be taken prior to the commencement of field work, from each set of sampling equipment to be used for that day. Refer to site QAPP or FSP for specific requirements.

(3) trip blank: a trip blank is required to accompany each volatile sample shipment. These blanks are prepared in the laboratory by filling a 40-mL volatile organic analysis (VOA) bottle with distilled/deionized water.

V. Low-Permeability Formations and Fractured Rock

The overall sampling program goals or sampling objectives will drive how the sampling points are located, installed, and choice of sampling device. Likewise, site-specific hydrogeologic factors will affect these decisions. Sites with very low permeability formations or fractures causing discrete flow channels may require a unique monitoring approach. Unlike water supply wells, wells installed for ground-water quality assessment and restoration programs are often installed in low water-yielding settings (e.g., clays, silts). Alternative types of sampling points and sampling methods are often needed in these types of environments, because low-permeability settings may require extremely low-flow purging (<0.1 L/min) and may be technology-limited. Where devices are not readily available to pump at such low flow rates, the primary consideration is to avoid dewatering of

the well screen. This may require repeated recovery of the water during purging while leaving the pump in place within the well screen.

Use of low-flow techniques may be impractical in these settings, depending upon the water recharge rates. The sampler and the end-user of data collected from such wells need to understand the limitations of the data collected; i.e., a strong potential for underestimation of actual contaminant concentrations for volatile organics, potential false negatives for filtered metals and potential false positives for unfiltered metals. It is suggested that comparisons be made between samples recovered using low-flow purging techniques and samples recovered using passive sampling techniques (i.e., two sets of samples). Passive sample collection would essentially entail acquisition of the sample with no or very little purging using a dedicated sampling system installed within the screened interval or a passive sample collection device.

A. Low-Permeability Formations (<0.1 L/min recharge)

1. Low-Flow Purging and Sampling with Pumps

a. "portable or non-dedicated mode" - Lower the pump (one capable of pumping at <0.1 L/min) to mid-screen or slightly above and set in place for minimum of 48 hours (to lessen purge volume requirements). After 48 hours, use procedures listed in Part IV above regarding monitoring water quality parameters for stabilization, etc., but do not dewater the screen. If excessive drawdown and slow recovery is a problem, then alternate approaches such as those listed below may be better.

b. "dedicated mode" - Set the pump as above at least a week prior to sampling; that is, operate in a dedicated pump mode. With this approach significant reductions in purge volume should be realized. Water quality parameters should stabilize quite rapidly due to less disturbance of the sampling zone.

2. Passive Sample Collection

Passive sampling collection requires insertion of the device into the screened interval for a sufficient time period to allow flow and sample equilibration before extraction for analysis. Conceptually, the extraction of water from low yielding formations seems more akin to the collection of water from the unsaturated zone and passive sampling techniques may be more appropriate in terms of obtaining "representative" samples. Satisfying usual sample volume requirements is typically a problem with this approach and some latitude will be needed on the part of regulatory entities to achieve sampling objectives.

B. Fractured Rock

In fractured rock formations, a low-flow to zero purging approach using pumps in conjunction with packers to isolate the sampling zone in the borehole is suggested. Passive multi-layer sampling devices may also provide the most "representative" samples. It is imperative in these settings to identify flow paths or water-producing fractures prior to sampling using tools such as borehole flowmeters and/or other geophysical tools.

After identification of water-bearing fractures, install packer(s) and pump assembly for sample collection using low-flow sampling in "dedicated mode" or use a passive sampling device which can isolate the identified water-bearing fractures.

VI. Documentation

The usual practices for documenting the sampling event should be used for low-flow purging and sampling techniques. This should include, at a minimum: information on the conduct of purging operations (flow-rate, drawdown, water-quality parameter values, volumes extracted and times for measurements), field instrument calibration data, water sampling forms and chain of custody forms. See Figures 2 and 3 and "Ground Water Sampling Workshop -- A Workshop Summary" (U. S. EPA, 1995) for example forms and other documentation suggestions and information. This information coupled with laboratory analytical data and validation data are needed to judge the "useability" of the sampling data.

VII. Notice

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Figure 2. **Ground Water Sampling Log**

Project _____ **Site** _____ **Well No.** _____ **Date** _____

Well Depth _____ **Screen Length** _____ **Well Diameter** _____ **Casing Type** _____

Sampling Device _____ **Tubing type** _____ **Water Level** _____

Measuring Point _____ **Other Infor** _____

_____

Sampling Personnel _____

Time	pH	Temp	Cond.	Dis.O_2	Turb.	[ ]Conc			Notes

Type of Samples Collected

_____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $Vol_{cyl} = \pi r^2 h$, $Vol_{sphere} = 4/3\pi r^3$

Figure 3. **Ground Water Sampling Log** (with automatic data logging for most water quality parameters)

Project _____ **Site** _____ **Well No.** _____ **Date** _____

Well Depth _____ **Screen Length** _____ **Well Diameter** _____ **Casing Type** _____

Sampling Device _____ **Tubing type** _____ **Water Level** _____

Measuring Point _____ **Other Infor** _____

_____

Sampling Personnel _____

Time	Pump Rate	Turbidity	Alkalinity	[ ] Conc	Notes

Type of Samples Collected

_____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $Vol_{cyl} = \pi r^2 h$, $Vol_{sphere} = 4/3\pi r^3$

Appendix G

Transport and Disposal Log

CTO No	Project No	Project Name	Site Description	Container Type	Container Desig.	Waste Profile Sample No	Contractor	Transporter	Date Transported	Transporter EPA ID	Load ID	Disposal Facility	Disp Fac EPA ID	Media	Waste Type (Haz, Nonhaz, TSCA)	Waste Code/ Haz Waste No	Disposal Date	Manifest Number	Disposal Treatment Method (Enter disposal quantity under appropriate method)					Certif of Disp/ Destruc Date	Comments/ Notes	File Status (see note)
																			Incineration	Recycle	Landfill	Other	Unit			
0048		NASP Bronson Field	Site Characterization																							

Appendix H

Quality Control Attachments

- Submittal Register
- Testing Plan and Log
- Project QC Manager Appointment Letter

Submittal Register

Contract Number: N62467-98-D-0995	CTO No.: 0071	CTO Title:Site Characterization for Site 1159, Outlying Landing Field Bronson	Location: NAS Pensacola, Pensacola, Florida	Contractor: CH2M HILL Constructors, Inc.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Item Number	Spec Section	Item Description	Para. Number	Approving Authority	Other Reviewers	Submittal Number	Scheduled Submission Date	CCI Review Date	CCI Disposition	CCI Transmit Date	QC Admin Received Date	QC Disposition	QC Admin Transmit Date	Contracting Officer Received	Contracting Officer Disposition	Contracting Officer Return	Remarks
		General Documentation															
		SD-09 Reports															
		A Remedial Action Plan Addendum															
		B Work Plan															
		C Health and Safety Plan															
		D QA/QC Plan															
		E Sampling and Analysis Plan															
		F Decontamination Procedures															
		G Material Safety Data Sheets															
		SD-18 Records															
		A As Built Records															
		B Environmental Conditions Report															
		C Test Results Summary															
		D Daily Production Report															
		E Daily QC Report															
		F Rework Items List															
		G Permits															
		H Decission Logic															
		Remediation System Installation and Performance															
		SD-02 Manufacturer's Catalog Data															
		A Well Heads and Covers															
		B AAS/SVE Materials															
		C AAS/SVE Piping Materials															
		D Compressor Components (Fileter, Silencer, Gauges, Sensors, etc.)															
		E AAS/SVE System Controls															
		F AAS/SVE System Valves															
		G Blower															
		H Heat Exchanger															
		I Motors (Compressors, Heat Exchangers, Blowers, Pumps, Combustion Blowers)															
		J Tramsfer Pump															
		K Waste Holding Tank															
		L Moisture Separator															
		M Granular Activated Carbon Vessels															
		N Fencing and Gate Materials															
		O Interior/Exterior Wiring (Switches and Circuit Breakers, Conductors, etc.)															
		P Thermal/Catalytic Oxidizer															
		Q Thermal/Catalytic Oxidizer Control Panal															
		R System Enclosure															
		SD-04 Drawings															
		A Well Heads and Covers															
		B Preconstruction AAS/SVE System Layout															

Submittal Register

Contract Number: N62467-98-D-0995	CTO No.: 0071	CTO Title:Site Characterization for Site 1159, Outlying Landing Field Bronson	Location: NAS Pensacola, Pensacola, Florida	Contractor: CH2M HILL Constructors, Inc.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Item Number	Spec Section	Item Description	Para. Number	Approving Authority	Other Reviewers	Submittal Number	Scheduled Submission Date	CCI Review Date	CCI Disposition	CCI Transmit Date	QC Admin Received Date	QC Disposition	QC Admin Transmit Date	Contracting Officer Received	Contracting Officer Disposition	Contracting Officer Return	Remarks
		C Preconstruction Treatment Compound Layout															
		D AAS Field Piping Layout															
		E SVE Field Piping Layout															
		F Design Drawings															
		G Final As-builts															
		SD-12 Field Testing Reports															
		A Calibration Tests															
		B O&M Reports															
		C Pipe Pressure Tests															
		D Air Emissions Analysis Test															
		SD-18 Records															
		A Permits															
		B MSDS Sheets															
		C Startup Sheets															
		D Design Calculations															
		SD-19 O&M Manuals															
		A AAS Unit															
		B SVE Unit															
		C Power and Control Panels															
		D Wiring Diagrams															
		E Startup, Operating and Shut-down Procedures															
		F Safety Precautions															
		G Failure Procedures															
		Sampling Requirements															
		SD-08 Statements															
		A Sample Logs (COCs)															
		SD-12 Field Test Reports															
		A Disposal Sample Analytical Results															
		B Monitoring Sampling Results															
		C Screening Sample Results															
		D O&M Sample Analytical Results															
		E Electronic Copy of All Analytical Results															
		F Field Data Sheets															
		SD-13 Certification															
		A Laboratory Certification															

Submittal Register

Contract Number: N62467-98-D-0995	CTO No.: 0071	CTO Title:Site Characterization for Site 1159, Outlying Landing Field Bronson	Location: NAS Pensacola, Pensacola, Florida	Contractor: CH2M HILL Constructors, Inc.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Item Number	Spec Section	Item Description	Para. Number	Approving Authority	Other Reviewers	Submittal Number	Scheduled Submission Date	CCI Review Date	CCI Disposition	CCI Transmit Date	QC Admin Received Date	QC Disposition	QC Admin Transmit Date	Contracting Officer Received	Contracting Officer Disposition	Contracting Officer Return	Remarks
		General Drilling (Well Installation), Trenching and Bac															
		SD-18 Records															
		A Boring Logs															
		B Fill Materials															
		C Well Construction Diagrams															
		SD-13 Certification															
		A Well Driller's Certification															
		B Well Driller's H&S Records															
		Transportation and Disposal															
		SD-08 Statements															
		A Treatment Facility Permit															
		SD-18 Records															
		A Shipment Manifests															
		B Delivery Certificates															
		C T&D Log															
		Asphalt and Curbing Removal and Replacement															
		SD-08 Statements															
		A Asphalt Materials															
		B Curbing materials															
		C Concrete Mix Design															
		SD-12 Field Test Reports															
		A Compaction Tests															
		B Slump Tests															
		Electrical Work															
		SD-02 Manufacturer's Catalog Data															
		A Conduit															
		B Conductors															
		C Meter Base															
		D Meter															
		SD-04 Drawings															
		A Electrical Line Diagram															
		B Control Panal															
		C Final As-Builts															
		SD-12 Field Test Reports															
		A Grounding System Test															
		B															

Submittal Register

Contract Number: N62467-98-D-0995			CTO No.: 0071			CTO Title:Site Characterization for Site 1159, Outlying Landing Field Bronson					Location: NAS Pensacola, Pensacola, Florida				Contractor: CH2M HILL Constructors, Inc.		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Item Number	**Spec Section**	**Item Description**	**Para. Number**	**Approving Authority**	**Other Reviewers**	**Submittal Number**	**Scheduled Submission Date**	**CCI Review Date**	**CCI Disposition**	**CCI Transmit Date**	**QC Admin Received Date**	**QC Disposition**	**QC Admin Transmit Date**	**Contracting Officer Received**	**Contracting Officer Disposition**	**Contracting Officer Return**	**Remarks**
		C															
		SD-19 O&M Manuals															
		A Power and Control Panals															
		B Wiring Diagrams, Control Diagrams and Control Logic															

Testing Plan and Log

CH2M HILL Constructors, Inc.

Contract Number: N62467-98-D-0995		CTO No.: 0071		CTO Title: NAS PENSACOLA, Bronson Field				Location: Pensacola, FL		
A	B	C	D	E	F	G	H	I	J	K
Spec Section and Paragraph WP Addendum 0	Test Required	Proposed Lab	Sampled By	Tested By	Test Location	Frequency	Date Test Made	Test Results	Date Results Forwarded	Remarks

CH2M HILL
Northpark 400
1000 Abernathy Road
Suite 1600
Atlanta, GA 30328
Tel 770.604.9095
Fax 770.604.9282

November 14, 2007

Mr. John Towns
CH2M HILL
1766 Sea Lark Lane
Navarre, Florida 32566

RE: Contract No. N62467-98-D-0995
Contract Task Order No. 0071
Naval Air Station (NAS) Pensacola – Pensacola, Florida
Project Quality Control Manager Letter of Appointment

Dear Mr. Towns:

Herein describes the responsibilities and authority delegated to you in your capacity as the Project QC Manager on the NAS Pensacola site, Contract Task Order (CTO) 0071 under RAC III Contract No. N62467-98-D-0995.

In this position, you assist and represent the Program QC Manager in continued implementation and enforcement of the Project QC Plans. Your primary role is to ensure all requirements of the contract are met. Consistent with this responsibility, you will: (i) implement the QC program as described in the Navy RAC contract; (ii) manage the site-specific QC requirements in accordance with the Project QC Plans; (iii) attend the coordination and mutual understanding meeting; (iv) conduct QC meetings; (v) oversee implementation of the three phases of control; (vi) perform submittal review and approval; (vii) ensure testing is performed; (viii) prepare QC certifications and documentation required in the Navy RAC Contract; and, (ix) furnish a Completion Certificate to the Contracting Officer or designated representative, upon completion of work under a contract task order , attesting that "the work has been completed, inspected, and tested, and is in compliance with the contract."

Your responsibilities further include identifying and reporting quality problems, rejecting nonconforming materials, initiating corrective actions, and recommending solutions for nonconforming activities.

You have the authority to control or stop further processing, delivery, or installation activities until satisfactory disposition and implementation of corrective actions are achieved. You have the authority to direct the correction of non-conforming work. All work requiring corrective action will be documented on daily reports, and, in the event non-conforming work is not immediately corrected you are required to submit a non-conformance report to the PM and copy the Program QC Manager. A status log will be kept of all non-conforming work. You shall immediately notify the Program QC Manager in the event of any stop work order.

It is imperative that you comply with all terms of the basic contract. In particular, Section C, Paragraph 6.5.2, which states:

> *"No work or testing may be performed unless the QC Program Manager or Project QC Manager is on the work site."*

In the event that you are not able to be at the work site when work or testing is to be performed, it is your responsibility to inform the Program QC Manager and Project Manager, in advance, so that other arrangements can be made.

Further, if you are requested to perform the duties of the Site Supervisor, it is your responsibility to inform the Program QC Manager so that approval can be obtained in advance from the Contracting Officer or designated representative, in accordance with Section C Paragraph.6.2.1of the contract.

You are a key member of the Project Manager's team. You ensure that work meets the specific requirements and intent of the work plan, the Navy's scope of work and the basic contract. Should you have any questions regarding this role, you should immediately contact the Program QC Manager, Theresa Rojas. Your day-to-day activities on the site should be coordinated with all site personnel and the Project Manager. In event of any deficient items, the Superintendent and Project Manager should be advised immediately so they have opportunity to remedy the situation.

Sincerely,

CH2M HILL Constructors, Inc.

Michael Halil
Deputy Program Manager

cc: Eric Burrell/ATL
Greg Wilfley/ATL
Project File No. 266690

CH2M HILL
Northpark 400
1000 Abernathy Road
Suite 1600
Atlanta, GA 30328
Tel 770.604.9095
Fax 770.604.9282

November 14, 2007

Mr. Chad Diamond
CH2M HILL
1766 Sea Lark Lane
Navarre, Florida 32566

RE: Contract No. N62467-98-D-0995
Contract Task Order No. 0071
Naval Air Station (NAS) Pensacola – Pensacola, Florida
Alternate Project Quality Control Manager Letter of Appointment

Dear Mr. Diamond:

Herein describes the responsibilities and authority delegated to you in your capacity as the alternate Project QC Manager on the NAS Pensacola, Contract Task Order (CTO) 0071 under RAC Contract No. N62467-98-D-0995.

In this position, you assist and represent the Project QC Manager in the event that he is not on the project site and the Program QC Manager in continued implementation and enforcement of the Project QC Plans. Your primary role is to ensure all requirements of the contract are met. Consistent with this responsibility, you will: (i) implement the QC program as described in the Navy RAC contract; (ii) manage the site-specific QC requirements in accordance with the Project QC Plans; (iii) attend the coordination and mutual understanding meeting; (iv) conduct QC meetings; (v) oversee implementation of the three phases of control; (vi) perform submittal review and approval; (vii) ensure testing is performed; , (viii) prepare QC certifications and documentation required in the Navy RAC Contract; and, (ix) furnish a Completion Certificate to the Contracting Officer or designated representative, upon completion of work under a contract task order , attesting that "the work has been completed, inspected, and tested, and is in compliance with the contract."

Your responsibilities further include identifying and reporting quality problems, rejecting nonconforming materials, initiating corrective actions, and recommending solutions for nonconforming activities.

You have the authority to control or stop further processing, delivery, or installation activities until satisfactory disposition and implementation of corrective actions are achieved. You have the authority to direct the correction of non-conforming work. All work requiring corrective action will be documented on daily reports, and, in the event non-conforming work is not immediately corrected you are required to submit a non-conformance report to the PM and copy the Program QC Manager. A status log will be kept of all non-conforming work. You shall immediately notify the Program QC Manager in the event of any stop work order.

It is imperative that you comply with all terms of the basic contract. In particular, Section C, Paragraph 6.5.2, which states:

> *"No work or testing may be performed unless the QC Program Manager or Project QC Manager is on the work site."*

In the event that you are not able to be at the work site when work or testing is to be performed, it is your responsibility to inform the Program QC Manager and Project Manager, in advance, so that other arrangements can be made.

Further, if you are requested to perform the duties of the Site Supervisor, it is your responsibility to inform the Program QC Manager so that approval can be obtained in advance from the Contracting Officer or designated representative, in accordance with Section C Paragraph.6.2.1of the contract.

You are a key member of the Project Manager's team and ensure that work meets the specific requirements and intent of the work plan, the Navy's scope of work and the basic contract. Should you have any questions regarding this role, you should immediately contact the Program QC Manager, Theresa Rojas. Your day-to-day activities on the site should be coordinated with all site personnel and the Project Manager. In event of any deficient items, the Superintendent and Project Manager should be advised immediately so they have opportunity to remedy the situation.

You may be assigned other responsibilities concurrent with this assignment. Regardless of other responsibilities assigned, you shall take your QC and safety responsibilities as primary. Any other assigned responsibilities shall be secondary to your QC and safety responsibilities.

Sincerely,

CH2M HILL Constructors, Inc.

Michael Halil
Deputy Program Manager

cc: Eric Burrell/ATL
Greg Wilfley/ATL
Project File No. 266690