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FINAL VAPOR INTRUSION INVESTIGATION SAMPLING AND ANALYSIS PLAN FOR SITE 21 INDUSTRIAL AREA ST JULIENS CREEK ANNEX CHESAPEAKE VA

08/01/2009

CH2M HILL

Final

Site 21—Industrial Area Vapor Intrusion Investigation Sampling and Analysis Plan

St. Juliens Creek Annex
Chesapeake, Virginia

Prepared for

Department of the Navy

Naval Facilities Engineering Command
Mid-Atlantic

Contract No. N62470-02-D-3052
CTO-0057

August 2009

Prepared by

CH2MHILL

SAP Worksheet #1—Title and Approval Page

Final

Site 21—Industrial Area Vapor Intrusion Investigation Sampling and Analysis Plan

St. Juliens Creek Annex
Chesapeake, Virginia

Contract Task Order 057

August 2009

Prepared for:

Department of the Navy
Naval Facilities Engineering Command
Atlantic

Under the

NAVFAC CLEAN III Program
Contract N62470-02-D-3052

Prepared by:

CH2MHILL

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Review Signatures:

Paul Favara, P.E./CH2M HILL – Activity Quality Manager/Date

Loren Lund/CH2M HILL – Senior Technical Consultant/Date

Approval Signatures:

Sherri Eng/NAVFAC Atlantic – Chemist/Quality Assurance Officer/Date

Other Approval Signatures:

Walt Bell, P.E./NAVFAC Mid-Atlantic – Remedial Project Manager

John Burchette/USEPA Region 3 – Remedial Project Manager

Karen Doran/VDEQ – Remedial Project Manager

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Executive Summary

This Sampling and Analysis Plan (SAP) presents the technical approach for the vapor intrusion investigation to be conducted by CH2M HILL at Environmental Restoration Program (ERP) Site 21 – Industrial Area, at St. Juliens Creek Annex (SJCA), Chesapeake, Virginia. This investigation is being conducted for Department of the Navy (Navy), Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, under the Comprehensive Long-term Environmental Action – Navy (CLEAN) III Program in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986, and, to the extent practicable, the National Oil and Hazardous Substances Contingency Plan.

This SAP has been completed under contract number N62470-02-D-3052, Contract Task Order 057, in accordance with the Navy's Uniform Federal Policy Sampling and Analysis Plan (UFP-SAP) policy guidance to ensure that environmental data collected are scientifically sound, of known and documented quality, and suitable for intended purposes. The objectives and technical approach included in this SAP were jointly scoped by the SJCA Tier I Partnering Team, which includes representatives from the Navy, United States Environmental Protection Agency (USEPA) Region III, and Virginia Department of Environmental Quality (VDEQ). This SAP supplements the *Final Master Project Plans for St. Juliens Creek Annex, Chesapeake, Virginia,* which addresses the protocols and standard operating procedures (SOPs) to be used for all investigations (CH2M HILL, 2003).

The laboratory information cited in this work plan is specific to Test America Laboratories (TAL) in Knoxville, Tennessee.[1] If additional laboratory services are requested requiring modification to the existing SAP, revised SAP worksheets will be submitted to the Navy and regulatory agencies for approval.

This SAP consists of the 37 worksheets specific to the Navy's UFP-SAP guidance. All tables and figures are included following the Worksheets. Project scoping materials are provided in **Attachment A**, field SOPs are included as **Attachment B**, site-specific laboratory operating procedures are included as **Attachment C**, the Explosives Safety Submission (ESS) waiver is included as **Attachment D**, and the Navy CLEAN Data Management Plan documents are included as **Attachment E**.

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[1] http://www.testamericainc.com/

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SAP Worksheets

Figures

Attachments

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Abbreviations and Acronyms

μg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
AF	attenuation factor
AM	Activity Manager
amsl	above mean sea level
AQM	Activity Quality Manager
bgs	below ground surface
CA	corrective action
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLEAN	Comprehensive Long-term Environmental Action Navy
COC	constituent of concern
CSM	conceptual site model
CVOC	chlorinated volatile organic compound
DCA	dichloroethane
DCE	dichloroethene
DNAPL	dense non-aqueous phase liquid
DPT	direct push technology
DQI	data quality indicator
EDD	electronic data deliverable
EDS	Environmental Data Services
EIS	Environmental Information Specialist
ERP	Environmental Restoration Program
ESS	Explosive Safety Submission
ESTCP	Environmental Security Technology Certification Program
FS	feasibility study
ft	feet/foot
ft^2	square feet/foot
FTL	Field Team Leader
FY	fiscal year
GC/MS	Gas Chromatograph/Mass Spectrometer
GIS	Geographic Information System
H&S	health and safety
HASP	Health and Safety Plan
HHRA	Human Health Risk Assessment
HVAC	heating, ventilating, and air conditioning
HW	hazardous waste

ITRC	Interstate Technology and Regulatory Council
LCS	laboratory control sample
LUC	land use control
MCL	maximum contaminant level
MDL	method detection limit
MEC	munitions and explosives of concern
MPC	measurement performance criteria
MS/MSD	matrix spike/matrix spike duplicate
N/A	not applicable
NAB	Naval Amphibious Base
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NFA	No Further Action
NFESC	Naval Facilities Engineering Service Center
NIRIS	Naval Installation Restoration Information Solution
O/E	ordnance/explosives
ORP	oxidation reduction potential
PAL	project action limit
PCE	tetrachloroethene
PM	Project Manager
ppb	parts per billion
ppm	parts per million
POC	point of contact
PQO	project quality objective
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QL	Quantitation Limit
RI	Remedial Investigation
ROD	Record of Decision
RPD	relative percent difference
RPM	Remedial Project Manager
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan
SJCA	St. Juliens Creek Annex
SOP	Standard Operating Procedure
SSC	Site Safety Coordinator
TAL	Test America Laboratories
TBD	to be determined
TCE	trichloroethene
UFP-SAP	Uniform Federal Policy Sampling and Analysis Plan

USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound

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SAP Worksheet #2—SAP Identifying Information

Site Name/Number: Site 21—Industrial Area
Operable Unit: 12
Contractor Name: CH2M HILL
Contract Number: N62470-02-D-3052, Contract Task Order 057
Contract Title: Navy Comprehensive Long-term Environmental Action – Navy (CLEAN) III Program

1. This SAP was prepared in accordance with the requirements of:

Uniform Federal Policy – Quality Assurance Project Plans (USEPA, 2005)

United States Environmental Protection Agency (USEPA) *Guidance for Quality Assurance Project Plans (QAPPs)*

USEPA QA/G-5, QAMS (USEPA, 2002)

USEPA *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA, 2006).

2. Identify regulatory program:

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

3. This SAP is specific to:

The St. Juliens Creek Annex (SJCA) Site 21 Vapor Intrusion Investigation

4. List dates of scoping sessions that were held:

Scoping Session	Date
SJCA Tier I Partnering Meeting	May 2008
SJCA Tier I Partnering Meeting	June 2008
SJCA Tier I Partnering Meeting	July 2008
SJCA/Naval Amphibious Base Little Creek Vapor Intrusion Partnering Meeting	November 2008
SJCA Tier I Partnering Meeting	November 2008
SJCA Tier I Partnering Meeting	February 2009

5. List dates and titles of any SAP documents written for previous site work that are relevant to the current investigation:

Title	Date
Final Work Plan for Additional Groundwater Delineation Activities at Site 21, St. Juliens Creek Annex, Chesapeake, Virginia.	August 2005
Addendum to Work Plan for Additional Groundwater Delineation Activities at Site 21	September 2006

6. List organizational partners (stakeholders) and connection with lead organization:

Virginia Department of Environmental Quality (VDEQ) – regulatory stakeholder

USEPA Region 3 – regulatory stakeholder

SAP Worksheet #2—SAP Identifying Information (continued)

7. Lead organization (see Worksheet #7 for detailed list of data users):

Department of the Navy – Lead Agency

8. If any required SAP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below:

All SAP elements required for this project are described herein on the 37 Uniform Federal Policy Sampling and Analysis Plan (UFP-SAP) Worksheets.

SAP Worksheet #3—Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number (Optional)	E-mail Address or Mailing Address
Walt Bell, P.E.	Remedial Project Manager (RPM)	Naval Facilities Engineering Control (NAVFAC) Mid-Atlantic	757-445-6638	walt.j.bell@navy.mil
Sherri Eng	Chemist/ Quality Assurance (QA) Officer	NAVFAC Atlantic	757-332-4366	Sherri.Eng@navy.mil
John Burchette	RPM	USEPA Region 3	215-814-3378	burchette.john@epamail.gov
Robert Stroud	RPM	USEPA Region 3	410-305-2748	stroud.robert@epamail.gov
Karen Doran	RPM	VDEQ	804-698-4594	kmdoran@deq.virginia.gov
Janna Staszak, P.E.	Activity Manager (AM) Project Manager (PM)	CH2M HILL	757-671-6256	janna.staszak@ch2m.com
Paul Favara, P.E.	Activity Quality Manager (AQM)	CH2M HILL	352-384-7067	paul.favara@ch2m.com
Loren Lund	Senior Technical Consultant	CH2M HILL	208-357-5351	loren.lund@ch2m.com
Roni Warren	Senior Human Health Risk Assessor	CH2M HILL	814-364-2454	roni.warren@ch2m.com
Adrienne Jones	UFP-SAP Primary Author	CH2M HILL	757-671-6236	adrienne.jones@ch2m.com
Megan Hilton	Project Chemist	CH2M HILL	401-619-2657	Megan.hilton@ch2m.com
Kyle Block	Project Environmental Information Specialist (EIS)	CH2M HILL	617-626-7013	kyle.block@ch2m.com
Field Team Leader (FTL)		CH2M HILL	To be determined (TBD)	TBD
Field Team Members		CH2M HILL	TBD	TBD
Terry Wasmund	PM	TAL- Knoxville	865-291-3000	Terry.wasmund@testamericainc.com
Chris Rigell	QA Officer	TAL- Knoxville	865-291-3011	Chris.Rigell@testamericainc.com

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SAP Worksheet #4—Project Personnel Sign-Off Sheet

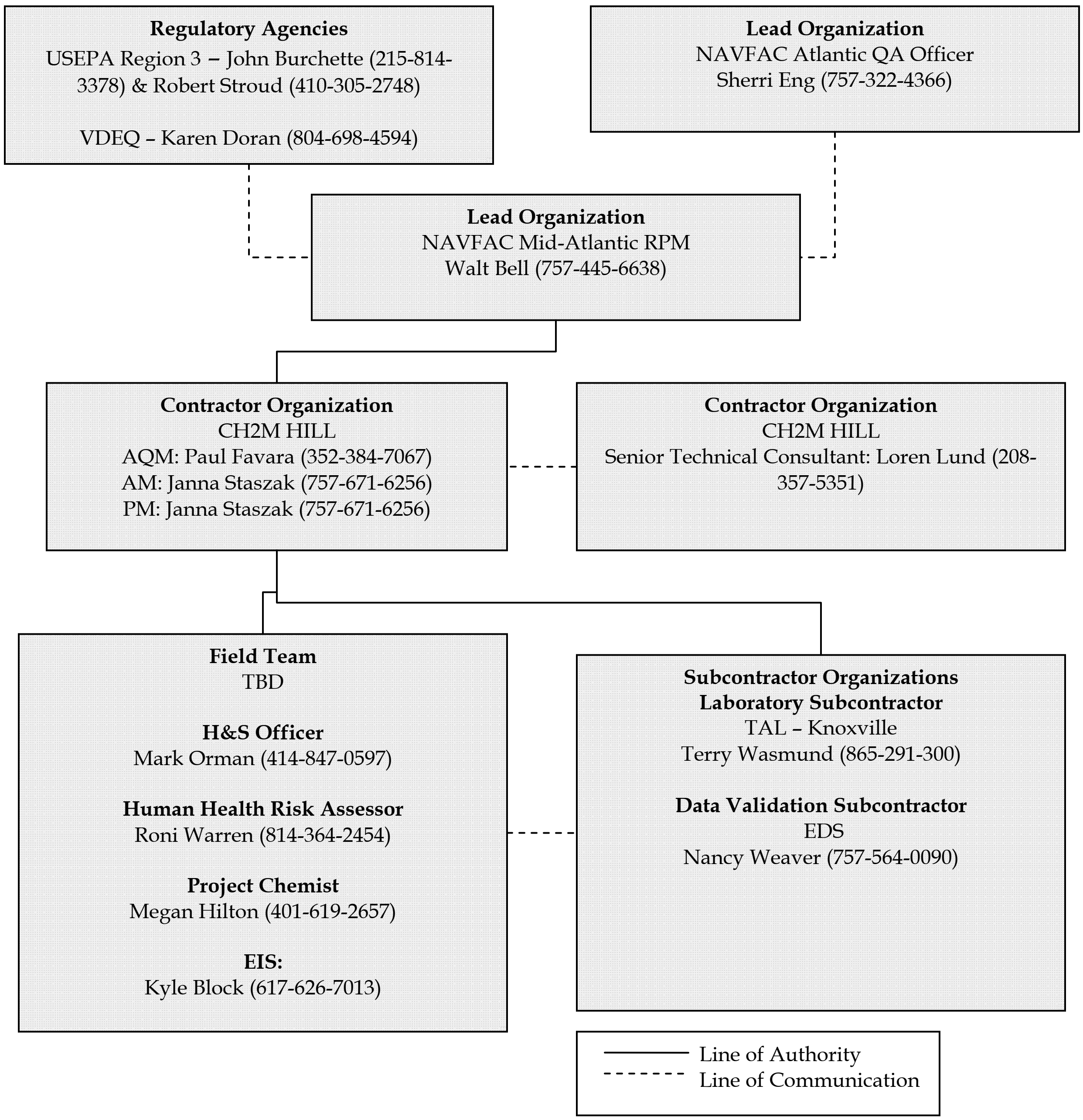
Each organization will read the SAP and provide an original copy of the sign-off sheet to the PM for maintenance in the central project file.

Name	Title/Role	Telephone Number	Signature/E-mail Receipt	Date SAP Read
TAL- Knoxville				
Terry Wasmund	TAL- Knoxville/ PM	865-291-3000		
Chris Rigell	TAL- Knoxville/ QA Officer	865-291-3011		
Bryan Dameron	TAL- Knoxville/ Sample Login, Receipt, Custody	865-291-3000		
Ryan Henry	TAL- Knoxville/ Sample Disposal	865-291-3000		
David Flores	TAL- Knoxville/ Sample Prep (TO 15)	865-291-3000		
Holly Taj	TAL- Knoxville/ Sample Analysis (TO 15)	865-291-3000		
Scot Goss	TAL- Knoxville/ Sample Analysis (8260B)	865-291-3000		
David Wiles	TAL- Knoxville/ Volatiles Department Manager	865-291-3000		
Anna Barlozhetskaya	TAL- Knoxville/ Sample Prep (8260B)	865-291-3000		
Environmental Data Services (EDS)				
Nancy Weaver	PM	757-564-0090		
Navy				
Walt Bell, P.E.	RPM	757-445-6638		
CH2M HILL				
Janna Staszak, P.E.	AM PM	757-671-6256		

SAP Worksheet #4—Project Personnel Sign-Off Sheet (continued)

Name	Title/Role	Telephone Number	Signature/E-mail Receipt	Date SAP Read
Paul Favara, P.E.	AQM Navy CLEAN Program UFP-SAP Reviewer	352-384-7067		
Anita Dodson	Navy CLEAN Program Chemist	757-671-6218		
Loren Lund	Senior Technical Consultant	208-357-5351		
Roni Warren	Senior Human Health Risk Assessor	814-364-2454		
Megan Hilton	Project Chemist	401-619-2657		
Kyle Block	EIS	617-626-7013		
FTL/Site Safety Coordinator (SSC)		TBD		
Field Team Members		TBD		

SAP Worksheet #5—Project Organizational Chart



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SAP Worksheet #6—Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Phone Number	Procedure
Communication with Navy (lead agency)	RPM	Walt Bell	757-445-6638	Primary point of contact (POC) for Navy; can delegate communication to other internal or external points of contact. Any issue that may impact project work should be reported to Walt immediately.
Communication with USEPA (regulatory agency)	RPM	John Burchette	215-814-3378	Primary POC for USEPA; can delegate communication to other internal or external points of contact. Upon notification of field changes, USEPA will have 24 hrs to approve or comment on the field changes.
	RPM	Robert Stroud	410-305-2748	
Communication with VDEQ (regulatory agency)	RPM	Karen Doran	804-698-4594	Primary POC for VDEQ; can delegate communication to other internal or external points of contact. Upon notification of field changes, VDEQ will have 24 hrs to approve or comment on the field changes.
Oversight of Environmental Restoration Program (ERP) implementation	AM	Janna Staszak	757-671-6256	Primary POC for stakeholder and agency managers; can delegate communication to other contract staff as appropriate. Issues reported to the Navy RPM immediately and followed up in writing within 2 business days.
Management of ERP Implementation	PM			Primary modes of communication are phone, email, letter, document submittal; timing dependent on nature of communication and predefined schedules as applicable and as requested by stakeholder agencies. All information and materials about the project will be forwarded to the AM on a daily basis.
Technical communications for UFP-SAP implementation, data interpretation	Senior Human Health Risk Assessor	Roni Warren	814-364-2454	Contact senior human health risk assessor regarding questions/issues encountered in the field, input on data interpretation, as needed. Senior human health risk assessor will have 24 hrs to respond to technical field questions as necessary. Responses will be communicated to the PM via email or phone.
Technical communications for project implementation, and data interpretation	AQM	Paul Favara	352-384-7067	Contact AQM regarding questions/issues encountered in the field, input on data interpretation, as needed. AQM will have 24 hrs to respond to technical field questions as necessary. Responses will be communicated to the PM via email or phone.
Technical communications for project implementation, and data interpretation	Senior Technical Consultant	Loren Lund	208-357-5351	Contact senior technical consultant regarding questions/issues related to vapor intrusion sampling and data interpretation, as needed. Senior technical consultant will have 24 hrs to respond to technical field questions as necessary. Responses will be communicated to the PM via email or phone.
Health and Safety (H&S)	SSC	TBD		Responsible for the adherence of team members to the site safety requirements described in the H&S Plan. Will report H&S incidents and near losses to PM.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number	Procedure
SAP Field Changes	FTL	TBD		Notify the PM by phone and email of changes to the SAP made in the field and the reasons within 24 hours. Documentation of deviations from the work plan will be kept in the field logbook; deviations made only with the approval of the contractor PM.
Data Tracking from collection through upload to database	EIS	Kyle Block	617-626-7013	EIS will track data from sample collection through upload to the database ensuring Work Plan requirements are met by laboratory and field staff. EIS will act as main POC for laboratory QA officer. Lab issues will be reported to the PM and project chemist within 4 hrs.
Field Corrective Action (CA)	FTL	TBD		The need for CA for field and analytical issues will be determined by the FTL and/or senior ecological risk assessor and senior consultant. The Sr. support will ensure SAP requirements are met by field staff. The FTL will notify the PM of any needed field CAs. The PM will have 24 hrs to respond to the request for field CA.
Analytical CAs	Project Chemist	Megan Hilton	401-619-2657	The need for CA by the analytical laboratory will be determined by the project chemist. The project chemist will ensure SAP requirements are met by the laboratory.
Reporting Lab Data Quality Issues	Laboratory PM	Terry Wasmund	865-291-3000	All QA/Quality Control (QC) issues with project field samples will be reported within 2 days to the project chemist (Megan Hilton) by the laboratory.
Reporting Data Quality Issues	Data Validator	Nancy Weaver		The data validator reviews and qualifies analytical data as necessary. The data along with a validation narrative are returned to the CH2M HILL EIS within 14 calendar days.

SAP Worksheet #7—Personnel Responsibilities and Qualifications Table

Name	Title/Role	Organizational Affiliation	Responsibilities
Walt Bell, P.E.	RPM	NAVFAC Mid-Atlantic	Coordinates the work of Navy resources to accomplish ERP goals and policies at SJCA
Janna Staszak, P.E.	AM	CH2M HILL	Oversees ERP activities at SJCA
	PM		Manages project; directs and oversees project staff
Paul Favara, P.E.	AQM	CH2M HILL	Provides senior technical support for overall project
	Navy CLEAN Program UFP-SAP Reviewer		Provides program-level review of UFP-SAP
Roni Warren	Senior Human Health Risk Assessor	CH2M HILL	Evaluate and document potential human health constituents of concern (COCs)
Loren Lund	Senior Technical Consultant	CH2M HILL	Provides senior technical support for vapor intrusion activities
Anita Dodson	Navy CLEAN Program Chemist	CH2M HILL	Provides program-level review of UFP-SAP
Megan Hilton	Project Chemist	CH2M HILL	Preparation of chemistry specific UFP-SAP worksheets. Ensure proper data tracking, reporting, and maintaining communication with EIS. Responsible for coordination of laboratory deliverables.
Kyle Block	EIS	CH2M HILL	Data Management: manages sample tracking, communicates with laboratory and data validator
FTL		CH2M HILL	Coordinates all field activities and sampling; tracks, stores, and retrieves all laboratory and field supplies
Mark Orman	H&S Officer	CH2M HILL	Prepares H&S Plan; manages H&S for all field activities
SSC		CH2M HILL	Oversees H&S for all field activities
Terry Wasmund	Laboratory PM	TAL-Knoxville	Manages samples tracking and maintains communication with project chemist and EIS
Chris Rigell	Laboratory QA Officer	TAL-Knoxville	Responsible for audits, CA, checks of QA performance within the laboratory
Nancy Weaver	Data Validator PM	EDS	Validate data received from laboratory prior to data use

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SAP Worksheet #8—Special Personnel Training Requirements Table

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records / Certificates
Site 21 Environmental Field Work	Hazwoper 40-hour training or 8-hour annual refresher, as appropriate	Registered training organization	Agency- and contractor-specific	FTL (TBD), field team members (TBD), SSC (TBD); Navy and regulatory agency representatives	Field team members and SSCs from CH2M HILL; onsite visitors from Navy and regulatory agencies	Contractor, Navy, or regulatory agency human resources department.
Site 21 Environmental Field Work	SSC – Hazardous Waste (HW)	Registered training organization	Agency specific	SSC	SSC from CH2M HILL	Contractor human resources department.
Site 21 Intrusive Environmental Field Work	Ordnance/ Explosives (O/E) Awareness Training	CH2M HILL UXO Technician	Prior to mobilization	FTL (TBD), field team members (TBD), SSC (TBD)	Field team members and SSCs from CH2M HILL	Project folder

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SAP Worksheet #9 - Project Scoping Session Participants Sheet

Several scoping sessions were conducted and are documented in the subsequent pages as follows:

- Worksheet #9-1:
  - Meeting: SJCA Tier I Partnering Meeting, Site 21 Vapor Intrusion Topic
  - Date: May 2, 2008
  - Purpose: Introduce the team to the UFP SAP process and begin scoping the Site 21 air vapor investigation.
- Worksheet #9-2:
  - Meeting: SJCA Tier I Partnering Meeting, Site 21 Vapor Intrusion Topic
  - Date: June 18, 2008
  - Purpose: Discuss and resolve the EPA and VDEQ comments on UFP SAP Worksheets 10 and 11 and the CSM, previously distributed for team review. Develop a path forward for the investigation of the vapor intrusion pathway.
- Worksheet #9-3:
  - Meeting: SJCA Tier I Partnering Meeting, Site 21 Vapor Intrusion Topic
  - Date: July 31, 2008
  - Purpose: Discuss the vapor intrusion investigation approach and come to consensus on the decision tree.
- Worksheet #9-4:
  - Meeting: Joint SJCA – Naval Amphibious Base Little Creek Joint Tier I Partnering Team Technical Meeting
  - Date: November 18, 2008
  - Purpose: Discuss the vapor intrusion decision tree (Attachment A-3) developed for SJCA Site 21 and reach consensus-based decisions on how to move forward with the vapor intrusion investigations for SJCA Site 21 and NAB Little Creek Site 11a.
- Worksheet #9-5:
  - Meeting: SJCA Tier I Partnering Meeting, Site 21 Vapor Intrusion Topic
  - Date: November 19, 2008
  - Purpose: Rework the decision tree and Worksheets 10 and 11.
- Worksheet #9-6:
  - Meeting: SJCA Tier I Partnering Meeting, Site 21 Vapor Intrusion Topic
  - Date: February 3, 2009
  - Purpose: Review the Vapor Intrusion UFP SAP status, resolve comments on worksheets 10 and 11, and discuss the document schedule.

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SAP Worksheet #9-1—Project Scoping Session Participants Sheet

Project Name: Site 21 Vapor Intrusion Investigation **Projected Date(s) of Sampling:** August 2008 and January 2009 **PM:** Janna Staszak – CH2M HILL	**Site Name:** Site 21 – Industrial Area **Site Location:** SJCA, Chesapeake, Virginia

Date of Session: May 2, 2008

Scoping Session Purpose: Introduce the team to the UFP-SAP process and begin scoping the Site 21 air vapor investigation.

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Timothy Reisch	RPM	NAVFAC Mid-Atlantic	757-444-6890	timothy.resich@navy.mil	RPM
Walt Bell	RPM	NAVFAC Mid-Atlantic	757-445-6638	walt.j.bell@navy.mil	RPM
Josh Barber	RPM	USEPA Region 3	215-814-3393	barber.josh@epamail.epa.gov	Regulator
John Burchette	RPM	USEPA Region 3	215-814-3378	burchette.john@epa.gov	Regulator
Karen Doran	RPM	VDEQ	804-698-4594	kmdoran@deq.virginia.gov	Regulator
Kim Henderson	AM	CH2M HILL	757-671-6231	kimberly.henderson@ch2m.com	AM
Janna Staszak	PM	CH2M HILL	757-671-6256	janna.staszak@ch2m.com	PM
Sherri Eng	NAVFAC Chemist/Quality Assurance Reviewer	NAVFAC Atlantic	757-322-4366	Sherri.eng@navy.mil	Chemist

Site 21 Scoping Session

Sherri presented an introduction to the UFP-SAP. The UFP-SAP consists of 37 required elements in 37 worksheets that document and integrate all technical and quality aspects of the project throughout its life cycle (problem statement and objectives; conceptual site model [CSM]; sampling design and rationale; action levels and analytical methods; verification validation, and usability; and exit strategy). UFP-SAP is driven by EPA Office of Superfund Remediation and Technology Innovation Directive 9272.0-17, Department of Defense Procurement Policy, Office of the Chief of Naval Operations Instruction 5090.1C Chpt 29, and NAVFAC Best Management System, Deputy Under Secretary of Defense for Environmental Security Memo (April 2006).

SAP Worksheet #9-1—Project Scoping Session Participants Sheet (continued)

Sherri provided the explanation for the use of the term UFP-SAP. A QAPP documents and integrates all technical and quality aspects of the project through its life cycle. SAP = field sampling plan + QAPP. Work Plan = UFP-SAP + Health and Safety Plan (HASP). NAVFAC

does not review the HASP. UFP-SAPs are required for any Base Realignment and Closure or Environmental Restoration, Navy funded work initiated after October 1, 2007. NAVFAC has observed a cost increase of 15 to 30 percent for UFP-SAP work plans over traditional work plans. However, NAVFAC is hoping that the cost is reduced as the system becomes more developed. NAVFAC also feels the additional upfront cost is offset by savings over the life of the projects. Sherri indicated that the NAVFAC chemist review of UFP-SAPs is 21 working days, and a chemist review and signature are required. Changes resulting from the initiation of the UFP-SAP process include the document format, addition of collaborative scoping, revisions to work scope, and schedule delays. Things that remain the same as for the traditional work plans include: the authority and responsibility of RPMs stays the same, regulatory review and concurrence is still required, and the number of deliverables is the same.

Sherri explained the development process of the UFP-SAP. Use of NAVFAC BMS worksheets (as opposed to EPA worksheets) is mandatory. All worksheets must be used; those that are not completed must still be included with a statement explaining why they were not completed. Worksheets are ordered for ease of review, rather than ease of data population; therefore, teams generally don't fill them out in order. The key scoping worksheets are 9, 10, 11, and 15. The site CSM and if-then statements/decision logic should be included within these worksheets. Key project elements are systematic project planning, establishment of the environmental questions needing to be addressed, and development of the decision processes and lines of communication.

Sherri provided examples of some of the most common comments from the chemist review, including that quantitation limits are above action levels or that things are being analyzed for that are not COCs, and that Standard Operating Procedures (SOPs) are not dated within a year (NAVFAC policy requires annual updates).

Sherri indicated that Worksheets 34 through 37 are the most challenging, focusing on verification, validation, and usability. The review process is not currently providing significant comments on these sections, while the chemists learn more about these requirements and inform teams what should be included.

NAVFAC currently writes a waiver for waste characterization sampling and in other limited situations where data collected has no impact on decision for the site. Additionally, UFP-SAPs are not currently required for Munitions Response Program sites (except for the investigation of munitions constituents, for which a UFP-SAP is required).

The team discussed the upcoming investigation at Site 21.

Worksheet #10, Problem Definition. The team identified the environmental questions to be answered during the investigation:

SAP Worksheet #9-1—Project Scoping Session Participants Sheet (continued)

- Is there a complete exposure pathway from groundwater to site buildings?
- Is there unacceptable risk to building occupants?

Based on limitations in data evaluation and collection procedures because of the shallow groundwater depth, the team assumes that there is a potential pathway to evaluate site buildings.

Worksheet #11, Project Quality Objectives/Systematic Planning Process Statements. The team concluded that data would be used for comparison to background and for the evaluation of risk. Only occupied buildings would be investigated; land use controls will be implemented for the unoccupied buildings. The data will be screened against the values in the EPA guidance; therefore, an analytical method that can achieve the required reporting limits for SUMMA canister samples must be identified. The team decided that background data should be collected, and discussed the methodology for determining background (e.g., locations to collect data, number of samples). The team considered collecting background samples at the building air intakes, within the site boundary, or outside of the site boundary upwind of the site. The team decided that samples within the site boundary (e.g., near the air intakes) would actually provide reference concentrations (ambient concentrations on site) instead of background. The team decided that collection of representative samples would be valuable in determining what is entering the buildings from outside air as opposed to what is entering the buildings through the foundations via vapor intrusion. If indoor air concentrations are less than in reference outdoor samples, then the concentrations in air are not a result of vapor intrusion, but instead of outdoor air.

The team decided to collect three data sets:

Data Set	Analysis	Evaluation	Approach
Background air (upwind)	COCs	Statistical comparison	Team will allow statistician to develop.
Reference air (ambient)	COCs	Statistical comparison; will only be used for risk management	Team will allow statistician to develop.
Indoor air	COCs	Point-to-point comparison	Team decided on number (see below); locations will be field determined.

The team developed a decision tree for evaluating the data (**Attachment A-1**).

Worksheet #17, Sampling Design and Rationale. The team reviewed the worksheet and concluded the following:

- Building 54: one indoor air sample will be collected at a field-determined location, unless it is determined that SUMMA canister sample collection has a high failure rate and two co-located samples will be collected.
- Building 1556: A minimum of six indoor air samples will be collected (two in offices/break room and 4 throughout the large bay area).

SAP Worksheet #9-1—Project Scoping Session Participants Sheet (continued)

- Building 47: two indoor air samples will be collected (one in an office and one in the open area).
- Samples will be collected at locations showing the highest potential for vapor intrusion, such as sumps or cracks.
- Samples will be collected over an 8-hr duration, representative of industrial use. A land use control (LUC) to prevent residential use will be implemented.
- Two rounds of samples will be collected at a 4-month interval, potentially August and December. The locations of the samples will have to be recorded (e.g., global positioning system outdoors and measurement from building features indoors) to ensure the locations can be the same at each event.

The team decided to have a risk assessor review the sampling plan to confirm that sufficient data is being collected to perform a risk assessment, if required.

The team discussed QC data, and concluded that sufficient QC data should be collected to validate the data, as directed by the data validator. The team considered duplicate samples and was uncertain on what they would be used for. John's concern is having a check for the lab (e.g., blind duplicate). The team concluded that a performance sample may be better, if they are available for SUMMA, and will look into their availability.

Worksheet #8, Special Personnel Training Requirements Table. The team concluded that the field team should have experience with air sampling.

Worksheet #14, Summary of Project Tasks. The team identified the project tasks, which will include conducting a building survey to determine any potential sources of volatile organic compounds (VOCs) and collection of 2 rounds of air samples.

<u>Path forward</u>: Worksheets #10 and #11 and the CSM will be completed and sent to EPA and VDEQ for review. Upon EPA and VDEQ concurrence, the complete UFP-SAP will be prepared and submitted to the NAVFAC chemist for review.

SAP Worksheet #9-2—Project Scoping Session Participants Sheet

Project Name: Site 21 Vapor Intrusion Investigation **Projected Date(s) of Sampling:** December 2008 and April 2009 **PM:** Janna Staszak – CH2M HILL			**Site Name:** Site 21 – Industrial Area **Site Location:** SJCA, Chesapeake, Virginia		
Date of Session: June 18, 2008 **Scoping Session Purpose:** Discuss and resolve the EPA and VDEQ comments on UFP-SAP Worksheets 10 and 11 and the CSM. Develop a path forward for the investigation of the vapor intrusion pathway.					
Name	**Title**	**Affiliation**	**Phone #**	**E-mail Address**	**Project Role**
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Janna Staszak	PM	CH2M HILL	757-671-6256	janna.staszak@ch2m.com	PM

Site 21 Scoping Session

Overview of Discussion: The team discussed the comments received on the approach to evaluating the vapor intrusion pathway at Site 21 buildings and developed a path forward.

Tim opened the discussion by indicating that NAVFAC acknowledges that collection of indoor air samples would be representative of a snapshot in time, and not necessarily representative of long-term conditions. Therefore, NAVFAC is open to the collection of subslab vapor samples if the team could develop a method for evaluating the data.

The team discussed what subslab vapor sample results would be compared to. Because of the shallow groundwater table at Site 21, the applicability of the screening values in the vapor intrusion guidance documents is questionable. Collection of subslab vapor samples and indoor air samples concurrently could allow for development of a site-specific attenuation factor to use in determining screening values. The team will work with risk assessors to develop screening values.

John indicated that EPA supports collection of the subslab vapor sample data concurrently with indoor air data. The team discussed the number of rounds of subslab vapor data which would be sufficient, and determined that 1 round should be sufficient. John asked if

SAP Worksheet #9-2—Project Scoping Session Participants Sheet (continued)

subslab vapor samples indicate risk but indoor air samples do not, would there be a point in which indoor air would be re-evaluated? Tim indicated that the 5-year review would be a good point for re-evaluating the indoor air pathway.

The team agreed to collect subslab vapor and indoor air samples. The revised approach will be incorporated into the UFP-SAP. The team discussed Worksheets 10 and 11, including comments provided by VDEQ and EPA and the incorporation of the subslab vapor samples.

Worksheet #10:

VDEQ has no comments on this worksheet. EPA comments were discussed and responses were incorporated into the UFP-SAP pdf.

CSM: EPA requested that the floor drain depicted in Building 47 should be removed, unless it is present. Kim indicated that it may depict historical sources of contamination, as the floor drain was not observed during the building survey. Tim suggested the incorporation of an additional building survey prior to the sampling event to identify preferential pathways and collect an additional round of pressure measurements.

Worksheet #11:

The team discussed the project action levels (PALs). VDEQ (Comment #2) requested the use of 5 micrograms per cubic meter ($\mu g/m^3$) as the PAL for trichloroethene (TCE). EPA indicated that the value was within the acceptable risk range (Comment #7). The team discussed how the Regional Screening Levels (RSLs) impact the screening. The RSLs include an industrial air screening value, which addresses inhalation of air by an industrial worker, using worker exposure factors. The team decided to consult with risk assessors on the appropriate use of the RSL values. The team will also consult with risk assessors on the development of screening criteria for the subslab vapor data.

The team developed a sampling strategy and identified outstanding questions for which technical staff should be consulted:

Sample strategy:

- Reference - minimum of one outdoor air sample per building, collected within the site boundary
- Background – one outdoor air sample collected off-site and upwind
- Indoor Air – indoor air samples collected within the buildings at field-determined locations, including preferential pathways (two samples in Buildings 47, one sample in Building 54, and six in Building 1556)
- Subslab –vapor samples collected within the buildings at field-determined locations (consider one sample in Buildings 47 and 54 and 5 in Building 1556 [three around the plume, one in an interior room, one in warehouse])

SAP Worksheet #9-2—Project Scoping Session Participants Sheet (continued)

Outstanding questions:

- Can subslab vapor samples be collected from underneath buildings where there is a shallow water table (e.g., less than 5 ft)?
- How far do subslab vapor samples need to be collected away from the walls?

  Action Kim/Janna – Determine if there is a minimum distance from the building edge where subslab vapor samples can effectively be collected.

- How will the data be evaluated for risk? Will a risk screening be conducted on the subslab vapor and indoor air data? How will natural attenuation factors be developed based on the subslab and indoor air data? Will a direct estimate of risk be calculated for both a worker exposure and potential future resident exposure?

Path Forward: CH2M HILL will revise the UFP-SAP Worksheets 10 and 11 and the decision tree based on the comments received and partnering discussion and resubmit for team review by July 3.

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SAP Worksheet #9-3—Project Scoping Session Participants Sheet

Project Name: Site 21 Vapor Intrusion Investigation **Projected Date(s) of Sampling:** April 2009 and August 2009 **PM:** Janna Staszak – CH2M HILL	**Site Name:** Site 21 – Industrial Area **Site Location:** SJCA, Chesapeake, Virginia

Date of Session: July 31, 2008

Scoping Session Purpose: Discuss the vapor intrusion investigation approach and come to consensus on the decision tree.

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Timothy Reisch	RPM	NAVFAC Mid-Atlantic	757-444-6890	timothy.resich@navy.mil	RPM
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Loren Lund	Senior Vapor Intrusion Technologist	CH2M HILL	208-357-5351	loren.lund@ch2m.com	Vapor Intrusion Technologist

Site 21 Scoping Session

Overview of Discussion: Tim updated the team on NAVFAC's approach for vapor intrusion investigation. While the SJCA team was developing an approach for Site 21, the Naval Amphibious Base (NAB) Little Creek team was also developing a vapor intrusion investigation work plan. In working with both teams, Tim realized that the teams were each taking different approaches. Therefore, NAVFAC is attempting to develop a consistent approach for addressing sites across the region. John indicated that by creating the decision tree with the level of detail that NAVFAC is planning, the decision tree will need to be reviewed by EPA technical experts.

The key difference in the revised approach for Site 21 is that it relies more heavily on subslab vapor data than indoor air data. Loren presented the revised decision tree (**Attachment A-2**). He explained that the screening levels are the EPA RSLs adjusted by a factor of 10, based on the attenuation factor from the 2002 USEPA guidance that a maximum of 10 percent of subslab vapor concentrations migrate to indoor air. He indicated that there have been several case studies that show that the actual amount of attenuation is much lower. Karen indicated that the use of the attenuation factor of 0.1 seems reasonable, but that she will have to run it by the VDEQ risk assessor.

Loren discussed the spatial and temporal variability of subslab vapor data versus the variability of indoor air data. Environmental Security Technology Certification Program

SAP Worksheet #9-3—Project Scoping Session Participants Sheet (continued)

(ESTCP) has published a study to evaluate the variability. The study concluded that the indoor air data does not vary much either spatially (room to room) or temporally (season to season). However, the subslab vapor data varied considerably. Therefore, collection of multiple rounds of subslab vapor data is more useful than multiple rounds of indoor air data.

Action Janna – Distribute copy of ESTCP study evaluating the spatial and temporal variability of indoor air and subslab vapor data to the team.

Loren indicated that a factor of 10 is proposed for defining significance when comparing indoor air concentrations to ambient air concentrations and subslab vapor concentrations to indoor air concentrations. John asked what the source of the factor of 10 for defining significance is. Loren started by discussing indoor air concentrations versus outdoor air concentrations: New York vapor intrusion guidance, Appendix C, compiles a number of studies (2003 department of health vapor intrusion study, EPA 2001 Building assessment and database, 1997 New York, 1988 EPA Ambient Air Study, 2005 National Health Institute Study). Loren pulled out three common indicators (benzene, tetrachloroethene [PCE], and TCE) and compared the indoor air to outdoor air concentration. The studies indicated a 2 to 4 times higher concentration in indoor air than outdoor air in background conditions (no sub-surface source). The reason is likely that even though you exchange your indoor air for outdoor, you have pockets where you don't get true mixing and your volatiles accumulate. Loren also discussed the ESTCP study, which looked at the spatial and temporal variability of 2 to 3 times. Therefore, a factor of 10 is reasonable for indicating a significant difference. Loren also discussed the significant difference between indoor air and subslab vapor. The basis is similar to indoor/outdoor air. The EPA database indicates worst case of 10 percent of subslab concentrations reach indoor air.

The team discussed the placement of the human health risk assessment (HHRA) in the decision tree. The multiple lines of evidence have been incorporated earlier in the decision tree to determine whether or not a pathway is actually present. Vapor intrusion is different than HHRA with other media, where it is clear if there is or is not a pathway present.

The team discussed the use of the background data. The background data will be factored into the multiple lines of evidence approach. It seems most appropriate for consideration down the road if mitigation is necessary. John asked if it was necessary to collect the data. Loren and Walt indicated they would prefer to collect the data for comparison.

Tim indicated he would like the team to consider proceeding with Feasibility Study (FS) and Record of Decision (ROD) for groundwater. If it is determined that vapor intrusion is a problem, the team could amend Remedial Investigation (RI), FS, and ROD, or address the changes through an explanation of significant differences for the ROD.

Action team – Look into ROD guidance to determine if a ROD will be possible if vapor intrusion is still being assessed. Consider an interim ROD.

Path Forward: CH2M HILL will revise UFP-SAP worksheets 10 and 11 and the decision tree based on the discussion and distribute to the team by August 8.

SAP Worksheet #9-4—Project Scoping Session Participants Sheet

Project Name: Site 21 Vapor Intrusion Investigation **Projected Date(s) of Sampling:** Spring and Fall 2009 **PM:** Janna Staszak – CH2M HILL	**Site Name:** Site 21 – Industrial Area **Site Location:** SJCA, Chesapeake, Virginia
Date of Session: November 18, 2008 **Scoping Session Purpose**: Reach consensus-based decisions on how to move forward with the vapor intrusion investigations for SJCA Site 21 and NAB Little Creek Site 11a, focusing on the decision tree development.	

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
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SAP Worksheet #9-4—Project Scoping Session Participants Sheet (continued)

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
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Note, this was a joint SJCA – NAB Little Creek Tier I partnering teams scoping session with Tier II and technical support. Meeting minutes were prepared to capture the overall meeting discussion. However, the following has been tailored to cover the SJCA-specific discussion.

Statement from Tier II

Objectives: Tim provided a statement from Tier II to the Tier I teams regarding empowerment.

Overview of Discussion: Tim presented a message from Tier II, which had met last week to discuss this meeting. Tier II reminded the project managers of their roles and responsibilities as risk managers and passed along Tier II's support/empowerment to Tier I for making decisions during this meeting, as well as in general applications. The decisions made in the room today are not applicable to all Navy sites, Mid-Atlantic region, or even the individual facilities; they are intended to be site-specific. Tier II hopes the teams can reach consensus-based decisions on how to move forward with SJCA Site 21 and NAB Little Creek Site 11a. Tier II recognizes that the vapor intrusion process is evolving, and sites can not be force-fit into boxes. Appropriate levels of assessment must be determined on site-by-site basis. The decisions must be developed up front because the UFP-SAP requires data collected have an intended purpose. However, if the data does not make sense, the process will be re-evaluated and revised as appropriate.

Tim requested that side bar discussions are minimized to ensure everyone is listening and being heard. If a productive side bar is necessary, a time out should be called.

SAP Worksheet #9-4—Project Scoping Session Participants Sheet (continued)

Brief Site History and CSM

Objectives: Present site-specific information and the CSMs for SJCA Site 21 and NAB Little Creek Site 11a. Present site descriptions, review site history, review site characteristics, present the vapor intrusion CSMs, and discuss the site status in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process.

Overview of Discussion: Copies of the presentation were distributed. Kim and Jamie presented overviews of the SJCA and NAB Little Creek sites, respectively. Information relating to NAB Little Creek was captured in the meeting minutes but is not provided in this scoping session summary.

Kim presented an overview of SJCA Site 21. SJCA is a small facility (approximately 490 acres) in Chesapeake at the confluence of St. Juliens Creek and the Southern Branch of the Elizabeth River. Its current mission is to serve as a radar-testing facility and provide warehousing and administrative facilities for nearby naval activities. Site 21 is located in the central industrial area of SJCA. The area consists of several industrial buildings, asphalt parking areas and roads, and minimal grassy areas. TCE was historically used for degreasing operations in various buildings and reportedly disposed on railroad tracks, roads, and around buildings; there is no distinct source of contamination.

Kim reviewed the physical characteristics of Site 21. The topography is relatively flat and ranges from 7 to 9 feet (ft) above mean sea level (amsl). The water table generally ranges from 2-ft to 7-ft below ground surface (bgs). The Columbia aquifer, consisting of fine to coarse silty and clayey sands, extends to 13.5- to 20-ft bgs. Groundwater flow is estimated at 72 ft/year toward the storm sewer system, which runs south, parallel to Building 1556, toward the Site 2 inlet to St. Juliens Creek. The Columbia aquifer is underlain by the Yorktown confining unit, which is approximately 17 feet thick and comprised of relatively impermeable silt and clay.

Kim reviewed the nature and extent of the contamination at Site 21. A chlorinated volatile organic compound (CVOC) plume has been delineated in shallow groundwater extending over approximately 8-acre area. TCE, cis-1,2-dichloroethene (DCE), 1,1-DCE, and vinyl chloride have been detected above maximum contaminant levels (MCLs). The maximum TCE concentration of 16,000 parts per billion (ppb) was detected at SJS21-MW15S. Kim presented a figure depicting the TCE plume and identified the locations where the highest CVOC concentrations were detected. Loren asked what sample interval the data was collected. Kim indicated the majority of samples were collected across the screened interval, with the exception of a few depth-specific samples collected at the bottom of the aquifer. Frank asked if the wells are screened at the top of the aquifer. Kim indicated that the wells are screened at the bottom of the Columbia aquifer because the objective of previous investigations was to delineate the magnitude and extent of CVOCs, which were expected to be highest closer to the bottom of the aquifer. The wells each have a 10-ft screen, and the screens are likely below the top of the aquifer. Frank indicated if data indicates that there is a clean layer over identified, areas can be ruled out. Kim indicated that groundwater results and membrane interface probe data indicate the highest CVOC concentrations are located at the bottom of aquifer. Collection of data at the top of the

SAP Worksheet #9-4—Project Scoping Session Participants Sheet (continued)

aquifer was initially proposed to assess the vapor intrusion pathway; however, team uncertainty for usability of data using current guidance resulted in the decision to collect subslab data instead.

Kim reviewed contaminant fate and transport. The primary migration pathways of CVOCs consist of dissolved plume migration downgradient with groundwater flow (advection), groundwater discharge into the leaking storm sewer system and south toward St. Juliens Creek, and potential dense non-aqueous phase liquid (DNAPL) desorbing from the top of the Yorktown confining unit into shallow groundwater. Vapor intrusion into indoor air was identified as a potential migration pathway.

Kim indicated the team identified three buildings at Site 21 (Buildings 47, 54, and 1556) for potential vapor intrusion consideration. Kim reviewed the CSMs and building survey data for each of the three buildings. Building 47 is primarily used for storage and some mechanical work. Approximately 20 employees access the building and work 1 to 2 hours per day inside. The building is a single-story building comprised of corrugated steel exterior walls over wood, constructed on a concrete slab on-grade foundation. The interior consists mainly of open bay storage with several interior offices constructed of drywall. There is no functioning central air handling system in the building. Building 54 is a workshop for equipment maintenance in which two employees work approximately 8 hours per day. It is a single-story concrete block building, mostly open with one small interior office, constructed on a concrete slab on-grade foundation. The building does not have a functioning central air handling system; a wall-mounted exhaust fan and interior floor fan provide air circulation. Building 1556 is the Mid-Atlantic Regional Maintenance Center, where approximately 50 employees work 8 hours per day. The building is also constructed on a concrete slab on-grade foundation. The majority of the building is one story, though a second story is present at the southern end of the building. Roof-top air handling units provide ventilation for the building.

Kim reviewed the status of Site 21. The RI report was finalized in June 2008 and recommended no further action (NFA) for soil, deep groundwater, storm water, and surface water; and recommended a FS for shallow groundwater. The FS, which addresses the potable use scenario for shallow groundwater, is currently under regulatory review and should be finalized in December. The vapor intrusion pathway was recommended for further evaluation in the RI, and is not addressed within the FS. An Interim Proposed Plan and Interim ROD are scheduled for completion in fiscal year (FY) 09 to enable implementation of a groundwater remedial action.

Navy Rationale for Site-Specific Vapor Intrusion Assessment Process for SJCA Site 21

Objectives: Present the Navy rationale for development of the proposed site-specific process, presented as a decision tree (**Attachment A-3**), and the requirements of the UFP-SAP to help the team develop a consensus-based path forward.

Overview of Discussion: Dan discussed the Navy ERP position on vapor intrusion. He reviewed some general Navy policy issues to identify constraints the Navy must consider

SAP Worksheet #9-4—Project Scoping Session Participants Sheet (continued)

with regard to vapor intrusion investigation and mitigation. Overall, the Navy is required to identify sources of contamination and must focus on cleaning up sites that are related to a CERCLA release. Two Navy policies that must be considered are background policy and fiscal policy:

- Background policy: Background policy requires the Navy to identify chemicals that are in the environment due to a site-related release. They must establish background concentrations for comparison with constituents of concern (COCs) at the site. There are various ways of comparing site data to background data. For vapor intrusion, the primary considerations are outdoor air coming into the buildings and chemicals being used in indoors. Navy policy does not allow for cleanup action levels that are below background concentrations. The policy has a practical application, in particular when you develop ways to mitigate vapor intrusion (e.g., increasing the air exchange rate with outdoor air could only result in indoor air concentrations as low as those outdoor).
- Fiscal policy: Fiscal policy requires the Navy use their funding to address CERCLA issues. It is considered a mis-use of funding if funding is used for other purposes, which presents a legal concern. Dan indicated the Navy is committed to worker safer and wants to address any risk identified. However, the funding may need to come from other sources if the release is not attributed to a CERCLA release. Therefore, identification of the source(s) is a big concern for the Navy.

Loren discussed some of the technical considerations. He explained the NAVFAC's logic in the decision tree and discussed some key decision points (**Attachment A-3**). Box C (groundwater below foundation) is the first key point. Ahmet asked if there is reason to believe groundwater may not be below the building foundation. Janna responded that groundwater is very shallow in parts of the site, in particular in the vicinity of Building 54 where it has been measured at approximately 1.5 feet bgs at the closest monitoring wells. Tim indicated the groundwater is expected to be below the building foundation; however, there is a potential for groundwater to be in contact with the foundation. Because of the time associated with writing, reviewing, and receiving approval of a UFP-SAP, the team decided to include collection of groundwater samples in this work plan as a contingency to prevent further delay if the collection of soil gas samples was not possible.

Loren indicated that if the groundwater level is below the building foundation, NAVFAC proposes to collect subslab vapor samples. Collection of subslab vapor samples (Box D, **Attachment A-3**) focuses on site-related chemicals and removes the uncertainty associated with indoor air sampling (e.g., concentrations attributable to indoor air). Loren indicated that the Interstate Technology and Regulatory Council (ITRC) guidance identifies subslab soil gas sampling as the preferred approach, primarily because of the elimination of other background sources (e.g., in indoor air). NAVFAC proposes screening the subslab vapor concentrations using 0.1 as the attenuation factor. For subslab vapor, the attenuation factor (AF) is the indoor air concentration divided by the subslab vapor concentration (AF = indoor air/subslab vapor). For groundwater, the attenuation factor is the indoor air concentration divided by the groundwater concentration adjusted by Henry's Law constant

SAP Worksheet #9-4—Project Scoping Session Participants Sheet (continued)

[indoor air/(Henry's Law*groundwater)]. The 0.1 attenuation factor is a generic value from EPA 2002 guidance, which essentially assumes that the subslab vapor concentrations are 10 times higher than indoor air concentrations. The NAVFAC decision tree proposes that if the subslab vapor concentrations are less than the screening values, no action is necessary. Dr. Helen Dawson presented data at most recent EPA workshop indicating 0.1 is still protective and conservative for use as an attenuation factor. Real data has shown attenuation ranging from 1 in 10 to 1 in a million. Therefore, 0.1 is felt to be conservative and was selected to be protective of 95 percent of situations.

Loren indicated the decision tree includes a minimum of two rounds of subslab vapor samples separated by 4 months to address seasonal variability. Available data indicates subslab vapor concentrations tend to have high spatial and temporal variability, whereas indoor air concentrations tend to remain fairly constant. Paul asked if the 4-month timing is intended to be scheduled after the remedy is implemented. Tim responded the vapor intrusion evaluation will be conducted independent of the remedy.

Loren indicated that if subslab vapor concentrations exceed the industrial screening level, NAVFAC proposes collection of concurrent indoor air, subslab vapor, and ambient outdoor air (near building and upwind) samples. The results from these samples would be used to determine the contribution from the source. Loren discussed footnote 1 (**Attachment A-2**), which indicates that the multiple lines of evidence will be applied through the entire process (rather than constraining to one place in the flow chart). Loren also indicated that further down in the decision tree NAVFAC faced the challenge of determining the concentration of the indoor air resulting from subslab sources. Boxes L, M, N, and O (**Attachment A-2**) are intended to determine whether subslab vapor is the source of indoor air concentrations, or if the indoor air concentrations may be attributed to something else.

The teams discussed the collection and use of the outdoor air samples. NAVFAC proposes collection of both near building and upwind samples. Previous investigations demonstrate situations where near-building outdoor sources contributed to outdoor air. Loren distributed data from four buildings collected from another Navy facility within the last 6 months as an example for discussion (**Attachment A-3**). In the example, subslab vapor concentrations ranged from 120 to 36,000 $\mu g/m^3$. In all four cases, the indoor air concentration exceeded the screening level, but was similar to on-site outdoor air concentration and similar to the background air values provided in Appendix C of New York Guidance. The measured indoor air concentrations were within or below range of national background indoor air concentrations. The national background indoor air concentrations are two to four times higher than national background outdoor air concentrations.

Loren indicated the NAVFAC approach was developed from a practical perspective based on data that has been collected at other sites. It does not take into consideration extreme or unexpected results. The approach recognizes the natural variability in air and subslab vapor data. Boxes L, M, N, and O (**Attachment A-2**) focus on identifying and evaluating the variability. The factor of 10 used in those boxes was developed based on consideration of the national EPA database of paired indoor air and subslab vapor data.

SAP Worksheet #9-4—Project Scoping Session Participants Sheet (continued)

Regulatory Rationale for Site-Specific Vapor Intrusion Assessment Process for SJCA Site 21

Objective: Present the regulatory concerns with NAVFAC's vapor intrusion decision tree, the changes included in the regulatory decision tree, and the rationale for the changes.

Overview of Discussion: Ahmet presented the primary regulatory concerns with the left side of the NAVFAC decision tree. EPA and VDEQ generally agree with the NAVFAC approach until the point where indoor air samples are determined to be above the indoor air screening values. The main regulatory concern is the use of the factor of 10 for evaluating the indoor air, subslab vapor, and ambient air data. The basis for using a factor of 10 in the comparison is unclear to the regulatory agencies. EPA and VDEQ are concerned that the NAVFAC decision tree requires indoor air concentrations to be 10 times greater than ambient air to indicate that vapor intrusion is significant. If indoor air concentrations are less than 10 times ambient air, the NAVFAC decision tree indicates that exterior levels are contributing to the unacceptable levels in indoor air; however, EPA and VDEQ are uncertain on how subslab vapor intrusion is ruled out. Ahmet indicated that there is regulatory concern over the relationship between ambient air and indoor air concentrations, which can vary considerably depending on location (e.g., urban vs. rural). Ahmet indicated the basis for the factor of 10 is unclear and appeared somewhat arbitrary during initial regulatory review of the decision tree, though Loren's discussion during the Navy rationale presentation provided clarification. Ahmet indicated samples collected at heating, ventilating, and air conditioning (HVAC) intakes might not truly represent background air, but could be an exterior source combined with a significant contribution from vapor intrusion. Ahmet expressed a similar concern over the comparison of indoor air to subslab vapor concentrations using a factor of 10. The factor of 10 could imply that it is inherently impossible to have an attenuation factor of greater than 0.1. However, EPA and VDEQ have a concern that there could be a preferential pathway present resulting in little or no attenuation (e.g., sumps, utilities, deteriorated slab). It is possible there could be an indoor source combined with a significant contribution from subslab vapor. The regulatory agencies feel the NAVFAC decision tree may allow for an indoor air exceedance to be attributed only to an indoor air source when the exceedance results from combined indoor air and subslab sources.

Ahmet presented hypothetical data: Indoor air concentration = 59 $\mu g/m^3$, ambient air concentration = 6 $\mu g/m^3$, subslab vapor concentration = 585 $\mu g/m^3$. The indoor air concentration is less than 10 times the ambient air concentration and subslab vapor concentration is less than 10 times indoor air. According to the NAVFAC decision tree, an indoor source and an exterior source are present and therefore vapor intrusion is currently not occurring. However, in that situation, the indoor air RSL is 0.41 $\mu g/m^3$ (residential) and 2.08 $\mu g/m^3$ (industrial), and the indoor air concentrations exceed the screening values. Ahmet indicated it will be difficult for the regulators to ignore the concentrations exceeding the screening values. He acknowledged that vapor intrusion may or may not be occurring, but that it would need to be systematically addressed.

SAP Worksheet #9-4—Project Scoping Session Participants Sheet (continued)

Based on the discussion above, Ahmet identified the main changes to the left side of the regulatory decision tree (**Attachment A-4**) from the NAVFAC decision tree. The regulatory agencies removed the decision criteria associated with ambient air. The regulatory agencies also removed the decision criteria resulting in the conclusion that vapor intrusion may not be occurring if the subslab vapor concentration is greater than 10 times the indoor air concentration. The revised decision tree provides the opportunity to address ambient air issues and indoor source issues in Box 20 (characterize subslab vapor contribution to indoor air) (**Attachment A-4**) if subslab vapor concentrations are less than indoor air concentrations. Possible options for consideration of ambient air are: comparison to ambient air concentrations without the factor of 10, resampling after adjustment of the HVAC if ambient air contribution is suspected, resampling after removal of sources if an indoor air source is suspected, or use indicator compounds to determine the fraction of contaminants in indoor air coming from subslab vapor. The regulatory decision tree also includes the potential for post-remedy monitoring and 5-year monitoring if subslab vapor concentrations exceed residential screening levels.

Ahmet presented the primary regulatory concerns with the right side of the original NAVFAC version. On the right side, the regulatory agencies also have concern over the use of the factor of 10 (indoor air concentrations in comparison to ambient air concentrations). The regulatory agencies would like the right side to follow same path as left side, to the extent possible. The initial step of direct screening indoor air was thought to defeat the purpose of collecting groundwater samples. Ahmet indicated there is also regulatory concern because the right side does not lead to a quantitative human health risk assessment.

Based on the concerns identified, Ahmet presented the changes to right side (**Attachment A-4**): The regulatory agencies removed the ambient air criteria from their decision tree and added the opportunity to rule out vapor intrusion with just groundwater data using Henry's law after conversion of groundwater data to vapor phase concentrations.

Frank indicated he has not seen the studies Loren used as examples to demonstrate background indoor air concentrations tend to be 2 to 4 times background outdoor air, though Pat Flores has provided data showing surprisingly high outdoor concentrations. Frank does not discount the validity of the NAVFAC decision logic, but questions the use of the factor of 10; he indicated a factor of 2 sounds reasonable. Frank indicated the higher factors are more likely to be true only for lower concentrations (e.g., 5 $\mu g/m^3$, versus 20 $\mu g/m^3$ or 30 $\mu g/m^3$ in indoor air). Frank thinks that it is more appropriate to do a direct comparison first, then if the screening value is exceeded, sit down and look at data as a team and make a decision as to whether a factor should be considered. Frank reminded the teams that they can not make a decision to take/not take an action prior to a ROD. Frank suggested the teams consider adding boxes to outline team involvement in data evaluation. Tim indicated upfront scoping requires identification of DQOs including the identification of the questions that need to be answered and the data needed to answer those questions. Through the partnering process, if the analytical results do not make sense, it is the team's responsibility to re-evaluate the approach and path forward.

SAP Worksheet #9-4—Project Scoping Session Participants Sheet (continued)

Bruce asked Ahmet why the outdoor air to indoor air comparison was excluded from the regulatory decision tree. Ahmet indicated VDEQ removed it because the basis for the factor of 10 was unclear. To determine the source, it is VDEQ's preference to address ambient air in Box 20 (**Attachment A-4**). Dan suggested the teams focus on developing the specific considerations for Box 20 (**Attachment A-4**).

Decision Tree Focus/Areas of Disagreement

Objectives: Present the similarities and differences for each approach. Prioritize the differences for discussion and resolution.

Overview of Discussion: The meeting participants identified similarities and differences as follows:

- Loren identified Box 12 (**Attachment A-4**) as a difference (subslab concentrations orders of magnitude greater than indoor air concentrations). Frank indicated that several EPA work group members are focused on future slab degradation, and the issue will need to be addressed.
- The teams agreed the approaches are very similar for regulatory Boxes 1 through 11 (with the exception of Box 9) (**Attachment A-4**) and NAVFAC boxes A through K (**Attachment A-2**).
- Paul identified the 10-times rule as a key difference. Loren indicated the rule is based on three to five times spatial/temporal variability and two to four times background variability (outdoor to indoor variability). Therefore, Loren considers the factor of 10 as a clear indicator of vapor intrusion. A lower factor could be used, but there would be greater uncertainty when interpreting the data. Dan indicated Ahmet's concern regarding the magnitude of the data is a valid reason to consider the appropriate adjustment factor and should be further discussed.
- Loren identified the definition of "significance" as a challenge. Options to consider are point-to-point comparison with 95th percentile and statistical evaluation (e.g., central tendencies). Pat agreed significance is important. However, vapor intrusion policy relies on multiple lines of evidence, and the different relationships must be considered together.
- The teams identified the use of the multiple lines of evidence as a discussion point. Loren suggested subslab vapor, outdoor air, and ambient air should all be considered. Pat indicated she did not agree with considering Boxes L, M, N, and O (**Attachment A-2**) separately. Ahmet indicated VDEQ considers Box 20 (**Attachment A-4**) as the opportunity to incorporate the multiple lines of evidence.
- The teams identified measuring the significance of subslab vapor concentrations that are greater than indoor air concentrations in the screening step as a key difference.
- The teams identified the definition of "upwind" and the method to determine wind direction as discussion points.

SAP Worksheet #9-4—Project Scoping Session Participants Sheet (continued)

- John identified the timing for the human health risk assessment as a key difference. The NAVFAC decision tree only leads to a human health risk assessment after Box L (**Attachment A-2**). The regulatory decision tree uses Boxes 14 and 39 as "catch alls" for risk. Based on the regulatory decision tree a HHRA is completed if the evaluation proceeds to Box 11 (**Attachment A-4**).
- Ahmet identified Box 20 (**Attachment A-4**) as an opportunity to parse out other sources and evaluate risk associated with vapor intrusion. He agrees Box 20 should be before the HHRA. Tim suggested that Box 20 (**Attachment A-4**) should become a team decision point to allow the teams to determine the significance of the results and to subsequently determine if additional data collection is necessary or if a HHRA should be performed. Dan indicated NAVFAC needed the opportunity to evaluate the data and to determine the contributions to concentrations detected in indoor air.

Open Discussion on Prioritized Areas

Objectives: Refine the vapor intrusion decision tree to resolve uncommon areas based on the differences identified above.

Overview of Discussion: The meeting participants made changes to the regulatory agency decision tree to develop a joint decision tree. They began with the left side (**Attachment A-5**) and continued with the right side (**Attachment A-6**). The following items were discussed during development of the revised trees.

Loren asked if the teams will stick with the 0.1 attenuation factor for screening, or if the attenuation factor can be revised based on site-specific data collected. The teams indicated they are open to site-specific attenuation factors for consideration with the multiple lines of evidence.

Ahmet indicated the RPMs are concerned that contaminants in the plumes may be contributing contaminants to outdoor air because groundwater is shallow at these tidewater sites. Dan indicated a clean groundwater layer of 3-ft or more should be sufficient to keep groundwater contaminants from contributing to outdoor air.

Action Dan/Loren – Provide VDEQ and EPA information and reference regarding an appropriate layer of "clean" groundwater to provide a vapor intrusion barrier.

John expressed concern over potentially collecting three rounds of subslab vapor data, especially since two rounds could end up being collected within approximately 1 week. Loren indicated the paired data (subslab vapor with indoor air) is important due to temporal variability in subslab data; therefore, the samples must be collected during the same event.

The team reworked the decision tree. Everyone agreed that a minimum of two rounds of subslab vapor data is needed, collected at an interval to cover seasonal variation.

The team discussed how to characterize whether or not subslab vapor is contributing in the new green Box 13 (**Attachment A-5**). Ahmet suggested consideration of the 95th percentile

SAP Worksheet #9-4—Project Scoping Session Participants Sheet (continued)

of indoor air national background levels as a reference, with consideration of outdoor air national data base separately.

Frank indicated EPA prefers collecting paired data as the initial data collection step to determine if it is consistent with the data in Dr. Helen Dawson's data base. He would have concern and request more data if he saw data similar to the data provided by Loren in his example case (36,000 $\mu g/m^3$ and 3.3 $\mu g/m^3$). Frank indicated he would expect to see a linear correspondence of subslab vapor to indoor air concentrations. Loren indicated the difference is based on the nature of air in each situation (e.g., subslab vapor is stagnant; indoor air is mixed/moving). Frank would like consideration for the number and spacing of samples to ensure representativeness and reduce uncertainty associated with the patchy fog-nature of vapor.

The team identified lines of evidence for consideration in Box Green 13 (**Attachment A-5**):

- Tracer compounds used to develop building-specific attenuation factors (examples radon, 1,1-dichloroethene)
- Constituent ratios (comparison of constituent ratios in subslab, constituent ratios in indoor air, and constituent ratios in near building and upwind ambient air)
- Clean water at top of aquifer
- Comparison of indoor air to national background indoor air, site-specific upwind ambient and near building ambient air, and national outdoor background air (consider order of magnitude)
- Magnitude of contamination/exceedance of RSL
- Building survey information (pressure differential between building and subsurface, chemicals in building, slab/foundation condition).

Linda indicated that the screening levels are based on a risk level of 10^{-6}; the teams may want to consider screening at 10^{-4} instead.

Paul indicated he is concerned there is the potential for concentrations to have attenuated in groundwater (i.e. decreased to below the MCL) but not in the subslab vapor. Paul would like to know how to ensure subslab vapor is not a problem based on groundwater data. Pat indicated the uncertainty is the reason that VDEQ does not want to rely solely on groundwater data to make vapor intrusion decisions.

Regarding the human health risk assessment in Box 15 (**Attachment A-5**), Janna asked if the risk assessment would be performed using the total contaminant concentrations in indoor air or the concentrations determined to originate from subslab vapor intrusion. Dan and Ahmet suggest performing the risk assessment using the concentration that actually comes from subslab vapor, as identified using the multiple lines of evidence in Box 13 (**Attachment A-5**).

SAP Worksheet #9-4—Project Scoping Session Participants Sheet (continued)

Action Dan and Loren – Provide a description of what is meant by the near-building ambient air sample, why that sample will not be influenced by the plume if collected above the plume, and references to support the description.

The team moved on to the "right" side of the decision tree. Dan expressed concern over Box 30 (**Attachment A-4**), where Henry's Law is used without an attenuation factor. Henry's Law is based on equilibrium between the water and the gas. Because of the change over without the exchange rate, equilibrium would not be reached. Pat acknowledges using Henry's Law is very conservative. However, if the slab is actually wet, contaminants go straight to indoor air. Pat indicated the ITRC guidance indicates a wet slab is potentially an emergency situation. Paul suggested a step should be added after Box 28 (**Attachment A-4**) to evaluate the groundwater data. He suggested comparing the groundwater data to MCLs. Ahmet suggested the evaluation of the groundwater data be made parallel to the new left side of the decision tree. Janna indicated the left side is different because it uses subslab data to conservatively evaluate a hypothetical residential situation. For the right side, it is not as easy to screen for the residential scenario because there is no groundwater screening level for vapor intrusion and screening the indoor air concentrations from an industrial building would not be representative of a future residence. For the right side, it seems more critical to address the potential emergency situation, which is the current industrial scenario using the indoor air concentrations. If the indoor air data does not exceed the industrial screening level, then the groundwater data may be used to determine if there is potential for a future problem or for a future residence. Tim indicated NAVFAC may be willing to evaluate the industrial pathway only and implement land use controls to restrict residential development of the site if the indoor air concentrations are below the industrial screening level.

The time allotted for the topic expired before the right side of the decision tree could be resolved. The SJCA team will complete the decision tree independently during their Tier I partnering meeting and will consult with their technical consultants as necessary.

Path forward: The SJCA and NAB Little Creek Tier I Partnering Teams will revise and refine the decision tree as appropriate for each site during their individual team meetings.

SAP Worksheet #9-5—Project Scoping Session Participants Sheet

Project Name: Site 21 Vapor Intrusion Investigation **Projected Date(s) of Sampling:** Spring and Fall 2009 **PM:** Janna Staszak – CH2M HILL	**Site Name:** Site 21 – Industrial Area **Site Location:** SJCA, Chesapeake, Virginia
Date of Session: November 20, 2008 **Scoping Session Purpose:** Rework the decision tree and Worksheets 10 and 11.	

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
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Site 21 Scoping Session

Overview of Discussion: The team reviewed the left side of the version of the decision tree revised during the joint vapor intrusion meeting (**Attachment A-6**). John asked if the 0.1 attenuation factor is based on policy. Janna responded that it is. Minor revisions were made to the left side of the flowchart for clarification purposes. Janna suggested removing the screen against residential screening levels from Box 10 because indoor air in an industrial building should not be used to screen against residential indoor air RSLs. Karen was not comfortable with the revision, so the box was turned pink to indicate an area of the decision tree that the team should consult their technical support. John expressed concerns over the use of the national outdoor air background levels. Walt explained that those levels would only be used as a simple comparison to ensure concentrations detected at Site 21 make sense. Janna pointed out that the team will consider all lines of evidence together to make the decision, that the background levels alone will not be used to make a decision. Walt wanted to clarify Box 20 in order for it to be more open-ended. Box 20 was split into two boxes. The color of Box 20 was changed to green to indicate that establishing benchmarks for monitoring will be a team decision. The LUCs were separated from Box 20 into Box 21. "Subslab vapor and indoor air values" in Box 20 was changed to "monitoring program…" Box 14 was deleted because it is not needed based on the question asked in Box 13. Janna asked if it was possible to perform a HHRA using subslab vapor concentrations. John

SAP Worksheet #9-5—Project Scoping Session Participants Sheet (continued)

answered that he thinks it can be done by applying an attenuation factor of 0.1 to the subslab vapor data. The box was turned pink to indicate an area of the decision tree that the team should discuss with their technical support.

The team reviewed the right side of the decision tree (**Attachment A-7**). Minor revisions were made to the first box for consistency in sample terminology. Karen expressed that she would like the decision process on the right side to match that on the left side. Janna explained that the sides are different because the residential and industrial scenarios have to be addressed separately. On the right side, if groundwater is penetrating the slab an emergency situation is present and the current scenario needs to be addressed. Karen indicated that she would like to separate out the industrial scenario/emergency situation into its own path. The team agreed. The team discussed what lines of evidence can be used to characterize groundwater constituent of concern (COC) contributions to indoor air and refined Note 12. The team discussed use of Henry's Law. John asked what the Navy's stance is on the use of Henry's law. Kim responded that the Navy included Henry's Law in the flow chart for evaluation of future residential scenario only. Kim explained that Henry's Law should not be used for evaluating the current industrial scenario because it is extremely conservative and unrealistic. Janna suggested that one of the multiple lines of evidence that should be to taken into consideration is the groundwater ratio considering the vaporization potential for COCs. John suggested the use of a model to determine indoor air concentrations. Adrienne responded that the Navy had discussed the use of models and determined that they would not be accepted by the regulators because of the uncertainties associated with use of the Johnson and Ettinger model. The right side of the decision tree was revised without use of Henry's Law. Due to time constraints, the team did not complete the right side of the decision tree. CH2M HILL will draft the right side and distribute it to the team. The team will discuss the right side of the decision tree with their technical staff.

Path Forward: The revised decision tree (**Attachment A-8**) will be submitted to the team to review and a conference call will be held to discuss the outstanding issues**.**

SAP Worksheet #9-6—Project Scoping Session Participants Sheet

Project Name: Site 21 Vapor Intrusion Investigation **Projected Date(s) of Sampling:** Spring and Fall 2009 **PM:** Janna Staszak – CH2M HILL			**Site Name:** Site 21 – Industrial Area **Site Location:** SJCA, Chesapeake, Virginia Beach, Virginia		
Date of Session: February 3, 2009 **Scoping Session Purpose:** Review the VI UFP SAP status, resolve comments on worksheets 10 and 11, and discuss the document schedule.					
Name	**Title**	**Affiliation**	**Phone #**	**E-mail Address**	**Project Role**
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Site 21 Scoping Session

Overview of Discussion: Janna reviewed the status of the vapor intrusion UFP SAP. Handouts of the latest version of the flow chart were distributed for reference (**Attachment A-9**).

Discussion associated with the responses to EPA RPM comments:

Comment 2 - Janna explained that currently the process of tracking land use restrictions is done through the SJCA ER Program Geographic Information System (GIS), which is updated with the SMP and throughout the year as needed and provided to facility personnel. The GIS identifies areas of environmental concern and is used for planning and decision-making by facility personnel, who contact the Navy RPM when the facilities operations within an identified area may change. Walt asked Janna if the current process will be incorporated into NIRIS and Janna responded that it will but that the current process will also be maintained. Janna explained that once a remedy has been selected, LUCs will be documented in a ROD and developed in a LUC RD. John asked how LUCs have been incorporated at Site 4. Janna explained that because Site 4 has a ROD, the LUCs were incorporated into the ROD and LUC RD, which required a deed restriction and filing of a survey plat with the City of Chesapeake. John indicated that he is fine with the comment response if text is incorporated stating that LUCs will be addressed in the ROD.

Comment 5 - John indicated that he is okay with the comment response. Janna explained that an error was discovered when responding to the comment; the maximum number of

SAP Worksheet #9-6—Project Scoping Session Participants Sheet (continued)

potential sampling rounds is three, not four as indicated in Worksheet 11. Worksheet 11 will be corrected.

Discussion associated with the responses to EPA toxicologist comments:

Comment 1 - John indicated that he is okay with the comment response. Janna indicated that the associated decision tree notes will be revised to reflect the change.

Discussion associated with the response to the VDEQ comment:

Comment 1 - Janna thinks the number of sub-slab vapor samples proposed for Buildings 1556 and 47 is appropriate but an additional sample could be collected at Building 54. John agreed that it makes sense to collect two samples in the building for defensibility of the data. Jim also agreed that more than one sample is needed in Building 54 for spatial variability and that three samples would be better for statistical purposes. Janna indicated that collection of more than two samples within a building as small as Building 54 would be difficult due to the fact that samples are to be collected 10-15 ft from the building walls. Walt indicated that he is ok with collecting an additional sample. The text will be revised to incorporate collection of one additional sample (2 total samples) in Building 54.

Action Jim – Send EPA Vapor Intrusion Forum link to team

Janna reviewed the schedule. The worksheets will not be redistributed to the team separately before the entire draft SAP is distributed to the team for review. The team considered requesting an expedited review of the SAP by the Navy chemist in order to attempt to mobilize in April, and will further consider it during the schedule topic.

Path Forward: The draft UFP SAP will be submitted for Navy chemist review followed by submittal for team review.

SAP Worksheet #10—Problem Definition

Site Background

SJCA is approximately 490 acres and is situated at the confluence of St. Juliens Creek and the Southern Branch of the Elizabeth River in the City of Chesapeake, southeastern Virginia. SJCA was one of the largest ammunition depots in the United States involving wartime transfer of ammunitions to various other naval facilities. Non-ordnance operations at SJCA included degreasing operations; paint, machine, vehicle and locomotive maintenance; pest control; battery, print, and electrical shops; boiler plant, wash rack, and fire-fighter training operations; and storage of oil and chemicals.

Site 21 is located in a former industrial area in the south-central portion of SJCA (**Figure 1**). Buildings at Site 21 were historically used as machine, vehicle, and locomotive maintenance shops, electrical shops, and munitions loading facilities. Outdoor areas were used for equipment and chemical storage. The existing buildings at Site 21 are currently used for storage and maintenance activities.

A review of historical records indicated that several past practices through the industrial areas may have resulted in contaminant releases, including disposal of waste fluids (including TCE and hydraulic fluid) from degreasing and maintenance activities beside buildings, along railroad tracks, and into drainage swales. Investigations, summarized below, were conducted to determine if a contaminant release had occurred and to delineate the extent.

Investigation History

Site 21 is currently being investigated under the CERCLA procedures. Most recently, a RI was conducted in several phases between March 2005 and February 2007 at Site 21. TCE and associated degradation products (cis-1,2-DCE and vinyl chloride) were detected as a groundwater plume within the shallow groundwater beneath the site. Maximum concentrations of TCE, cis-1,2-DCE, and vinyl chloride were 16,000 micrograms per liter (µg/L), 2,600 µg/L, and 390 µg/L, respectively. 1,1-DCE was the only other CVOC detected in groundwater above regulatory standards with a maximum concentration of 11 µg/L, but much more infrequently. TCE is the most widespread contaminant within Site 21, and cis-1,2-DCE and vinyl chloride occur at generally similar monitoring wells. **Figure 2** presents the extent of the TCE plume within shallow groundwater.

As part of the RI, a baseline HHRA was conducted. Potential cancer risks and non-cancer hazard were identified associated with potable use of shallow groundwater. Additionally, potential risks to human health were identified due to industrial worker inhalation of vapors that may have potentially migrated from shallow groundwater to indoor air within the overlying buildings. Buildings 54 and 1556 were identified to have potential inhalation risks associated with possible TCE vapor migration. A FS report has been prepared to develop and evaluate remedial alternatives to prevent unacceptable risk associated with potable use of shallow groundwater at Site 21. The FS does not address the potential risk identified through inhalation of indoor air due to vapor intrusion. The results of this investigation will be incorporated into an addendum to the FS, if necessary.

SAP Worksheet #10—Problem Definition (continued)

Hydrogeology

Figure 3 presents the general CSM of Site 21, including the hydrogeology. Shallow soils beneath Site 21 are generally fine- to coarse-grained sands, silty sands, or clayey sands of the Columbia aquifer. The Columbia aquifer extends to a depth of 14 to 20 feet below ground surface and is underlain by the Yorktown confining unit. The Yorktown confining unit consists predominantly of relatively impermeable silt and clay layers interbedded with quartz sands. The Yorktown confining unit is approximately 17 feet thick beneath the site. Shallow groundwater is generally encountered from 2 to 7 feet below ground surface and flows to the southwest in the eastern portion of the site and to the southeast in the western portion of the site, towards the storm sewer system east of Building 1556.

Building Evaluation

A walk-through survey of Buildings 47, 54, and 1556 (which are the Site 21 buildings that are currently in use) was conducted in October 2007 to determine the building use, number of occupants, and general construction information.

Building 47 is a rectangular single-story building that is approximately 21,900 square feet (ft^2) with 20-ft ceilings. Low concentrations of CVOCs have been detected in the groundwater to the north, west, and south of the building. **Figure 4** presents the vapor intrusion CSM for Building 47. The building is primarily used for storage. The building foundation is concrete slab on-grade with some cracking. Building 47 has several open windows and doors, leaks through the roof, and broken windows; resulting in the building being largely open to outdoor air and neutrally pressurized relative to the outdoors. The building does not have a functioning central air handling system. Chemicals were found to be used within the building, including insecticides and common cleaners. Numerous 55-gallon drums were staged in the building and most of them were labeled as antifreeze. Other drums were not labeled.

Building 54 is a rectangular single-story building that is approximately 2,100 ft2 with 20-ft ceilings. **Figure 5** presents the vapor intrusion CSM for Building 54. Low concentrations of CVOCs have been detected in shallow groundwater around the building, indicating the CVOC plume may extend under the building. Additionally, the building is located within 50 feet of an area in which DNAPL is believed to be present at the bottom of the aquifer. The building is primarily used as a workshop in which equipment maintenance is performed. The building has a concrete slab foundation. The building does not have a central cooling system, and the door is often left open for ventilation. Chemicals used in the building were common insecticides and cleaners.

Building 1556 is a rectangular multi-level building that consists of a warehouse and office spaces. CVOCs have been detected in shallow groundwater north, east, and south of the building. Samples collected from within the building confirm the plume extends under portions of the building, with the highest concentrations located under the southeast corner. Additionally, the building is located within 70 feet of an area in which DNAPL is believed to be present at the bottom of the aquifer. **Figure 6** presents the vapor intrusion CSM for Building 1556. The building is approximately 89,000 ft^2 with 23-ft ceilings on the first floor and approximately 16,500 ft^2 with 9-ft ceilings on the second floor. The building serves as the Mid-Atlantic Regional Maintenance Center. The foundation is concrete slab on-grade with the

SAP Worksheet #10—Problem Definition (continued)

presence of several small and shallow cracks. The rooms in the building are generally ventilated by a central air handling unit located on the roof of the building. No chemicals were stored within the building.

General Problems to Address

The Site 21 RI evaluated the potential for vapor intrusion at all of the site buildings (Buildings 13, 46, 47, 54, 63, 90, and 1556) and identified the potential for human health risks related to the potential migration of CVOCs as vapors from the shallow groundwater into Buildings 54 and 1556. However, the reliability and uncertainty of the Johnson and Ettinger modeling and other lines of evidence presented in the HHRA were questioned by USEPA and VDEQ during review of the Site 21 RI report. No subslab vapor or air samples have been collected at the Site 21 buildings and there is uncertainty if CVOC vapor contamination is migrating into the site buildings. Therefore, further investigation at the occupied site buildings (47, 54, and 1556) is needed. Unoccupied buildings (Buildings 13, 46, 63, and 90) will not be investigated at this time, and land use controls prohibiting change in their current land use will be implemented.

The environmental questions to be answered during the investigation include:

- Are COCs present in subslab vapor (if groundwater levels confirm the ability to collect subslab vapor samples) at concentrations that could result in indoor air concentrations significant enough to present an unacceptable risk to building occupants?
- Are COCs present in indoor air (if collected) at concentrations that present an unacceptable risk to building occupants?
- Is there a complete and/or significant exposure pathway for contaminants present in groundwater to migrate to indoor air of site buildings?
- Is there unacceptable risk to potential future building occupants from inhalation of indoor air from migration of COC concentrations in subslab vapor?

The scope of this investigation is to assess potential vapor intrusion pathways at Site 21 and includes the following activities at the occupied buildings (Buildings 47, 54, and 1556):

- Conduct surveys at the buildings to identify current preferential pathways, record pressure measurements, and compile an inventory of chemicals used to identify the presence of other potential sources of VOC contamination.

SAP Worksheet #10—Problem Definition (continued)

- Collect samples at the buildings to determine whether or not a current vapor intrusion pathway is present, and, if identified, to evaluate whether there are unacceptable risks for building occupants.
  - Subslab vapor samples and potentially indoor air samples are planned; however, if the groundwater table is too shallow to allow for the collection of subslab vapor samples after two attempts separated by a minimum of 2 weeks, depth-specific groundwater samples will be collected at the top of the shallow aquifer adjacent to the buildings in place of subslab vapor samples.
- Collect outdoor air samples to evaluate near-building and upwind ambient conditions.

Subslab vapor sampling and potentially indoor air sampling were selected to evaluate if subslab vapor concentrations are contributing to indoor air via potential vapor intrusion pathways. Collection of indoor air samples will provide a direct measurement of exposure point concentration for use in a quantitative risk assessment, if necessary, to determine if unacceptable risk is present within the building. The subslab vapor data will assist in evaluating if contaminants in groundwater are volatilizing and producing concentrations in the subslab vapor that can migrate into indoor air and produce indoor air concentrations warranting further action (which will be fully evaluated using additional supporting lines of evidence).

Groundwater and concurrent indoor air sampling have been incorporated into this UFP SAP as a contingency measure in the event that subslab sampling is not possible due to the presence of a shallow water table. If the groundwater table is too shallow to collect subslab vapor samples, it may be due to a temporarily high water table, and the collection of subslab vapor samples will be attempted two weeks following the initial mobilization. If the water table is still too shallow to allow for the collection of subslab vapor samples at that point, groundwater and concurrent indoor air samples will be collected in accordance with the right hand side of the decision tree (Figure 7). The groundwater data will be used as one of the multiple lines of evidence for the partnering team to evaluate using professional judgment to determine whether contaminants in shallow groundwater are contributing to indoor air concentrations. This in part will be accomplished by evaluating constituent ratios between the groundwater and indoor air samples (e.g., TCE to cis-1,2-DCE concentrations in groundwater versus indoor air) to help identify potential sources (background and/or subsurface) of contaminants; taking into consideration the vaporization potential of the COCs using Henry's Law to account for differing volatilities.

The results of this investigation will be presented in an RI Addendum.

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements

- **Who will use the data?**

The data will be used by the Navy (and its contractors) and the other stakeholder agencies to ensure the site is adequately characterized and to assess potential human health risks. If appropriate, actions will be taken to provide adequate protection of human health. Engineers and scientists will evaluate the data for decision making and a chemist will evaluate laboratory data quality.

- What are the Project Action Limits (PALs)?

Subslab Vapor and Air Samples:

PALs have been established based on the regional screening levels (RSLs) for residential and industrial air, released by USEPA on September 12, 2008. PALs have not been established for cis-1,2-DCE because an inhalation toxicity value does not exist for it, and consequently an associated RSL does not exist since USEPA (2008) no longer supports route-to-route extrapolations.

The industrial indoor air PALs for the carcinogenic COCs (TCE, vinyl chloride, and 1,2-dichloroethane [DCA]) are the air RSL values. The industrial indoor air PALs for the non-carcinogenic COCs (trans-1,2-DCE; 1,1-DCE; and Freon-12) are the air RSLs adjusted by a Hazard Quotient of 0.1 (divided by 10) to account for additive effects.

The industrial and residential subslab PALs for the carcinogenic COCs are the air RSLs multiplied by 10 in order to adjust for a conservative attenuation factor of 0.1 (i.e., assumed 1 in 10 attenuation as shallow soil gas VOCs intrude into the indoor air). Refer to the USEPA (2008) Regional Screening Level technical support document for a description of the methods used to derive these risk-based screening levels. The industrial and residential subslab PALs for the non-carcinogenic COCs are the indoor air RSLs adjusted by a Hazard Quotient of 0.1 (divided by 10) to account for additive effects and multiplied by 10 in order to adjust for a conservative attenuation factor of 0.1.

The PALs are further discussed in Worksheet 15.

Constituent	Industrial Indoor Air ($\mu g/m^3$)		Industrial Subslab Vapor ($\mu g/m^3$)	Residential Subslab Vapor ($\mu g/m^3$)
TCE	6.1		61	12
Cis-1,2-DCE	An inhalation toxicity value does not exist for cis-1,2-DCE. Consequently, an associated RSL does not exist for cis-1,2-DCE since USEPA (2008) no longer supports route-to-route extrapolations. The uncertainties associated with the lack of an RSL will be addressed as part of the vapor intrusion assessment. Note that concentrations of cis-1,2-DCE would likely need to be significantly higher than the other CVOCs (e.g., trans-1,2-DCE) for this to result in a significant uncertainty.			
Trans-1,2-DCE	26		260	63
Vinyl Chloride	2.8		28	1.6

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

Constituent	Industrial Indoor Air (μg/m^3)		Industrial Subslab Vapor (μg/m^3)	Residential Subslab Vapor (μg/m^3)
1,1-DCE	88		880	210
1,2-DCA	0.47		4.7	0.94
Freon-12	88		880	210

Groundwater Samples:

PALs have not been established for groundwater samples. There is considerable uncertainty associated with the use of groundwater data alone for evaluation of the vapor intrusion pathway. USEPA 2002 provided groundwater screening values for use in vapor intrusion pathway evaluation; however, the guidance indicated that the standard values may not be applicable in cases of very shallow groundwater (e.g., less than 5 feet below ground surface). Therefore, the screening levels were not acceptable for use at Site 21 since shallow groundwater is less than 5 feet below ground surface in most areas. Currently, decision-making using groundwater data alone is discouraged by regulatory agencies. Groundwater sampling is included within this document as a contingency measure only, and if performed will be paired with indoor air sampling. The primary decision point will be comparison of the indoor air concentrations to the indoor air PALs. If the indoor air concentrations exceed the indoor air PALs, the groundwater results will be used qualitatively as one of the multiple lines of evidence when evaluating whether groundwater contaminants are contributing to contaminant concentrations in indoor air. This in part will be accomplished by evaluating constituent ratios between the groundwater and indoor air samples, taking into consideration the vaporization potential of the COCs. Therefore, detection limits will be established based on industry best practices/analytical methods. Not establishing PALs for groundwater is acceptable because the groundwater results alone will not be used to make a decision.

- **What will the data be used for?**

The data will be used to evaluate whether a complete and significant vapor intrusion pathway exists at Buildings 47, 54, and 1556. If a complete vapor intrusion pathway is present, the indoor air data will be used to determine if concentrations in indoor air attributed to vapor intrusion pose unacceptable risk to current building occupants and the subslab vapor data adjusted using attenuation factors to predict indoor air concentrations will be used to determine if concentrations in subslab vapor pose potential risk to future building occupants. If feasible and based on the magnitude of the subslab and indoor air results, a site-specific attenuation factor for existing buildings may be calculated using the data collected during the investigation (e.g., highest indoor air concentration to lowest subslab vapor concentration). The applicability of a site-specific attenuation factor will be reviewed and potentially used for a future use of current building scenario. For potential

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

future new structures, indoor air concentrations will be estimated using a conservative attenuation factor of 0.1

In addition, if necessary and appropriate, the Navy will identify and evaluate feasible mitigation measures. The decision tree for Site 21 is discussed in the if/then portion of this worksheet.

- **What types of data are needed (matrix, target analytes, analytical groups, field screening, onsite analytical or offsite laboratory techniques, sampling techniques)?**
  - Subslab vapor, air (indoor and outdoor), and/or groundwater samples will be submitted to an EPA and State certified off-site laboratory for analysis.
  - The target analytes are based on the site COCs (TCE, cis-1,2-DCE, vinyl chloride, 1,1-DCE, and Freon-12) identified in the RI. Other daughter products of TCE (trans-1,2-DCE and 1,2-DCA) will also be analyzed because the rate and controlling factors of TCE degradation in soil vapor differ compared with groundwater.
  - Subslab vapor samples, and if needed, air samples will be collected using 6-L SUMMA™ canisters equipped with flow controllers set to collect samples over a 24-hour time period.
  - Indoor-to-subslab pressure differential measurements will be collected up to 7 days before subslab vapor sample collection.
  - If necessary, depth-specific groundwater samples will be collected using a direct push technology grab sampler or from a temporary piezometer.
- **How "good" do the data need to be in order to support the environmental decision?**

The data will be of the quality necessary to provide technically sound and defensible assessments of potential risks to human receptors. A Level IV data package will be submitted by the analytical laboratory and sent to a third party data validator. Differential pressure monitoring data will be collected using an instrument that has a resolution of ±0.001 inches of water and is accurate to within ±1 percent.

Subslab vapor and air quantitation limits (QLs):

Quantitation Limits (QLs) will be selected as the laboratory's Reporting Limits (RLs), which will be less than the PALs to the extent feasible. If the QL is greater than the PAL, then the Method Detection Limit (MDL) will be taken into consideration during the risk assessment. Should there be instances where the RL is greater than the PAL, as a whole, the team will decide the appropriate action that needs to be taken, if any, and the appropriate path forward.

Groundwater QLs:

QLs will be selected as the laboratory's Reporting Limits for SW846 8260, which will meet industry standard.

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

- **How much data should be collected (number of samples for each analytical group, matrix, and concentration)?**

The amount of data collected will be based on the decision tree presented in **Figure 7**.

At least one indoor-to-subslab pressure difference measurement will be collected from each of the occupied buildings at a location near one of the proposed subslab sample locations up to 7 days prior to any subslab vapor sampling.

Initially, two subslab vapor samples will be collected at Building 47, two subslab vapor samples will be collected at Building 54, and five subslab vapor samples will be collected at Building 1556. At Building 1556, all of the subslab samples will be collected from areas of the building believed to be within the footprint of the groundwater plume. At a minimum, one of the subslab samples will be collected from within an interior office and one of the subslab samples will be collected from within the breakroom; the remaining subslab samples will be collected from within the open bay area. All subslab samples will be collected at least 10 to 15 feet from any exterior walls. The number of samples may be adjusted in the field based on observation of conditions that may be conducive to vapor intrusion.

If groundwater is too shallow and interferes or prevents subslab sampling, depth-specific groundwater samples will be collected from two locations adjacent to the buildings within the extent of the groundwater plume. To determine the sample depth, soil cores will first be collected at each sample location to identify the top of the aquifer. One groundwater sample will be collected from each location at the top of the aquifer to a maximum depth of 3 feet below the groundwater table.

Air samples will be collected based on the results of the subslab vapor samples or in the instance in which groundwater samples are collected instead of subslab vapor samples. One ambient air sample will be collected upwind of the site boundary (upwind ambient air sample) and a minimum of one ambient air sample will be collected at the air intake of each building (near-building ambient air sample) to assist in evaluating potential background ambient air influences (minimum of three total samples). Two indoor air samples will be collected in Building 47, one indoor air sample will be collected at Building 54, and six indoor air samples will be collected at Building 1556. At Building 1556, all of the indoor air samples will be collected from areas of the building believed to be within the footprint of the groundwater plume. At a minimum, one of the indoor air samples will be collected from within an interior office and one of the indoor air samples will be collected from within the breakroom; the remaining indoor air samples will be collected from within the open bay area. The number and location of samples may be adjusted in the field based on observation of conditions that may be conducive to vapor intrusion. Subslab-to-indoor air pressure differences will be measured at one central location within each building, as well as within an interior room of Building 1556 to account for different conditions between the main warehouse and the interior rooms.

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

The results of the initial sampling event will determine the total number of sampling events. A minimum of one and a maximum of three sampling events will be conducted. The decision tree for Site 21 is discussed in the if/then portion of this worksheet.

Each sample will be analyzed for TCE, cis-1,2-DCE, trans-1,2-DCE, 1,2-DCA, vinyl chloride, 1,1-DCE, and Freon-12.

- **Where, when, and how should the data be collected/generated?**

Samples will be collected at Site 21 during one to three sampling events, as described in the above section and in accordance with the decision tree (**Figure 7**). Note that the exact locations of the samples may be adjusted in the field if conditions conducive to vapor intrusion (e.g., preferential pathways) are observed. The first field event is planned to occur in August 2009. Data will be collected and generated in accordance with the procedures outlined in this UFP-SAP. Specifically, see the SOPs in **Attachments B** and **C** for more details. Prior to indoor air sampling, the windows of the buildings will be closed for a duration of 12 to 24 hours and the air handling units (if present) will be run under normal operating conditions.

- **Who will collect and generate the data? How will the data be reported?**
  - CH2M HILL field staff will collect the samples.
  - Chemical analytical data will be generated at the offsite analytical laboratory.
  - The data will be uploaded to the Naval Installation Restoration Information Solution (NIRIS) using the NIRIS Electronic Data Deliverable format. A hardcopy of the raw data will be provided.

- **How will the data be archived?**

The data will be archived in accordance with Navy Guidance. At the end of the project, archived data will be returned to the Navy.

- **List the project conditions in the form of if/then qualitative and quantitative statements.**

The results of this investigation will be used to determine whether or not further investigations or corrective action are necessary at Site 21 related to potential for significant indoor vapor intrusion. The decision tree to be used for the data evaluation during this investigation is presented in **Figure 7**.

The SJCA partnering team will be informed of results included in the decision making process throughout the investigation; however, five specific team decision points have been identified in the decision tree.

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

Box 13 or 38 identify the step in which the team will evaluate the subslab vapor or groundwater contributions to indoor air through the use of multiple lines of evidence, as outlined in Vapor Intrusion Pathway: A Practical Guideline (ITRC, 2007) to determine if significant concentrations within the building are attributed to vapor intrusion. These multiple lines of evidence consist of, but are not limited to:

- Calculation and consideration of building specific attenuation factors using available and appropriate data (e.g., tracer compounds) identified based on review of concurrent subslab vapor data, indoor air data, outdoor air data, and building survey results.
- Calculation of constituent ratios within each sample (subslab vapor, groundwater, indoor air, near-building ambient air, and upwind ambient air samples) and comparison between samples
- Evaluation of COC concentrations in groundwater samples collected from the top of the aquifer, along the perimeter of the buildings to determine vaporization potential
- Magnitude of PAL exceedances in comparison to indoor and ambient air concentrations
- Building survey results (i.e., pressure measurement results and preferential pathways)
- National indoor and outdoor air background concentrations in comparison to site-specific indoor and outdoor air data

When no significant current risk is present, Boxes 19, 34, and 43 allow the team to determine the appropriate monitoring plan needed to be protective of human health in the future based on the potential for building foundations to deteriorate or site conditions to change. This may include building inspections or additional subslab vapor, air, or groundwater sampling. The timing of the monitoring will be determined with consideration of the implementation of a groundwater remedial action and the 5-Year Review.

SAP Worksheet #12-1—Measurement Performance Criteria Table – Field QC Samples

Only parameters for which field QC samples will be collected are listed in Worksheet #12. See Worksheet #28 for laboratory QC sample information. The laboratory's performance criteria are adequate to meet the Data Quality Indicators for this project.

Matrix: Groundwater
Analytical Group: VOCs
Concentration Level: Medium

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Equipment Rinsate Blank	VOCs	One per day of sampling	Contamination/ bias	No target analytes > ½ QL	S&A
Ambient Field Blank		One per week of sampling	Contamination/ bias		S&A
Trip Blank		One per cooler to the laboratory	Contamination/ bias		S&A
Cooler Temperature Blank		One per cooler to the laboratory	Accuracy/ Representativeness	4 ± 2 °C	S
Field Duplicate		One per 10 samples per matrix	Precision	Relative Percent Difference (RPD) ≤ 25%	S&A
Matrix Spike/ Matrix Spike Duplicate (MS/MSD)		One per 20 set of field samples	Accuracy/ Bias/ Precision	See recovery limits in Worksheet #28-1a; RPD ≤ 30%	A

SAP Worksheet #12-2—Measurement Performance Criteria Table – Field QC Samples

Matrix: Air (Subslab vapor, indoor air, outdoor air)
Analytical Group: VOCs
Concentration Level: Medium

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	VOCs	One per 10 samples per matrix	Precision	RPD ≤ 35%	S&A

SAP Worksheet #13—Secondary Data Criteria and Limitations Table

Secondary Data	Data Source	Data Generator(s)	How Data Will Be Used	Limitations on Data Use
Site 21 RI Report	CH2M HILL, *Final Remedial Investigation Report for Site 21, St. Juliens Creek Annex, Chesapeake, Virginia, June 2008*	CH2M HILL with agreement from the Navy, VDEQ, and EPA collected groundwater samples	Data used to determine the proposed sample locations for the SAP.	None known

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SAP Worksheet #14—Summary of Project Tasks

Project Logistics

Field Investigation Activities

The technical approach for the proposed field activities at Site 21 is detailed below. The type of matrix that will be collected is dependent upon the depth of groundwater at the site during the investigation; therefore, all possible matrices have been included on this worksheet. A site-specific HASP will be completed prior to commencement of the field event. Applicable SOPs for project tasks outlined in this section are listed on **Worksheet #21** and provided in **Attachment B.**

- **Mobilization**
  - Following approval of the SAP, CH2M HILL will begin mobilization activities. Prior to mobilization, all field team members will review this SAP and the project-specific HASP. A field team kickoff meeting will be held prior to mobilization to ensure that personnel are familiar with the scope of field activities and safety issues. Mobilization activities include coordination with base personnel, building operators, and subcontractors, and preparation of field equipment.
  - Mobilization for the field effort includes procurement of necessary field equipment and initial transport to the site. Equipment and supplies will be brought to the site when the CH2M HILL field team mobilizes for field activities.
  - Prior to beginning any phase of work, CH2M HILL and its subcontractors will have field meetings to discuss the work items, worker responsibilities, and familiarize workers with the HASP. Prior to any intrusive activities, all appropriate approvals (i.e. site approval) will be obtained and the site will be marked for utilities. CH2M HILL will coordinate subsurface utility clearances with Miss Utility. A separate utilities subcontractor will be procured to confirm the accuracy of the utility markings. No intrusive activities will be initiated until the utility clearance has been completed.
  - Based on the site history and findings during investigations conducted to-date, there is a low probability of encountering munitions and explosives of concern (MEC). Therefore, a modification to the initial ESS waiver was submitted to Naval Ordnance Safety and Security Activity for implementation of O/E awareness training prior to the field activities and maintenance of a qualified MEC technician on-call for the duration of the project. The waiver was approved (**Attachment D**) and will be implemented. The O/E awareness training will be incorporated into the initial meetings and will involve participation by all field staff and subcontractors performing intrusive activities. The Procedures for Communicating Potential Live MEC to Navy if any suspected live MEC is encountered at SJCA is provided in **Attachment D**.

SAP Worksheet #14—Summary of Project Tasks (continued)

- **Building Surveys**
  - Building surveys will be conducted in accordance with the CH2M HILL field SOP, Conducting Building Surveys for Vapor Intrusion Evaluation (**Attachment B**).
  - Surveys will be conducted at the occupied buildings located on site, Buildings 47, 54, and 1556.
  - Building occupants will be notified of the future sampling event and will be provided instructions on appropriate actions required prior to and during sampling.
  - At least one indoor-to-subslab pressure difference measurement will be collected from each of the occupied buildings at a location near one of the proposed subslab sample locations 7 days prior to any subslab vapor sampling.
- **Subslab Vapor Sampling**
  - Subslab vapor samples will be collected in accordance with the CH2M HILL field SOP, Standard Operating Procedure for Installing Subslab Probes and Collecting Subslab Soil Gas Samples Using SUMMA Canisters (**Attachment B**).
  - Subslab soil vapor samples will be collected from a temporary sampling probe installed immediately beneath the building slab by a hammer drill.
  - The samples will be collected using 6-L SUMMA™ canisters equipped with flow controllers set to collect samples over a 24-hour time period.
- **The samples will be collected in the vadose zone above the groundwater plume, at least 10 to 15 feet from any exterior walls.**
  - The canisters will be shipped overnight to the laboratory for analysis.
  - Following sampling, the sampling probes will be removed and each hole will be filled with concrete.
- **Air Sampling**
  - Air samples will be collected in accordance with the CH2M HILL field SOP, Integrated Ambient Indoor, Outdoor, and Crawl Space Air Sampling Method for Trace VOCs Using SUMMA Canisters (**Attachment B**).
  - Prior to collection of indoor air samples, attempts will be made to close building windows for 12 to 24 hours prior to sampling.
  - Air samples will be collected using 6-L SUMMA$_{TM}$ canisters equipped with flow controllers set to collect samples over an 24-hour time period.
    - Canisters will be placed at breathing level (2 to 5 ft above the slab or ground surface) to reflect the type of air present at breathing level.

SAP Worksheet #14—Summary of Project Tasks (continued)

    - Indoor air samples will not be collected near appliances or vehicles that emit exhaust or near windows or air supplies.
    - Near-building ambient air samples will be collected in representative locations for the intakes of the building HVAC systems.
    - Upwind ambient air samples will be collected upwind of the building away from wind obstructions.
    - The canisters will be shipped overnight to the laboratory for analysis.

- **Depth-specific Grab Groundwater Sampling**
  - Direct push technology (DPT) groundwater samples will be collected in accordance with the CH2M HILL field SOP, Direct Push Groundwater Sample Collection (**Attachment B**).
  - DPT soil cores will be collected continuously at each sample location using clean, 4-ft, acetate sleeves, to the depth of the water table.
  - Soils will be logged in a field log book according to the Unified Soil Classification System (USCS). Descriptions will include grain size, USCS group symbol, color, moisture content, density, hardness, and any other relevant observations.
  - At each sample location, groundwater will be collected from the uppermost portion of the water table by advancing a stainless steel retractable screen.
    - The groundwater will be sampled directly through the screen using a peristaltic pump.
    - Water quality parameters (specific conductance, pH, turbidity, temperature, salinity, dissolved oxygen, and oxidation reduction potential [ORP]) will be measured and recorded at the time of sampling using a Horiba U-22®. Groundwater will be purged until turbidity has been reduced to the extent practical prior to sample collection.
  - Samples will be contained in laboratory-prepared, pre-preserved sample bottles and packed on ice for overnight shipment to the laboratory for analysis.
  - Following sampling, soil cores will be placed downhole and each boring will be filled with bentonite chips. At locations paved with concrete or asphalt, the top 6 in. will be patched to match the existing ground surface.

- **Sampling Equipment Decontamination**
  - All non-disposable sampling equipment will be decontaminated immediately after each use in accordance with the applicable SOPs. Heavy equipment such as DPT equipment (rods) will be steamed clean prior to each new DPT location. A decontamination pad will be set up to prevent the run off of decontamination water and to allow for easy collection of decontamination fluids.

SAP Worksheet #14—Summary of Project Tasks (continued)

- **Investigative-Derived Waste Management**
  - IDW generated during the field activities may consist of purge water (from groundwater sampling) and decontamination fluids. Aqueous IDW will be containerized in 55-gallon drums, which will be properly labeled and temporarily stored on secondary containment, at Site 2.
  - The IDW will be properly disposed of based on the results of the waste characterization by subcontractors within 90 days of generation. Disposable equipment, including personal protective equipment, poly sheeting, and paper towels, will be disposed of as solid waste. Test kit equipment will be disposed of properly.
- **Demobilization**
  - Sample locations will be surveyed.
  - Chains of custody will be reviewed to ensure that all analytical samples were collected as planned and submitted for the appropriate analysis
  - Rental equipment will be packaged and shipped for return to the appropriate vendors.

Data Management Activities

- **QA/QC**
  - See **Worksheet 20** for details on QA/QC samples.
  - Implement SOPs for field (**Attachment B**) and laboratory (**Attachment C**) activities being performed.
- **Sample Analysis and Data Validation**
  - Kyle Block, EIS, will track the samples from collection through analysis and obtain a Level IV data package from TAL-Knoxville within 28 calendar days from sample receipt. All analyses will be conducted at a laboratory that has been reviewed by Navy Facilities Engineering Service Center (NFESC) personnel (see **Worksheet 31**). A signed certificate of analysis will be provided in the narrative section of each laboratory data package. The laboratory will submit the data in hard copy and electronic format. CH2M HILL will manage the data according to the Navy CLEAN Data Management Plan (**Attachment E**).

SAP Worksheet #14—Summary of Project Tasks (continued)

- Analytical results will be validated from an analytical methodology standpoint by Environmental Data Services. The data set will be examined for consistency, anomalous results, reasonableness, and utility using professional judgment and procedures in **Worksheet 36**. The data validator will be provided with the hard copy and electronic version of the laboratory results and will add data validation qualifiers to both versions. The electronic version will be examined for completeness and accuracy and compared to the hardcopy results by Megan Hilton, project chemist, and then loaded into the CH2M HILL master database.
- Procedures for recording data, including guidelines for recording and correcting data can be found in the Navy CLEAN Data Management Plan, **Attachment E**.
- Computerized and manual procedures of data generation to final use and storage and QC checks for error detection to ensure data integrity can be found in the Navy CLEAN Data Management Plan, **Attachment E**.
- Guidance on data management steps such as data recording, data transformation, data reduction, data transfer and transmittal, data analysis, and data review can be found in the Navy CLEAN Data Management Plan, **Attachment E**.
- Procedures for data tracking, storage, archiving, retrieval and security for both electronic and hardcopy data can be found in the Navy CLEAN Data Management Plan, **Attachment E**.
- Stacy Davenport of the CH2M HILL Chantilly, VA, office coordinates archiving and retrieval of data.

- **Analytical Tasks**
  - The laboratory will maintain, test, inspect, and calibrate analytical instruments (**Worksheets #24 and #25**).
  - The laboratory will process and prepare samples for analysis.
  - The laboratory will analyze samples as shown on **Worksheet #18**.
- **Procedures for recording data, including guidelines for recording and correcting data**
  - Project Assessment/Audit (**Worksheets #31 and #32**)
  - Data Review
    - Data Validation (Worksheets #35 and #36)
    - Data Usability Assessment (Worksheet #37)

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SAP Worksheet #15-1—Reference Limits and Evaluation Table

Matrix: Groundwater
Analytical Group: VOCs

Analyte	CAS Number	Industrial Groundwater PAL (µg/L)	Residential Groundwater PAL (µg/L)	Project QL Goal[1] (µg/L)	Laboratory-specific	
					QLs (µg/L)	MDLs (µg/L)
1,1-DCE	75-35-4	NA	NA	1	1	0.036
1,2-DCA	107-06-2	NA	NA	1	1	0.043
Freon-12	75-71-8	NA	NA	2	2	0.082
TCE	79-01-6	NA	NA	1	1	0.043
Vinyl chloride	75-01-4	NA	NA	2	2	0.088
trans-1,2-DCE	156-60-5	NA	NA	1	1	0.04
cis-1,2-DCE	156-59-2	NA	NA	1	1	0.036

NA – PALs are not applicable for groundwater, see Worksheet #11 for further explanation.

[1] The project QL goals are the laboratory RLs.

SAP Worksheet #15-2—Reference Limits and Evaluation Table

Matrix: Air (Subslab Vapor)
Analytical Group: VOCs

Analyte	CAS Number	Industrial Sub-Slab Vapor PAL (µg/m³)	Residential Sub-Slab Vapor PAL (µg/m³)	Project QL Goal[1] (µg/m³)	Laboratory-specific	
					QLs (µg/m³)	MDLs (µg/m³)
1,1-DCE	75-35-4	880	210	70	0.79	0.13
1,2-DCA	107-06-2	4.7	0.94	0.31	0.81	0.19
Freon-12	75-71-8	880	210	70	0.99	0.34
TCE	79-01-6	61	12	4	1.07	0.19
Vinyl chloride	75-01-4	28	1.6	0.53	0.51	0.18
trans-1,2-DCE	156-60-5	260	63	21	0.79	0.20
cis-1,2-DCE	156-59-2	N/A[2]	N/A[2]	0.79	0.79	0.24

Refer to Worksheet #11 for a detailed discussion on development of PALs.

[1] The project QL goal is at least three times lower than the most conservative of the project action limits. In most cases, the laboratory quantitation limit is lower than the project QL goal. The exception in this case is 1,2-DCA. However, the laboratory QL is below the PAL for 1,2-DCA; therefore, the data usability will not be affected. The project QL goal for 1,2-DCA is shaded to illustrate this.

[2] An inhalation toxicity value does not exist for cis-1,2-DCE. Consequently, an associated RSL does not exist for cis-1,2-DCE since USEPA (2008) no longer supports route-to-route extrapolations. The uncertainties associated with the lack of an RSL will be addressed as part of the vapor intrusion assessment. Note that concentrations of cis-1,2-DCE would likely need to be significantly higher than the other CVOCs (e.g., trans-1,2-DCE) for this to result in a significant uncertainty. The laboratory quantitation limit will serve as the PAL and project QL goal for cis-1,2-DCE.

Shading indicates instances where the laboratory-specific QLs are greater than PALs and/or project QL goals.

SAP Worksheet #15-3—Reference Limits and Evaluation Table

Matrix: Air (Indoor and Outdoor)
Analytical Group: VOCs

Analyte	CAS Number	Industrial Indoor and Outdoor Air PAL ($\mu g/m^3$)	Project QL Goal[1] ($\mu g/m^3$)	Laboratory-specific	
				QLs ($\mu g/m^3$)	MDLs ($\mu g/m^3$)
1,1-DCE	75-35-4	88	7	0.79	0.13
1,2-DCA	107-06-2	0.47[2]	0.031	0.81	0.19
Freon-12	75-71-8	88	7	0.99	0.34
TCE	79-01-6	6.1	0.4	1.07	0.19
Vinyl chloride	75-01-4	2.8	0.053	0.51	0.18
trans-1,2-DCE	156-60-5	26	2.1	0.79	0.20
cis-1,2-DCE	156-59-2	N/A[3]	0.79	0.79	0.24

Refer to Worksheet #11 for a detailed discussion on development of PALs.

[1] The project QL goal is at least three times lower than the most conservative of the project action limits. In most cases, the laboratory QL is lower than the project QL goal. The exceptions in this case are shaded in the table above.

[2] The laboratory QL is below the PAL for all of the COCs except 1,2-DCA, which has been shaded to indicate this exception. 1,2-DCA concentrations between the QL and MDL will be considered estimated and have a “J” qualifier applied to them. Due to the uncertainty of this data, no action will be taken solely on “J” flagged 1,2-DCA results that are below the laboratory QL if no other analytes have been detected. In cases where 1,2-DCA is “J” flagged and other analytes are detected below their PAL, the team will evaluate the data on a case-by-case basis with consideration of factors such as order of magnitude of detection in relation to the PALs.

[3] An inhalation toxicity value does not exist for cis-1,2-DCE. Consequently, an associated RSL does not exist for cis-1,2-DCE since USEPA (2008) no longer supports route-to-route extrapolations. The uncertainties associated with the lack of an RSL will be addressed as part of the vapor intrusion assessment. Note that concentrations of cis-1,2-DCE would likely need to be significantly higher than the other CVOCs (e.g., trans-1,2-DCE) for this to result in a significant uncertainty. The laboratory quantitation limit will serve as the PAL and project QL goal for cis-1,2-DCE.

Shading indicates instances where the laboratory-specific QLs are greater than PALs and/or project QL goals.

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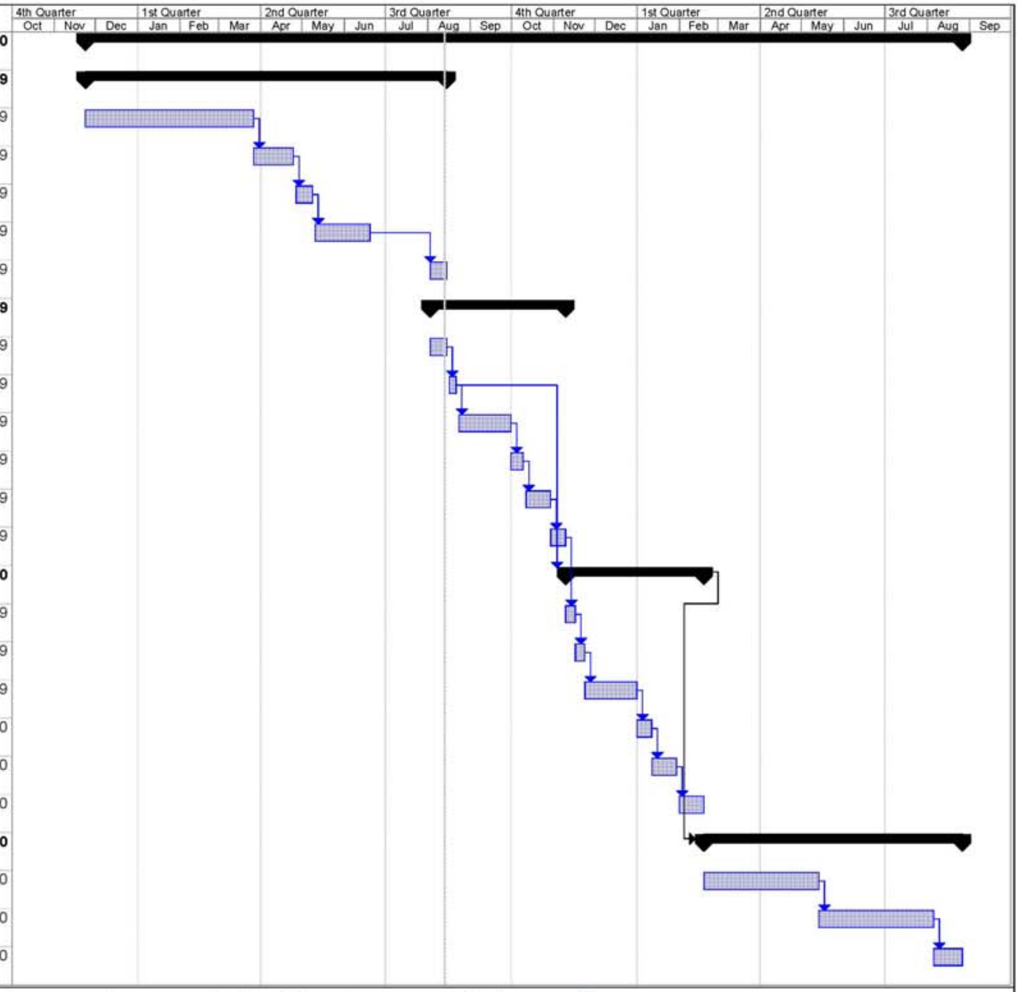
SAP Worksheet #16—Project Schedule/Timeline Table

ID	Task Name	Duration	Start	Finish
1	**Site 21 Vapor Intrusion Investigation Schedule**	**459 days**	**Mon 11/24/08**	**Thu 8/26/10**
2	**Vapor Intrusion Work Plan**	**190 days**	**Mon 11/24/08**	**Fri 8/14/09**
3	Pre-Draft UFP SAP Work Plan	89 days	Mon 11/24/08	Thu 3/26/09
4	Navy Comment Period	21 days	Fri 3/27/09	Fri 4/24/09
5	Draft UFP SAP Work Plan	10 days	Mon 4/27/09	Fri 5/8/09
6	Regulatory Comment Period	30 days	Mon 5/11/09	Fri 6/19/09
7	Final UFP SAP Work Plan	10 days	Mon 8/3/09	Fri 8/14/09
8	**Vapor Intrusion Investigation - Round 1**	**71 days**	**Mon 8/3/09**	**Mon 11/9/09**
9	Preparation	10 days	Mon 8/3/09	Fri 8/14/09
10	Investigaton Completion	5 days	Mon 8/17/09	Fri 8/21/09
11	Data Analysis	28 days	Mon 8/24/09	Wed 9/30/09
12	Data QC	7 days	Thu 10/1/09	Fri 10/9/09
13	Data Validation	14 days	Mon 10/12/09	Thu 10/29/09
14	Data QC and load	7 days	Fri 10/30/09	Mon 11/9/09
15	**Vapor Intrusion Investigation - Round 2**	**73 days**	**Tue 11/10/09**	**Thu 2/18/10**
16	Preparation	5 days	Tue 11/10/09	Mon 11/16/09
17	Investigaton Completion	5 days	Tue 11/17/09	Mon 11/23/09
18	Data Analysis	28 days	Tue 11/24/09	Thu 12/31/09
19	Data QC	7 days	Fri 1/1/10	Mon 1/11/10
20	Data Validation	14 days	Tue 1/12/10	Fri 1/29/10
21	Data QC and load	14 days	Mon 2/1/10	Thu 2/18/10
22	**Reporting**	**135 days**	**Fri 2/19/10**	**Thu 8/26/10**
23	Draft RI Addendum	60 days	Fri 2/19/10	Thu 5/13/10
24	Navy and Regulatory Comment Period	60 days	Fri 5/14/10	Thu 8/5/10
25	Final RI Addendum	15 days	Fri 8/6/10	Thu 8/26/10



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SAP Worksheet #17—Sampling Design and Rationale

Location	Matrix	Depth of Samples	Analysis	Method	Number of Samples	Rationale	Sampling Strategy
Building 47	Subslab Vapor	0 to ~3 inches beneath bottom of slab	Select VOCs	TO-15	2	Samples will be collected to evaluate potential vapor intrusion into occupied site buildings within 100 ft of the groundwater plume. The sample matrix collected is dependent upon groundwater elevation, as discussed in Figure 7. The number of samples collected within each building is dependent on the size of the building. Samples will be analyzed for the COCs identified in the RI and their daughter products.	See **Worksheets #11** and **#14**
Building 47	Indoor Air	2 to 5 ft above slab	Select VOCs	TO-15	2		
Building 47	Outdoor Air (near-building)	TBD – at building intake 3 ft above ground surface	Select VOCs	TO-15	1		
Building 47	Groundwater	Top 3 ft of Columbia aquifer	Select VOCs	SW-846	2		
Building 54	Subslab Vapor	0 to ~3 inches beneath bottom of slab	Select VOCs	TO-15	2		
Building 54	Indoor Air	2 to 5 ft above slab	Select VOCs	TO-15	1		
Building 54	Outdoor Air (near-building)	TBD – at building intake	Select VOCs	TO-15	1		
Building 54	Groundwater	Top 3 ft of Columbia aquifer	Select VOCs	SW-846	2		
Building 1556	Subslab Vapor	0 to ~3 inches beneath bottom of slab	Select VOCs	TO-15	5		
Building 1556	Indoor Air	2 to 5 ft above slab	Select VOCs	TO-15	6		
Building 1556	Outdoor Air (near-building)	TBD – at building intake	Select VOCs	TO-15	1		
Building 1556	Groundwater	Top 3 ft of Columbia aquifer	Select VOCs	SW-846	2		
Upwind of Site 21	Outdoor Air	2 to 5 ft above ground surface	Select VOCs	TO-15	1		

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SAP Worksheet #18—Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ Identification Number	Matrix	Depth	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference[1]
SJS21-SV01-09B	Subslab Vapor	0 to ~3 inches beneath bottom of slab	Select VOCs	See **Worksheets #14** and **#20**	**Worksheets #14** and **#21**, and **Attachment B**
SJS21-SV02-09B					
SJS21-SV03-09B					
SJS21-SV04-09B					
SJS21-SV05-09B					
SJS21-SV06-09B					
SJS21-SV07-09B					
SJS21-SV08-09B					
SJS21-SV09-09B					
SJS21-DW200-09B	Groundwater	Top 3 ft of Columbia aquifer			
SJS21-DW201-09B					
SJS21-DW202-09B					
SJS21-DW203-09B					
SJS21-DW204-09B					
SJS21-DW205-09B					
SJS21-DW206-09B					
SJS21-IA01-09B	Indoor Air	2 to 5 ft above slab			
SJS21-IA02-09B					
SJS21-IA03-09B					
SJS21-IA04-09B					
SJS21-IA05-09B					
SJS21-IA06-09B					
SJS21-IA07-09B					
SJS21-IA08-09B					
SJS21-IA09-09B					
SJS21-AA01-09B	Ambient Air – Near-building	TBD – At building air intakes			
SJS21-AA02-09B					
SJS21-AA03-09B					
SJS21-AA04-09B	Ambient Air - Upwind	2 to 5 ft above ground surface			

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SAP Worksheet #19—Analytical SOP Requirements Table

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference[1]	Containers	Sample volume	Preservation Requirements	Maximum Holding Time[2]
Subslab vapor, indoor air, outdoor air	VOCs	TO-15/ KNOX-MS-0001	(1) 6 liter (L) summa canister	600 mL[3]	None	30 days
Groundwater	VOCs	SW846 8260B/ KNOX-MS-0015	(3) 40 mL glass VOA vials	(3) 40 mL[4]	4 ± 2 °C; adjust pH <2; 0.008% $Na_2S_2O_3$[5]	7 days

[1] See Worksheet 23.

[2] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted. (Not Verified Time of Sample Receipt)

[3] The minimum sample size is based on a 200 ml analysis allowing for sufficient sample for reanalysis. The use of calibrated flow controllers are designed to provide sufficient sample for analysis in the specified timed sampling event (e.g. 24 hour sample)

[4] Triple volume is needed for the laboratory Matrix Spike/Matrix Spike Duplicate sample analysis.

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SAP Worksheet #20—Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates	No. of MS/MSDs	No. of Field Blanks	No. of Equip. Blanks	No. of VOA Trip Blanks	Total No. of Samples to Lab
First Event (There are two possible scenarios that may take place during the first event. See the decision tree in **Figure 7** for more details)								
Scenario 1								
Subslab vapor	Select VOCs	9	1	0	0	0	0	10
Scenario 2								
Groundwater	Select VOCs	6	1	1/1	1	1	1	12
Indoor Air	Select VOCs	9	1	0	0	0	0	10
Outdoor Air	Select VOCs	4	1	0	0	0	0	5
Second Event (There are three possible scenarios that may take place during the second event; however, this event should be considered tentative pending the analytical results from the first event. See the decision tree in **Figure 7** for more details)								
Scenario 1								
Subslab vapor	Select VOCs	9	1	0	0	0	0	10
Scenario 2								
Groundwater	Select VOCs	6	1	1/1	1	1	1	12
Indoor Air	Select VOCs	9	1	0	0	0	0	10
Outdoor Air	Select VOCs	4	1	0	0	0	0	5
Scenario 3								
Subslab vapor	Select VOCs	9	1	0	0	0	0	10
Indoor Air	Select VOCs	9	1	0	0	0	0	10
Outdoor Air	Select VOCs	4	1	0	0	0	0	5
Third Event (There is one possible scenario that may take place during the third event; however, this event as a whole should be considered tentative pending the analytical results from the preceding events. See the decision tree in **Figure 7** for more details)								

SAP Worksheet #20—Field Quality Control Sample Summary Table (continued)

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates	No. of MS/MSDs	No. of Field Blanks	No. of Equip. Blanks	No. of VOA Trip Blanks	Total No. of Samples to Lab
Subslab vapor	Select VOCs	9	1	0	0	0	0	10
Indoor Air	Select VOCs	9	1	0	0	0	0	10
Outdoor Air	Select VOCs	4	1	0	0	0	0	5

QA/QC samples will be collected for select VOCs analysis only based on the following guidelines:

1 Field duplicate will be collected for every 10 field samples.

1 MS/MSD pair will be collected for every 20 samples, including QA/QC and field samples. (Groundwater samples only)

1 Field blank will be collected during each week in the field. (Groundwater samples only)

1 Equipment blank will be collected per day for reusable equipment that is decontaminated daily. (Groundwater samples only)

1 Trip blank will be collected per cooler containing aqueous VOC samples. (Groundwater samples only)

SAP Worksheet #21—Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP-001	Decontamination of Personnel and Equipment	CH2M HILL	Sampling and H&S equipment	N	None
SOP-002	Disposal of Waste Fluids and Solids	CH2M HILL	N/A	N	None
SOP-003	Decontamination of Drilling Rigs and Equipment	CH2M HILL	Drill rig equipment	N	None
SOP-004	Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, ORP, and Temperature	CH2M HILL	Horiba U-22	N	None
SOP-005	Direct-Push Groundwater Sampling	CH2M HILL	Peristaltic Pump	N	None
SOP-006	Preparing Field Log Books	CH2M HILL	N/A	N	None
SOP-007	Locating and Clearing Underground Utilities	CH2M HILL	Magnetometer	N	None
SOP-008	Sampling Contents of Tanks and Drums	CH2M HILL	Bailer, bung wrench	N	None
SOP-009	Chain-of Custody	CH2M HILL	N/A	N	None
SOP-010	Packaging and Shipping Samples	CH2M HILL	N/A	N	None
SOP-011	VOC Sampling – Water	CH2M HILL	Peristaltic pump	N	None
SOP-012	Water level measurement	CH2M HILL	Water level indicator	N	None
SOP-013	Conducting Building Surveys for Vapor Intrusion Evaluations	CH2M HILL	Micromanometer	N	None
SOP-014	Standard Operating Procedure for Installing Subslab Probes and Collecting Subslab Soil Gas Samples Using SUMMA Canisters	CH2M HILL	SUMMA canisters	N	None
SOP-015	Ambient Air Sampling	CH2M HILL	SUMMA canisters	N	None
SOP-016	Field Rinse Blank Preparation	CH2M HILL	N/A	N	None

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SAP Worksheet #22—Field Equipment Calibration, Maintenance, Testing, and Inspection Table

<table>
<tr><th>Field Equipment</th><th>Calibration Activity</th><th>Maintenance Activity</th><th>Testing/ Inspection Activity</th><th>Frequency</th><th>Acceptance Criteria</th><th>CA</th><th>Resp. Person</th><th>SOP Reference</th></tr>
<tr><td>Horiba U-22 pH probe</td><td rowspan="5">Calibrate probe using Horiba® U-22 Auto-Calibration Standard Solution</td><td rowspan="5">Check Mechanical and electronic parts, verify system continuity, check battery, and clean probes.
Calibration check.</td><td rowspan="4">During calibration of other probes, check these readings against the day's atmospheric pressure and ambient temperature</td><td rowspan="4">Daily, before use</td><td>pH reads 4.0 +/- 3%</td><td rowspan="5">Clean probe with deionized water and calibrate again.
Do not use this instrument if unable to calibrate properly.</td><td rowspan="5">FTL</td><td rowspan="6">Attachment B</td></tr>
<tr><td>Horiba® U-22 Specific conductance Probe</td><td>conductivity reads 4.49 +/- 3%</td></tr>
<tr><td>Horiba® U-22 Turbidity Probe</td><td>turbidity reads 0 +/- 3%</td></tr>
<tr><td>Horiba® U-22 Dissolved oxygen and Temperature Probes</td><td>Consistent with the current atmospheric pressure and ambient temperature</td></tr>
<tr><td>Horiba® U-22</td><td>Visual Inspection</td><td>Daily before use, at the end of the day, and when unstable readings occur.</td><td>Stable readings after 3 minutes
pH reads 4.0 +/- 3%
conductivity reads 4.49 +/- 3%
turbidity reads 0 +/- 3%</td></tr>
<tr><td>Geopump</td><td>N/A</td><td>Maintained in good working order per manufacturers recommendations</td><td>Visual Inspection</td><td>Beginning of each day prior to filed activities</td><td>Flow rate below 500 ml per minute</td><td>Attempt troubleshooting in accordance with instruction manual. If unsuccessful, activities will halt until new piece of equipment can be delivered.</td><td>FTL</td></tr>
</table>

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SAP Worksheet #23—Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work (Y/N)
KNOX-MS-0001	VOA Canister Analysis, Revision 9, 10/28/08	Definitive	Air, VOCs	GC/MS	TAL-Knoxville	N
KNOX-MS-0015	Determination of Volatile Organics by GCMS based on Method 8260B, Revision 11, 10-9-08		Water, VOCs	GC/MS		
KNOX-SC-0003	Sample Receipt and Login, Rev. 13, 10/17/08		All	N/A		

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SAP Worksheet #24—Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
GC/MS (SW846 8260B VOCs)	Mass scale calibration using BFB (tuning)	Verify tune every 12 hours	Ion abundance within method specified ranges as listed in SOP	Inspect system; correct problem; rerun BFB.	Analyst	KNOX-MS-0015
	Initial Calibration (ICAL) (minimum 5 point calibration)	Prior to sample analysis, after major instrument changes and when continuing calibration criteria are not met.	% Relative Standard Deviation (RSD) ≤ 30% for Calibration Check Compounds (CCCs); System Performance Check Compounds (SPCCs) minimum avg. RF; ICAL % Relative Standard Deviation (RSD) < 15%, or linear / quadratic curve r^2 ≥0.990.	Inspect system; correct problem; repeat ICAL.		
	Initial Calibration Verification (ICV)	After ICAL; prior to sample analysis	± 30% Difference from ICAL.	Inspect system; correct problem; reanalyze ICV or repeat ICAL.		
	Continuing Calibration Verification (CCV)	At the beginning of each 12-hour shift	CCV % Difference < 20% for CCCs; SPCCs minimum avg. RF.	Inspect system; correct problem; repeat CCV. If still unacceptable, repeat ICAL.		
GC/MS (TO-15 VOCs)	Mass scale calibration verification using BFB (tuning)	Verify tune every 24 hours	Ion abundance within method specified ranges as listed in SOP	Inspect system; correct problem; rerun BFB.		KNOX-MS-0001
	ICAL (minimum 5 point calibration)	Prior to sample analysis, after major instrument changes and when continuing calibration criteria are not met.	ICAL % RSD ≤ 30% with ≤ 2 analytes ≤ 40%, or linear / quadratic curve r^2 ≥ 0.990.	Inspect system; correct problem; repeat ICAL.		
	ICV	After ICAL; prior to sample analysis	± 35% Difference from ICAL.	Inspect system; correct problem; reanalyze ICV or repeat ICAL.		
	CCV	At the beginning of each 24-hour shift	CCV % Difference ≤ 30% with ≤ 4 analytes ≤ 40%.	Inspect system; correct problem; repeat CCV. If still unacceptable, repeat ICAL.		

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SAP Worksheet #25—Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GC/MS (TO-15)	Clean source, change traps, replace filaments; maintain vacuum pumps	QC Standards	Refer to Worksheet #24	Service vacuum pumps twice per year; other maintenance as needed	Refer to Worksheet #24	Refer to Worksheet #24	Analyst	KNOX-MS-0001
GC/MS (8260B)	Clean source, change traps, replace filaments; maintain vacuum pumps			Service vacuum pumps twice per year; other maintenance as needed				KNOX-MS-0015

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SAP Worksheet #26-1—Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Project Field Team, FTL/CH2M HILL. Field SOPs are in Attachment B of this SAP.
Sample Packaging (Personnel/Organization): Project Field Team, FTL/CH2M HILL. Field SOPs are in Attachment B of this SAP.
Coordination of Shipment (Personnel/Organization): FTL/CH2M HILL
Type of Shipment/Carrier: FedEx Priority Overnight
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Bryan Dameron
Sample Custody and Storage (Personnel/Organization): Bryan Dameron
Sample Preparation (Personnel/Organization): David Flores (TO 15 VOCs), Anna Barlozhetskaya (8260B VOCs)
Sample Determinative Analysis (Personnel/Organization): Holly Taj (TO 15 VOCs Analyst), David Wiles (VOCs Department Manager), and Scot Goss (8260B VOCs Analysis)
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): 90 days from receipt
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 1 year
Biological Sample Storage (No. of days from sample collection): n/a
SAMPLE DISPOSAL
Personnel/Organization: Ryan Henry
Number of Days from Analysis: After submission, the laboratory will keep samples 90 days and the sample extracts for a minimum of 60 days.

SAP Worksheet #26-2—Sample's Life Flowchart

Step 1 — Planning Phase

- Staffing Schedules
- Kickoff Meeting
- Project Instructions (PIs)

Step 2A — Sample Collection

- Daily collection and shipments of samples
- One COC/cooler; One FedEx slip/cooler
- Field team coordinates w/ EIS for tracking & Lab notification
- GPS conducted (if applicable)

Step 2B — Sample Tracking

- EIS cross checks COC against PIs
- Also reviews lab confirmation sheets to verify all samples were received and in appropriate condition

Step 3 — Lab Analysis

- Standard 28-day unless otherwise arranged
- EIS reviews data for accuracy and works with lab to resolve discrepancies
- Chemist is informed of any analytical issues such as multiple dilutions or surrogates out
- EIS tracks schedule and keeps PM informed
- EIS inputs Field Data Entry Tool information from Log Books
- EIS can generate Unvalidated Raw and Detects Data Tables

Step 4 — Data Validation

- EIS reviews all data for accuracy against the PIs
- EIS sends data from lab to Data Validator
- Delays may occur if there is missing data or data is late from the lab
- EIS can generate Validated Raw and Detects Data Tables

Step 5 — Data Load

- Chemist performs a pre-load check on data. This involves a complete review and comparison of the hardcopy data, SNEDD, and data validation narratives.
- Chemist requests revisions from data validator if necessary then submits to EIS when complete
- EIS sends data to Database Specialist to be loaded into database

Step 6 — Quality Assurance/ Quality Control

- EIS is sent tables from Database Specialist for QA/QC check
- EIS verifies info loaded is correct (Sample, Station, Analyses, Result)
- EIS then helps decide whether info needs to be updated or not
- File and archive all Lab and DV deliverables

Step 7 — Report Generation

- Raw, Detects, Exceedance Reports
- Data Requests
- Exceedance Reports (criteria needed prior to this step and selected by PM)
- Human Health Risk Assessment
- Eco Risk Assessment

End of our Sample's Life?

- Data may be used in reports, posted on web, put into GIS, etc
- In that regard, a sample's life doesn't really ever end!

SAP Worksheet #27—Sample Custody Requirements Table

Sample Labeling Procedures

Sample labels will include, at a minimum, client name, site, sample identification, date/time collected, analysis group or method, and sampler's initials. A standardized numbering system will be used to identify all samples collected. The numbering system will provide a tracking procedure to ensure accurate data retrieval of all samples collected. Each sample will be designated by an alphanumeric code that will identify the facility, site, station identification, matrix sampled, and/or date and depth sampled. QA/QC samples will have a unique sample designation. The sample identification scheme for all samples collected during the investigation will use the format shown in **Worksheet #18**. The field logbook will identify the sample identification with the location, depth, date/time collected, and the parameters requested.

Field Sample Custody Procedures (Sample Collection, Packaging, Shipment, and Delivery to Laboratory)

Field samples will be collected by the field team members under the supervision of the field team leader. As samples are collected, they will immediately be placed in the appropriate containers and labeled, as outlined above. The labels will be filled out in the field by the field crew at the time of sample collection and checked for quality before being placed into the cooler, at which time the sample will be logged in on the chain of custody form and field logbook. The integrity of the sample labels for groundwater samples will be maintained through the practice of placing sample containers in Ziploc bags.

Samples will be cushioned with packaging material and placed into coolers. Coolers containing groundwater samples will be packed with enough ice to keep the groundwater samples below 4°C until they are received by the laboratory. The chain of custody will also be placed into the cooler. Coolers will be shipped to the laboratory via FedEx, with the airbill number indicated on the chain of custody (to relinquish custody). The FTL is responsible for the care and custody of samples until they are shipped or otherwise delivered to the laboratory custodian. Upon delivery, the laboratory will log in each cooler and report the status of the samples as discussed below.

Chain-of-Custody Procedures

Chain of custodies will include, at a minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information (**Attachment B**). Sample information will include sample identification, date/time collected, number and type of containers, preservative information, analysis method, and comments. The chain of custody will also have the sampler's name and signature. The chain of custody will link location of the sample from the field logbook to the laboratory receipt of the sample. The laboratory will use the sample information to populate the laboratory information management system database for each sample.

Laboratory Sample Custody Procedures (Receipt of Samples, Archiving, Disposal)

The laboratory receiving samples will comply with all sample custody requirements outlined in the laboratory SOP KNOX-SC-003.

SAP Worksheet #27—Sample Custody Requirements Table (continued)

Sample Integrity

A sample tracking system will be followed to ensure sample authenticity and data defensibility. A field team member or an EIS will notify the laboratory of upcoming field sampling activities and the subsequent transfer of samples to the laboratory. The EIS will ensure samples arrive to the lab in the appropriate timeframe and the condition of samples upon receipt is satisfactory. If samples are not delivered to the lab in the acceptable timeframe or condition, the PM will be notified and the decision will be made whether to recollect samples.

The EIS is responsible for checking the chain of custody forms against the field logbook and field project instructions to verify the sample identification, times, analyses, and methods are correct on the chain of custody form. Any discrepancies will be resolved with the field team and relayed to the lab. These actions will be documented by both the lab and the EIS. The lab is responsible for providing the EIS with sample log-in sheets the day of sample receipt in order for the EIS to verify the lab has accounted for all samples shipped and has correctly logged the samples into its software system.

SAP Worksheet #28-1—Laboratory QC Samples Table

Matrix: Groundwater
Analytical Group: Select VOCs
Analytical Method/SOP Reference: SW-846 8260B/ KNOX-MS-0015

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Resp. for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per Batch (20 samples)	No Target Compounds > ½ QL	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >20x blank result or sample results are nondetect.	Analyst / Section Supervisor	Accuracy/Bias-Contamination	No Target Compounds > ½ QL
Instrument Blank	Once per 12 hours if method blank is not run				Accuracy/Bias-Contamination	
Laboratory Control Sample (LCS)	1 per Batch (20 samples)	See recovery limits in **Worksheet #28-1a**	If sufficient sample is available, reanalyze samples. Qualify data as needed.		Accuracy/Bias	See recovery limits in **Worksheet #28-1a**
Surrogates	Every sample	1,2-Dichloroethane-d4 70-120% 4-Bromofluorobenzene 75-120% Dibromofluoromethane 85-115% Toluene-d8 85-120%	Check calculations and instrument performance; recalculate, reanalyze.		Accuracy/Bias	1,2-Dichloroethane-d4 70-120% 4-Bromofluorobenzene 75-120% Dibromofluoromethane 85-115% Toluene-d8 85-120%

SAP Worksheet #28-1a—LCS and MS/MSD Recoveries

Analyte	CAS Number	Recovery Limits (%)	
		Lower	Upper
1,1-Dichloroethene	75-35-4	70	130
1,2-Dichloroethane	107-06-2	70	130
Dichlorodifluoromethane (Freon-12)	75-71-8	30	155
Trichloroethene	79-01-6	70	125
Vinyl chloride	75-01-4	50	145
cis-1,2-Dichloroethene	156-59-2	70	125
trans-1,2-Dichloroethene	156-60-5	60	140

SAP Worksheet #28-2—Laboratory QC Samples Table

Matrix: Air (subslab vapor, indoor air, outdoor air)
Analytical Group: Select VOCs
Analytical Method/SOP Reference: TO-15 / KNOX-MS-0001

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Resp. for Corrective Action	DQI	Measurement Performance Criteria
Method Blank	1 per 20 samples or 24-hr tune, whichever is more frequent	No Target Compounds > ½ QL	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >20x blank result or sample results ND.	Analyst/ Section Supervisor	Accuracy/Bias-Contamination	No Target Compounds > ½ QL
LCS	1 per 20 samples or 24-hr tune, whichever is more frequent	Non-polar analytes: 70-130% Recovery with ≤ 2 within 60-140%. Polar analytes: 60-140% Recovery with ≤ 2 within 45-155%.	If sufficient sample is available, reanalyze samples. Qualify data as needed.		Accuracy/Bias	Non-polar analytes: 70-130% Recovery with ≤ 2 within 60-140%. Polar analytes: 60-140% Recovery with ≤ 2 within 45-155%.
Laboratory Duplicate	1 per Batch (20 samples)	RPD ≤ 25% for analytes >5x QL	Determine root cause; reanalyze DUP; flag data; discuss in narrative.		Precision	RPD ≤ 25% for analytes >5x QL
Surrogate	Every sample	70-130% Recovery	Check calculations and instrument performance; recalculate, reanalyze.		Accuracy/Bias	70-130% Recovery

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SAP Worksheet #29—Project Documents and Records Table

Document	Where Maintained
• Field Notebooks • Chain of custody Records • Air Bills • Custody Seals • CA Forms • Electronic Data Deliverables (EDDs) • Identification of QC Samples • Release of Analytical Data • Meteorological Data from Field • Sampling instrument calibration logs • Sampling locations and sampling plan • Sampling notes • Water quality parameters • Sample Receipt, chain of custody, and Tracking Records • Standard Traceability Logs • Equipment Calibration Logs • Sample Prep Logs • Run Logs • Equipment Maintenance, Testing, and Inspection Logs • Reported Field Sample Results • Reported Result for Standards, QC Checks, and QC Samples • Instrument printouts (raw data) for Field Samples, Standards, QC Checks, and QC Samples • Sample disposal records • Extraction/Cleanup Records • Raw Data (stored on disk) • Data Validation Reports • MDL Study Information	• Field data deliverables such as logbooks entries, chain of custodies, air bills, EDDs, etc will be kept on CH2M HILL's local internet server. • Field parameter data will be loaded with the analytical data into EnDat • Analytical laboratory hardcopy deliverables and data validation reports will be saved on the network server. • Electronic data from the laboratory will be loaded into EnDat and NIRIS

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SAP Worksheet #30—Analytical Services Table

Matrix	Analytical Group	Sample Locations/ ID Numbers	Analytical Method	Data Package Turnaround Time	Laboratory/ Organization	Backup Laboratory/ Organization
Groundwater	Select VOCs	See **Worksheet #18**	SW846 8260B	28 calendar days[1]	TAL- Knoxville Terry Wasmund 5815 Middlebrook Pike Knoxville, TN 37921 865.291.3000 Fax: 865.584.4315	TBD[2]
Subslab Vapor			TO-15			
Indoor Air						
Outdoor Air						

[1] Subslab vapor samples collected during the second event may be analyzed on a 72-hour turnaround time for the Form 1 results. The full data deliverable will be due within 28 calendar days.

[2] A backup laboratory has not been determined. If circumstances render the subcontracted laboratory unable to perform analytical services, another laboratory will be determined at that time.

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SAP Worksheet #31—Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Response to Assessment Findings[1]	Person(s) Responsible for Identifying and Implementing CA[1]	Person(s) Responsible for Monitoring Effectiveness of CA
Offsite Laboratory Technical Systems Audit	Laboratory must have current NFESC evaluation letter, which will identify the period of performance. The laboratory must be re-evaluated prior to expiration of period of performance	External	Navy (NFESC)	Project QA Officer- Pati Moreno/ NFESC, Port Hueneme, CA	TAL- Knoxville's QA Officer, Chris Rigell	TAL- Knoxville's QA Officer, Chris Rigell	Anita Dodson, Navy CLEAN Navy Program Chemist
Field Performance Audit	Once per definable feature of work.	Internal	CH2M HILL	FTL	FTL and SSC	FTL and SSC	Janna Staszak, CH2M HILL PM

Note: Stop Work Order: Any field member can immediately stop work if an unsafe condition, which is immediately threatening to human health, is observed. Ultimately, the FTL, PM, and AM can stop work for a period of time. NAVFAC Mid-Atlantic can stop work at any time.

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SAP Worksheet #32—Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response	Timeframe for Response
Field Performance Audit	Checklist and written audit report	Janna Staszak, PM CH2M HILL	Verbal – immediately Written Documentation – Within 1 week of audit	Memorandum	FTL (TBD) – CH2M HILL AQM – CH2M HILL	As soon as possible
Offsite Laboratory Technical Systems Audit	Written audit report from NFESC	TAL- Knoxville's QA Officer, Chris Rigell	Within 2 months of audit	Memorandum	NFESC Auditor (TBD)	Within two months of receipt of initial notification.

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SAP Worksheet #32-1—Corrective Action Form

Person initiating corrective action ______________________________ Date ____________________

Description of problem and when identified: ____

____

____

____

Cause of problem, if known or suspected: ____

____

____

Sequence of Corrective Action (CA): (including date implemented, action planned and personnel/data affected) ____

____

____

____

____

____

____

CA implemented by: ____ Date ____________________

CA initially approved by: ____________________________________ Date ____________________

Follow-up date: ____

Final CA approved by: _______________________________________ Date ____________________

Information copies to:

Anita Dodson/Navy CLEAN Program Chemist

NAVFAC Chemist

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SAP Worksheet #32-2—Field Performance Audit Checklist

Project Responsibilities

Project No.: ____________________________ Date: ___________________________________

Project Location: ________________________ Signature: _______________________________

Team Members:

Yes __ No __ 1) Is the approved work plan being followed?
Comments ____

____

Yes __ No __ 2) Was a briefing held for project participants?
Comments ____

____

Yes __ No __ 3) Were additional instructions given to project participants?
Comments ____

____

Sample Collection

Yes __ No __ 1) Is there a written list of sampling locations and descriptions?
Comments ____

____

Yes __ No __ 2) Are samples collected as stated in the Master SOPs?
Comments ____

____

Yes __ No __ 3) Are samples collected in the type of containers specified in the work plan?
Comments ____

____

Yes __ No __ 4) Are samples preserved as specified in the work plan?
Comments ____

____

SAP Worksheet #32-2—Field Performance Audit Checklist (continued)

Yes __ No __ 5) Are the number, frequency, and type of samples collected as specified in the work plan?
Comments ____

____

Yes __ No __ 6) Are quality assurance checks performed as specified in the work plan?
Comments ____

____

Yes __ No __ 7) Are photographs taken and documented?
Comments ____

____

Document Control

Yes __ No __ 1) Have any accountable documents been lost?
Comments ____

____

Yes __ No __ 2) Have any accountable documents been voided?
Comments ____

____

Yes __ No __ 3) Have any accountable documents been disposed of?
Comments ____

Yes __ No __ 4) Are the samples identified with sample tags?
Comments ____

____

Yes __ No __ 5) Are blank and duplicate samples properly identified?
Comments ____

____

Yes __ No __ 6) Are samples listed on a chain-of-custody record?
Comments ____

____

Yes __ No __ 7) Is chain-of-custody documented and maintained?
Comments ____

____

SAP Worksheet #33—QA Management Reports Table

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Field Performance CA Memorandum	After Field Audit	1 week after audit, if necessary	CH2M HILL FTL	Will be posted in project file.
Final Report QA/QC Section	Once results are received from data validator	Approximately 8 weeks following sample collection	CH2M HILL QA Officer	Will be posted in project file.

The following will be addressed in the QA/QC section of final report:

- Summary of project QA/QC programs and trainings
- Conformance of project activities to SAP requirements and procedures
- Status of project and schedule delays
- Deviations from approved SAP and approved amendments to SAP
- Description and findings of audits
- Results of data review activities in terms of amount of usable data generated (results of the Chemist's QC Check on data prior to loading into CH2M HILL's database)
- Required CAs and effectiveness of CA implementation
- Data usability assessments in terms of accuracy, precision, representativeness, completeness, comparability and sensitivity.
- Limitations on use of measurement data generated.

The report will also include data quality concerns:

- Narrative and timelines of project activities
- Summary of project quality objective (PQO) development
- Reconciliation of project data with PQOs
- Summary of major problems encountered and their resolution
- Data summary, including tables, charts, graphs, with appropriate sample identification or station location numbers, concentration units, percent solids (not applicable), and data quality flags
- Conclusions and recommendations

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SAP Worksheet #34—Verification (Step I) Process Table

Verification Input	Description	Internal / External	Responsible for Verification
Planning Documents	Evidence of approval and completeness of UFP-SAP.	Internal	Janna Staszak – CH2M HILL
Chains of custody and shipping forms	CoC forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the chain of custody will be initialed by the reviewer, a copy of the chain of custody retained in the site file, and the original and remaining copies taped inside the cooler for shipment. See chain of custody SOP (Attachment B) for further details.	Internal	FTL – CH2M HILL Kyle Block – CH2M HILL
Field Log Notebooks	Field notes will be reviewed to ensure completeness of field data parameters, shipping information, and sample collection times, etc. The logbook will also be used to document, explain, and justify all deviations from the approved work plan and UFP-SAP.	Internal	Janna Staszak – CH2M HILL
Laboratory Receipt	Upon their arrival at the laboratory, the samples will be cross-referenced against the chain of custody records. All sample labels will be checked against the chain of custody, and any mislabeling will be identified, investigated, and corrected. The samples will be logged in at every storage area and workstation required by the designated analyses. Individual analysts will verify the completeness and accuracy of the data recorded on the forms.	Internal	TAL– Knoxville employees
QC Summary Report	A summary of all QC sample results will be verified for completeness once the data is received from the laboratory.	External	Kyle Block – CH2M HILL
Laboratory Data Package	Once received from the laboratory, the data package will be reviewed for completeness and consistency before the data is loaded or sent to a third party validator.	External	Kyle Block – CH2M HILL

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SAP Worksheet #35—Validation (Steps IIa and IIb) Process Table

Step IIa / IIb[1]	Validation Input	Description	Responsible for Validation
IIb	Onsite Screening	Ensure that all field data meet Work Plan requirements for completeness and accuracy based on the field calibration records.	FTL – CH2M HILL
IIa	SOPs	Ensure that all sampling and analytical SOPs were followed.	FTL – CH2M HILL
IIa	Method QC Results	Ensure that all required QC samples were run and meet method and/or project required limits.	Nancy Weaver – EDS
IIb	Work Plan QC Sample Results	Ensure that all required Work Plan QC samples were run and meet required limits.	Megan Hilton – CH2M HILL
IIb	QLs	Ensure all sample results met the project quantification limit specified in the Work Plan.	Megan Hilton – CH2M HILL
IIa	Raw Data	10 percent review of raw data to confirm laboratory calculations	Nancy Weaver – EDS

[1] IIa=compliance with methods, procedures, and contracts.
IIb=comparison with Measurement Performance Criteria (MPC) in the SAP.

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SAP Worksheet #36 –Analytical Data Validation (Steps IIa and IIb) Summary Table

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	Data Validator
IIa	Subslab vapor, Indoor air, Outdoor air, Groundwater	Select VOCs	Analytical methods and laboratory SOPs as presented in this SAP will be used to evaluate compliance against QA/QC criteria. Should adherence to QA/QC criteria yield deficiencies, data may be qualified. The data qualifiers that may be used are those presented in Region III Modifications to *National Functional Guidelines for Organic Data Review, (October 1994).* These guidelines will not be used for data validation; however, the specific qualifiers listed therein may be applied to data should non-conformances against the QA/QC criteria as presented in this SAP be identified.	Nancy Weaver – EDS
IIb			See project action limits in **Worksheet #15**	Megan Hilton, Janna Staszak – CH2M HILL

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SAP Worksheet #37—Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:

- Non-detected site contaminants will be evaluated to ensure that project QL goals in **Worksheet #15** were achieved. If project QLs were achieved and the verification and validation steps yielded acceptable data, then the data is considered usable.
- During verification and validation steps, data may be qualified as estimated with the following qualifiers: J, UJ, K, L, or UL. These qualifiers represent minor QC deficiencies that will not affect the usability of the data. When major QC deficiencies are encountered, data will be qualified with an R and in most cases is not considered usable for project decisions.
  - J- Analyte present. Reported value may or may not be accurate or precise
  - UJ- Analyte not detected. QL may be inaccurate or imprecise
  - K- Analyte present. Reported value may be biased high. Actual value is expected to be lower
  - L- Analyte present. Reported value may be biased low. Actual value is expected to be higher
  - UL- Analyte not detected. QL is probably higher.
  - R- Rejected result. Result not reliable.
- Additional qualifiers that may be given by the validator are:
  - B- Not detected substantially above the level reported in laboratory or field blanks
  - Interferences present which may cause the results to be biased high
  - N- Tentative Identification. Consider Present. Special methods may be needed to confirm its presence or absence in future sampling efforts
  - NJ- Qualitative identification questionable due to poor resolution. Presumptively present at approximate quantity
  - U- Not Detected
- For statistical comparisons non-detect values will be represented by a concentration equal to one-half the sample reporting limit. For duplicate sample results, the most conservative value will be used for project decisions.
- Analytical data will be checked to ensure the values and any qualifiers are appropriately transferred to the electronic database. These checks include comparison of hardcopy data and qualifiers to the electronic data deliverable. Once the data has been uploaded into the electronic database, another check will be performed to ensure all results were loaded accurately.
- Field and laboratory precision will be compared as RPD between the two results.
- Deviations from the SAP will be reviewed to assess whether CA is warranted and to assess impacts to achievement of project objectives.

SAP Worksheet #37—Usability Assessment (continued)

Describe the evaluative procedures used to assess overall measurement error associated with the project.

- To assess whether a sufficient quantity of acceptable data are available for decision-making, the data will be reconciled with MPC following validation and review of data quality indicators.
- If significant biases are detected with laboratory QA/QC samples it will be evaluated to assess impact on decision making. Low biases will be described in greater detail as they represent a possible inability to detect compounds that may be present at the site.
- If significant deviations are noted between lab and field precision the cause will be further evaluated to assess impact on decision making.

Identify the personnel responsible for performing the usability assessment.

The CH2M HILL Project Team, including the PM, Project Chemist, and Senior Vapor Intrusion Technologist, will review the data and compile a RI addendum for the Tier I Partnering Team (Navy, USEPA, and VDEQ). The Tier I Partnering Team as a whole will assess the usability of the data.

Describe the documentation that will be generated during the usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

The following will be prepared by CH2M HILL and presented to and submitted to the Tier I Partnering Team for review and decisions on the path forward for the site.

- Data tables will be produced to reflect detected and non-detected site COCs as well as other parameters analyzed. Data qualifiers will be reflected in the tables and discussed in the data quality evaluation.
- A data quality evaluation considering all of the above will be provided as part of the RI addendum prepared to assess potential risk from vapor intrusion. The RI addendum will identify any data usability limitations and make recommendations for CA if necessary.

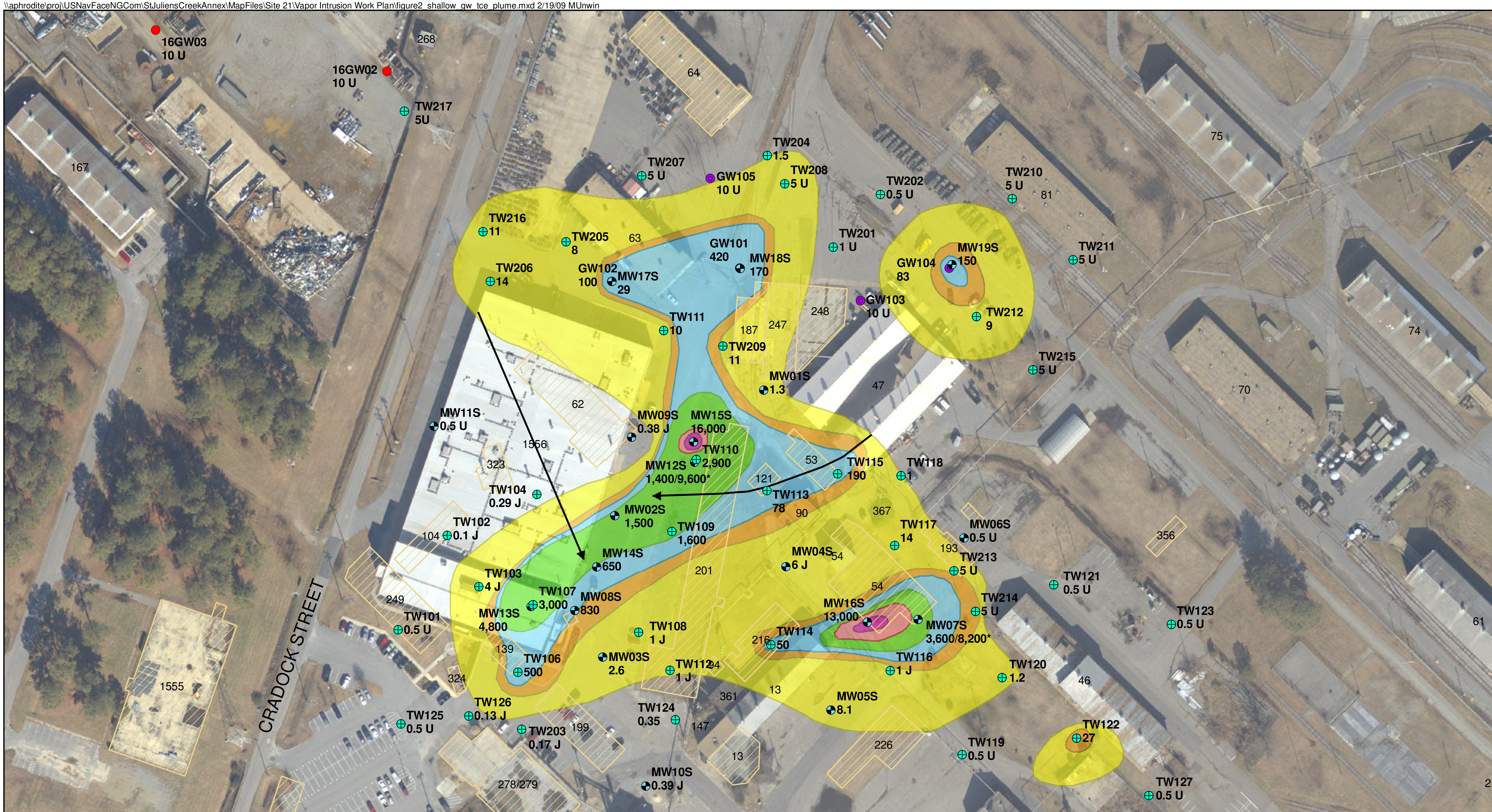
Figures

\\aphrodite\proj\USNavFacEngCom\StJuliensCreekAnnex\MapFiles\Site 21\Vapor Intrusion Work Plan\figure1_site21_location.mxd 2/19/09 MUnwin

Figure 1
Site 21 Location
Site 21 Vapor Intrusion Investigation Work Plan
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

\\aphrodite\proj\USNavFaceNGCom\StJuliensCreekAnnex\MapFiles\Site 21\Vapor Intrusion Work Plan\figure2_shallow_gw_tce_plume.mxd 2/19/09 MUnwin



Legend

- Shallow Monitoring Well Location
- Temporary Monitoring Well Location
- Grab Groundwater Sample Location
- RRR Groundwater Sample Location
- Demolished Buildings
- Estimated Groundwater Flow Direction
- TCE Concentration 1 - 25
- TCE Concentration 26 - 49
- TCE Concentration 50 - 999
- TCE Concentration 1,000 - 4,999
- TCE Concentration 5,000 - 9,999
- TCE Concentration >= 10,000

All results are reported in µg/L
J - Reported value is estimated
U - No Detect
Concentrations shown are the most recent results, with the exception of MW09S, at which a previous result was used because the most recent detection limit was above the MCL.
* Concentrations from depth specific DPT GW sample collected at the bottom of the aquifer; not used to delineate the plume

N
W E
S

0 120 240
Feet

Figure 2
Shallow Groundwater TCE Plume
Site 21 Vapor Intrusion Investigation Work Plan
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

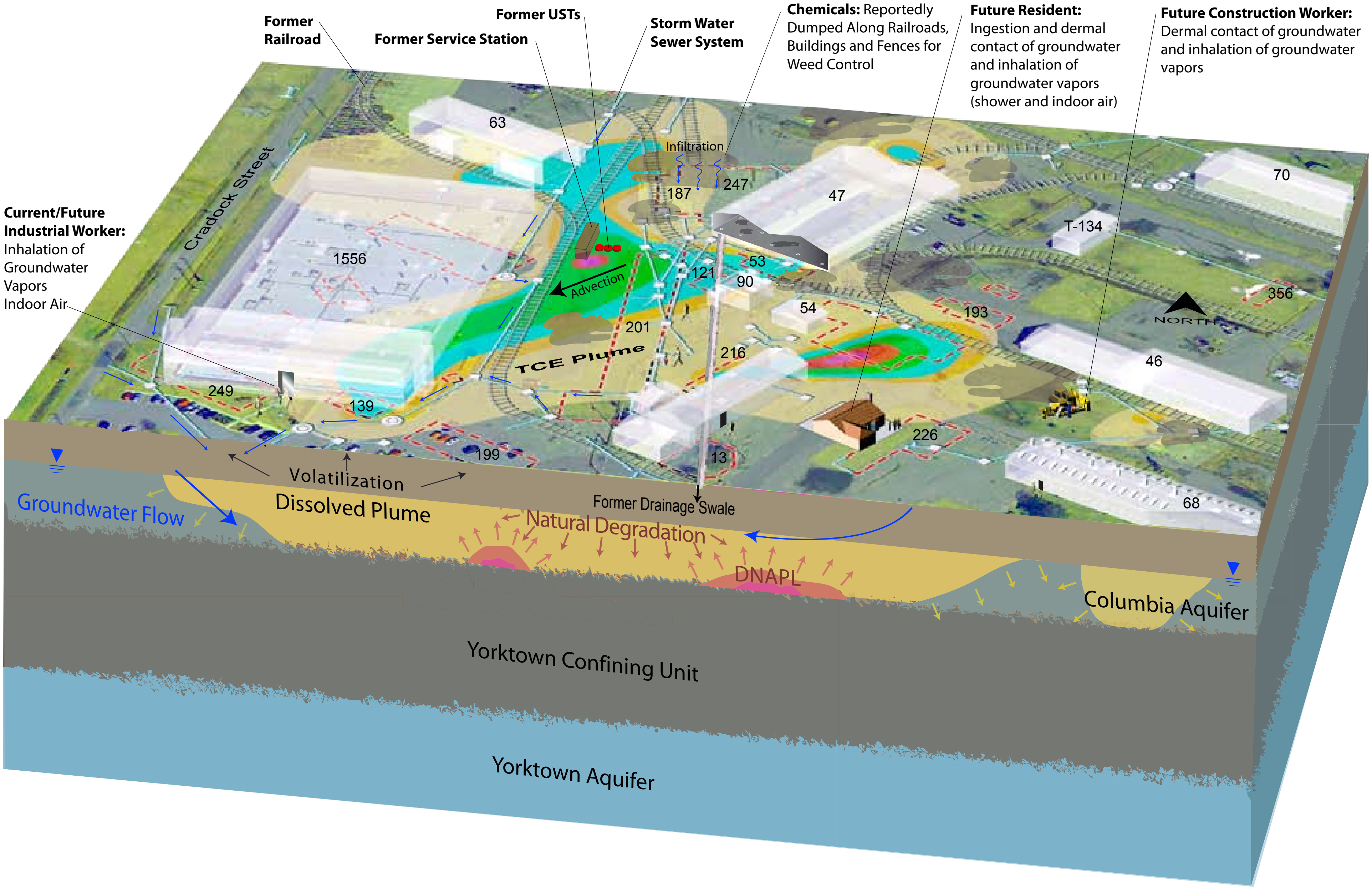


FIGURE 3
Site 21 Conceptual Site Model
St. Juliens Creek Annex,
Chesapeake, Virginia

CH2MHILL

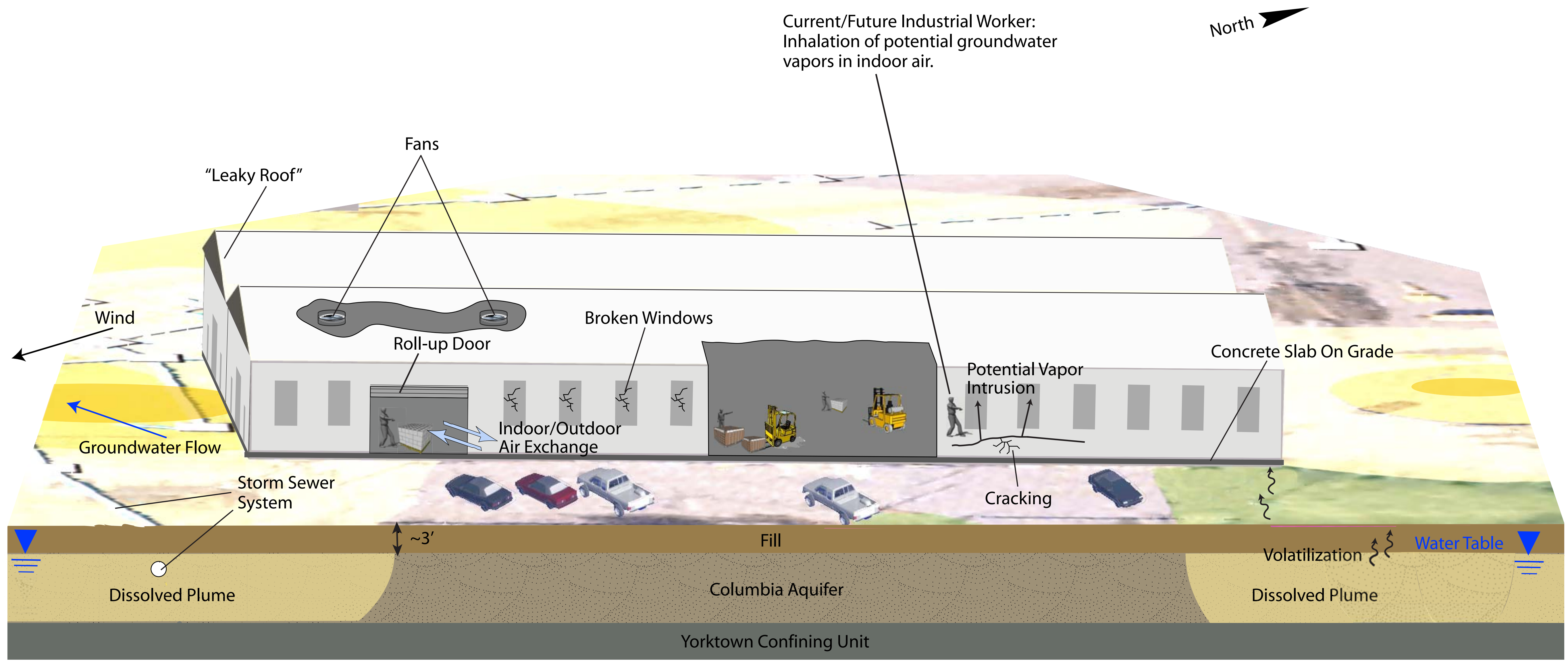


FIGURE 4
Site 21 Building 47 Vapor Intrusion Conceptual Site Model
St. Juliens Creek Annex,
Chesapeake, Virginia

CH2MHILL

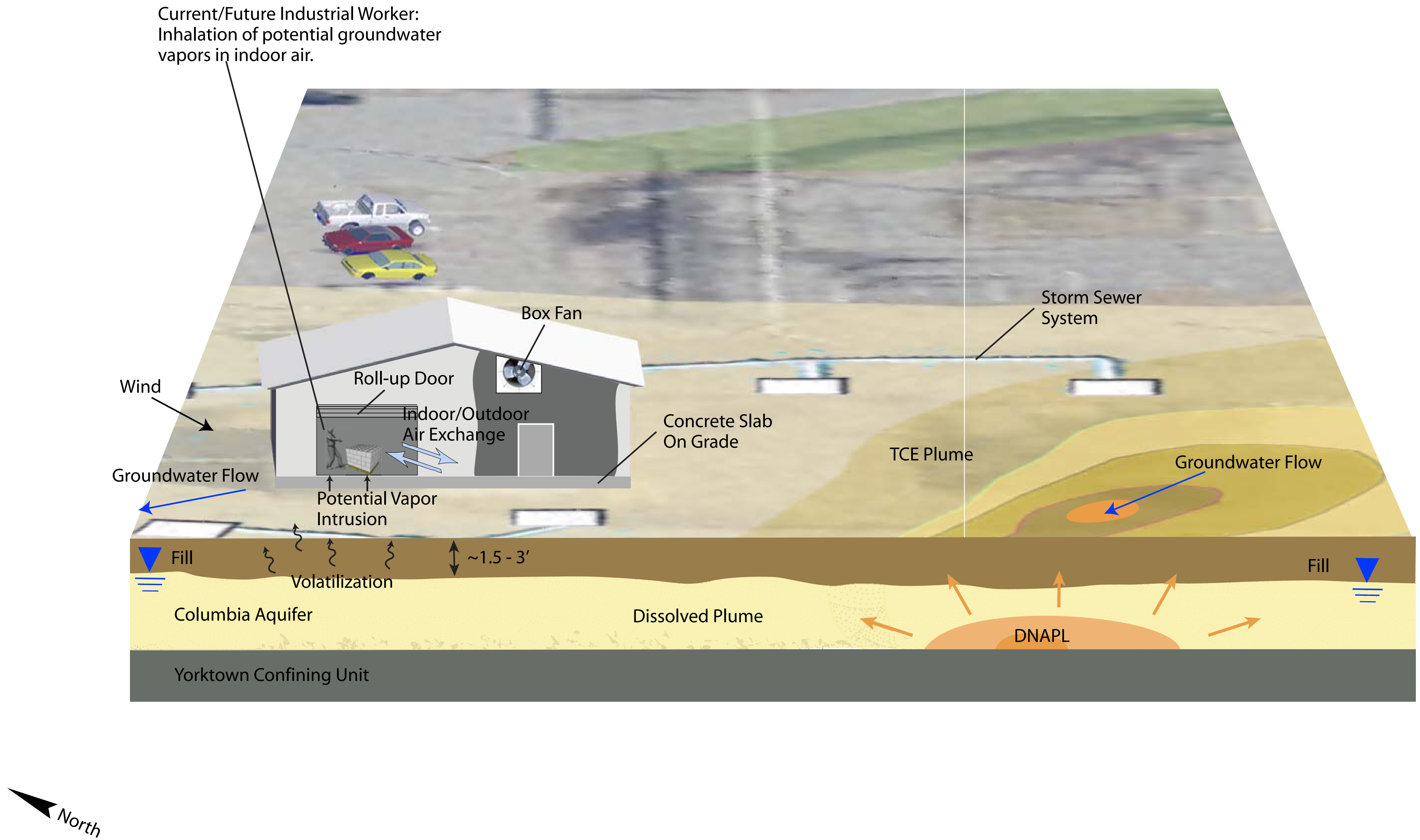


FIGURE 5
Site 21 Building 54 Vapor Intrusion Conceptual Site Model
St. Juliens Creek Annex,
Chesapeake, Virginia

CH2MHILL

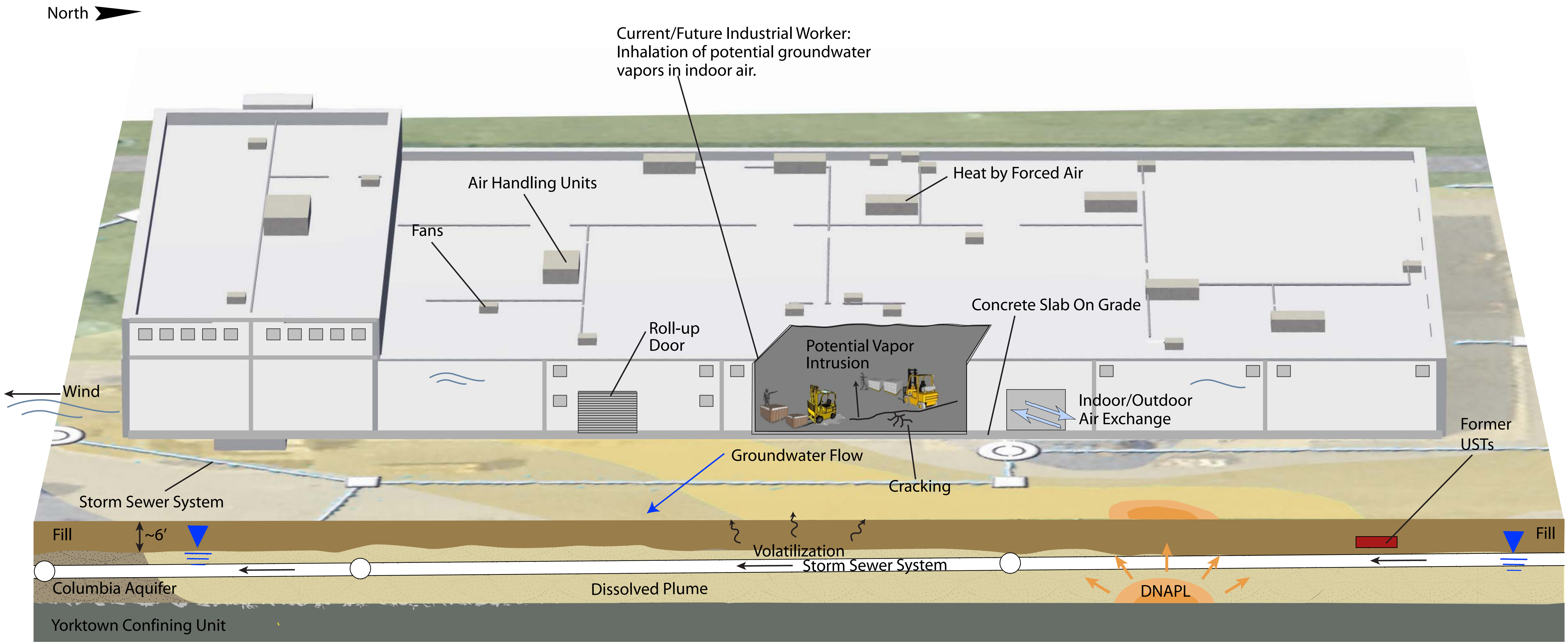
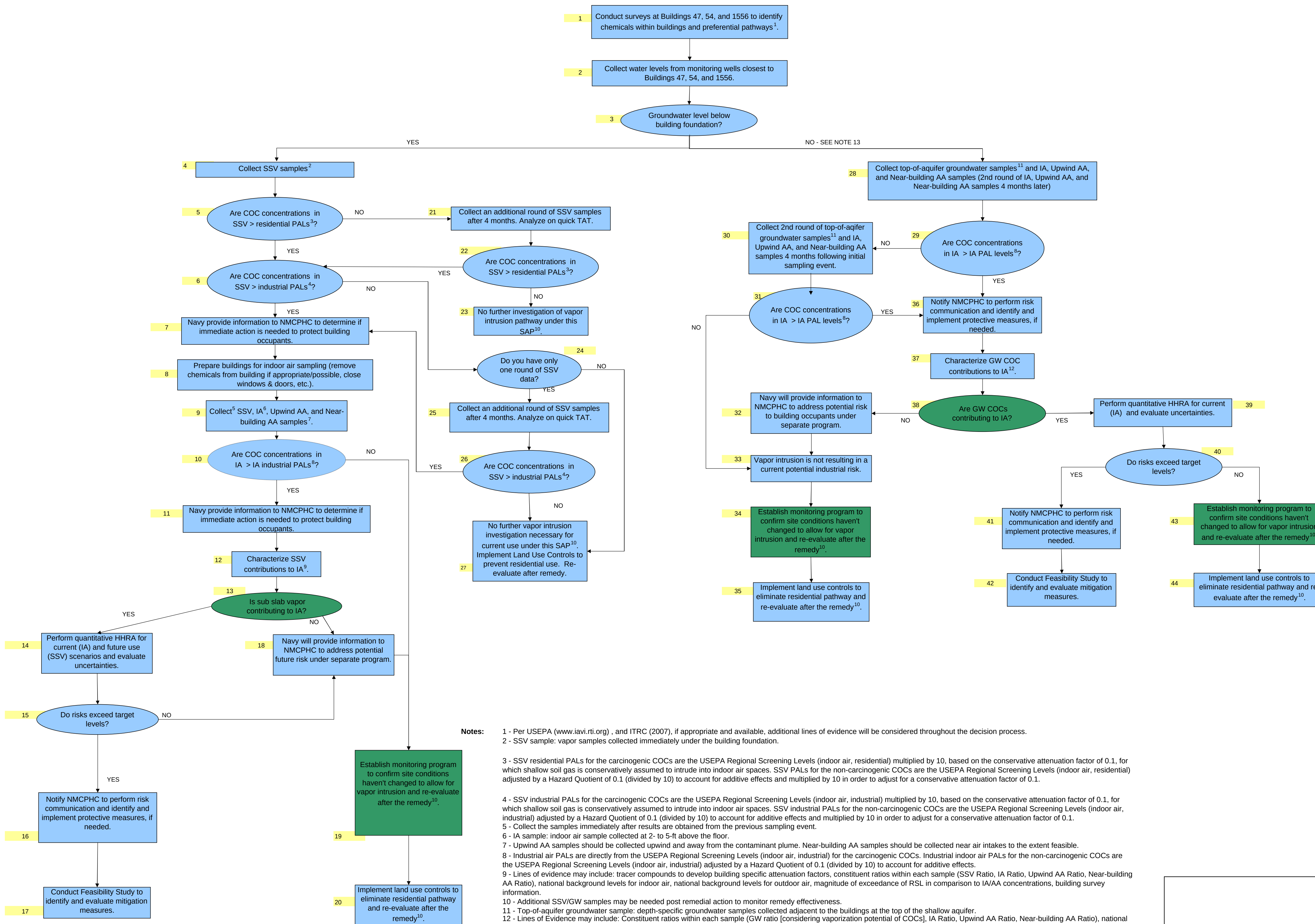


FIGURE 6
Site 21 Building 1556 Vapor Intrusion Conceptual Site Model
St. Juliens Creek Annex,
Chesapeake, Virginia

CH2MHILL



Notes:

1 - Per USEPA (www.iavi.rti.org) , and ITRC (2007), if appropriate and available, additional lines of evidence will be considered throughout the decision process.
2 - SSV sample: vapor samples collected immediately under the building foundation.

3 - SSV residential PALs for the carcinogenic COCs are the USEPA Regional Screening Levels (indoor air, residential) multiplied by 10, based on the conservative attenuation factor of 0.1, for which shallow soil gas is conservatively assumed to intrude into indoor air spaces. SSV PALs for the non-carcinogenic COCs are the USEPA Regional Screening Levels (indoor air, residential) adjusted by a Hazard Quotient of 0.1 (divided by 10) to account for additive effects and multiplied by 10 in order to adjust for a conservative attenuation factor of 0.1.

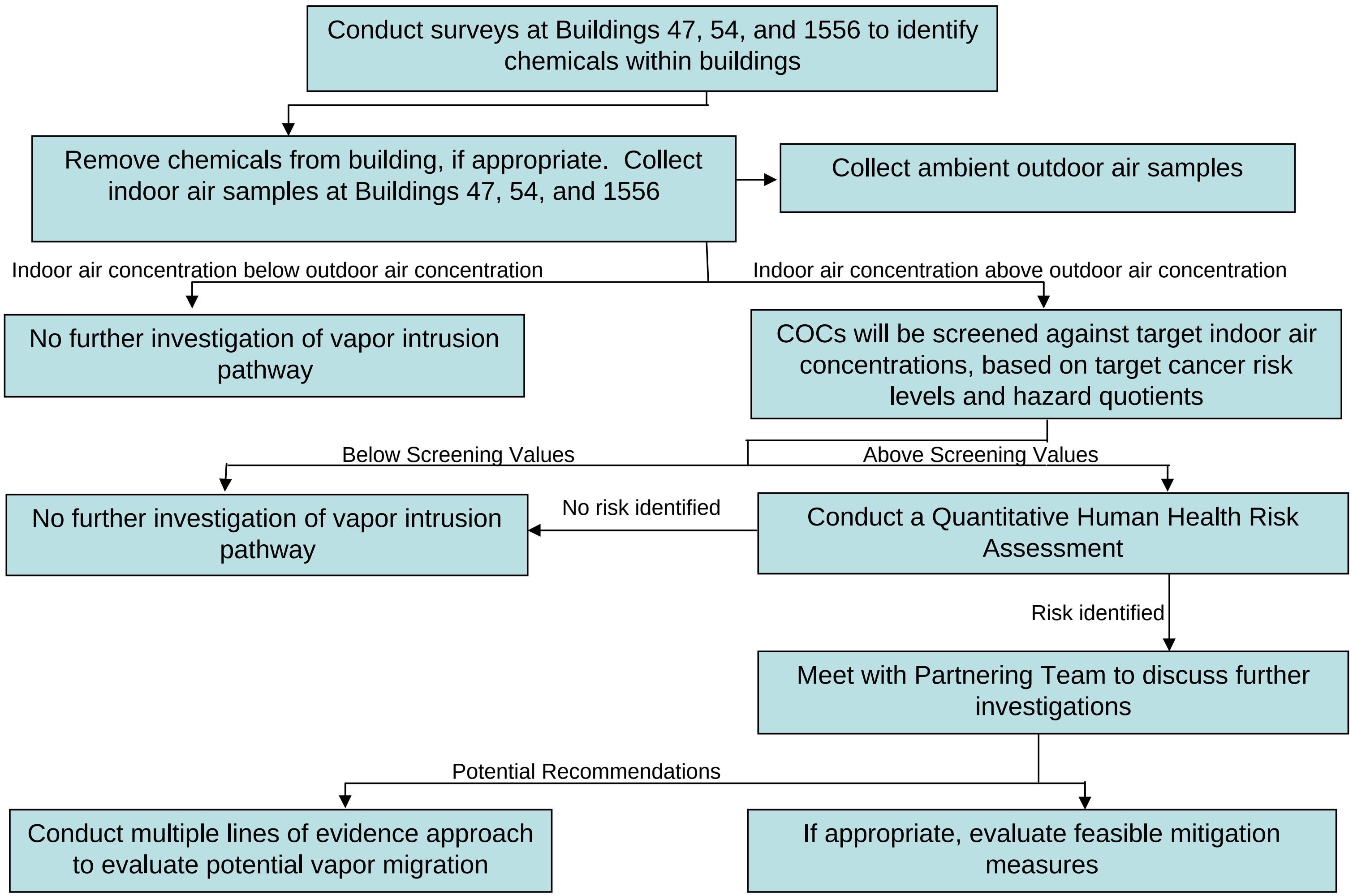
4 - SSV industrial PALs for the carcinogenic COCs are the USEPA Regional Screening Levels (indoor air, industrial) multiplied by 10, based on the conservative attenuation factor of 0.1, for which shallow soil gas is conservatively assumed to intrude into indoor air spaces. SSV industrial PALs for the non-carcinogenic COCs are the USEPA Regional Screening Levels (indoor air, industrial) adjusted by a Hazard Quotient of 0.1 (divided by 10) to account for additive effects and multiplied by 10 in order to adjust for a conservative attenuation factor of 0.1.
5 - Collect the samples immediately after results are obtained from the previous sampling event.
6 - IA sample: indoor air sample collected at 2- to 5-ft above the floor.
7 - Upwind AA samples should be collected upwind and away from the contaminant plume. Near-building AA samples should be collected near air intakes to the extent feasible.
8 - Industrial air PALs are directly from the USEPA Regional Screening Levels (indoor air, industrial) for the carcinogenic COCs. Industrial indoor air PALs for the non-carcinogenic COCs are the USEPA Regional Screening Levels (indoor air, industrial) adjusted by a Hazard Quotient of 0.1 (divided by 10) to account for additive effects.
9 - Lines of evidence may include: tracer compounds to develop building specific attenuation factors, constituent ratios within each sample (SSV Ratio, IA Ratio, Upwind AA Ratio, Near-building AA Ratio), national background levels for indoor air, national background levels for outdoor air, magnitude of exceedance of RSL in comparison to IA/AA concentrations, building survey information.
10 - Additional SSV/GW samples may be needed post remedial action to monitor remedy effectiveness.
11 - Top-of-aquifer groundwater sample: depth-specific groundwater samples collected adjacent to the buildings at the top of the shallow aquifer.
12 - Lines of Evidence may include: Constituent ratios within each sample (GW ratio [considering vaporization potential of COCs], IA Ratio, Upwind AA Ratio, Near-building AA Ratio), national background levels for indoor air, national background levels for outdoor air, clean water layer, magnitude of exceedance of RSL in comparison to IA/AA concentrations, building survey information.
13 - If the groundwater table is not below the building foundation during the initial mobilization, repeat Box 3 after a 2-week wait. If the answer is still "No" on the second attempt, proceed to Box 28.

Acronyms:

AA - ambient air
CERCLA - Comprehensive Response, Compensation, and Liability Act
COC - chemical of concern
HHRA - Human Health Risk Assessment
IA - indoor air
NMCPHC - Navy and Marine Corps Public Health Center
PAL - Project Action Limit
SAP - Sampling and Analysis Plan
SSV - sub slab vapor
TAT - turn-around-time

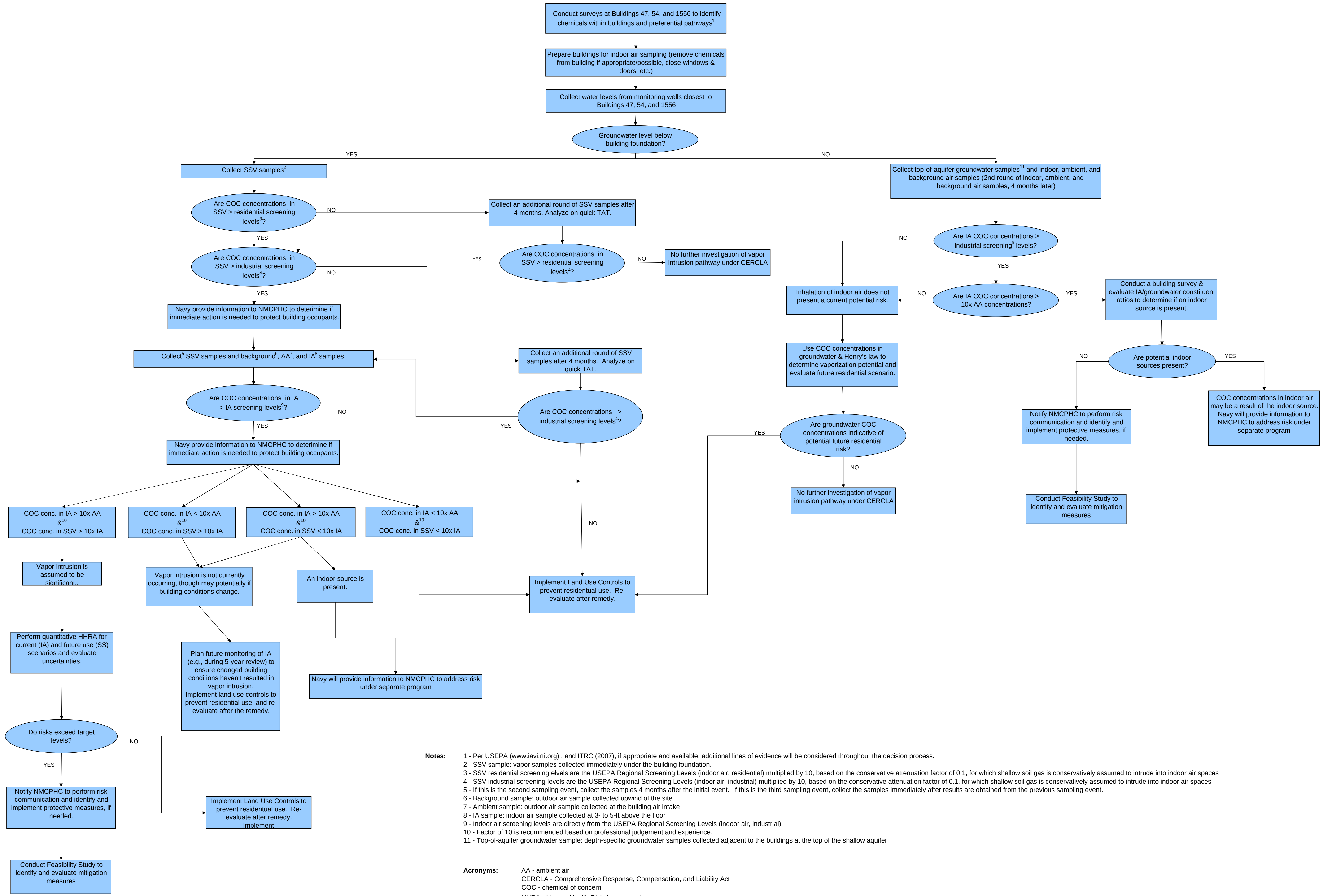
Figure 7
Site-Specific Decision Tree
Site 21
St. Juliens Creek Annex

Attachment A
Project Scoping Sheets



COC - Chemical of Concern

Attachment A-1
Decision Tree
Site 21
St. Juliens Creek Annex



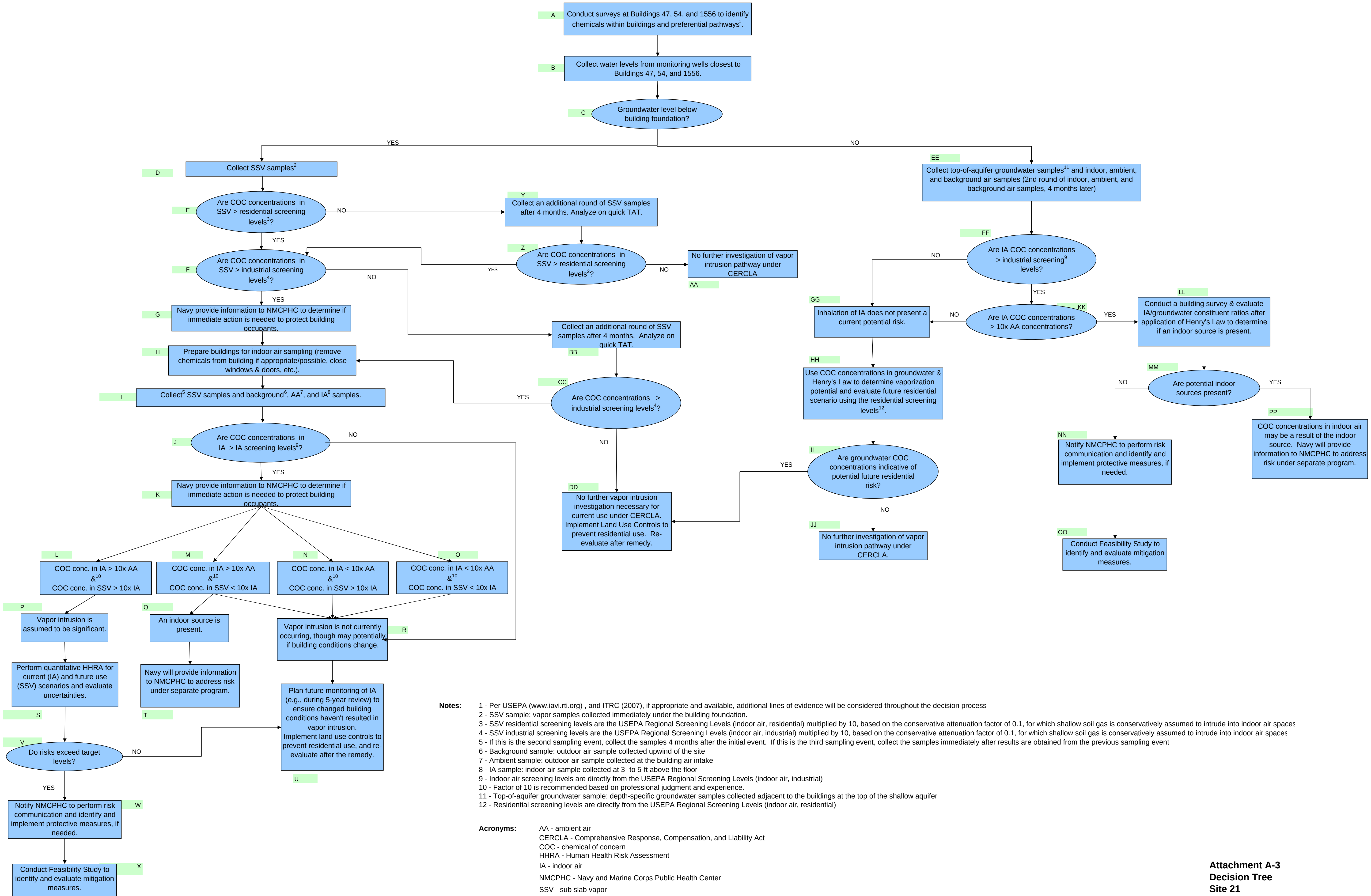
Notes:

1 - Per USEPA (www.iavi.rti.org) , and ITRC (2007), if appropriate and available, additional lines of evidence will be considered throughout the decision process.
2 - SSV sample: vapor samples collected immediately under the building foundation.
3 - SSV residential screening elvels are the USEPA Regional Screening Levels (indoor air, residential) multiplied by 10, based on the conservative attenuation factor of 0.1, for which shallow soil gas is conservatively assumed to intrude into indoor air spaces
4 - SSV industrial screening levels are the USEPA Regional Screening Levels (indoor air, industrial) multiplied by 10, based on the conservative attenuation factor of 0.1, for which shallow soil gas is conservatively assumed to intrude into indoor air spaces
5 - If this is the second sampling event, collect the samples 4 months after the initial event. If this is the third sampling event, collect the samples immediately after results are obtained from the previous sampling event.
6 - Background sample: outdoor air sample collected upwind of the site
7 - Ambient sample: outdoor air sample collected at the building air intake
8 - IA sample: indoor air sample collected at 3- to 5-ft above the floor
9 - Indoor air screening levels are directly from the USEPA Regional Screening Levels (indoor air, industrial)
10 - Factor of 10 is recommended based on professional judgement and experience.
11 - Top-of-aquifer groundwater sample: depth-specific groundwater samples collected adjacent to the buildings at the top of the shallow aquifer

Acronyms:

AA - ambient air
CERCLA - Comprehensive Response, Compensation, and Liability Act
COC - chemical of concern
HHRA - Human Health Risk Assessment
IA - indoor air
NMCPHC - Navy and Marine Corps Public Health Center
SSV - subslab vapor

DRAFT
Attachment A-2
Decision Tree
Site 21
St. Juliens Creek Annex



Notes:

1 - Per USEPA (www.iavi.rti.org) , and ITRC (2007), if appropriate and available, additional lines of evidence will be considered throughout the decision process
2 - SSV sample: vapor samples collected immediately under the building foundation.
3 - SSV residential screening levels are the USEPA Regional Screening Levels (indoor air, residential) multiplied by 10, based on the conservative attenuation factor of 0.1, for which shallow soil gas is conservatively assumed to intrude into indoor air spaces
4 - SSV industrial screening levels are the USEPA Regional Screening Levels (indoor air, industrial) multiplied by 10, based on the conservative attenuation factor of 0.1, for which shallow soil gas is conservatively assumed to intrude into indoor air spaces
5 - If this is the second sampling event, collect the samples 4 months after the initial event. If this is the third sampling event, collect the samples immediately after results are obtained from the previous sampling event
6 - Background sample: outdoor air sample collected upwind of the site
7 - Ambient sample: outdoor air sample collected at the building air intake
8 - IA sample: indoor air sample collected at 3- to 5-ft above the floor
9 - Indoor air screening levels are directly from the USEPA Regional Screening Levels (indoor air, industrial)
10 - Factor of 10 is recommended based on professional judgment and experience.
11 - Top-of-aquifer groundwater sample: depth-specific groundwater samples collected adjacent to the buildings at the top of the shallow aquifer
12 - Residential screening levels are directly from the USEPA Regional Screening Levels (indoor air, residential)

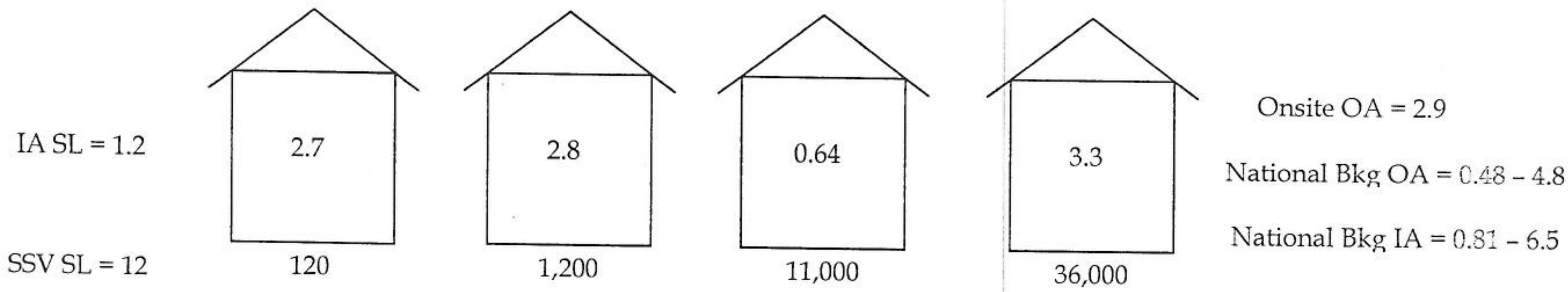
Acronyms:

AA - ambient air
CERCLA - Comprehensive Response, Compensation, and Liability Act
COC - chemical of concern
HHRA - Human Health Risk Assessment
IA - indoor air
NMCPHC - Navy and Marine Corps Public Health Center
SSV - sub slab vapor
TAT - turn-around-time

Attachment A-3
Decision Tree
Site 21
St. Juliens Creek Annex

Example Using Empirical Data from Navy Base

Trichloroethylene (ug/m3)



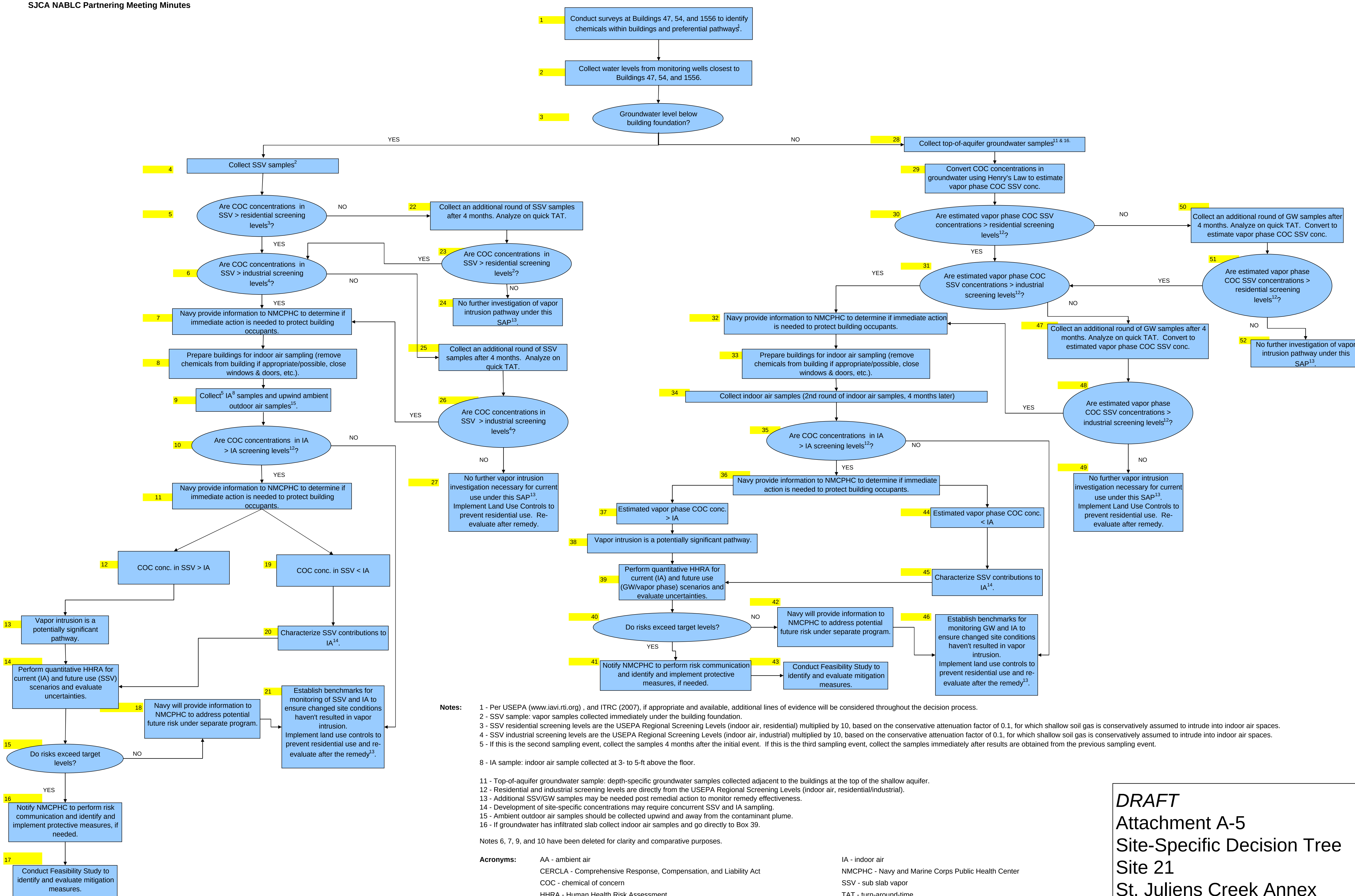
IA = Indoor Air
SSV = Subslab Vapor

OA = Outdoor Air
SL = Screening Level

Key Points

- Measured IA similar to outdoor air (onsite and national bkgd)
- Measured IA within or below range of national bkgd IA
- National bkgd IA 2-4 times national bkgd OA at sites without subsurface impacts
- Increasing SSV concs. did not correlate with higher IA, indicating: 1) no significant vapor intrusion; and 2) AF of 0.1 is conservative (may be as low as 1E-04, or lower; common empirical observation)

Attachment A-4
Case Study
Site 21
St. Juliens Creek Annex



Notes:

1 - Per USEPA (www.iavi.rti.org) , and ITRC (2007), if appropriate and available, additional lines of evidence will be considered throughout the decision process.
2 - SSV sample: vapor samples collected immediately under the building foundation.
3 - SSV residential screening levels are the USEPA Regional Screening Levels (indoor air, residential) multiplied by 10, based on the conservative attenuation factor of 0.1, for which shallow soil gas is conservatively assumed to intrude into indoor air spaces.
4 - SSV industrial screening levels are the USEPA Regional Screening Levels (indoor air, industrial) multiplied by 10, based on the conservative attenuation factor of 0.1, for which shallow soil gas is conservatively assumed to intrude into indoor air spaces.
5 - If this is the second sampling event, collect the samples 4 months after the initial event. If this is the third sampling event, collect the samples immediately after results are obtained from the previous sampling event.

8 - IA sample: indoor air sample collected at 3- to 5-ft above the floor.

11 - Top-of-aquifer groundwater sample: depth-specific groundwater samples collected adjacent to the buildings at the top of the shallow aquifer.
12 - Residential and industrial screening levels are directly from the USEPA Regional Screening Levels (indoor air, residential/industrial).
13 - Additional SSV/GW samples may be needed post remedial action to monitor remedy effectiveness.
14 - Development of site-specific concentrations may require concurrent SSV and IA sampling.
15 - Ambient outdoor air samples should be collected upwind and away from the contaminant plume.
16 - If groundwater has infiltrated slab collect indoor air samples and go directly to Box 39.

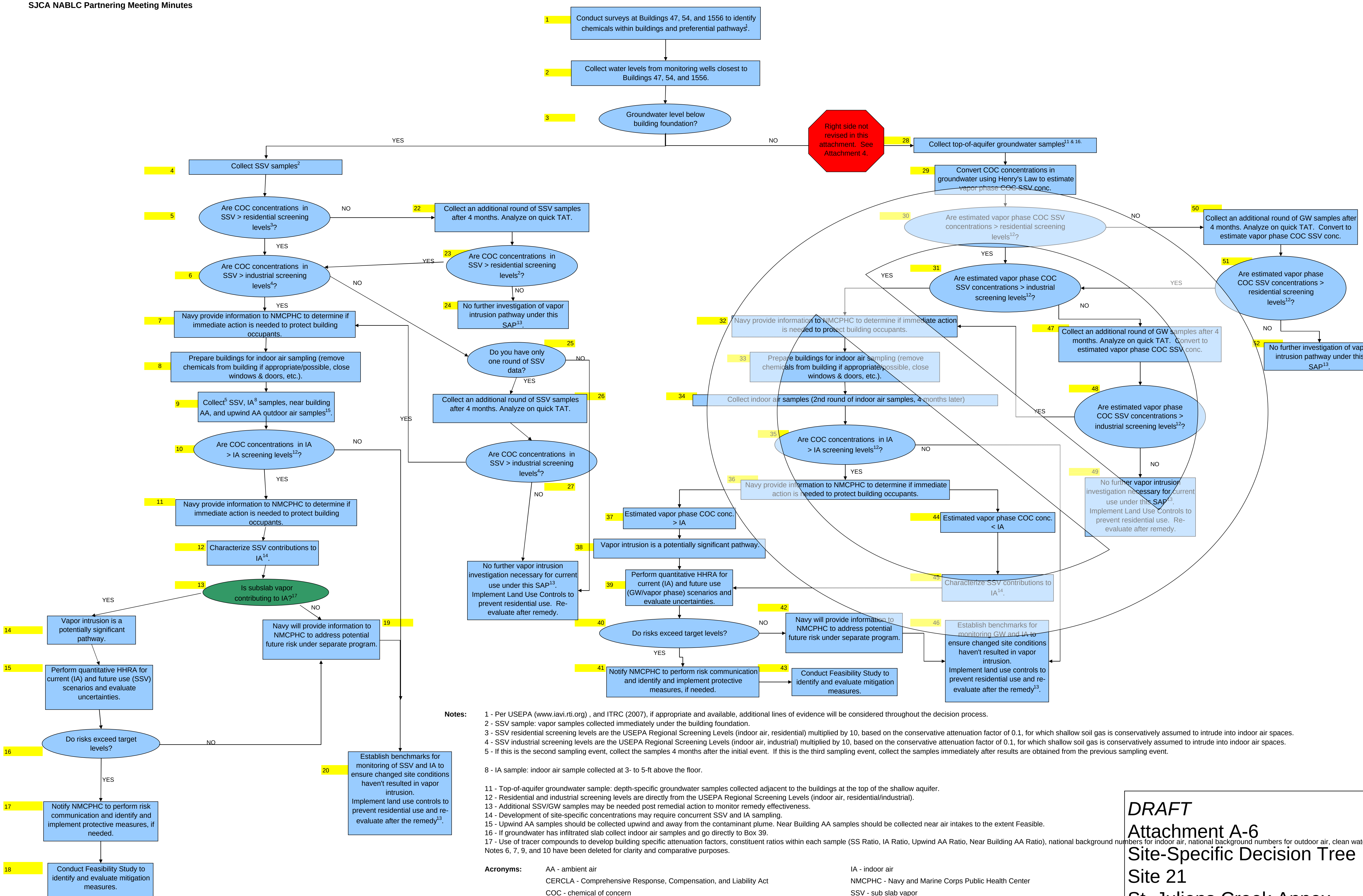
Notes 6, 7, 9, and 10 have been deleted for clarity and comparative purposes.

Acronyms:

AA - ambient air
CERCLA - Comprehensive Response, Compensation, and Liability Act
COC - chemical of concern
HHRA - Human Health Risk Assessment
IA - indoor air
NMCPHC - Navy and Marine Corps Public Health Center
SSV - sub slab vapor
TAT - turn-around-time

DRAFT
Attachment A-5
Site-Specific Decision Tree
Site 21
St. Juliens Creek Annex

Attachment 4 - Joint Decision Tree, Left Side
SJCA NABLC Partnering Meeting Minutes



Notes:

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3 - SSV residential screening levels are the USEPA Regional Screening Levels (indoor air, residential) multiplied by 10, based on the conservative attenuation factor of 0.1, for which shallow soil gas is conservatively assumed to intrude into indoor air spaces.
4 - SSV industrial screening levels are the USEPA Regional Screening Levels (indoor air, industrial) multiplied by 10, based on the conservative attenuation factor of 0.1, for which shallow soil gas is conservatively assumed to intrude into indoor air spaces.
5 - If this is the second sampling event, collect the samples 4 months after the initial event. If this is the third sampling event, collect the samples immediately after results are obtained from the previous sampling event.

8 - IA sample: indoor air sample collected at 3- to 5-ft above the floor.

11 - Top-of-aquifer groundwater sample: depth-specific groundwater samples collected adjacent to the buildings at the top of the shallow aquifer.
12 - Residential and industrial screening levels are directly from the USEPA Regional Screening Levels (indoor air, residential/industrial).
13 - Additional SSV/GW samples may be needed post remedial action to monitor remedy effectiveness.
14 - Development of site-specific concentrations may require concurrent SSV and IA sampling.
15 - Upwind AA samples should be collected upwind and away from the contaminant plume. Near Building AA samples should be collected near air intakes to the extent Feasible.
16 - If groundwater has infiltrated slab collect indoor air samples and go directly to Box 39.
17 - Use of tracer compounds to develop building specific attenuation factors, constituent ratios within each sample (SS Ratio, IA Ratio, Upwind AA Ratio, Near Building AA Ratio), national background numbers for indoor air, national background numbers for outdoor air, clean water layer, ma
Notes 6, 7, 9, and 10 have been deleted for clarity and comparative purposes.

Acronyms:

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CERCLA - Comprehensive Response, Compensation, and Liability Act
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HHRA - Human Health Risk Assessment
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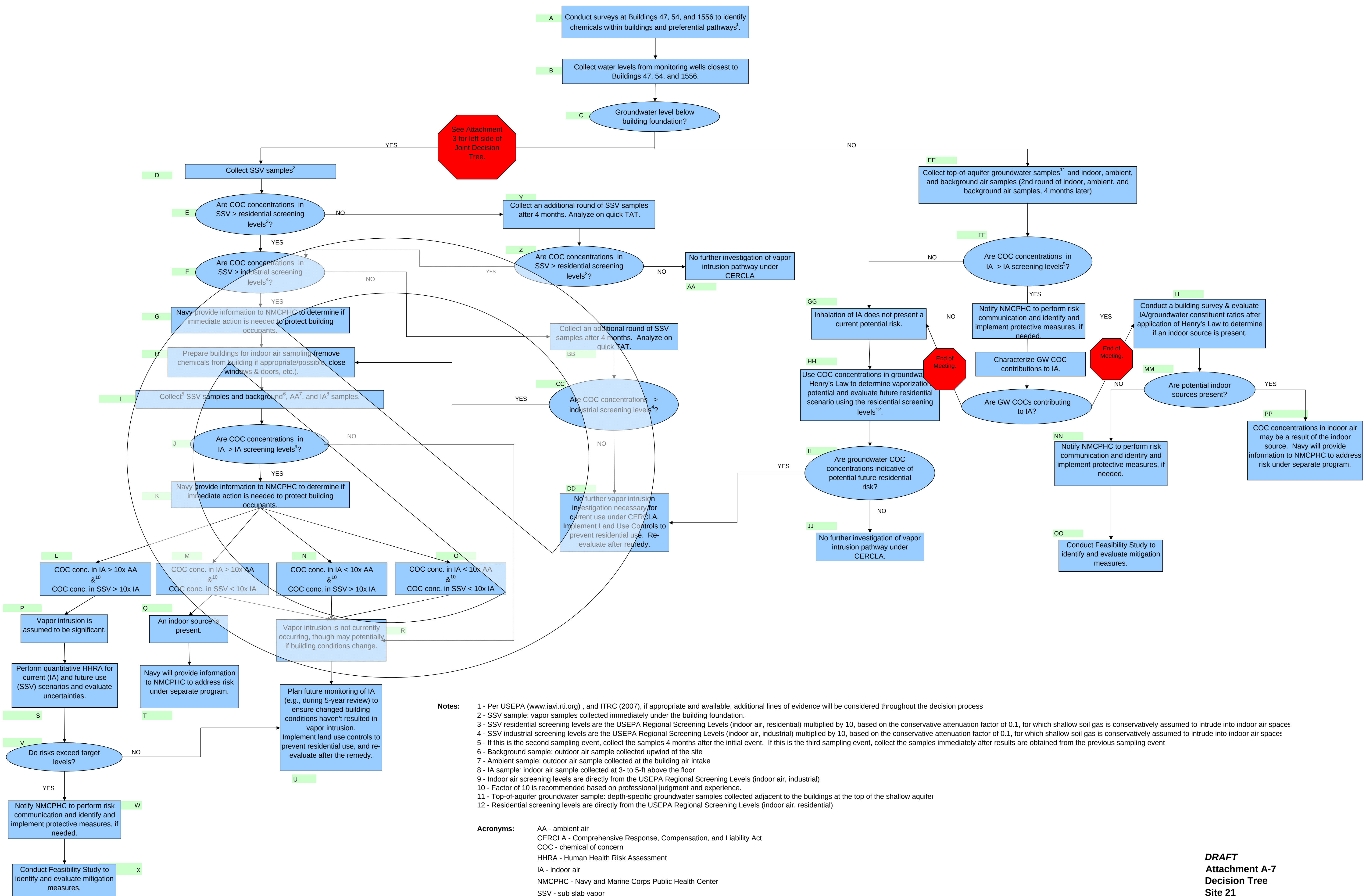
NMCPHC - Navy and Marine Corps Public Health Center
SSV - sub slab vapor
TAT - turn-around-time

DRAFT
Attachment A-6
Site-Specific Decision Tree
Site 21
St. Juliens Creek Annex



Notes:

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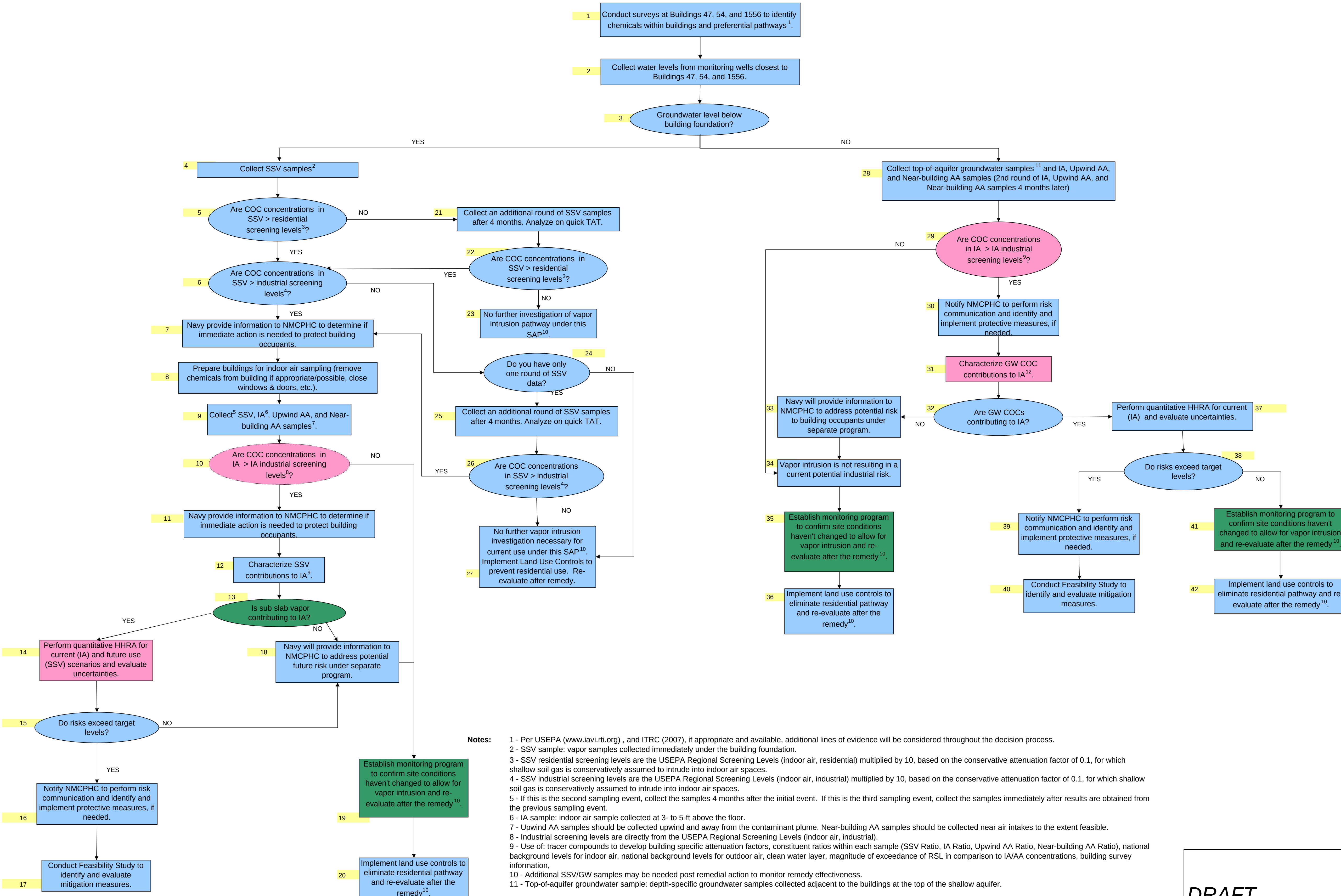
4 - SSV industrial screening levels are the USEPA Regional Screening Levels (indoor air, industrial) multiplied by 10, based on the conservative attenuation factor of 0.1, for which shallow soil gas is conservatively assumed to intrude into indoor air spaces
5 - If this is the second sampling event, collect the samples 4 months after the initial event. If this is the third sampling event, collect the samples immediately after results are obtained from the previous sampling event
6 - Background sample: outdoor air sample collected upwind of the site
7 - Ambient sample: outdoor air sample collected at the building air intake
8 - IA sample: indoor air sample collected at 3- to 5-ft above the floor
9 - Indoor air screening levels are directly from the USEPA Regional Screening Levels (indoor air, industrial)
10 - Factor of 10 is recommended based on professional judgment and experience.
11 - Top-of-aquifer groundwater sample: depth-specific groundwater samples collected adjacent to the buildings at the top of the shallow aquifer
12 - Residential screening levels are directly from the USEPA Regional Screening Levels (indoor air, residential)

Acronyms:

AA - ambient air
CERCLA - Comprehensive Response, Compensation, and Liability Act
COC - chemical of concern
HHRA - Human Health Risk Assessment
IA - indoor air
NMCPHC - Navy and Marine Corps Public Health Center
SSV - sub slab vapor
TAT - turn-around-time

DRAFT
Attachment A-7
Decision Tree
Site 21
St. Juliens Creek Annex



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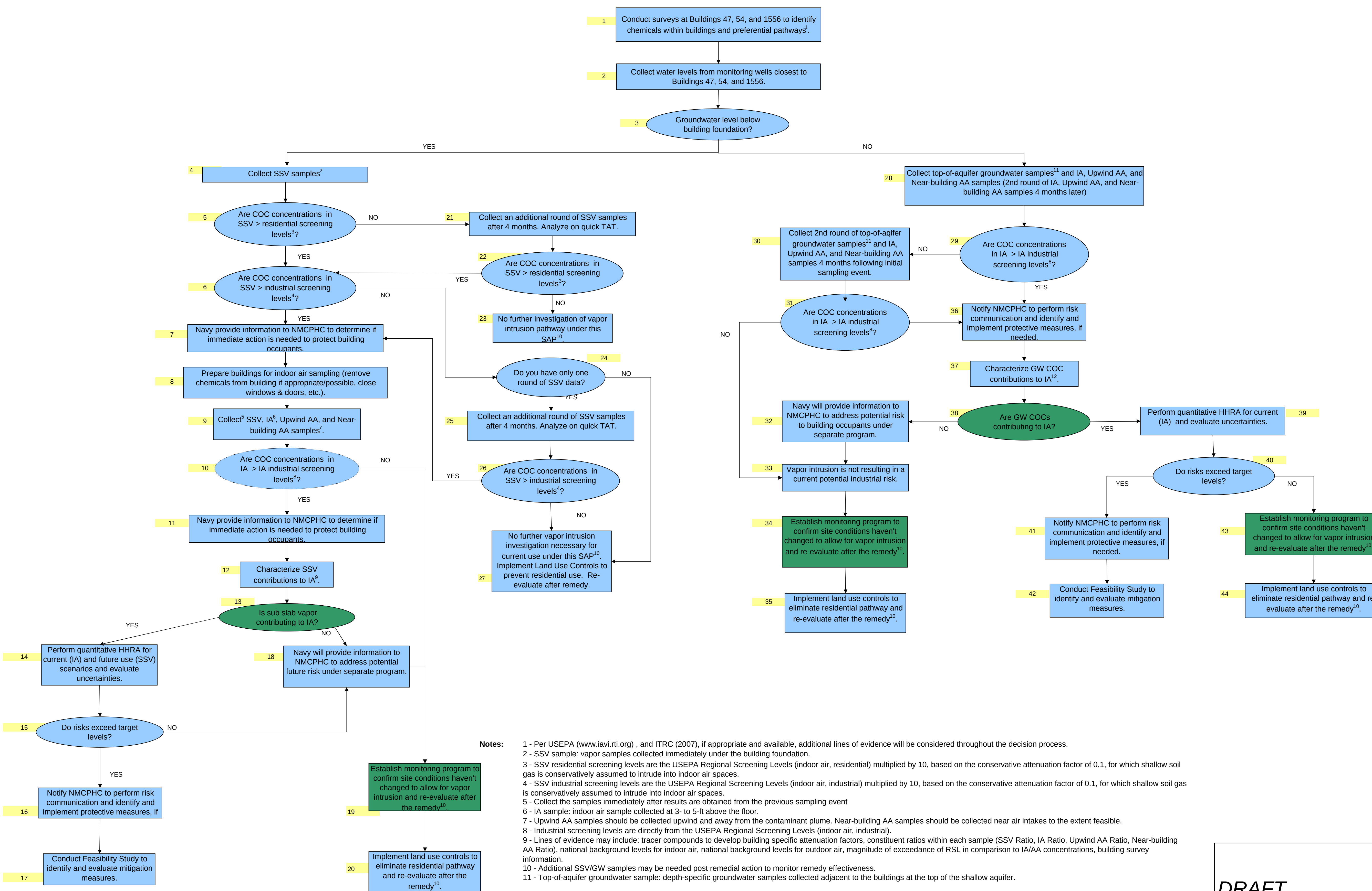
5 - If this is the second sampling event, collect the samples 4 months after the initial event. If this is the third sampling event, collect the samples immediately after results are obtained from the previous sampling event.
6 - IA sample: indoor air sample collected at 3- to 5-ft above the floor.
7 - Upwind AA samples should be collected upwind and away from the contaminant plume. Near-building AA samples should be collected near air intakes to the extent feasible.
8 - Industrial screening levels are directly from the USEPA Regional Screening Levels (indoor air, industrial).
9 - Use of: tracer compounds to develop building specific attenuation factors, constituent ratios within each sample (SSV Ratio, IA Ratio, Upwind AA Ratio, Near-building AA Ratio), national background levels for indoor air, national background levels for outdoor air, clean water layer, magnitude of exceedance of RSL in comparison to IA/AA concentrations, building survey information,
10 - Additional SSV/GW samples may be needed post remedial action to monitor remedy effectiveness.
11 - Top-of-aquifer groundwater sample: depth-specific groundwater samples collected adjacent to the buildings at the top of the shallow aquifer.
12 - Use of: Constituent ratios within each sample (GW ratio [considering vaporization potential of COCs], IA Ratio, Upwind AA Ratio, Near-building AA Ratio), national background levels for indoor air, national background levels for outdoor air, clean water layer, magnitude of exceedance of RSL in comparison to IA/AA concentrations, building survey information.

ACTION | GENERAL QUESTION | TEAM QUESTION/ INPUT POINT

Acronyms:

AA - ambient air
CERCLA - Comprehensive Response, Compensation, and Liability Act
COC - chemical of concern
HHRA - Human Health Risk Assessment
IA - indoor air
NMCPHC - Navy and Marine Corps Public Health Center
SAP - Sampling and Analysis Plan
SSV - sub slab vapor
TAT - turn-around-time

DRAFT
Attachment A-8
Site-Specific Decision Tree
Site 21
St. Juliens Creek Annex



Notes:

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4 - SSV industrial screening levels are the USEPA Regional Screening Levels (indoor air, industrial) multiplied by 10, based on the conservative attenuation factor of 0.1, for which shallow soil gas is conservatively assumed to intrude into indoor air spaces.
5 - Collect the samples immediately after results are obtained from the previous sampling event
6 - IA sample: indoor air sample collected at 3- to 5-ft above the floor.
7 - Upwind AA samples should be collected upwind and away from the contaminant plume. Near-building AA samples should be collected near air intakes to the extent feasible.
8 - Industrial screening levels are directly from the USEPA Regional Screening Levels (indoor air, industrial).
9 - Lines of evidence may include: tracer compounds to develop building specific attenuation factors, constituent ratios within each sample (SSV Ratio, IA Ratio, Upwind AA Ratio, Near-building AA Ratio), national background levels for indoor air, national background levels for outdoor air, magnitude of exceedance of RSL in comparison to IA/AA concentrations, building survey information.
10 - Additional SSV/GW samples may be needed post remedial action to monitor remedy effectiveness.
11 - Top-of-aquifer groundwater sample: depth-specific groundwater samples collected adjacent to the buildings at the top of the shallow aquifer.

12 - Lines of Evidence may include: Constituent ratios within each sample (GW ratio [considering vaporization potential of COCs], IA Ratio, Upwind AA Ratio, Near-building AA Ratio), national background levels for indoor air, national background levels for outdoor air, clean water layer, magnitude of exceedance of RSL in comparison to IA/AA concentrations, building survey information.

ACTION | GENERAL QUESTION | TEAM QUESTION/ INPUT POINT

Acronyms:

AA - ambient air
CERCLA - Comprehensive Response, Compensation, and Liability Act
COC - chemical of concern
HHRA - Human Health Risk Assessment
IA - indoor air
NMCPHC - Navy and Marine Corps Public Health Center
SAP - Sampling and Analysis Plan
SSV - sub slab vapor
TAT - turn-around-time

DRAFT
Attachment A-9
Site-Specific Decision Tree
Site 21
St. Juliens Creek Annex

Attachment B
Field Standard Operating Procedures

STANDARD OPERATING PROCEDURE

Decontamination of Personnel and Equipment

I. Purpose

To provide general guidelines for the decontamination of personnel, sampling equipment, and monitoring equipment used in potentially contaminated environments.

II. Scope

This is a general description of decontamination procedures.

III. Equipment and Materials

- Demonstrated analyte-free, deionized ("DI") water (specifically, ASTM Type II water or lab-grade DI water)
- Distilled water
- Potable water; must be from a municipal water supplier, otherwise an analysis must be run for appropriate volatile and semivolatile organic compounds and inorganic chemicals (e.g., Target Compound List and Target Analyte List chemicals)
- 2.5% (W/W) Liquinox® (or Alconox®)and water solution
- Concentrated (V/V) pesticide grade methanol (DO NOT USE ACETONE)
- Large plastic pails or tubs for Liquinox® and water, scrub brushes, squirt bottles for Liquinox® solution, methanol and water, plastic bags and sheets
- DOT approved 55-gallon drum for disposal of waste
- Phthalate-free gloves such as Nitrile
- Decontamination pad and steam cleaner/high pressure cleaner for large equipment

IV. Procedures and Guidelines

A. PERSONNEL DECONTAMINATION

To be performed after completion of tasks whenever potential for contamination exists, and upon leaving the exclusion zone.

1. Wash boots in Liquinox® solution, then rinse with water. If disposable latex booties are worn over boots in the work area, rinse with Liquinox® solution, remove, and discard into DOT-approved 55-gallon drum.
2. Wash outer gloves in Liquinox® solution, rinse, remove, and discard into DOT-approved 55-gallon drum.
3. Remove disposable coveralls ("Tyveks") and discard into DOT-approved 55-gallon drum.
4. Remove respirator (if worn).
5. Remove inner gloves and discard.
6. At the end of the work day, shower entire body, including hair, either at the work site or at home.
7. Sanitize respirator if worn.

B. SAMPLING EQUIPMENT DECONTAMINATION—GROUNDWATER SAMPLING PUMPS

Sampling pumps are decontaminated after each use as follows.

1. Don phthalate-free gloves.
2. Spread plastic on the ground to keep equipment from touching the ground
3. Turn off pump after sampling. Remove pump from well and remove and dispose of tubing. Place pump in decontamination tube.
4. Turn pump back on and pump 1 gallon of Liquinox® solution through the sampling pump.
5. Rinse with 1 gallon of 10% methanol solution pumped through the pump. (DO NOT USE ACETONE).
6. Rinse with 1 gallon of tap water.
7. Rinse with 1 gallon of deionized water.
8. Keep decontaminated pump in decontamination tube or remove and wrap in aluminum foil or clean plastic sheeting.
9. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.
10. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums.

C. SAMPLING EQUIPMENT DECONTAMINATION—OTHER EQUIPMENT

Reusable sampling equipment is decontaminated after each use as follows.

1. Don phthalate-free gloves.
2. Before entering the potentially contaminated zone, wrap soil contact points in aluminum foil (shiny side out).
3. Rinse and scrub with potable water.
4. Wash all equipment surfaces that contacted the potentially contaminated soil/water with Liquinox® solution.
5. Rinse with potable water.
6. Rinse with distilled or potable water and methanol solution (DO NOT USE ACETONE).
7. Air dry.
8. Rinse with deionized water.
9. Completely air dry and wrap exposed areas with aluminum foil (shiny side out) for transport and handling if equipment will not be used immediately.
10. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.
11. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums.

D. HEALTH AND SAFETY MONITORING EQUIPMENT DECONTAMINATION

1. Before use, wrap soil contact points in plastic to reduce need for subsequent cleaning.
2. Wipe all surfaces that had possible contact with contaminated materials with a paper towel wet with Liquinox® solution, then a towel wet with methanol solution, and finally three times with a towel wet with distilled water. Dispose of all used paper towels in a DOT-approved 55-gallon drum.

E. SAMPLE CONTAINER DECONTAMINATION

The outsides of sample bottles or containers filled in the field may need to be decontaminated before being packed for shipment or handled by personnel without hand protection. The procedure is:

1. Wipe container with a paper towel dampened with Liquinox® solution or immerse in the solution AFTER THE CONTAINERS HAVE BEEN SEALED. Repeat the above steps using potable water.
2. Dispose of all used paper towels in a DOT-approved 55-gallon drum.

F. HEAVY EQUIPMENT AND TOOLS

Heavy equipment such as drilling rigs, drilling rods/tools, and the backhoe will be decontaminated upon arrival at the site and between locations as follows:

1. Set up a decontamination pad in area designated by the Facility
2. Steam clean heavy equipment until no visible signs of dirt are observed. This may require wire or stiff brushes to dislodge dirt from some areas.

V. Attachments

None.

VI. Key Checks and Items

- Clean with solutions of Liquinox®, methanol, and distilled water.
- Do not use acetone for decontamination.
- Drum all contaminated rinsate and materials.
- Decontaminate filled sample bottles before relinquishing them to anyone.

STANDARD OPERATING PROCEDURE

Disposal of Waste Fluids and Solids

I. Purpose and Scope

This SOP describes the procedures used to dispose of hazardous fluid and solid materials generated as a result of the site operations. This SOP does not provide guidance on the details of Department of Transportation regulations pertaining to the transport of hazardous wastes; the appropriate Code of Federal Regulations (49 CFR 171 through 177) should be referenced. Also, the site investigation-derived waste management plan should be consulted for additional information and should take precedence over this SOP.

II. Equipment and Materials

A. Fluids

- DOT-approved 55-gallon steel drums or Baker® Tanks
- Tools for securing drum lids
- Funnel for transferring liquid into drum
- Labels
- Paint Pens
- Marking pen for appropriate labels
- Seals for 55-gallon steel drums

B. Solids

- DOT-approved 55-gallon steel drums or rolloffs
- Tools for securing drum lids
- Paint Pens
- Plastic sheets
- Labels
- Marking pen for appropriate labels

III. Procedures and Guidelines

A. Methodology

Clean, empty drums or rolloffs or Baker® Tanks will be brought to the site by the drilling subcontractor for soil and groundwater collection and storage. The empty drums will be located at the field staging area and moved to drilling locations as required. The drums will be filled with the drilling and well installation wastes, capped, sealed, and moved to the onsite drum storage area by the drilling subcontractor. The full drums will separate types of wastes by media. The drums will be labeled as they are filled in the field and labels indicating that the contents are potentially hazardous affixed.

The drum contents will be sampled to determine the disposal requirements of the drilling wastes. The drum sampling will be accomplished through the collection and submittal of composite samples, one sample per 10 drums containing the same media. Similar compositing will be performed in each rolloff to obtain a representative sample. The compositing of the sample will be accomplished by collecting a specific volume of the material in each drum into a large sample container. When samples from each of the drums being sampled in a single compositing are collected, the sample will be submitted for TCLP, ignitability, corrosivity, and reactivity analysis. The analysis will be used to determine if drilling wastes are covered by land disposal restrictions.

If rolloffs are used, compositing and sampling of soil will comply with applicable state and federal regulations.

B. Labels

Drums and other containers used for storing wastes from drilling operations will be labeled when accumulation in the container begins. Labels will include the following minimum information:

- Container number
- Container contents
- Origin (source area including individuals wells, piezometers, and soil borings)
- Date that accumulation began
- Date that accumulation ended
- Generator Contact Information
- When laboratory results are received, drum labels will be completed or revised to indicate the hazardous waste constituents in compliance with Title 40 of the Code of Federal Regulations, Part 262, Subpart C.

C. Fluids

Drilling fluids generated during soil boring and groundwater discharged during development and purging of the monitoring wells will be collected in 55-gallon, closed-top drums. When a drum is filled, the bung will be secured tightly. Fluids may also be transferred to Baker® Tanks after being temporarily contained in drums to minimize the amount of drums used.

When development and purging is completed, the water will be tested for appropriate hazardous waste constituents. Compositing and sampling of fluids will comply with applicable state and federal regulations.

D. Solids

The soil cuttings from well and boring drilling will constitute a large portion of the solids to be disposed of.

The solid waste stream also will include plastic sheeting used for decontamination pads, Tyveks, disposable sampling materials, and any other disposable material used during the field operations that appears to be contaminated. These materials will be placed in designated drums.

E. Storage and Disposal

The wastes generated at the site at individual locations will be transported to the fenced drum storage area by the drilling services subcontractor. Drums should be stored on pallets on plastic sheeting to capture small spills.

Waste solid materials that contain hazardous constituents will be disposed of at an offsite location in a manner consistent with applicable solid waste, hazardous waste, and water quality regulations. Transport and disposal will be performed by a commercial firm under subcontract.

The liquid wastes meeting acceptable levels of discharge contamination may be disposed of through the sanitary sewer system at the site. Prior to disposal to the sanitary sewer system, contract arrangements will be made with the appropriate authorities. Wastes exceeding acceptable levels for disposal through the sanitary sewer system will be disposed of through contract with a commercial transport and disposal firm.

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

- Check that representative samples of the containerized materials are obtained.
- Be sure that all state and federal regulations are considered when classifying waste for disposal.

STANDARD OPERATING PROCEDURE

Decontamination of Drilling Rigs and Equipment

I. Purpose and Scope

The purpose of this guideline is to provide methods for the decontamination of drilling rigs, downhole drilling tools, and water-level measurement equipment. Personnel decontamination procedures are not addressed in this SOP; refer to the site safety plan and SOP *Decontamination of Personnel and Equipment*. Sample bottles will not be field decontaminated; instead they will be purchased with certification of laboratory sterilization.

II. Equipment and Materials

- Portable steam cleaner and related equipment
- Potable water
- Phosphate-free detergent such as Alconox® or Liquinox®
- Buckets
- Brushes
- Distilled organic-free water
- Methanol, pesticide grade
- ASTM–Type II grade water
- Aluminum foil

III. Procedures and Guidelines

A. Drilling Rigs and Monitoring Well Materials

Before the onset of drilling, after each borehole, before drilling through permanent isolation casing, and before leaving the site, heavy equipment and machinery will be decontaminated by steam cleaning at a designated area. The steam cleaning area will be designed to contain decontamination wastes and waste waters and can be an HDPE-lined, bermed pad. A pumping system will be used to convey decontaminated water from the pad to drums.

Surface casings may be steam cleaned in the field if they are exposed to contamination at the site prior to use.

B. Downhole Drilling Tools

Downhole tools will be steam cleaned before the onset of drilling, prior to drilling through permanent isolation casing, and between boreholes. This will include, but is not limited to, rods, split-spoons or similar samplers, coring equipment, augers, and casing.

Before the use of a sampling device such as a split-spoon sampler for the collection of a soil sample for physical characterization, the sampler shall be cleaned by scrubbing with a detergent solution followed by a potable water rinse.

Before the use of a sampling device such as a split-spoon sampler for the collection of a soil sample for chemical analysis, the sampler shall be decontaminated following the procedures outlined in the following subsection.

C. Field Analytical Equipment

1. Water Level Indicators

Water level indicators that consist of a probe that comes into contact with the groundwater must be decontaminated using the following steps:

a. Rinse with tap water
b. Rinse with de-ionized water
c. Solvent rinse with methanol
d. Rinse with de-ionized water

2. Probes

Probes, for example, pH or specific ion electrodes, geophysical probes, or thermometers that would come in direct contact with the sample, will be decontaminated using the procedures specified above unless manufacturer's instructions indicate otherwise. For probes that make no direct contact, for example, OVM equipment, the probe will be wiped with clean paper-towels or cloth wetted with methanol.

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

The effectiveness of field cleaning procedures will be monitored by rinsing decontaminated equipment with organic-free water and submitting the rinse water in standard sample containers for analysis. Anytime a sampling event occurs, at least one such quality control sample shall be collected. The total number of equipment blanks will be at least 5 percent of the number of samples collected during large-scale field sampling efforts.

At least one piece of field equipment shall be selected for this procedure each time equipment is washed. An attempt should be made to select different pieces of equipment for this procedure.

STANDARD OPERATING PROCEDURE

Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, ORP, and Temperature Using the Horiba® U-22 with Flow-through Cell

I. Purpose and Scope

The purpose of this procedure is to provide a general guideline for using the Horiba® U-22 for field measurements of pH, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (ORP), and temperature of groundwater samples. The operator's manual should be consulted for detailed operating procedures.

II. Equipment and Materials

- Horiba® U-22 Water Quality Checker with flow-though cell
- Distilled water in squirt bottle
- Horiba® U-22 Auto-Calibration Standard Solution

III. Procedures and Guidelines

A. Parameters and Specifications:

Parameter	Range of measurement	Accuracy
pH	0 to 14 pH units	+/- 0.1 pH units
Specific conductance	0 to 9.99 S/m	+/- 3 % full scale
Turbidity	0 to 800 NTU	+/- 5 % full scale
Dissolved oxygen	0 to 19.99 mg/l	+/- 0.2 mg/l
Temperature	0 to 55 °C	+/- 1.0 °C
ORP	-1999 to +1999 mV	+/- 15 mV
Salinity	0 to 4 %	+/- 0.3 %

B. Calibration:

Prior to each day's use, clean the probe and flow-through cell using deionized water and calibrate using Horiba® Standard Solution. Calibration procedure:

1. Fill the calibration beaker to about 2/3 with the pH 4 standard solution.

2. Fit the probe into the beaker. All the parameter sensors will now be immersed in the standard solution except the D.O. sensor; the D.O. calibration is done using atmospheric air.

3. Turn power on.

4. Press CAL key to put the unit in the calibration mode.

5. Press the ENT key to start automatic calibration. Wait a moment, and the upper cursor will gradually move across the four auto-calibration parameters one by one: pH, COND, TURB, and DO. When the calibration is complete, the readout will briefly show END. The instrument is now calibrated.

6. If the unit is calibrated properly, pH will read 4.0 +/- 3%, conductivity will read 4.49 +/- 3%, and turbidity will read 0 +/- 3%

C. Sample Measurement:

As water passes through the flow-through Cell, press MEAS to obtain reading; record in the field notebook.

IV. Key Checks and Preventive Maintenance

- Calibrate meter
- Clean probe with deionized water when done
- Refer to operations manual for recommended maintenance
- Check batteries, and have a replacement set on hand
- Due to the importance of obtaining these parameters, the field team should have a spare unit readily available in case of an equipment malfunction.

STANDARD OPERATING PROCEDURE

Direct-Push Groundwater Sample Collection

I. Purpose

To provide a general guideline for the collection of groundwater samples using direct-push (e.g., Geoprobe®) sampling methods.

II. Scope

Standard direct-push (e.g., Geoprobe®) groundwater sampling methods.

III. Equipment and Materials

- Truck-mounted hydraulic percussion hammer.
- Direct-push (e.g., Geoprobe®) sampling rods and slotted lead rod
- Polyethylene sampling tubing and stainless steel foot valve
- Pre-cleaned sample containers
- Clean latex or surgical gloves.

IV. Procedures and Guidelines

1. Decontaminate slotted lead rod and other downhole equipment in accordance with SOP *Decontamination of Personnel and Equipment*.
2. Drive slotted steel lead rod to the desired sampling depth using the truck-mounted hydraulic percussion hammer.
3. Insert the stainless steel foot valve into the end of the polyethylene sampling tubing and insert tubing through the rods.
4. Fill all sample containers, beginning with the containers for VOC analysis.
5. Remove polyethylene sampling tubing from the rods. Remove the foot valve and discard polyethylene tubing.
6. Backfill borehole at each sampling location with grout or bentonite and repair the surface with like material (bentonite, asphalt patch, concrete, etc.), as required.

V. Key Checks and Items

- Verify that the hydraulic percussion hammer is clean and in proper working order.
- Ensure that the direct-push operator thoroughly completes the decontamination process between sampling locations.
- Ensure that the slotted lead rod has been inserted to the desired sampling depth.
- Verify that the borehole made during sampling activities has been properly backfilled.

STANDARD OPERATING PROCEDURE

Preparing Field Log Books

I. Purpose

To provide general guidelines for entering field data into log books during site investigation and remediation field activities.

II. Scope

This is a general description of data requirements and format for field log books. Log books are needed to properly document all field activities in support of data evaluation and possible legal activities.

III. Equipment and Materials

- Log book
- Indelible pen

IV. Procedures and Guidelines

Properly completed field log books are a requirement of much of the work we perform under the Navy CLEAN contract. Log books are legal documents and, as such, must be prepared following specific procedures and must contain required information to ensure their integrity and legitimacy. This SOP describes the basic requirements for field log book entries.

A. PROCEDURES FOR COMPLETING FIELD LOG BOOKS

1. Field notes commonly are kept in bound, orange-covered logbooks used by surveyors and produced, for example, by Peninsular Publishing Company and Sesco, Inc. Pages should be water-resistant and notes should be taken only with water-proof, non-erasable permanent ink, such as that provided in Sanford Sharpie® permanent markers.
2. On the inside cover of the log book the following information should be included:
   - Company name and address
   - Log-holders name if log book was assigned specifically to that person

- Activity or location
- Project name
- Project manager's name
- Phone numbers of the company, supervisors, emergency response, etc.

3. All lines of all pages should be used to prevent later additions of text, which could later be questioned. Any line not used should be marked through with a line and initialed and dated. Any pages not used should be marked through with a line, the author's initials, the date, and the note "Intentionally Left Blank."

4. If errors are made in the log book, cross a single line through the error and enter the correct information. All corrections shall be initialed and dated by the personnel performing the correction. If possible, all corrections should be made by the individual who made the error.

5. Daily entries will be made chronologically.

6. Information will be recorded directly in the field log book during the work activity. Information will not be written on a separate sheet and then later transcribed into the log book.

7. Each page of the log book will have the date of the work and the note takers initials.

8. The final page of each day's notes will include the note-takers signature as well as the date.

9. Only information relevant to the subject project will be added to the log book.

10. The field notes will be copied and the copies sent to the Project Manager or designee in a timely manner (at least by the end of each week of work being performed).

B. INFORMATION TO BE INCLUDED IN FIELD LOG BOOKS

1. Entries into the log book should be as detailed and descriptive as possible so that a particular situation can be recalled without reliance on the collector's memory. Entries must be legible and complete.

2. General project information will be recorded at the beginning of each field project. This will include the project title, the project number, and project staff.

3. Scope: Describe the general scope of work to be performed each day.

4. Weather: Record the weather conditions and any significant changes in the weather during the day.

5. Tail Gate Safety Meetings: Record time and location of meeting, who was present, topics discussed, issues/problems/concerns identified, and corrective actions or adjustments made to address concerns/ problems, and other pertinent information.

6. Standard Health and Safety Procedures: Record level of personal protection being used (e.g., level D PPE), record air monitoring data on a regular basis and note where data were recording (e.g., reading in borehole, reading in breathing zone, etc). Also record other required health and safety procedures as specified in the project specific health and safety plan.

7. Instrument Calibration; Record calibration information for each piece of health and safety and field equipment.

8. Personnel: Record names of all personnel present during field activities and list their roles and their affiliation. Record when personnel and visitors enter and leave a project site and their level of personal protection.

9. Communications: Record communications with project manager, subcontractors, regulators, facility personnel, and others that impact performance of the project.

10. Time: Keep a running time log explaining field activities as they occur chronologically throughout the day.

11. Deviations from the Work Plan: Record any deviations from the work plan and document why these were required and any communications authorizing these deviations.

12. Heath and Safety Incidents: Record any health and safety incidents and immediately report any incidents to the Project Manager.

13. Subcontractor Information: Record name of company, record names and roles of subcontractor personnel, list type of equipment being used and general scope of work. List times of starting and stopping work and quantities of consumable equipment used if it is to be billed to the project.

14. Problems and Corrective Actions: Clearly describe any problems encountered during the field work and the corrective actions taken to address these problems.

15. Technical and Project Information: Describe the details of the work being performed. The technical information recorded will vary significantly between projects. The project work plan will describe the specific activities to be performed and may also list requirements for note taking. Discuss note-taking expectations with the Project Manager prior to beginning the field work.

16. Any conditions that might adversely affect the work or any data

obtained (e.g., nearby construction that might have introduced excessive amounts of dust into the air).

17. Sampling Information; Specific information that will be relevant to most sampling jobs includes the following:

- Description of the general sampling area – site name, buildings and streets in the area, etc.
- Station/Location identifier
- Description of the sample location – estimate location in comparison to two fixed points – draw a diagram in the field log book indicating sample location relative to these fixed points – include distances in feet.
- Sample matrix and type
- Sample date and time
- Sample identifier
- Draw a box around the sample ID so that it stands out in the field notes
- Information on how the sample was collected – distinguish between "grab," "composite," and "discrete" samples
- Number and type of sample containers collected
- Record of any field measurements taken (i.e. pH, turbidity, dissolved oxygen, and temperature, and conductivity)
- Parameters to be analyzed for, if appropriate
- Descriptions of soil samples and drilling cuttings can be entered in depth sequence, along with PID readings and other observations. Include any unusual appearances of the samples.

C. SUGGESTED FORMAT FOR RECORDING FIELD DATA

1. Use the left side border to record times and the remainder of the page to record information (see attached example).
2. Use tables to record sampling information and field data from multiple samples.
3. Sketch sampling locations and other pertinent information.
4. Sketch well construction diagrams.

V. Attachments

Example field notes.

0715 ARRIVE ON SITE At XYZ Site.
CH2M Hill STAFF:
John Smith: FIELD TEAM LEADER
Bob Builder: SITE SAFETY COORD.
WEATHER: OVERCAST + Cool, 45°F
CHANCE OF LATE SHOWERS
SCOPE: • Collect GROUNDWATER
SAMPLES for LTM work at Site 14
• SUPERVISE SURVEY CREW
At Site 17
0725 BB ~~Cal JS~~ (JS) Calibrates
PID: 101 ppm/100 ppm ok
PID Model #, SERIAL #
0730 BB Calibrates HORIBA METER
Model #, SERIAL #
→ List Calibration Results
0738 Survey Crew ARRIVES on Site
→ List NAMES
0745 BB Holds H+S TALK ON Slips,
Trips, FAlls, Ticks + AIR Monitoring
JS + SURVEY CREW ATTEND
No H+S ISSUES IDENTIFIED as
CONCERNS. All work is in "Level D."
0755 JS Conducts site-WIDE Air Monitoring
All readings = 0.0 ppm in

JS
5-12-03

SITE 14 LTM
BREATHING ZONE (BZ)
0805 Mobilize to well MW-22 to
SAMPLE, surveyors setting up
At Site 17
0815 PM (PAUL PAPER PUSHER) CALLS AND
INFORMS JS to collect GW SAMPLE
At well MW-44 today for 24 hour
TAT ANALYSIS OF VOC's
0820 Purging MW-22
→ RECORD WATER QUALITY DATA
JS
5-12-03

0843 Collect SAMPLE At MW-22 for
total TAL Metals AND VOC's. No
Dissolved Metals Needed PER PM.
0905 JS + BB Mobilize to Site 17 to
show surveyors wells to Survey.
0942 Mobilize to well MW-22 to
Collect SAMPLE
0950 CAN NOT ACCESS Well MW-22
due to BASE OPERATIONS; Contact
PAUL PAPER PUSHER AND HE STATED
HE will check on GAINING ACCESS
with BASE contact.
0955 Mobilize to well MW-19

JS
5-12-03

Standard Operating Procedure

Locating and Clearing Underground Utilities

I. Purpose

The purpose of this SOP is to provide general guidelines and specific procedures that must be followed on Navy CLEAN projects for locating underground utilities and clearing dig locations in order to maximize our ability to avoid hitting underground utilities and to minimize liabilities to CH2M HILL and its subcontractors and health and safety risks to our project staff.

This SOP shall be used by Activity Managers and Project Managers to, in-turn, develop Activity-specific and project-specific utility location procedures. The activity and project-specific procedures will become part of work plans and project instructions and will be used to prepare scopes of work (SOWs) for the procurement of utility location subcontractors to meet the needs of individual projects.

This SOP also identifies the types of utility locating services that are available from subcontractors and the various tools that are used to locate utilities, and discusses when each type of service and tool may or may not be applicable.

II. Scope

Depending on the Navy/Marine Activity we typically find ourselves in one of two scenarios:

Scenario 1

The Activity provides utility locating (or dig clearance) services through the public works department or similar organization, or has a contract with an outside utility clearance service. Some of these services are provided in the form of dig permits which are required before you can dig or drill. In other cases no official permit is required and the process is somewhat vague.

Scenario 2

The Activity does not get involved in any utility locating processes aside from possibly providing the most recent utility maps, and relies on CH2M HILL to clear the dig locations.

Table 1 provides an up to date summary of which scenarios apply to the various primary Activities served under the Navy CLEAN program.

Scenario 1 is preferred because under this scenario the Navy tends to assume the responsibility if the location is improperly cleared, a utility is struck, and property damage results. However, our experience has been that the clearance services provided by the Navy do not meet the standards that we consider to be adequate, in that they often simply rely on available base maps to mark utilities and do not verify locations using field geophysics. And if they do use locating tools, they do not provide adequate documentation or marking to confirm that a location has been cleared. So while the Navy's process may protect us from liability for property damage, it does not adequately protect our staff and subcontractors from health risks nor does it compensate us for down time, should a utility be hit.

Therefore, regardless of what services the Navy provides, in most cases we still need to supplement this effort with clearance services from our own third party utility location subcontractor following the procedures and guideline outlined in Section IV of this SOP. The cost implications of providing this service will range from $500 to several $1,000 depending on the size of the project.

The scope of services that we ask our subcontractors to provide can involve utility marking/mapping or the clearing of individual dig locations. In the former we ask our subs to mark all utilities within a "site" and often ask them to prepare a map based on their work. In the later, we ask them to clear (identify if there are any utilities within) a certain radius of a proposed dig/drill location.

The appropriate requested scope of services for a project will depend on the project. Clearing individual boreholes is often less expensive and allows the sub to concentrate their efforts on a limited area. However if the scope of the investigation is fluid (all borehole locations are not predetermined) it may be best to mark and map an entire site or keep the subcontractor on call.

Clearance of individual dig locations should be done to a minimum 20 foot radius around the location.

An example SOW for a utility subcontractor procurement is provided in Attachment A.

III. Services and Equipment

This section provides a general description of the services available to help us locate subsurface utilities and describes the types of equipment that these services may (or may not) use to perform their work. It identifies the capabilities of each type of equipment to help the PM specify what they should require from our utility location subs.

Services

The services that are available to us for identifying and marking underground utilities are:

- The local public/private utility-run service such as Miss Utility
- Utility location subcontractors (hired by us)

Attachment B provides a detailed description of each type of organization. It also provides contact numbers and web sites for the various Miss-Utility-type organizations in the areas where we do work for the Navy and contacts and services provided by several subcontractors that we have used or spoken to in the past.

Equipment

Attachment C provides a summary of the various types of equipment used for subsurface utility location. It describes the capabilities and limitations of each in order to help the PM determine if the equipment being used by a subcontractor is adequate.

It is important to make the potential subcontractors aware of the possible types of utilities (and utility materials) that are at the site, and to have them explain in their bid what types of equipment they will use to locate utilities /clear dig locations, and what the limitations of these equipment are.

A list of in-house experts that can be used to help you evaluate bids or answer questions you may have is provided in Appendix C.

IV. Procedures and Guidelines

This section presents specific procedures to be followed for the utility location work to be conducted by CH2M HILL and our subcontractors. In addition, a PM will have to follow the procedures required by the Activity to obtain their approvals, clearances and dig permits where necessary. These "dig permit" requirements vary by Activity and must be added to the project-specific SOP, or project instructions. It is preferable that the Activity perform their clearance processes before we follow up with our clearance work.

Activity Notification and Dig Permit Procedures

Identify Activity-specific permit and/or procedural requirements for excavation and drilling activities. Contact the Base Civil Engineer and obtain the appropriate form to begin the clearance process.

Activity Specific: To be provided by Activity or Project Manager

CH2M HILL Utility Clearance Procedures

Do not begin subsurface construction activities (e.g., trenching, excavation, drilling, etc.) until a check for underground utilities and similar obstructions has been conducted by CH2M HILL as a follow-up to the services provided by the Navy. The use of as-built drawings and utility company searches must be supplemented with a geophysical or other survey by a qualified, independent survey contractor (subcontracted to CH2M HILL) to identify additional and undiscovered buried utilities.

Examples of the type of geophysical technologies include (these are further described in Attachment C):

- **Ground Penetrating Radar (GPR),** which can detect pipes, including gas pipes, tanks, conduits, cables etc, both metallic and non-metallic at depths up to 30 feet depending on equipment. Sensitivity for both minimum object size and maximum depth detectable depends on equipment selected, soil conditions, etc.
- **Radio Frequency (RF),** involves inducing an RF signal in the pipe or cable and using a receiver to trace it. Some electric and telephone lines emit RF naturally and can be

detected without an induced signal. This method requires knowing where the conductive utility can be accessed to induce RF field if necessary.

- **Dual RF**, a modified version of RF detection using multiple frequencies to enhance sensitivity but with similar limitations to RF
- **Ferromagnetic Detectors**, are metal detectors that will detect ferrous and non-ferrous utilities. Sensitivity is limited, e.g. a 100 mm iron disk to a depth of about one meter or a 25 mm steel paper clip to a depth of about 20 cm.
- **Electronic markers,** are emerging technologies that impart a unique electronic signature to materials such as polyethylene pipe to facilitate location and tracing after installation. Promising for future installations but not of help for most existing utilities already in place.

The following procedures shall be used to identify and mark underground utilities during subsurface construction activities on the project:

- Contact utility companies or the state/regional utility protection service (such as Miss Utility) at least two (2) working days prior to intrusive activities to advise of the proposed work, and ask them to establish the location of the utility underground installations prior to the start of actual excavation: this is a law. These services will only mark the location of public-utility-owned lines and not Navy-owned utilities. In many cases there will not be any public-utility-owned lines on the Activity. There may also be Base-access issues to overcome.
- Procure and schedule the independent survey.
- The survey contractor shall determine the most appropriate geophysical technique or combinations of techniques to identify the buried utilities on the project site, based on the survey contractor's experience and expertise, types of utilities anticipated to be present and specific site conditions. ***The types of utilities must be provided to the bidding subcontractors in the SOW and procedures to be used must be specified by the bidder in their bid. It is extremely helpful to provide the sub with utility maps, with the caveat that all utilities are not necessarily depicted.***
- The survey subcontractor shall employ the same geophysical techniques used to identify the buried utilities, to survey the proposed path of subsurface investigation/construction work to confirm no buried utilities are present.
- Obtain utility clearances for subsurface work on both public and private property.
- Clearances provided by both the "Miss Utility" service and the CH2M HILL-subcontracted service are to be in writing, signed by the party conducting the clearance. The Miss Utility service will have standard notification forms/letters which typically simply state that they have been to the site and have done their work. The CH2M HILL subcontractor shall be required to fill out the form provided in Attachment D (this can be modified for a particular project) indicating that each dig/drill location has been addressed. ***This documentation requirement (with a copy of the form) needs to be provided in the subcontractor SOW.***

- Marking shall be done using the color coding presented in Attachment E. The type of material used for marking must be approved by the Activity prior to marking. Some base commanders have particular issues with persistent spray paint on their sidewalks and streets. ***Any particular marking requirements need to be provided in the subcontractor SOW.***
- Protect and preserve the markings of approximate locations of facilities until the markings are no longer required for safe and proper excavations. If the markings of utility locations are destroyed or removed before excavation commences or is completed, the Project Manager must notify the utility company or utility protection service to inform them that the markings have been destroyed.
- Perform a field check prior to drilling/digging (preferably while the utility location sub is still at the site) to see if field utility markings coincide with locations on utility maps. Look for fire hydrants, valves, manholes, light poles, lighted signs, etc to see if they coincide with utilities identified by the subcontractor.
- Underground utility locations must be physically verified (or dig locations must be physically cleared) by hand digging using wood or fiberglass-handled tools, air knifing, or by some other acceptable means approved by CH2M HILL, when the dig location (e.g. mechanical drilling, excavating) is expected to be within 5 feet of a marked underground system. Hand clearance shall be done to a depth of four feet unless a utility cross-section is available that indicates the utility is at a greater depth. In that event, the hand clearance shall proceed until the documented depth of the utility is reached.
- Conduct a site briefing for employees at the start of the intrusive work regarding the hazards associated with working near the utilities and the means by which the operation will maintain a safe working environment. Detail the method used to isolate the utility and the hazards presented by breaching the isolation.
- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon during drilling or change in color, texture or density during excavation that could indicate the ground has been previously disturbed).

IV. Attachments

A- Example SOW for Utility Location Subcontractor Procurement
B - Services Available for Identifying and Marking Underground Utilities
C – Equipment Used for Identifying Underground Utilities
D – Utility Clearance Documentation Form
E – Utility Marking Color Codes

Attachment A – Example SOW for Subcontracting Underground Utilities Locating Services

CTO-XXX

Scope of Work

Subsurface Utility Locating

Site XX

Navy Activity

City, State

A licensed and insured utility locator will be subcontracted to identify and mark out subsurface utilities for an environmental investigation/remediation project at Site XX of <<insert name of base, city, and state>>. The subcontractor will need to be available beginning at <<insert time>> on <<insert date>>. It is estimated that the work can be completed within XX days.

Proposed Scope of Work

The subcontractor will identify and mark all subsurface utilities (CHOOSE 1) that lie within a radius of 20 feet of each of XX sampling locations at Site XX shown on the attached Figure 1; (OR) that lie within the bounds of Site XX as delineated on the attached Figure 1. (If multiple sites are to be cleared, provide maps of each site with sample locations or clearance boundaries clearly delineated and a scale provided.)

Utilities will be identified using all reasonably available as-built drawings, electronic locating devices, and any other means necessary to maintain the safety of drilling and sampling personnel and the protection of the base infrastructure. The location of utilities identified from as-built drawings or other maps must be verified in the field prior to marking.

Base utility drawings for the Site(s) (CHOOSE 1) can be found at <<insert specific department and address or phone number on the base>> and should be reviewed by the subcontractor and referenced as part of the utility locating. (OR), will be provided to the subcontractor by CH2M HILL upon the award of the subcontract. (OR), are not available. Utility drawings shall not be considered definitive and must be field verified.

Field verification will include detection using nonintrusive subsurface detection equipment (magnetometers, GPR, etc) as well as opening manhole covers to verify pipe directions. As part of the bid, the Subcontractor shall provide a list of the various subsurface investigation tools they propose to have available and use at the site and what the limitations are of each tool.

A CH2M HILL representative shall be present to coordinate utility clearance activities and identify points and features to be cleared.

Field Marking and Documentation

All utilities located within **(CHOOSE 1)** ***a 20-ft radius of the XX proposed soil boring locations*** **(OR)** ***within the boundary of the site(s)*** as identified on the attached figure(s) will be marked using **paint** ***(some Bases such as the WNY may have restrictions on the use of permanent paint)*** and/or pin flags color coded to indicate electricity, gas, water, steam, telephone, TV cable, fiber optic, sewer, etc. The color coding shall match the industry standard as described on the attached form. In addition, the ***Buried Utility Location Tracking Form*** (attached) will be completed by the Subcontractor based upon what is identified in the field during the utility locating and submitted back to CH2M HILL (field staff or project manager) within 24 hours of completing the utility locating activities.

(OPTIONAL) ***The subcontractor shall also provide a map (or hand sketch) of the identified utilities to the Engineer within XX days of field demobilization. The map shall include coordinates or ties from fixed surface features to each identified subsurface utility.***

Bid Sheet/Payment Units

The subcontractor will bid on a time and materials basis for time spent on site and researching utility maps. Mobilization (including daily travel to the site) should be bid as a lump sum, as well as the preparation of the AHA and any required mapping. The per diem line item should be used if the field crew will require overnight accommodations at the project site.

Health and Safety Requirements

The utility locating subcontractor is to provide and assume responsibility for an adequate corporate Health and Safety Plan for onsite personnel. Standard personal safety equipment including: hard hat, safety glasses, steel-toed boots, gloves are recommended for all project activities. Specific health and safety requirements will be established by the Subcontractor for each project. The health and safety requirements will be subject to the review of CH2M HILL.

The subcontractor shall also prepare and provide to the Engineer, at least 48 hours prior to mobilization, an acceptable Activity Hazard Analysis (AHA) using the attached AHA form or similar.

It is also required that all subcontractor personnel who will be on site attend the daily 15-minute health and safety tailgate meeting at the start of each day in the field.

Subcontractor personnel showing indications of being under the influence of alcohol or illegal drugs will be sent off the job site and their employers will be notified. Subcontractor personnel under the influence of prescription or over-the-counter medication that may impair their ability to operate equipment will not be permitted to do so. It is expected that the subcontractor will assign them other work and provide a capable replacement (if necessary) to operate the equipment to continue work.

Security

The work will be performed on US Navy property. CH2M HILL will identify the Subcontractor personnel who will perform the work to the appropriate Navy facility point-of-contact, and will identify the Navy point-of-contact to the Subcontractor crew. The Subcontractor bears final responsibility for coordinating access of his personnel onto Navy property to perform required work. This responsibility includes arranging logistics and providing to CH2M HILL, in advance or at time of entry as specified, any required identification information for the Subcontractor personnel. Specifically, the following information should be submitted with the bid package for all personnel that will perform the work in question (this information is required to obtain a base pass):

- Name
- Birth Place
- Birth Date
- Social Security Number
- Drivers License State and Number
- Citizenship

Please be advised that no weapons, alcohol, or drugs will be permitted on the Navy facility at any time. If any such items are found, they will be confiscated, and the Subcontractor will be dismissed.

Quality Assurance

The Subcontractor will be licensed and insured to operate in the State of <<state>> and will comply with all applicable federal, state, county and local laws and regulations. The subcontractor will maintain, calibrate, and operate all electronic locating instruments in accordance with the manufacturer's recommendations. Additionally, the Subcontractor shall make all reasonable efforts to review as-built engineering drawings maintained by Base personnel, and shall notify the CH2M HILL Project Manager in writing (email is acceptable) whenever such documentation was not available or could not be reviewed.

Subcontractor Standby Time

At certain periods during the utility locating activities, the Subcontractor's personnel may be asked to stop work and standby when work may normally occur. During such times, the Subcontractor will cease activities until directed by the CH2M HILL representative to resume operations. Subcontractor standby time also will include potential delays caused by the CH2M HILL representative not arriving at the site by the agreed-upon meeting time for start of the work day. Standby will be paid to the

Subcontractor at the hourly rate specified in the Subcontractor's Bid Form attached to these specifications.

Cumulative Subcontractor standby will be accrued in increments no shorter than 15 minutes (i.e., an individual standby episode of less than 15 minutes is not chargeable).

During periods for which standby time is paid, the surveying equipment will not be demobilized and the team will remain at the site. At the conclusion of each day, the daily logs for the Subcontractor and CH2M HILL representative will indicate the amount of standby time incurred by the Subcontractor, if any. Payment will be made only for standby time recorded on CH2M HILL's daily logs.

Down Time

Should equipment furnished by the Subcontractor malfunction, preventing the effective and efficient prosecution of the work, or inclement weather conditions prevent safe and effective work from occurring, down time will be indicated in the Subcontractor's and CH2M Hill representative's daily logs. No payment will be made for down time.

Schedule

It is anticipated that the subsurface utility locating activities will occur on <<insert date>>. It is estimated that the above scope will be completed within XXX days.

Attachment B - Services Available for Identifying and Marking Underground Utilities

The services that are available to us for identifying and marking underground utilities are:

- The Activity's PWC (or similar organization)
- The local public/private utility -run service such as Miss Utility
- Utility location subcontractors (hired by CH2M HILL)

Each are discussed below.

Navy Public Works Department

A Public Works Department (PWD) is usually present at each Activity. The PWD is responsible for maintaining the public works at the base including management of utilities. In many cases, the PWD has a written permit process in place to identify and mark-out the locations of Navy-owned utilities [Note: The PWD is usually NOT responsible for the locations/mark-outs of non-Navy owned, public utilities (e.g., Washington Gas, Virginia Power, municipal water and sewer, etc.). Therefore, it is likely that we will have to contact other organizations besides the PWD in order to identify non-Navy owned, public utilities].

At some Activities, there may not be a PWD, the PWD may not have a written permit process in place, or the PWD may not take responsibility for utility locating and mark-outs. In these cases, the PWD should still be contacted since it is likely that they will have the best understanding of the utility locations at the Activity (i.e., engineering drawings, institutional knowledge, etc.). Subsequently, the PWD should be brought into a cooperative arrangement (if possible) with the other services employed in utility locating and mark-out in order to have the most comprehensive assessment performed.

At all Activities we should have a contact (name and phone number), and preferably an established relationship, with PWD, either directly or through the NAVFAC Atlantic, Midlant, or Washington NTR or Activity Environmental Office that we can work with and contact in the event of problems.

Miss Utility or "One Call" Services for Public Utility Mark-outs

Miss Utility or "One Call" service centers are information exchange centers for excavators, contractors and property owners planning any kind of excavation or digging. The "One Call" center notifies participating public utilities of the upcoming excavation work so they can locate and mark their underground utilities in advance to prevent possible damage to underground utility lines, injury, property damage and service outages. In some instances, such with southeastern Virginia bases, the Navy has entered into agreement with Ms. Utilities and is part of the response process for Miss

Utilities. Generally, a minimum of 48 hours is required for the public utility mark-outs to be performed. The "One Call" services are free to the public. Note that the "One Call" centers only coordinate with participating public utilities. There may be some public utilities that do NOT participate in the "One Call" center which may need to be contacted separately. For example, in Washington, DC, the Miss Utility "One Call" center does not locate and mark public sewer and water lines. Therefore, the municipal water and sewer authority must be contacted separately to have the sewer and water lines marked out. The AM should contact the appropriate one-call center to determine their scope of services.

A national listing of the "One Call" service centers for each state is presented on the web at http://www.underspace.com/refs/ocdir.htm. For the Mid-Atlantic region, the following "One Call" service centers are available.

Name	**Phone**	**Website**	**Comments**
Miss Utility of DELMARVA	800-257-7777	www.missutility.net	Public utility mark-outs in Delaware, Maryland, Washington, DC, and Northern Virginia
Miss Utility of Southern Virginia (One Call)	800-552-7001	not available	Public utility mark-outs in Southern Virginia
Miss Utility of Virginia	800-257-7777 800-552-7007	www.missutilityofvirginia.com	General information on public utility mark-outs in Virginia, with links to Miss Utility of DELMARVA and Miss Utility of Southern Virginia (One Call)
Miss Utility of West Virginia, Inc	800-245-4848	none	Call to determine what utilities they work with in West Virginia
North Carolina One Call Center	800-632-4949	www.ncocc.org/ncocc/default.htm	Public Utility Markouts in North Carolina

Private Subcontractors

1. Utility-locating support is required at some level for most all CH2M HILL field projects in "clearing" proposed subsurface boring locations on the project site. Utility location and sample clearance can include a comprehensive effort of GIS map interpretation, professional land surveying, field locating, and geophysical surveying. Since we can usually provide our own GIS-related services for projects and our professional land surveying services are normally procured separately, utility-locating subcontractors will normally only be required for some level of geophysical surveying support in the field. This level of geophysical surveying support can range widely from a simple electromagnetic (EM) survey over a known utility line, to a blind geophysical effort, including a ground-penetrating radar (GPR) survey and/or a comprehensive EM survey to delineate and characterize all unknown subsurface anomalies.

   The level of service required from the subcontractor will vary depending on the nature of the site. At sites where utility locations are well defined on the maps and recent construction is limited, CH2M HILL may be confident with a limited effort from a traditional utility-locating subcontractor providing a simple EM survey. At sites where utility locations are not well defined, where recent constructions may have altered utility locations, or the nature of the site makes utility location difficult, CH2M HILL will require the services of a comprehensive geophysical surveying subcontractor, with a wide range of GPR and EM services available for use on an "as-needed" basis. Typical costs for geophysical surveying subcontractors will range from approximately $200 per day for a simple EM effort (usually one crew member and one instrument) to approximately $1,500 per day for a comprehensive geophysical surveying effort (usually a two-person crew and multiple instruments). Comprehensive geophysical surveying efforts may also include field data interpretation (and subsequent report preparation) and non-destructive excavation to field-verify utility depths and locations.

The following table provides a list of recommended geophysical surveying support subcontractors that can be used for utility-locating services:

Company Name and Address	Contact Name and Phone Number	Equipment[1]					Other Services[2]		
		1	2	3	4	5	A	B	C
US Radar, Inc.* PO Box 319 Matawan, NJ 07747	Ron LaBarca 732-566-2035			4					
Utilities Search, Inc.*	Jim Davis 703-369-5758	4				4	4	4	4
So Deep, Inc.* 8397 Euclid Avenue Manassas Park, VA 20111	703-361-6005	4					4	4	4
Accurate Locating, Inc. 1327 Ashton Rd., Suite 101 Hanover, MD 21076	Ken Shipley 410-850-0280	4	4						
NAEVA Geophysics, Inc. P.O. Box 7325 Charlottesville, VA 22906	Alan Mazurowski 434-978-3187	4	4	4	4	4	4	4	4
Earth Resources Technology. Inc. 8106 Stayton Rd. Jessup, MD 20794	Peter Li 240-554-0161	4	4	4	4	4	4	4	
Geophex, Ltd 605 Mercury Street Raleigh, NC 27603	I. J. Won 919-839-8515	4	4	4	4	4	4	4	4

Notes:

*Companies denoted with an asterisk have demonstrated reluctance to assume responsibility for damage to underground utilities or an inability to accommodate the insurance requirements that CH2M HILL requests for this type of work at many Navy sites.

[1]Equipment types are:

1. Simple electromagnetic instruments, usually hand-held
2. Other, more innovative, electromagnetic instruments, including larger instruments for more area coverage
3. Ground-penetrating radar systems of all kinds
4. Audio-frequency detectors of all kinds
5. Radio-frequency detectors of all kinds

[2]Other services include:

A. Data interpretation and/or report preparation to provide a permanent record of the geophysical survey results and a professional interpretation of the findings, including expected accuracy and precision.

B. Non-destructive excavation to field-verify the depths, locations, and types of subsurface utilities.

C. Concrete/asphalt coring and pavement/surface restoration.

Attachment C – Equipment Used for Identifying Underground Utilities

This attachment provides a summary of the various types of equipment used for subsurface utility location. It describes the capabilities and limitations of each in order to help the AM and PM determine if the equipment being proposed by a subcontractor or Navy is adequate. A list of in-house experts that can be used to answer questions you may have is provided below.

CH2M HILL In-house Utility Location Experts

Tamir Klaff/WDC

Home Office Phone – 703-669-9611

Electromagnetic Induction (EMI) Methods

EMI instruments, in general, induce an electromagnetic field into the ground (the primary field) and then record the response (the secondary field), if any. Lateral changes in subsurface conductivity, such as caused by the presence of buried metal or by significant soil variations, cause changes in the secondary field recorded by the instrument and thus enable detection and mapping of the subsurface features. It should be noted that EMI only works for electrically conductive materials--plastic or PVC pipes are generally not detected with EMI. Water and gas lines are commonly plastic, although most new lines include a copper "locator" strip on the top of the PVC to allow for detection with EMI.

EMI technology encompasses a wide range of instruments, each with inherent strengths and weaknesses for particular applications. One major division of EMI is between "time-domain" and "frequency-domain" instruments that differ in the aspect of the secondary field they detect. Another difference in EMI instruments is the operating frequency they use to transmit the primary field. Audio- and radio-frequencies are often used for utility detection, although other frequencies are also used. Consideration of the type of utility expected, surface features that could interfere with detection, and the "congestion" of utilities in an area, should be made when choosing a particular EMI instrument for a particular site.

One common EMI tool used for utility location is a handheld unit that can be used to quickly scan an area for utilities and allows for marking locations in "real time". This method is most commonly used by "dig-safe" contractors marking out known utilities prior to excavation. It should be noted that this method works best when a signal (the primary field) can be placed directly onto the line (i.e., by clamping or otherwise connecting to the end of the line visible at the surface, or for larger utilities such as sewers, by running a transmitter through the utility). These types of tools also have a limited capability to scan an area for unknown utilities. Usually this requires having enough area to separate a hand held transmitter at least a hundred feet from the receiver. Whether hunting for unknown, or confirming known, utilities, this method will only detect continuous lengths of metallic conductors.

In addition to the handheld EMI units, larger, more powerful EMI tools are available that provide more comprehensive detection and mapping of subsurface features. Generally, data with these methods are collected on a regular grid in the investigation area, and are then analyzed to locate linear anomalies that can be interpreted as utilities. These methods will usually detect *all* subsurface metal (above a minimum size), including pieces of abandoned utilities. In addition, in some situations, backfill can be detected against native soils giving information on trenching and possible utility location. Drawbacks to these methods are that the secondary signals from utilities are often swamped (i.e., undetectable) close to buildings and other cultural features, and that the subsurface at heavily built-up sites may be too complicated to confidently interpret completely.

Hand-held metal detectors (treasure-finders) are usually based on EMI technology. They can be used to locate shallow buried metal associated with utilities (e.g., junctions, manholes, metallic locators). Advantages of these tools is the ease of use and real-time marking of anomalies. Drawbacks include limited depths of investigations and no data storage capacity.

Ground Penetrating Radar (GPR)

GPR systems transmit radio and microwave frequency (e.g., 80 megaHertz to 1,000 megaHertz) waves into the ground and then record reflections of those waves coming back to the surface. Reflections of the radar waves typically occur at lithologic changes, subsurface discontinuities, and subsurface structures. Plastic and PVC pipes can sometimes be detected in GPR data, especially if they are shallow, large, and full of a contrasting material such as air in a wet soil, or water in a dry soil. GPR data are usually collected in regular patterns over an area and then analyzed for linear anomalies that can be interpreted as utilities. GPR is usually very accurate in x-y location of utilities, and can be calibrated at a site to give very accurate depth information as well. A significant drawback to GPR is that depth of investigation is highly dependant on background soil conductivity, and it will not work on all sites. It is not uncommon to get only 1-2 feet of penetration with the signal in damp, clayey environments. Another drawback to GPR is that sites containing significant fill material (e.g., concrete rubble, scrap metal, garbage) will result in complicated anomalies that are difficult or impossible to interpret.

Magnetic Field Methods

Magnetic field methods rely on detecting changes to the earth's magnetic field caused by ferrous metal objects. This method is usually more sensitive to magnetic metal (i.e., deeper detection) than EMI methods. A drawback to this method is it is more susceptible to being swamped by surface features such as fences and cars. In addition, procedures must usually be implemented that account for natural variations in the earth's background field as it changes throughout the day. One common use of the method is to measure and analyze the gradient of the magnetic field, which eliminates most of the drawbacks to the method. It should be noted this method only detects ferrous metal, primarily iron and steel for utility location applications. Some utility detector combine magnetic and EMI methods into a single hand-held unit.

Optical Methods

Down the hole cameras may be useful in visually reviewing a pipe for empty conduits and/or vaults.

Attachment D – Utility Clearance Documentation Form

Attachment E – Utility Marking Color Codes

The following is the standard color code used by industry to mark various types of utilities and other features at a construction site.

White – Proposed excavations and borings

Pink – Temporary survey markings

Red – Electrical power lines, cables, conduits and lighting cables

Yellow – Gas, oil, steam, petroleum or gaseous materials

Orange – Communication, alarm or signal lines, cables, or conduits

Blue – Potable water

Purple – Reclaimed water, irrigation and slurry lines

Green – Sewer and storm drain lines

Buried Utility Location Tracking Form

(Submit to CH2M HILL PM within 24 hrs of location activities)

Project Location:
CH2M HILL Project No.:
CH2M HILL Project Manager: Name/Phone:
Fax:
Email:
CH2M HILL Field Team Leader: Name/Phone:

CH2M HILL Purchase Order:

Utility Location Subcontractor:
Subcontractor POC:

Dates of location activities:

	Check each box using an "X" if a buried utility is present within 5 feet of a marked Station ID. If color of the flag or paint differs from listed color, note change in color on the form.																
Station ID	**Gas (Yellow)**	**Electric (Red)**	**Fiber optic (Orange)**	**Cable (Orange)**	**Water (Blue)**	**San. Sewer (Green)**	**Storm Sewer (Green)**	**Steam (Yellow)**	**Petroleum (Yellow)**	**Compressed air (Yellow)**	**Other ___**	**Other ___**	**Other ___**	**Other ___**	**Date completed**	**Technician initials**	Notes (methods/tools used)

The findings of the buried utility location activities summarized herein were conducted in strict accordance with the CH2M HILL scope of work.

______________________________ __________

Subcontractor's Signature	Date

STANDARD OPERATING PROCEDURE

Sampling Contents of Tanks And Drums

I. Scope and Application

This procedure provides an overview approach and guidelines for the routine sampling of drums and tanks. Its purpose is to describe standard procedures and precautions which are applied in sampling drums and tanks. Procedures for opening drums with the individual instruments are included in Attachment D.

The samples obtained may be used to obtain physical chemical or radiological data. The resulting data may be qualitative or quantitative in nature, and are appropriate for use in preliminary surveys as well as confirmatory sampling.

II. References

A. *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001, U.S. Environmental Protection Agency, Washington, D.C., 1987.

B. *Data Quality Objectives for Remedial Activities - Development Process*, EPA/540/G-87/003, U.S. Environmental Protection Agency, Washington, D.C., 1987.

C. Annual Book of ASTM Standards, *Standard Recommended Practices for Sampling Industrial Chemicals*, ASTM-E-300, 1986.

D. *Test Method for Evaluating Solid Waste*, SW-846, Volume II, Field Methods, Second Edition, U.S. Environmental Protection Agency, Washington, D.C., 1982.

E. U.S. Environmental Protection Agency, *Characterization of Hazardous Waste Sites – A Method Manual: Volume II, Available Sampling Methods*, USEPA Environmental Monitoring Systems Laboratory, Las Vegas, EPA-600/ 4-84-076, December, 1984.

F. *Environmental Surveillance Procedures*, Quality Control Program, Martin Marietta Energy Systems, ESH/Sub/87-21706/1, Oak Ridge, TN, September 1988.

III. Summary of Methods

Drums are generally sampled by means of sampling tubes such as glass sample tubes or COLIWASA samplers. In either case, the sampling tube is manually inserted into the waste material. A sample of the drum contents is withdrawn by the sampling device. Should a drum contain bottom sludge, a glass tube will retrieve a sample of this as well.

Storage tank and tank trailers, because of their greater depths, require sampling devices that can be lowered from the top, filled at a particular depth, then withdrawn. Such devices are a COLIWASA, a Kemmerer depth sampler, or a Bacon Bomb. Where samples of bottom sludge are desired, a gravity corer can be utilized. This heavy tube with a tapered nose piece will penetrate the sludge as it free falls through the tank.

IV. Comments

The sampling of tanks, containers, and drums present unique problems not associated with environmental samples. Containers of this sort are generally closed except for small access ports, manways, or hatches on the larger vessels, or taps and bungs on smaller drums. The physical size, shape, construction material, and location of access limit the types of equipment and methods of collection that can be used.

When liquids are contained in sealed vessels, gas vapor pressure can build up, sludges can settle out, and density layerings (stratification) can develop. Bulging drums may be under pressure and extreme caution should be exercised. The potential exists for explosive reactions or the release of noxious gases when containers are opened. All vessels should be opened with extreme caution. Check the HSP for the level of personnel protection to be worn. A preliminary sampling of any headspace gases is warranted. As a minimum, a preliminary check with an explosimeter and an organic vapor analyzer may be of aid in selecting a sampling method.

In most cases it is impossible to observe the contents of these sealed or partially sealed vessels. Since some layering or stratification is likely in any solution left undisturbed over time, a sample must be taken that represents the entire depth of the vessel.

V. Required Equipment and Apparatus

A. **Health and safety equipment/materials**: As listed in the site safety plan.

B. **Sampling equipment**: COLIWASA, glass sample tubes, Kemmerer depth sampler, Bacon Bomb, gravity corer.

C. **Tools**: Rubber mallet, bung wrench, speed wrench with socket, etc., (all non-sparking), paint marker.

D. **Heavy equipment**: Backhoe equipped with explosion shield, drum grappler, and 3-foot copper-beryllium (non-sparking) spike with 6-inch collar (to puncture top of drums for sampling, if necessary).

E. **Sample Containers**: As specified in the field sampling plan.

VI. Procedures

A. Drums

NOTE: DO NOT open more than one drum at a time. Each drum must be handled and sampled as a separate entity to reduce vapors in the sampling area.

1. Drums will be sampled on an area-by-area basis. Drums will be sampled after they have been placed in overpack drums but before they are transferred from the excavation to the onsite storage area.

2. Record, in logbook, all pertinent information from visual inspection of drum (e.g., physical condition, leaks, bulges, and labels). Label each drum with a unique identifying number.

3. If possible, stage drums for easy access.

4. If necessary, attach ground strap to drums and grounding point.

5. Remove any standing material (water, etc.) from container top.

6. Using non-sparking tools, carefully remove the bung or lid while monitoring air quality with appropriate instruments. If necessary (and as a last resort), the non-sparking spike affixed to the backhoe can also be used to puncture the drum for sampling. See Attachment D for method of drum opening. Record air-quality monitoring results.

7. When sampling a previously sealed vessel, a check should be made for the presence of bottom sludge. This is accomplished by measuring the depth to apparent bottom, then comparing it to the known interior depth.

8. Agitation to disrupt the layers and rehomogenize the sample is physically difficult and almost always undesirable. If the vessel is greater than 3 feet in depth (say, a 55-gallon drum), the appropriate sampling method is to slowly lower the sampling device (i.e., suction line of peristaltic pump, glass tube) in known increments of length. Discrete samples can be collected from various depths, then combined or analyzed separately. If the depth of the vessel is greater than the lift capacity of the pump, an at-depth water sampler, such as the Kemmerer or Bacon Bomb type, may be required.

9. Extract a representative sample from the drum using a glass rod, COLIWASA, Bacon Bomb, Kemmerer bottle, or gravity corer (See Attachments). Ensure that the entire depth of material is penetrated. Depending on the size of the opening of the drum, three to four takes should be collected from random locations across the drum surface, to ensure a representative sample. Any observed stratification must be

recorded in logbook, including number and thickness of the layers and a conceptualized sketch.

10. Record a visual description of the sample (e.g., liquid, solid, color, viscosity, and percent layers).

11. When possible, sampling equipment (like glass tubes) should be expendable and be left inside the drum for disposal with drum contents, once sampling is completed.

12. Place lid, bung, cap, etc., back in place on drum. Tighten hand tight. If necessary, the sampling port can be sealed using a cork.

13. Wipe up spilled material with lab wipes. Wipe off sample containers.

14. Mark the drum with a unique sample identification number and date using a paint marker.

15. Samples will be handled as high hazard samples. Samples will be placed in containers defined according to the analytical needs, wiped clean, and then packed in paint cans for shipping. Packaging, labeling, and preparation for shipment procedures will follow procedures as specified in the field sampling plan.

B. Underground Storage Tanks

1. A sampling team of at least two people is required for sampling—one will collect samples, the other will relay required equipment and implements.

2. Sampling team will locate a sampling port on the tank. Personnel should be wearing appropriate protective clothing at this time and carrying sampling gear.

3. Do not attempt to climb down into tank. Sampling MUST BE accomplished from the top.

4. Collect a sample from the upper, middle, and lower section of the tank contents with one of the recommended sampling devices.

5. If compositing is necessary, ship samples to laboratory in separate containers for laboratory compositing.

6. Samples will be handled as hazardous. Samples will be placed in appropriate containers and packed with ice in a cooler. Packaging, labeling, and preparation for shipment will follow procedures specified in the field sampling plan.

C. Tank Trailers or Above-Ground Storage Tanks

1. A sampling team of two is required. One will collect samples, the other will relay required equipment and implements.

2. Samples will be collected through the manhole (hatch) on top of the tanker or the fill port. Do not open valves at the bottom. Before opening the hatch, check for a pressure gauge or release valve. Open the release valve slowly to bring the tank to atmospheric pressure.

3. If tank pressure is too great, or venting releases large amounts of toxic gas, discontinue venting and sampling immediately. Measure vented gas with organic vapor analyzer and explosimeter.

4. If no release valve exists, slowly loosen hatch cover bolts to relieve pressure in the tank. (Again, stop if pressure is too great.)

5. Once pressure in tank has been relieved, open the hatch and withdraw sample using one of the recommended sampling devices.

6. Sample each trailer compartment.

7. If compositing is necessary, ship samples to laboratory in separate containers for laboratory compositing.

8. Samples will be handled as hazardous. Samples will be placed in appropriate containers and packed with ice in a cooler. Packaging, labeling, and preparation for shipment will follow procedures specified in the field sampling plan.

D. Refer to Attachment B for procedures for sampling with appropriate devices as follows:

Drum

Glass tube	–	Procedure 1
COLIWASA	–	Procedure 2

Storage Tank and Tank Trailer

COLIWASA	–	Procedure 2
Bacon Bomb	–	Procedure 3
Gravity Corer (for bottom sludge)	–	Procedure 4

VII. Contamination Control

Sampling tools, instruments, and equipment will be protected from sources of contamination prior to use and decontaminated after use as specified in SOP *Decontamination of Personnel and Equipment*. Liquids and materials from decontamination operations will be handled in accordance with the waste management plan. Sample containers will be protected from sources of contamination. Sampling personnel shall wear chemical resistant gloves when handling any samples. Gloves will be decontaminated or disposed of between samples.

VIII. Attachments

A. Collection of Liquid-Containerized Wastes Using Glass Tubes

B. Sampling Containerized Wastes Using the Composite Liquid Waste Sample (COLIWASA)

C. Sampling Containerized Wastes Using the Bacon Bomb Sampler

D. Gravity Corer for sampling Sludges in Large Containers

E. Construction of a Typical COLIWASA

F. Drum Opening Techniques and Equipment

IX. Field Checklist

_______ Sampling Instruments

_______ Tools

_______ Rubber Mallet

_______ Logbook

_______ Safety Glasses or Monogoggles

_______ Safety Shoes

_______ Ice/Cooler, as required

_______ Custody Seals, as required

_______ Chain-of-Custody Forms

_______ Drum Labels, as required

_______ Paint Marker, if drum sampling

_______ Black Indelible Pen

_______ Monitoring Instruments

_____ Labels

_____ Sampling and Analysis Plan

_____ Health and Safety Plan

_____ Decontamination Equipment

_____ Lab Wipes

_____ Lab Spatulas or Stainless Steel Spoons

_____ Chemical Preservatives, as required

_____ Appropriate Containers for Waste and Equipment

_____ Duct Tape

_____ Plastic Sheeting

Attachment A Collection of Liquid-Containerized Wastes Using Glass Tubes

Discussion

Liquid samples from opened containers (i.e., 55-gallon drums) are collected using lengths of glass tubing. The glass tubes are normally 122 centimeters long and 6 to 16 millimeters inside diameter. Larger diameter tubes may be used for more viscous fluids if sampling with the small diameter tube is not adequate. The tubing is broken and discarded in the container after the sample has been collected, eliminating difficult cleanup and disposal problems. This method should not be attempted with less than a two-person sampling team.

Uses

This method provides for a quick, relatively inexpensive means of collecting concentrated containerized wastes. The major disadvantage is from potential sample loss that is especially prevalent when sampling low-viscosity fluids. Splashing can also be a problem and proper protective clothing should always be worn.

Note: A flexible tube with an aspirator attached is an alternative method to the glass tube, and allows various levels to be sampled discretely.

Procedures for Use

1. Remove cover from sample container.
2. Insert glass tubing almost to the bottom of the container. Tubing should be of sufficient length so that at least 30 centimeters extend above the top of the container.
3. Allow the waste in the drum to reach its natural level in the tube.
4. Cap the top of the tube with a safety-gloved thumb or a stopper.
5. Carefully remove the capped tube from the drum. If the tube has passed through more than one layer, the boundary should be apparent in the glass tube.
6. Insert the bottom, uncapped end into the sample container.
7. Partially release the thumb or stopper on the top of the tube and allow the sample to slowly flow into the sample container. If separation of phases is desired, cap off tube before the bottom phase has completely emptied. It may be advisable to have an extra container for "waste," so that the fluid on either side of the phase boundary can be directed into a separate container, allowing collection of pure phase liquids in the sample containers. The liquid remaining after the boundary fluid is removed is collected in yet a third container. NOTE: It is not necessary to put phases in separate containers if analysis of separate phases is not desired.
8. Repeat steps 2 through 6 if more volume is needed to fill the sample container.

9. Remove the tube from the sample container and replace the tube in the drum, breaking it, if necessary, in order to dispose of it in the drum.

Optional Method (if sample of bottom sludge is desired)

1. Remove the cover from the container opening.
2. Insert glass tubing slowly almost to the bottom of the container. Tubing should be of sufficient length so that at least 30 cm extends above the top of the container.
3. Allow the waste in the drum to reach its natural level in the tube.
4. Gently push the tube towards the bottom of the drum into the sludge layer. Do not force it.
5. Cap the top of the tube with a safety-gloved thumb or stopper.
6. Carefully remove the capped tube from the drum and insert the uncapped end into the sample container.
7. Release the thumb or stopper on the top of the tube and allow the sample container to fill to approximately 90 percent of its capacity. If necessary, the sludge plug in the bottom of the tube can be dislodged with the aid of the stainless steel laboratory spatula.
8. Repeat if more volume is needed to fill sample container and recap the tube.

Note:

1. If a reaction is observed when the glass tube is inserted (violent agitation, smoke, light, etc.), the investigators should leave the area immediately.
2. If the glass tube becomes cloudy or smoky after insertion into the drum, the presence of hydrofluoric acid maybe indicated, and a comparable length of rigid plastic tubing should be used to collect the sample.
3. When a solid is encountered in a drum (either layer or bottom sludge) the optional method described above may be used to collect a core of the material, or the material may be collected with a disposable scoop attached to a length of wooden or plastic rod.

Attachment B: Sampling Containerized Wastes using the Composite Liquid Waste Sampler (COLIWASA)

Discussion

The COLIWASA is a much-cited sampler designed to permit representative sampling of multiphase wastes from drums and other containerized wastes. The sampler is commercially available or can be easily fabricated from a variety of materials, including PVC, glass, or Teflon. In its usual configuration it consists of a 152 cm by 4 cm (inside diameter) section of tubing with a neoprene stopper at one end attached by a rod running the length of the tube to a locking mechanism at the other end. Manipulation of the locking mechanism opens and closes the sampler by raising and lowering the neoprene stopper. See Attachment E: Construction of a COLIWASA.

Uses

The COLIWASA is primarily used to sample containerized liquids. The PVC COLIWASA is reported to be able to sample most containerized liquid wastes except for those containing ketones, nitrobenzene, dimethylforamide, mesityloxide, and tetrahydrofuran. A glass COLIWASA is able to handle all wastes unable to be sampled with the plastic unit except strong alkali and hydrofluoric acid solutions. Due to the unknown nature of many containerized wastes, it would therefore be advisable to eliminate the use of PVC materials and use samplers composed of glass or Teflon.

The major drawback associated with using a COLIWASA is concern for decontamination and costs. The sampler is difficult, if not impossible, to decontaminate in the field, and its high cost in relation to alternative procedures (glass tubes) makes it an impractical throwaway item. It still has applications, however, especially in instances where a true representation of a multiphase waste is absolutely necessary.

Procedures for Use

1. Check to make sure the sampler is functioning properly. Adjust the locking mechanism, if present, to make sure the neoprene rubber stopper provides a tight closure.

2. Put the sampler in the open position by placing the stopper rod handle in the T-position and pushing the rod down until the handle sits against the sampler's locking block.

3. Slowly lower the sampler into the liquid waste. Lower the sampler at a rate that permits the levels of the liquid inside and outside the sampler tube to be about the same. If the level of the liquid in the sample tube is lower than that outside the sampler, the sampling rate is too fast and will result in a non-representative sample.

4. When the sampler stopper hits the bottom of the waste container, push the sampler tube downward against the stopper to close the sampler. Lock the sampler in the

closed position by turning the T-handle until it is upright and one end rests tightly on the locking block.

5. Slowly withdraw the sampler from the waste container with one hand while wiping the sampler tube with a laboratory wipe with the other hand. A phase boundary, if present, can be observed through the tube.

6. Carefully discharge the sample into a suitable sample container by slowly pulling the lower end of the T-handle away from the locking block while the lower end of the sampler is positioned in a sample container.

7. Unscrew the T-handle of the sampler and disengage the locking block.

Attachment C: Sampling Containerized Wastes using the Bacon Bomb Sampler

Discussion

The Bacon Bomb is designed for the withdrawal of samples from various levels within a storage tank. It consists of a cylindrical body with an internal tapered plunger that acts as a valve to admit the sample. A line attached to the top of the plunger is used to open and close the valve. A removable cover provides a point of attachment for the sample line and has a locking mechanism to keep the plunger closed after sampling. The Bacon Bomb is usually constructed of chrome-plated brass and bronze with a rubber O-ring acting as the plunger-sealing surface. Stainless steel versions are also available. The volumemetric capacity is 8, 16, or 32 oz (237, 473, or 946 ml).

<u>Uses</u>

The Bacon Bomb is a heavy sampler suited best for viscous materials held in large storage tanks or in lagoons. If a more non-reactive sampler is needed, the stainless steel version would be used, or any of the samplers could be coated with Teflon.

<u>Procedures for Use</u>

1. Attach the sample line and the plunger line to the sampler.
2. Measure and then mark the sampling line at the desired depth.
3. Gradually lower the sampler by the sample line until the desired level is reached.
4. When the desired level is reached, pull up on the plunger line and allow the sampler to fill for a sufficient length of time before releasing the plunger line to seal off the sampler.
5. Retrieve the sampler by the sample line, being careful not to pull up on the plunger line, thereby accidentally opening the bottom valve.
6. Wipe off the exterior of the sampler body.
7. Position the sampler over the sample container and release its contents by pulling up on the plunger line.

Attachment D: Gravity Corer for Sampling Sludges in Large Containers

Discussion

A gravity corer is a metal tube with a replaceable tapered nosepiece on the bottom and a ball or other type of check valve on the top. The check valve allows water to pass through the corer on descent but prevents a washout during recovery. The tapered nosepiece facilitates cutting and reduces core disturbance during penetration. Most corers are constructed of brass or steel and many can accept plastic liners and additional weights.

Uses

Corers are capable of collecting samples of most sludges and sediments. They collect essentially undisturbed samples that represent the strata profile that may develop in sediments and sludges during variations in the deposition process. Depending on the density of the substrate and the weight of the corer, penetration to depths of 75 cm (30 in.) can be attained. Exercise care when using gravity corers in vessels or lagoons that have liners because penetration depths could exceed those of the substrate; this could result in damage to the liner material.

Procedures for Use

1. Attach a precleaned corer to the required length of sample line. Solid braided 5-mm (3/16-in.) nylon line is sufficient; however, 20-mm (3/4-in.) nylon is easier to grasp during hand hoisting. An additional weight can be attached to the outside of the corer if necessary.
2. Secure the free end of the line to a fixed support to prevent accidental loss of the corer.
3. Allow corer to free fall through the liquid to the bottom.
4. Retrieve corer with a smooth, continuous, up-lifting motion. Do not bump corer because this may result in some sample loss.
5. Remove nosepiece from corer and slide sample out of corer into stainless steel or Teflon pan (preferred).
6. Transfer sample into appropriate sample bottle with a stainless steel lab spoon or laboratory spatula.

Attachment E: Construction of a Typical COLIWASA

The sampling tube consists of a 1.52-m (5-ft) by 4.13-cm (1-5/8 in) I.D. translucent plastic pipe, usually polyvinyl chloride (PVC) or borosilicate glass plumbing tube. The closure-locking mechanism consists of a short-length, channeled aluminum bar attached to the sampler's stopper rod by an adjustable swivel. The aluminum bar serves both as a T-handle and lock for the samplers' closure system. When the sampler is in the open position, the handle is placed in the T-position and pushed down against the locking block. This manipulation pushes out the neoprene stopper and opens at the sampling tube. In the closed position, the handle is rotated until one leg of the T is squarely perpendicular against the locking block. This tightly seats the neoprene stopper against the bottom opening of he sampling tube and positively locks the sampler in the closed position. The closure tension can be adjusted by shortening or lengthening the stopper rod by screwing it in or out of the T-handle swivel. The closure system of the sampler consists of a sharply tapered neoprene stopper attached to a 0.95-cm (3/8-in) O.D. rod, usually PVC. The upper end of the stopper rod is connected to the swivel of the aluminum T-handle. The sharply tapered neoprene stopper can be fabricated according to specifications by plastic-products manufacturers at an extremely high price, or it can be made in-house by grinding down the inexpensive stopper with a shop grinder.

COLIWASA samplers are typically made out of plastic or glass. The plastic type consists of translucent plastic (usually PVC) sampling tube. The glass COLIWASA uses borosilicate glass plumbing pipe as the sampling tube and a Teflon plastic stopper rod. For purpose of multiphase sampling, clear plastic or glass is desirable in order to observe the profile of the multiphase liquid.

The sampler is assembled as follows:

a. Attach the swivel to the T-handle with the 3.18-cm (1-1/4 in) long bolt and secure with the 0.48-cm (3/16-in) National Coarse (NC) washer and lock nut.

b. Attach the PFTE stopper to one end of the stopper rod and secure with the 0.95-cm (3/8-in) washer and lock nut.

c. Install the stopper and stopper rod assembly in the sampling tube.

d. Secure the locking block sleeve on the block with glue or screw. This block can also be fashioned by shaping a solid plastic rod on a lathe to the required dimension.

e. Position the locking block on top of the sampling tube such that the sleeveless portion of the block fits inside the tube, the sleeve sits against the top end of the tube, and the upper end of the stopper rod slips though the center hole of the block.

f. Attach the upper end of the stopper rod to the swivel of the T-handle.

g. Place the sampler in the close position and adjust the tension on the stopper by screwing the T-handle in or out.

Attachment F: Drum Opening Techniques and Equipment [1]

I. Introduction

The opening of closed drums prior to sampling entails considerable risk if not done with the proper techniques, tools, and safety equipment. The potential for vapor exposure, skin exposure due to splash or spraying, or even explosion resulting from sparks produced by friction of the tools against the drum, necessitate caution when opening any closed container. Both manual drum opening and remote drum opening will be discussed in the following paragraphs. When drums are opened manually risks are greater than when opened remotely; for this reason, the remote opening of drums is advised whenever possible.

Prior to sampling, the drums should be staged to allow easy access. Also, any standing water or other material should be removed from the container top so that the representative nature of the sample is not compromised when the container is opened. There is also the possibility of encountering a water-reactive substance.

II. Manual Drum Opening

A. Bung Wrench

A common method for opening drums manually is using a universal bung wrench. These wrenches have fittings made to remove nearly all commonly encountered bungs. They are usually constructed of cast iron, brass, or a bronze-beryllium (a non-sparking alloy formulated to reduce the likelihood of sparks). The use of bung wrenches marked "NON SPARKING" is encouraged. However, the use of a "NON SPARKING" wrench does not completely eliminate the possibility of spark being produced. Such a wrench only prevents a spark caused by wrench-to-bung friction, but it cannot prevent sparking between the threads on the drum and the bung.

A simple tool to use, the fitting on the bung wrench matching the bung to be removed is inserted into the bung and the tool is turned counterclockwise to remove the bung. Since the contents of some drums may be under pressure (especially, when the ambient temperature is high), the bung should be turned very slowly. If any hissing is heard, the person opening the drum should back off and wait for the hissing to stop. Since drums under pressure can spray out liquids when opened, the wearing of appropriate eye and skin protection in addition to respiratory protection is critical.

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[1] Taken from EPA Training Course: "Sampling for Hazardous Materials," U.S. Environmental Protection Agency, Office of Emergency and Remedial Response Support Division, March 24, 1987.

B. Drum Deheader

One means by which a drum can be opened manually when a bung is not removable with a bung wrench is by using a drum deheader. This tool is constructed of forged steel with an alloy steel blade and is designed to cut the lid of a drum off or part way off by means of a scissors-like cutting action. A limitation of this device is that it can be attached only to closed head drums (i.e., DOT Specification 17E and 17F drums); drums with removable heads must be opened by other means.

Drums are opened with a drum deheader by first positioning the cutting edge just inside the top chime and then tightening the adjustment screw so that the deheader is held against the side of the drum. Moving the handle of the deheader up and down while sliding the deheader along the chime will enable the entire top to be rapidly cut off if so desired. If the top chime of a drum has been damaged or badly dented it may not be possible to cut the entire top off. Since there is always the possibility that a drum may be under pressure, the initial cut should be made very slowly to allow for the gradual release of any built-up pressure. A safer technique would be to employ a remote pressure release method prior to using the deheader.

C. Hand Pick or Spike

When a drum must be opened and neither a bung wrench nor a drum deheader is suitable, then it can be opened for sampling by using a hand pick, pickaxe, or spike. These tools are usually constructed of brass or a non-sparking alloy with a sharpened point that can penetrate the drum lid or head when the tool is swung. The hand picks or pickaxes that are most commonly used are commercially available, whereas the spikes are generally uniquely fabricated 4- foot long poles with a pointed end. Often the drum lid or head must be hit with a great deal of force in order to penetrate it. Because of this, the potential for splash or spraying is greater than with other opening methods and therefore this method of drum opening is not recommended, particularly when opening drums containing liquids. Some spikes used for drum opening have been modified by the addition of a circular splash plate near the penetrating end. This plate acts as a shield and reduces the amount of splash in the direction of the person using the spike. Even with this shield, good splash gear is essential.

Since drums, some of which may be under pressure, cannot be opened slowly with these tools, “sprayers” may result and appropriate safety measures must be taken. The pick or spike should be decontaminated after each drum is opened to avoid cross contamination and/or adverse chemical reaction from incompatible materials.

III. Remote Opening

A. Backhoe Spike

The most common means used to open drums remotely for sampling is the use of a metal spike attached or welded to a backhoe bucket. In addition to being very efficient, this method can greatly reduce the likelihood of personnel exposure.

Drums should be "staged," or placed in rows with adequate aisle space to allow ease in backhoe maneuvering. Once staged, the drums can be quickly opened by punching a hole in the drum head or lid with the spike.

The spike should be decontaminated after each drum is opened to prevent cross contamination. Even though some splash or spray may occur when this method is used, the operator of the backhoe can be protected by mounting a large shatter-resistant shield in front of the operator's cage. This, combined with the normal sampling safety gear, should be sufficient to protect the operator. Additional respiratory protection can be afforded by providing the operator with an on-board airline system. The hole in the drum can be sealed with a cork.

B. Hydraulic Devices

Recently, remotely operated hydraulic devices have been fabricated to open drums remotely. One such device is discussed here. This device uses hydraulic pressure to pierce through the wall of a drum. It consists of a manually operated pump that pressurizes oil through a length of hydraulic line. A piercing device with a metal point is attached to the end of this line and is pushed into the drum by the hydraulic pressure. The piercing device can be attached so that a hole for sampling can be made in either the side or the head/lid of the drum. Some of the metal piercers are hollow or tube-like so that they can be left in place, if desired, and serve as a permanent tap or sampling port. The piercer is designed to establish a tight seal after penetrating the container.

C. Pneumatic Devices

Pneumatically-operated devices utilizing compressed air have been designed to remove drum bungs remotely. A pneumatic bung remover consists of a compressed air supply (usually SCBA cylinders) that is controlled by a heavy-duty, 2-stage regulator. A high pressure air line of desired length delivers compressed air to a pneumatic drill that is adapted to turn a bung fitting (preferably, a bronze-beryllium alloy) selected to fit the bung to be removed. An adjustable bracketing system has been designed to position and align the pneumatic drill over the bung. This bracketing system must be attached to the drum before the drill can be operated. Once the bung has been loosened, the bracketing system must be removed before the drum can be sampled. This attachment and removal procedure is time- consuming and is the major drawback of this device. This remote bung opener does not permit the slow venting of the container, and therefore appropriate precautions must be taken. It also requires the container to be upright and relatively level. Bungs that are rusted shut cannot be removed with this device.

IV. Summary

The opening of closed containers is one of the most hazardous site activities. Maximum efforts would be made to ensure the safety of the sampling team. Proper protective equipment and a general wariness of the possible dangers will minimize the risk inherent to sampling operations. Employing proper drum opening techniques and equipment will also safeguard personnel. The use of remote sampling equipment whenever feasible is highly recommended.

STANDARD OPERATING PROCEDURE

Chain-of-Custody

I Purpose

The purpose of this SOP is to provide information on chain-of-custody procedures to be used under the CLEAN Program.

II Scope

This procedure describes the steps necessary for transferring samples through the use of Chain-of-Custody Records. A Chain-of-Custody Record is required, without exception, for the tracking and recording of samples collected for on-site or off-site analysis (chemical or geotechnical) during program activities (except wellhead samples taken for measurement of field parameters). Use of the Chain-of-Custody Record Form creates an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis. This procedure identifies the necessary custody records and describes their completion. This procedure does not take precedence over region specific or site-specific requirements for chain-of-custody.

III Definitions

Chain-of-Custody Record Form - A Chain-of-Custody Record Form is a printed two-part form that accompanies a sample or group of samples as custody of the sample(s) is transferred from one custodian to another custodian. One copy of the form must be retained in the project file.

Custodian - The person responsible for the custody of samples at a particular time, until custody is transferred to another person (and so documented), who then becomes custodian. A sample is under one's custody if:

- It is in one's actual possession.
- It is in one's view, after being in one's physical possession.
- It was in one's physical possession and then he/she locked it up to prevent tampering.
- It is in a designated and identified secure area.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the point and time that it was collected.

IV Responsibilities

Project Manager - The Project Manager is responsible for ensuring that project-specific plans are in accordance with these procedures, where applicable, or that other, approved procedures are developed. The Project Manager is responsible for development of documentation of procedures which deviate from those presented herein. The Project Manager is responsible for ensuring that chain-of-custody procedures are implemented. The Project Manager also is responsible for determining that custody procedures have been met by the analytical laboratory.

Field Team Leader - The Field Team Leader is responsible for determining that chain-of-custody procedures are implemented up to and including release to the shipper or laboratory. It is the responsibility of the Field Team Leader to ensure that these procedures are implemented in the field and to ensure that personnel performing sampling activities have been briefed and trained to execute these procedures.

Sample Personnel - It is the responsibility of the field sampling personnel to initiate chain-of-custody procedures, and maintain custody of samples until they are relinquished to another custodian, the sample shipper, or to a common carrier.

V Procedures

The term "chain-of-custody" refers to procedures which ensure that evidence presented in a court of law is valid. The chain-of-custody procedures track the evidence from the time and place it is first obtained to the courtroom, as well as providing security for the evidence as it is moved and/or passed from the custody of one individual to another.

Chain-of-custody procedures, recordkeeping, and documentation are an important part of the management control of samples. Regulatory agencies must be able to provide the chain-of-possession and custody of any samples that are offered for evidence, or that form the basis of analytical test results introduced as evidence. Written procedures must be available and followed whenever evidence samples are collected, transferred, stored, analyzed, or destroyed.

V.1 Sample Identification

The method of identification of a sample depends on the type of measurement or analysis performed. When *in situ* measurements are made, the data are recorded directly in bound logbooks or other field data records with identifying information.

Information which shall be recorded in the field logbook, when in-situ measurements or samples for laboratory analysis are collected, includes:

- Field Sampler(s),
- Contract Task Order (CTO) Number,
- Project Sample Number,
- Sample location or sampling station number,

- Date and time of sample collection and/or measurement,
- Field observations,
- Equipment used to collect samples and measurements, and
- Calibration data for equipment used

Measurements and observations shall be recorded using waterproof ink.

V.1.1 Sample Label

Samples, other than for *in situ* measurements, are removed and transported from the sample location to a laboratory or other location for analysis. Before removal, however, a sample is often divided into portions, depending upon the analyses to be performed. Each portion is preserved in accordance with the Sampling and Analysis Plan. Each sample container is identified by a sample label (see Attachment A). Sample labels are provided, along with sample containers, by the analytical laboratory. The information recorded on the sample label includes:

- Project - CTO Number.
- Station Location - The unique sample number identifying this sample.
- Date - A six-digit number indicating the day, month, and year of sample collection (e.g., 01/21/08).
- Time - A four-digit number indicating the 24-hour time of collection (for example: 0954 is 9:54 a.m., and 1629 is 4:29 p.m.).
- Medium - Water, soil, sediment, sludge, waste, etc.
- Sample Type - Grab or composite.
- Preservation - Type and quantity of preservation added.
- Analysis - VOA, BNAs, PCBs, pesticides, metals, cyanide, other.
- Sampled By - Printed name of the sampler.
- Remarks - Any pertinent additional information.

Using only the work assignment number of the sample label maintains the anonymity of sites. This may be necessary, even to the extent of preventing the laboratory performing the analysis from knowing the identity of the site (e.g., if the laboratory is part of an organization that has performed previous work on the site). The field team should always follow the sample ID system prepared by the project EIS and reviewed by the Project Manager.

V.2 Chain-of-Custody Procedures

After collection, separation, identification, and preservation, the sample is maintained under chain-of-custody procedures until it is in the custody of the analytical laboratory and has been stored or disposed of.

V.2.1 Field Custody Procedures

- Samples are collected as described in the site Sampling and Analysis Plan. Care must be taken to record precisely the sample location and to ensure that the sample number on the label matches the Chain-of-Custody Record exactly.

- The person undertaking the actual sampling in the field is responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

- When photographs are taken of the sampling as part of the documentation procedure, the name of the photographer, date, time, site location, and site description are entered sequentially in the site logbook as photos are taken. Once downloaded to the server or developed, the electronic files or photographic prints shall be serially numbered, corresponding to the logbook descriptions; photographic prints will be stored in the project files. To identify sample locations in photographs, an easily read sign with the appropriate sample/ location number should be included.

- Sample labels shall be completed for each sample, using waterproof ink unless prohibited by weather conditions (e.g., a logbook notation would explain that a pencil was used to fill out the sample label if the pen would not function in freezing weather.)

V.2.2 Transfer of Custody and Shipment

Samples are accompanied by a Chain-of-Custody Record Form. A Chain-of-Custody Record Form example is shown in Attachment B. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the Record. This Record documents sample custody transfer from the sampler, often through another person, to the analyst in the laboratory. The Chain-of-Custody Record is filled out as given below:

- Enter header information (CTO number, samplers, and project name).

- Enter sample specific information (sample number, media, sample analysis required and analytical method grab or composite, number and type of sample containers, and date/time sample was collected).

- Sign, date, and enter the time under "Relinquished by" entry.

- Have the person receiving the sample sign the "Received by" entry. If shipping samples by a common carrier, print the carrier to be used in this space (i.e., Federal Express).

- If a carrier is used, enter the airbill number under "Remarks," in the bottom right corner;

- Place the original (top, signed copy) of the Chain-of-Custody Record Form in a plastic zipper-type bag or other appropriate sample-shipping package. Retain the copy with field records.

- Sign and date the custody seal, a 1-inch by 3-inch white paper label with black lettering and an adhesive backing. Attachment C is an example of a custody seal. The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field. Custody seals shall be provided by the analytical laboratory.

- Place the seal across the shipping container opening (front and back) so that it would be broken if the container were to be opened.

- Complete other carrier-required shipping papers.

The custody record is completed using waterproof ink. Any corrections are made by drawing a line through and initialing and dating the change, then entering the correct information. Erasures are not permitted.

Common carriers will usually not accept responsibility for handling Chain-of-Custody Record Forms; this necessitates packing the record in the shipping container (enclosed with other documentation in a plastic zipper-type bag). As long as custody forms are sealed inside the shipping container and the custody seals are intact, commercial carriers are not required to sign the custody form.

The laboratory representative who accepts the incoming sample shipment signs and dates the Chain-of-Custody Record, completing the sample transfer process. It is then the laboratory's responsibility to maintain internal logbooks and custody records throughout sample preparation and analysis.

VI Quality Assurance Records

Once samples have been packaged and shipped, the Chain-of-Custody copy and airbill receipt become part of the quality assurance record.

VII Attachments

A. Sample Label
B. Chain of Custody Form
C. Custody Seal

VIII References

USEPA. *User's Guide to the Contract Laboratory Program*. Office of Emergency and Remedial Response, Washington, D.C. (EPA/540/P-91/002), January 1991.

STANDARD OPERATING PROCEDURE

Packaging and Shipping Samples

I. Purpose and Scope

These general procedures describe the proper packaging and shipping of samples.

II. Equipment and Materials

- Coolers
- Ice
- Tape (strapping, duct and/or packing tapes)
- Ball-point pens and indelible makers
- Chains of Custody forms
- Heavy-duty garbage bags
- Ziploc® bags
- Blanks (temperature and trip blanks as necessary)

III. Procedures and Guidelines

A. Standard Parameters

- Prepare coolers for shipment:
    - Tape drains shut.
    - Affix "This Side Up" labels on all four sides and "Fragile" labels on at least two sides of each cooler.
    - Place mailing label with laboratory address on top of coolers.
- Arrange sample containers in groups by sample number. Consolidate VOC samples into one cooler to minimize the need for trip blanks.
- Affix appropriate adhesive sample labels to each container. Protect with clear label protection tape after labeling.
- Seal each sample bottle within a separate Ziploc® plastic bag or bubble wrap, if available. Tape the bag around bottle. Sample label should be visible through the bag.

- Arrange sample bottles in coolers so that they do not touch.
- If ice is required to preserve the samples, cubes should be repackaged in zip-lock bags and placed on and around the containers.
- Sign chain-of-custody form (or obtain signature) and indicate the time and date it was relinquished to Federal Express or the courier.
- Separate copies of forms. Seal proper copies (traffic reports, packing lists) along with a return address label within a large zip-lock bag and tape to inside lid of cooler.
- Close lid and latch.
- Carefully peel custody seals from backings and place intact over lid openings (right front and left back). Cover seals with clear protection tape.
- Tape cooler shut on both ends, making several complete revolutions with strapping tape. Do not cover custody seals.
- Relinquish to Federal Express or to a courier arranged with the laboratory. Place airbill receipt inside the mailing envelope and send to the sample documentation coordinator along with the other documentation.
- Complete an original FedEx Airbill as instructed. That is, under Section 6, fill in the number of packages and net quantity per box next to the dry ice box in the "Special Handling" section on the Airbill. There is no need for a "Shipper's Declaration" if dry ice is the only Dangerous Good in the shipment.

V. Attachments

None.

Quality Analytical Laboratories, Inc.
2567 Fairlane Drive
Montgomery, Alabama 36116
PH. (334)271-2440

Client ______________________
Sample No. ______________________
Location ______________________

Analysis ______________________

Preservative HCL
Date ____________ By ____________

CEIMIC
CORPORATION
10 Dean Knauss Drive, Narragansett, R.I. 02882 • (401) 782-8900

SITE NAME	DATE
ANALYSIS	TIME
	PRESERVATIVE

SAMPLE TYPE

☐ Grab ☐ Composite ☐ Other ________

COLLECTED BY:

CH2M H...
APPLIED SCIENCES LABORATORY

CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CH2M Hill Project # ☐☐☐☐☐☐☐☐.☐☐.☐☐

Purchase Order #

Project Name

Company Name CH2M HILL Office

Project Manager & Phone #
Mr. [ ]
Ms. [ ]
Dr. [ ]

Report Copy to:

Requested Completion Date:

Sampling Requirements: SDWA ☐ NPDES ☐ RCRA ☐ OTHER ____

Sample Disposal: Dispose ☐ Return ☐

LAB TEST CODES

ANALYSES REQUESTED

SHADED AREA– FOR LAB USE ONLY

Lab 1 #	Lab 2 #
Quote #	Kit Request #
Project #	
No. of Samples	Page of
Login	LIMS Ver

Sampling Date	Sampling Time	Type: COMP	Type: GRAB	Matrix: WATER	Matrix: SOIL	Matrix: AIR	CLIENT SAMPLE ID (9 CHARACTERS)	# OF CONTAINERS	ANALYSES REQUESTED	REMARKS	LAB 1 ID	LAB 2 ID

Sampled By & Title (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time	QC Level: 1 2 3 Other: ____
Received By (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time	COC Rec / ICE
Received By (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time	Ana Req / TEMP; Cust Seal / Ph
Received By (Please sign and print name)	Date/Time	Shipped Via UPS BUS Fed-Ex Hand Other ____	Shipping #	
Work Authorized By (Please sign and print name)	Remarks			

Instructions and Agreement Provisions on Reverse Side

DISTRIBUTION: Original - LAB, Yellow - LAB, Pink - Client
REV 3/94 FORM 340

CH2M HILL

CUSTODY SEAL

Date ______________________ ______________________

Signature ______________________ ______________________

STANDARD OPERATING PROCEDURE

VOC Sampling--Water

I. Purpose

To provide general guidelines for sampling aqueous volatile organic compounds.

II. Scope

Standard techniques for collecting representative samples are summarized. Site-specific details are discussed in the Field Sampling Plan.

III. Equipment and Materials

- Sample vials pre-preserved at laboratory with Hydrochloric acid (HCl)
- Surgical or latex gloves

IV. Procedures and Guidelines

1. Sample VOCs before sampling other analyte groups.

2. When sampling for VOCs, especially residential wells, evaluate the area around the sampling point for possible sources of air contamination by VOCs. Products that may give off VOCs and possibly contaminate a sample include perfumes and cosmetics, skin applied pharmaceuticals, automotive products (gasoline, starting fluid, windshield deicers, carburetor cleaners, etc.) and household paint products (paint strippers, thinners, turpentine, etc.).

3. Keep the caps off the sample vials for as short a time as possible.

4. Wear clean latex or surgical gloves.

5. Fill the sample vial immediately, allowing the water stream to strike the inner wall of the vial to minimize formation of air bubbles. DO NOT RINSE THE SAMPLE VIALS BEFORE FILLING.

6. Fill the sample vial with a minimum of turbulence, until the water forms a positive meniscus at the brim.

7. Replace the cap by gently setting it on the water meniscus. Tighten firmly, but DO NOT OVERTIGHTEN.

8. Invert the vial and tap it lightly. If you see air bubbles in the sample, do not add more sample. Use another vial to collect another sample. Repeat if necessary until you obtain a proper sample.

V. Attachments

None.

VI. Key Checks and Items

- Check for possible sources of contamination.
- Fill slowly, with as little turbulence as possible.
- Check for air bubbles.

STANDARD OPERATING PROCEDURE

Water-Level Measurements

I. Purpose and Scope

The purpose of this procedure is to provide a guideline for the measurement of the depth to groundwater in monitoring wells, where a second phase of floating liquid (e.g., gasoline) is not encountered. This SOP includes guidelines for discrete measurements of static water levels.

II. Equipment and Materials

A. Discrete Measurements of Static Water Level

- Electronic water level meter, Solinst or equivalent, with a minimum 100-foot tape; the tape should have graduations in increments of 0.01 feet or less

III. Procedures and Guidelines

A. Measurement of Static Water Level

Verify that the unit is turned on and functioning properly. Slowly lower the probe on its cable into the well until the probe just contacts the water surface; the unit will respond with a tone or light signal. Sight across the top of the locking well casing adjacent to the measuring point, recording the position of the cable when the probe is at the water surface. The measuring point will be a standardized surveyed location on the top of each well casing, adjacent to the lock hasp, indicated by a notch, paint mark, or similar method. Measure the distance from this point to the closest interval marker on the tape, and record the water level reading in the log book.

Measure and record the three following additional readings: (1) the depth of the well; (2) the depth from the top of the casing to the top of the well riser; and (3) the distance to the surface of the concrete pad or to ground. Measurements are to be taken with respect to the measuring point on the top of the well casing. The depth of the well may be measured using the water-level probe with the instrument turned off.

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

A. Discrete Measurements of Static Water Level

Prior to each use, verify that the battery is charged by pressing the test button on the water-level meter. Verify that the unit is operating correctly by testing the probe in distilled or deionized water. Leave the unit turned off when not in use.

STANDARD OPERATING PROCEDURE

Conducting Building Surveys for Vapor Intrusion Evaluation

1. Background

This standard operating procedure (SOP) describes the procedures for conducting building surveys for vapor intrusion evaluations. A building survey is performed as part of a vapor intrusion evaluation to obtain information for development of a conceptual site model (CSM) and to prepare for vapor intrusion sampling.

2. Purpose and Objectives

The three purposes of performing a building survey are to 1) gather building characteristics data for the vapor intrusion CSM, 2) select optimal vapor intrusion sampling locations within the building, and 3) determine if there are any potential indoor sources.

This SOP can be used to perform building surveys in residential, commercial, or industrial buildings. At project sites with multiple buildings, a building survey should be performed for each building that is included in the vapor intrusion evaluation.

A CSM for vapor intrusion pathway evaluation describes potential constituent sources, migration pathways, and potential human receptors under current and/or future land uses at the site.

The important building characteristics for vapor intrusion pathway evaluation include construction materials; room dimensions; building/room use; presence of a basement or crawl space; condition of the slab; presence/condition of doors and windows; type, age, and typical operational settings of the air handling unit; identification of potential vapor intrusion pathways into the building (e.g., cracks, sumps, drains, etc.); and the presence of potential indoor sources of volatile organic compounds (VOCs).

The building survey will likely be the first interaction with the occupants at the building and is an appropriate time to provide occupants with information on the vapor intrusion evaluation being performed and any sampling procedures that will be used.

3. Project-Specific Considerations

Some states include building survey procedures and forms in their regulations or guidance documents. It is the responsibility of the project team to make sure this procedure meets all applicable regulatory standards and receives approval/concurrence from the leading regulatory agency for the project.

Varying levels of detail can be attained for building surveys. The project should develop data quality objectives (DQOs) to determine what specific information should be collected for their project.

For vapor intrusion evaluations in residential areas, a community outreach plan should be developed and the field team should be trained on how to communicate with residents.

Ideally, the building survey should be conducted at least one week before the actual indoor air or subslab soil gas sampling event. This advance timeframe allows the vapor intrusion investigator to identify and eliminate (to the extent practical) potential background sources of indoor air contamination. It also permits the investigator to confirm the sample locations with the occupants and regulatory agency(s) (if applicable) ahead of the scheduled sampling event.

4. Health and Safety

There are several health and safety topics to consider when performing building surveys:

- Field teams should perform building surveys in pairs. A field team member should never enter a residence alone. The mental stability of a home owner should not be taken for granted. Building surveys at abandoned buildings should also be performed in pairs; if one team member is injured, the other will be able to seek help.
- Walk slowly and with caution to avoid slips, trips, and falls.
- Beware of animals and insects. This applies to abandoned buildings and residences.
- Be careful of overhead hazards in basements. Do not attempt to enter crawl spaces.

5. Materials

- *Building Survey Form* – to record survey information. Example forms are provided in Attachment A of this SOP; there is one for residential buildings, and one for industrial/commercial buildings.
- Flashlight
- Walking wheel or measuring tape – to measure building and room dimensions
- Camera – to photograph the building, heating, ventilation, and air conditioning (HVAC) system, etc.
- Micromanometer – for differential pressure measurements (*OPTIONAL*)
- Photoionization detector – to monitor total VOCs for health and safety at sites where high VOC concentrations may be expected (*OPTIONAL*)

6. Field Procedures

6.1. Gain access to the building. Schedule the site visit with the site contact. At a client-owned and -operated site this step may just require a phone call to the client. At an off-site residence this may require significant coordination, including obtaining an access agreement and providing vapor intrusion fact sheets to inform residents of the vapor intrusion pathway and the reason for the investigation.

6.2. Obtain occupant information. The building occupants are the potential receptors in the vapor intrusion CSM. Is the building use residential, commercial, or industrial? How many people typically occupy the building? Are there sensitive receptors (children, elderly, or immune-impaired) in the building? How much time do occupants spend in the building?

6.3. Obtain building information. How old is the building? What was its original use? Have there been any additions or other significant modifications? How many floors does the building have? Does the building have a basement? If so, how far does it extend below grade? Is the slab on grade? Is the slab elevated above the ground surface?

6.4. Observe the slab condition. The building slab is the barrier between subslab soil gas and the indoor air. How thick is the slab? What is the general condition of the slab? What is the floor covering in each room of the lowest floor (carpet, tile, etc.)?

6.5. Identify potential vapor intrusion pathways. The entry of organic vapors into a structure is caused by the infiltration of contaminants through the floor and walls that are in contact with the soil. Any openings, cracks, or penetrations in the foundation may be entryways for subslab soil gas. Are there any utilities that penetrate the foundation? Are they sealed properly? Are there cracks in the slab? If so, note where these cracks are and their approximate size. Are there sumps? If so, note the dimensions of each and their typical operating conditions. Is the wall/floor juncture sealed well? Is there a French drain? Has the basement been waterproofed? Are there expansion joints in the slab? If so, note their condition. Are there any utilities that penetrate the foundation? If so, are they sealed well?

6.6. Other vapor intrusion pathways may be cracks in the walls and floors, sumps, spaces around the wall/floor juncture of floating floor construction, or other breaches in the walls or slab. The *Building Survey Form* asks a series of questions that are designed to assist in the identification of potential points of vapor intrusion. Identify the type of building foundation, construction of the basement floor, and the presence of sumps or drains. Any obvious breaches in the walls or slab in the basement (or lowest floor) should be noted. The investigator should also examine the points at which all utility lines enter the structure.

6.7. Survey the building envelope. The condition of the building envelope will determine the rate of outdoor to indoor air exchange. A high rate of outdoor air exchange can dilute soil gas that may be migrating into the building. Walk around the inside and outside of the building and record information on the building construction and condition. How many doors/windows/loading docks are there, what condition are they in, and are they typically left open or closed? What are the building construction materials?

6.8. Determine the indoor air volume. If a building has a very large indoor air volume, soil gas migrating into the building may become quickly diluted. Indoor air sampling may be necessary in multiple rooms if the indoor air volume is not connected. Measure the building dimensions (length, width, and height). Measure the dimensions of rooms within the building. How are the rooms connected? Are doors typically kept open or shut?

6.9. Evaluate the HVAC system. The HVAC system's operation can determine if the building is negatively or positively pressurized. If a building is negatively pressurized, then subslab gas will be pulled into the building and if the building is positively pressurized, subslab gas will not enter the building. Record the type/model of the systems and the typical operating conditions. Is there one air conditioning zone or multiple zones (look for multiple thermostats)? Does the HVAC system use radiant heat or forced air? Are there ventilation fans? If so, note where and their typical operating conditions.

6.10. Identify any existing vapor mitigation systems. Is there a radon mitigation system or other subslab depressurization system? Is there sealant on any cracks or crevices? Is there a sealant coat on the floor for vapor or water mitigation?

6.11. Sketch the building floor plan. Record all pertinent building characteristics for the vapor intrusion evaluation. Include building dimensions, locations of windows/doors/loading docks, outdoor surface cover (grass, asphalt, etc.), and locations of any potential indoor VOC sources.

6.12. Identify potential indoor contaminant sources within the building. Record the location of the potential sources and determine if they can be removed before indoor air sampling is performed. Potential indoor sources of VOCs may include cleaning products, paint, dry-cleaned clothes, gasoline, cosmetics, or cigarette smoke. Recent remodeling activities, including painting, new carpeting or flooring, and new furniture should be identified because they could be potential sources of VOCs. It may be necessary to include additional sheets to inventory all the potential VOC sources within the structure. When potential indoor VOC sources are identified and removed from a building, it may be necessary to ventilate the rooms affected in advance of the air sampling event. This ventilation should be completed at least 24 hours before the commencement of the indoor air sampling event. A hand-held field screening instrument can also be used to pinpoint potential indoor VOC sources.

6.13. Identify potential outdoor contaminant sources. These may include gas stations, major roadways, dry cleaners, repair shops, industries, or landfills.

6.14. *OPTIONAL.* Collect differential pressurization measurements. If a building is positively pressurized compared to the outdoor air and/or subslab, then vapor intrusion is less likely to occur. Using a micromanometer, measure the pressure differential between the inside of the building and the outside. If there are existing subslab soil gas probes, the pressure differential between the subslab and inside of the building should also be measured. The procedures to conduct long-term differential pressure measurements are provided in the *Long-Term Measurement of Sub-Slab/Indoor Air Differential Pressure for Vapor Intrusion Investigations Standard Operating Procedure***.**

6.15. *OPTIONAL.* Identify possible indoor air and subslab sample locations that meet the project-specific DQOs.

Typically, indoor air samples should be collected on the lowest floor of the building at breathing zone height (approximately 3 to 5 feet) toward the center of the building away from windows. Consideration should be given on a case-specific basis to those situations (such as a day care facility) where a different sampling height may also be appropriate to evaluate a unique setting or population. Indoor air samples can be collected from more than one floor within a structure to address varying risk exposures and as part of the process to distinguish contaminants related to vapor intrusion from background sources. Thus, the location and position of the sample container will vary depending on which floor the sampling event takes place. In residential structures, ground floor (living space) samples should be located to approximate human risk exposure. The basement sample(s) are primarily designed to investigate "worst case" situations within a structure. Therefore, basement samples are positioned as close as possible to the source area (e.g., sumps or major cracks in the foundation).

Subslab sample locations should also be toward the center of the building and ideally in an area of exposed concrete away from any penetrations in the slab. Positions near the perimeter of the slab are subject to dilution and should be avoided. To minimize potential damage to flooring, it may be necessary to select a location in a closet or utility room (where carpeting or tiles are less visible or not present at all). The selected location(s) should be chosen in consultation with the property owner during the building survey.

Procedures for collecting indoor air and subslab soil gas samples inside a building are described in the *Ambient Air Sampling Standard Operating Procedure* and the *Subslab Soil Gas Sampling Standard Operating Procedure*.

7. Data Reduction and Evaluation

The information collected during the building survey can be used to develop a preliminary vapor intrusion CSM for the work plan, refine an existing CSM, select locations for indoor air and subslab samples, or to provide information to support the evaluation of the vapor intrusion pathway in a vapor intrusion evaluation or human health risk assessment.

8. Quality Control

Adequate time should be reserved for performing building surveys and detailed notes should be recorded at the time of the building survey.

Preliminary Building Survey for Vapor Intrusion Investigation

CH2MHILL

Date: ____________________

Preparer: ____________________

Facility: ____________________

Address: ____________________

____

____

Contact Person: ____________________

Phone Number: ____________________

e-mail address: ____________________

Building Description

Building or Room Identifier: ____________________

Primary Activity within Building (select one):

- ☐ Manufacturing ☐ Storage ☐ Other
- ☐ Chemical processing ☐ Chemical Storage
- ☐ Administrative ☐ Instrumentation/Control

Notes: ____________________

____

____

Approximate floor space ____________________

Number of floors ____________________

Multi-room building ☐ or Single room ☐

Ceiling height ____________________

Aboveground Construction ☐ Wood ☐ Concrete

☐ Brick ☐ Cinderblock

☐ Other ____________________

Floor plan attached? ☐ Yes ☐ No

Notes: ____________________

____

Preliminary Building Survey for Vapor Intrusion Investigation

Evaluation of Potential Conduits from Soil

Floor/foundation description (check all that apply)

☐ Wood ☐ Concrete ☐ Elevated above grade?
☐ Below grade?

☐ Other ______________________

Expansion joints present (if concrete floor)?	☐ Yes	☐ No	☐ N/A
Are expansion joints sealed?	☐ Yes	☐ No	☐ N/A
Are sumps or floor drains present?	☐ Yes	☐ No	☐ N/A
Are basements or subsurface vaults present?	☐ Yes	☐ No	☐ N/A
Are there subsurface drainage problems?	☐ Yes	☐ No	☐ N/A

Notes: ______________________

Evaluation of Potential Pathways/Driving Forces

Are there locations with elevated positive or negative pressure (look for doors not opening/closing properly, perceptible airflow, audible fan noise)

Is there one air conditioning zone or multiple zones (if in a multi-room building)?

☐ Single zone ☐ Multi-zone ☐ Other ______________________

(building management may know; another tip-off is the presence of multiple thermostats = multiple zones)

Sources of outdoor air

☐ Mechanical (air handling unit) ☐ Doors
☐ Windows

Are windows/doors left open routinely? ☐ Yes ☐ No

Notes: ______________________________

Evaluation of Potential Existing Chemical Sources Indoors

List principal solvent or VOC-containing products used (obtain MSDSs if available)

______________ ______________
______________ ______________
______________ ______________

Are any of the target analytes used in this building/room?

☐ Yes ☐ No

______________ ______________
______________ ______________

Are pesticides used indoors for pest control? ☐ Yes ☐ No

Names of pesticide products used? ______________

Has there been a pesticide application within the past 6 months? ☐ Yes ☐ No

Is smoking permitted in the building? ☐ Yes ☐ No

Description of Vapor Mitigation Systems

Has a radon or vapor mitigation system been installed in this building/room? ☐ Yes ☐ No

Date of installation? ______________

Type of system?
☐ Passive venting
☐ Active subslab depressurization
☐ Crack/crevice sealing
☐ Dilution ventilation control
☐ N/A

Notes: ______________________________

Additional Notes

Additional Notes

Date: ______________________

Preparer: ______________________

Facility: ______________________

Description (floor): ______________________

Floor Plan Information

Standard Operating Procedure for Installing Subslab Probes and Collecting Subslab Soil Gas Samples Using SUMMA Canisters

1.0 Scope and Application

This standard operating procedure (SOP) describes the approach for installing subslab probes and collecting subslab soil gas samples in SUMMA canisters. It includes instructions on probe installation, leak checking, soil gas sampling, and probe abandonment. This SOP should be used in conjunction with project data quality objectives. The project team is responsible for making sure this procedure meets all applicable regulatory standards and receives approval/concurrence from the leading regulatory agency for the project. Only persons trained in the collection of subslab samples should attempt this procedure.

2.0 Project-Specific Considerations

2.1 A utility clearance should be performed before mobilization, as with all intrusive site work. The sampling team should look around the building to locate where utilities come into the building and make sure they are not underground. Utility shut-off valves should be located in case an underground utility is encountered. It is highly recommended that ground penetrating radar (GPR) be used to identify utilities, wire mesh, and/or rebar in the slab prior to drilling.

2.2 There are three types of probe installation techniques. The type chosen depends on site access, probe seal integrity considerations, and the number of sampling events planned. It is critical that the sealing compound used is low in volatile organic compounds (VOCs). The suggested sealing compounds below have been tested and approved for use. Consult a subject matter expert if another compound is preferred or available. See Table 1 for more specific details.

2.2.1 Temporary – Beeswax – Use if time is short, access is an issue, and a higher risk of leaks (requiring repeated resealing of the probe) is acceptable. It MUST be 100% pure, natural beeswax.

2.2.2 Semi-permanent – Fix-It-All –Use if setting the probe and sampling on one day is preferred, access limitations are minimal, only one sampling event is intended, and minimal moisture is present.

2.2.3 Permanent – Portland cement/bentonite clay mixture – Use if there is unlimited access and multiple sampling events are desired.

3.0 Materials

3.1 Subslab Probe Installation

- Hammer drill and drill bits (7/8-inch or 1-inch and 5/16-inch or 3/8-inch)
- Vacuum cleaner ('shop vac' type or handheld) for removing concrete dust from the drilled hole
- Subslab probe (for permanent or semi-permanent installations) See Figure 8 for an expanded view of the probe parts.
    - 1/4-inch stainless steel tube
    - Swagelok® nut and ferrule
    - Probe union (1/4-inch male Swagelok® to 1/8-inch female NPT)
    - Probe seal (1/8-inch NPT slotted brass plug) – Napa Auto Parts (Pt.# 3150 x 2)
- Metal tubing cutter for adjusting the length of the probe so that it does not extend below the slab

- Probe seal consisting of beeswax, Fix-it-All, or portland cement/bentonite clay mixture
- Wax melter (for beeswax only) – can be obtained from a beauty supply store (paraffin wax melter or body hair wax melter). Also need a metal measuring cup with handle for placing the wax into the melter; this way the wax can be melted in the cup and then easily poured into the probe hole. The beeswax CANNOT be melted with a direct flame because this generates VOCs.
- Large Q-tips or paper towels and water for cleaning the concrete dust out of the hole
- Tongue depressor, putty knife, or similar tool for putting the probe seal material into the hole
- Tape measure to measure the thickness of the slab
- Optional: Sonicare® toothbrush with bristles removed. (This can be useful in removing air bubbles from the cement mixture while installing the probe thus making a more competent seal)

3.2 The helium leak check equipment, including the helium (high-grade, absolutely NOT balloon grade), enclosure, helium canister, regulator for the helium canister, and helium detector. The enclosure may be constructed from a small bowl or container. The helium detector can be rented from an equipment rental company.

3.3 Sampling

- Sampling union (1/4-inch male Swagelok® or equivalent to ¼-inch male NPT)
- Vacuum pump for purging with rotometer to control flow to 200 mL/min
- Sampling manifold consisting of Swagelok® gas-tight fittings with three valves and one pressure gauge to attach the probe to the air pump and the sample canister. See Figure 10. This manifold must be clean, free of oils, and flushed free of VOCs before use.
- Teflon tubing, 1/4-inch outer diameter
- Tedlar bag (1-L or 3-L) to collect the purged soil gas so it is not discharged into the building
- Gem2000 Landfill Gas Meter – this is optional if field measurements of CO2, O2, CH4 are necessary
- MiniRae PID Meter – this is optional if field measurements of total VOCs are necessary
- Flow controller or critical orifice, certified clean, and set at desired sampling rate. These are typically provided and set by the laboratory.
- Canister, SUMMA polished, certified clean, and evacuated. (Canisters are typically provided by the laboratory.)
- Miscellaneous fitting to connect tubing to sampling union and SUMMA canister
- Negative pressure gauge, oil-free and clean, to check canister pressure. The pressure gauges are typically provided by the laboratory. The laboratory may either provide one pressure gauge to be used with all of the canisters, or a pressure gauge for each canister to be left on during sample collection. Sometimes the canisters are fitted with built-in pressure gauges that are not removable.

3.4 Probe Abandonment

- Probe removal fitting
- Crowbar
- Concrete patch (either pre-mixed cement patch or portland cement)

3.5 Miscellaneous

- Teflon tape

- Wrenches and screwdriver (clean and free of contaminants), various sizes as needed for connecting fittings and making adjustment to the flow controller. A 9/16-inch wrench fits the 1/4-inch Swagelok® fittings, which most canisters and flow controllers have.
- Extension cord
- Timer/watch
- Tools required to cut carpet, and/or tools needed for removal of other floor coverings
- Shipping container, suitable for protection of canister during shipping. Typically, strong cardboard boxes are used for canister shipment. The canisters should be shipped to the laboratory in the same shipping container in which they were received.

4.0 Probe Installation

4.1 Locate the sampling locations in accordance with the work plan. Note the location of the probe, locations of significant features (walls, cracks, sumps, drains, etc), and conditions of the slab and soil.

4.2 If needed, expose the concrete by cutting the carpet or other loose floor coverings (Note: Carpet need not be removed, but rather an ‘L’ shape should be cut to expose the concrete for drilling and the leak check enclosure).

4.3 Drill a 7/8-inch or 1-inch diameter hole to a depth of 1-3/4 inches (measured to the center of the hole) to allow room for installing the probe nut and probe union (See Figure 2). Remove the cuttings using a vacuum cleaner. Be careful to not compromise the integrity of the slab during drilling (i.e., cracking it), although note if this occurs. It is important that the slab and the probe hole remain airtight for sampling and that cracks are noted.

4.4 Drill a 5/16-inch or 3/8-inch diameter hole through the remainder of the slab and approximately 3 inches down into the subslab material (See Figure 3). Drilling into the subslab material creates a void that is free of obstructions that might plug the probe during sampling. Record the total depth of the slab and the depth drilled into the subslab material.

4.5 Clean out the drilled hole with the vacuum (equipped with a micro tip), Q-tips and paper towel. This removes any remaining dust, allowing the seal material to adhere to the hole wall better.

4.6 Some agencies may require that glass beads be poured into the subslab hole before installing the probe. If so, pour glass beads into the hole until enough beads have been added so that the top of the beads are even with the bottom of the slab. A thin piece of wire marked with the slab thickness and inserted into the hole can be used to determine this.

4.7 Install the subslab probe into the hole. First, trim the probe to the appropriate length so that when inserted into the hole it will not extend below the slab. Then wrap the end of the probe tubing with Teflon tape so that the probe fits tightly into the hole to prevent the seal material from clogging the probe. For permanent of semi-permanent probes, the probe is constructed of stainless steel tubing and Swagelok® parts. Temporary probes consist of 1/4 -inch OD Teflon tubing.

4.7.1 Temporary Seal (beeswax)

4.7.1.1 Melt the beeswax in the wax melter and pour the melted wax into the hole around the tubing. Be sure to get wax on all sides of the smaller diameter hole by moving the sample tube away from the walls. Continue to add wax until the hole is completely full.

4.7.1.2 Let the wax cool for 10 minutes.

4.7.1.3 Be sure to never leave the probe hole open to atmosphere for extended periods to minimize the effects of surface infiltration.

4.7.1.4 <u>Be careful to never put too much force on the sampling tube</u>. The wax is only a temporary seal, and its sealing integrity can be compromised easily.

4.7.2 Semi-permanent (Fix-It-All) or Permanent (portland cement/bentonite clay mixture) Seal

4.7.2.1 Wet the walls of the hole using the Q-tip or moistened paper towel. This helps the mortar bond to the drilled concrete. Prepare the mortar in accordance with manufacturer's directions to a stiff consistency. Make sure that the consistency is such that the mixture will not run down the sides of the hole and potentially clog the probe or hole but is still easy enough to work with (so it can be easily scooped into the hole.) The cement/clay mixture should consist of 5% bentonite clay in the Portland cement. Only mix an amount that can be used in 15 minutes. Place sample probe and sample union part way into the hole, as shown in Figure 4. Using the tongue depressor or similar tool, apply mortar around the base of the sampling probe and sampling union such that it will be sealed once it is in place.

4.7.2.2 Fill the hole with mortar, and press the probe further into the hole until its top is flush with the floor. In doing so, slightly wiggle the probe to create good 'wetting' contact between the probe and the mortar as well as the mortar and the drilled concrete. It may be helpful to work the concrete with a Sonicare® toothbrush (with the bristles removed) during this step to remove the air bubbles from the mortar and make a more competent seal. Scrape off excess and make sure there is clear access to the probe. See Figure 5.

4.7.2.3 For Fix-It-All, let dry for 30 minutes. For cement/clay mixture, let dry for 24 hours.

4.7.2.4 Be sure to never leave the probe hole open to atmosphere for extended periods to minimize the effects of surface infiltration.

5.0 System Set-up

5.1 For semi-permanent and permanent subslab probes, remove the probe seal and attach the sampling union to the subslab probe. Then attach 1/4-inch Teflon tubing to the sampling union with a Swagelok® nut and feral set. See Figure 6.

5.2 Place the helium leak check enclosure over the subslab probe by threading the Teflon tubing through the hole of the enclosure. Slide the enclosure down so it seals on the concrete slab. Attach the other end of the sample tube to the sampling manifold. See Figures 7 and 9.

5.3 Attach the subslab sample tubing to the sampling manifold. See Figure 10. ***Do not connect the canister at this time***.

5.4 Adjust the vacuum pump to achieve the desired flow rate of 200 milliliters/minute (ml/min). This should be performed at the outlet of the vacuum pump before purging, either by using a suitable flow meter or calculating the amount of time required to fill a 1-liter Tedlar bag.

5.5 Attach the air pump to the sampling manifold and the Tedlar bag to the air pump exhaust.

6.0 System Leak Checking and Purging

6.1 Physical Leak Check - Perform a leak check of the sample manifold system by doing the following:

6.1.1 Make sure the gas probe valve (valve #1) is closed and the sample valve (valve #2) is open.

6.1.2 Open the purge valve (valve #3) and start the vacuum pump. Verify that the flow is set to 200 ml/min.

6.1.3 Close the sample valve (valve #2) and achieve a vacuum gauge reading of 10 inches of mercury ("Hg) or to a vacuum that will be encountered during sampling, whichever is greater.

6.1.4 A leak-free system will be evident by closing off the purge valve (valve #3), turning off the vacuum pump, and observing no loss of vacuum within the sampling manifold system for a period of 30 seconds. Repair any leaks prior to use.

6.1.5 Record the leak check date and time on the field sampling log.

6.2 System Purge and Helium Leak Check -A purge of the subslab probe and sampling manifold system is required. The helium leak check procedure is also performed during this step. This leak check will verify the integrity of the probe seal. This is accomplished by doing the following:

6.2.1 Place the helium leak check enclosure around the subslab probe to achieve a buildup of helium in the leak check enclosure. The enclosure should not be tightly sealed and there should be an exhaust for the helium so pressure doesn't build up in the enclosure.

6.2.2 Start the flow of helium to the leak check enclosure at 200 ml/min. Let the helium fill the enclosure for 1 minute.

6.2.3 Open the sample valve (valve #2) and the purge valve (valve #3) and start the purge pump. Verify that the flow rate is still 200 ml/min.

6.2.4 To start the soil gas probe purge, open the gas probe valve (valve #1) and close the sample valve (valve #2) at the same time, and start timing. It is important to switch these 2 valves simultaneously. Otherwise, a vacuum can be built up in the sampling system, and its sudden release can draw concrete powder (left at the bottom of the probe hole after drilling) into the sampling system which will damage the valves and vacuum pump.

6.2.5 If there is shallow groundwater in the area, carefully watch the tubing as the pump is turned on. If water is observed in the sample tubing, shut the pump off immediately. Subslab soil gas collection may not be feasible.

6.2.6 Purge the first 30 seconds (approx. 100 mls) into a 1 liter Tedlar bag. Remove the bag and replace with a fresh 1 liter Tedlar bag. Continue the purge for at least another 2.5 minutes. This will result in a total of about 500 mls of purge gas in the second bag and 600 mls of purge volume total. At the end of the purge time, remove the Tedlar bag from the pump and connect it to the helium detector. If a reading of >1 percent (verify that this limit is consistent with appropriate project-specific agency guidance) is observed, then the probe leak check has failed and corrective action is required. There are three options:

6.2.6.1 Make sure that all the fittings are tight.

6.2.6.2 Try fortifying the probe seal by adding more sealing material and repeating the purge and leak check procedure.

6.2.6.3 If that fails, abandon the hole, drill a new one, and repeat the whole procedure.

Note: Helium leak detectors may be sensitive to high concentrations of methane (or other atmospheric gasses.) If these are expected to be present in the subslab vapor, then caution should be used with this technique as false positive readings may be encountered during leak testing.

6.2.7 At the end of the purge and after the system is verified to be leak-free, close the purge valve (valve #3). Do not open it again. Doing so will result in loss of the purge integrity and will require re-purging. Turn off the helium leak detector.

6.2.8 The purged subslab soil gas in the Tedlar bag can be screened with a Gem2000 landfill gas meter to get field measurements of CO2, O2 and CH4 and/or a miniRae PID to get field measurements of total VOCs.

6.2.9 Record the purge date, time, purge rate, leak check result, and purge volume on the field sampling log.

6.2.10 Immediately move on to the sampling phase. Little to no delay should occur between purging and sampling.

7.0 Sample Collection

7.1 'Clean' sampling protocols must be followed when handling and collecting samples. This requires care in the shipping, storage, and use of sampling equipment. The cleanliness of personnel who come in contact with the sampling equipment is also important, so smoking, eating, drinking, perfumes, deodorants, and dry-cleaned clothing are prohibited. Canisters should not be transported in vehicles with gas-powered equipment or gasoline cans. Sharpie markers should not be used for labeling or note-taking during sampling.

7.2 The SUMMA canisters are certified clean and evacuated by the laboratory to near absolute zero pressure. Care should be used at all times to prevent inadvertent loss of canister vacuum. ***Never open the canister's valve unless the intent is to collect a sample or check the canister pressure.***

7.3 Verify that the vacuum pressure of the canister is between 28 and 30 inches Hg. Do not use a canister that has an initial vacuum pressure of less than 28 inches Hg because that canister likely leaked during shipment.

7.3.1 Remove the protective cap from the valve on the canister.

7.3.2 If using an external gauge, attach the gauge to the canister and open the valve. If the pressure gauge has two openings, make sure that the other opening is closed; the canister cap can be used for this. After taking the reading, close the canister and remove the gauge.

7.3.3 If using assigned pressure gauges, attach the pressure gauge to the canister, then attach the flow controller. When sample collection begins, record the initial pressure.

7.4 Attach the canister to the flow controller and then connect the flow controller to the sample valve (valve #2) on the sampling manifold. Open the sample valve (valve #2)

7.5 Before taking the sample, confirm that the sampling system valves are set as follows: 1) the purge valve (valve #3) is confirmed to be closed, gas probe valve (valve #1) is open, and 2) the sample valve is (valve #2) is open.

7.6 Slowly open the canister's valve approximately one full turn.

7.7 After sampling for the appropriate amount of time (determined from project instructions, see Table 1), close the sample valve (valve #2) and the canister's valve. If the canister has a built-in or assigned pressure gauge, allow the canister to fill until the vacuum pressure reaches 2 to 10 inches Hg. Remove the canister from the sampling manifold.

7.8 If using an external vacuum gauge, re-attach it, open the canister valve, and record the final pressure. Close the valve, remove the gauge, and replace and tighten the cap on the canister. Ideal final vacuum pressure in the canister is between 2 and 10 inches Hg. More than 10 inches Hg can greatly increase reporting limits; however, a small amount of vacuum pressure should be left in the canister so the laboratory can confirm that the canister was not opened during shipment. Consult with the project team if a final vacuum pressure greater than 10 or less than 2 is encountered.

7.9 Record the sampling date, time, canister identification (ID), flow controller ID, and any other observation pertinent to the sampling event on the field sampling log. The indoor and outdoor temperature and barometric pressure should be recorded.

7.10 Fill out all appropriate documentation (sampling forms, sample labels, chain of custody, sample tags, etc.).

7.11 Disassemble the sampling system.

7.12 Using the vacuum pump, evacuate the Tedlar bags. Be sure this is done outside.

8.0 Sample Handling and Shipping

8.1 Fill out all appropriate documentation (chain of custody, sample tags) and return canisters and equipment to the laboratory

8.2 The canisters should be shipped back to the laboratory in the same shipping container in which they were received. The samples do not need to be cooled during shipment. DO NOT put ice in the shipping container.

8.3 When packing the canisters for shipment, verify that the valve (just past finger tight) and valve caps are snug (1/4 turn past finger tight), and use sufficient clean packing to prevent the valves from rubbing against any hard surfaces. Never pack the cans with other objects or materials that could cause them to be punctured or damaged.

8.4 **Do not place sticky labels or tape on any surface of the canister.**

8.5 Place a custody seal over the openings to the shipping container.

8.6 Make sure to insure the package for the value of the sample containers and flow controllers.

8.7 Ship canisters for overnight delivery.

9.0 Quality Control

9.1 Canister supplied by the laboratory must follow the performance criteria and quality assurance prescribed in U.S. Environmental Protection Agency (EPA) Method TO-14/15 for canister cleaning, certification of cleanliness, and leak checking. SOPs are required.

9.2 Flow controllers supplied by the laboratory must follow the performance criteria and quality assurance prescribed in EPA Method TO-14/15 for flow controller cleaning and adjustment. SOPs are required.

10.0 Probe Abandonment and Removal

10.1 After sampling, it is critical that the probe either be removed or plugged to prevent the creation of a new pathway for vapor intrusion.

10.2 If the probe is to be used again in the future, wrap the probe seal insert with Teflon tape and tighten it into the probe opening, using a hex key, until it is tight and flush with the concrete floor.

10.3 If the probe is to be removed, insert the removal fitting into the probe. Using a crow bar, remove the entire probe assembly. If the probe cannot be removed in this manner, then over drill the probe with the drill and 1-inch bit.

10.4 Fill the hole with cement mix.

Table 1 – Probe Seal Types

Probe Type	Suggested Probe Seal	Benefits	Drawbacks
Temporary	Beeswax	Quick. Can Set probe and take sample in one visit	Wax is brittle when cool and is very susceptible to leakage.
		Easy to remove	
Semi-permanent	Fix-It-All	Sets up fairly quickly (>30 min.), but may require 2 visits on the same day	Not good for wet environments. Material breaks down
		Solid seal	
		Easy to remove	
Permanent	Portland cement	Solid permanent seal	Takes at least 24 hours to set.
		Good for multiple sampling events	Will require at least 2 visits on consecutive days
			Difficult to remove

Table 2 - Common Sampling Rates for Subslab Sampling

Can Size	Length of Sampling Time	Sampling Flow Rate (ml/min)
6 Liter	1 hour	90
6 Liter	8 hours	11.25
6 Liter	24 hours	3.75
1 Liter	5 minutes	180
1 Liter	1 hour	15
850 ml	5 minutes	150
850 ml	1 hour	12

Figure 1 – Subslab Sampling

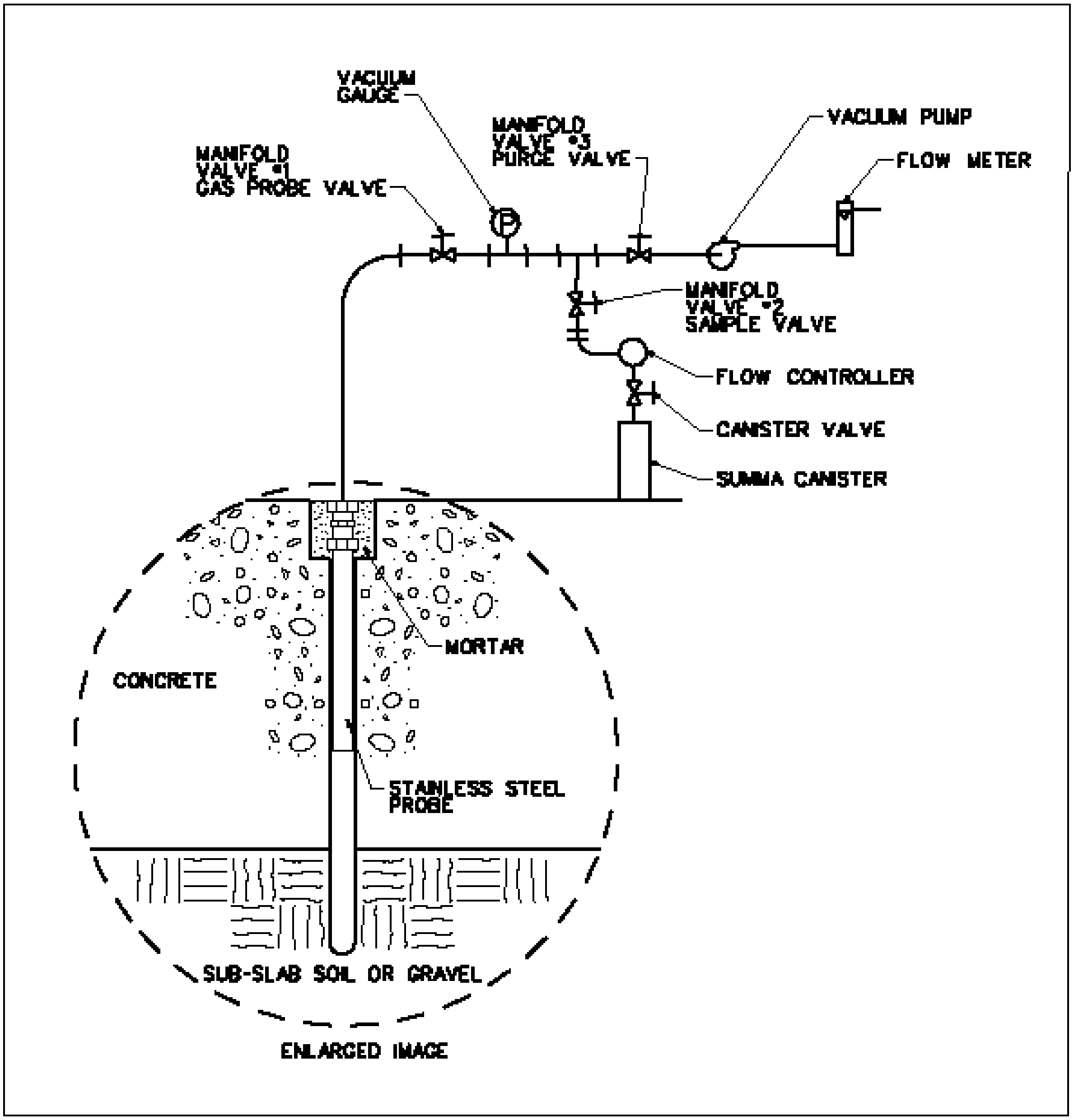


Figure 2 – Drilling 1-inch mortar hole to a depth of 1 and 3/4-inch

Figure 3 – Drilling 3/8" probe hole

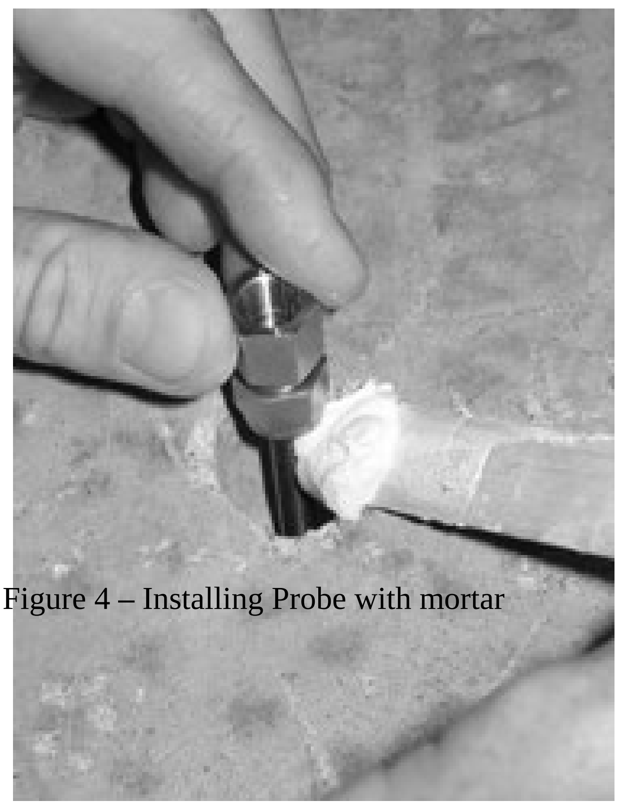


Figure 4 – Installing Probe with mortar

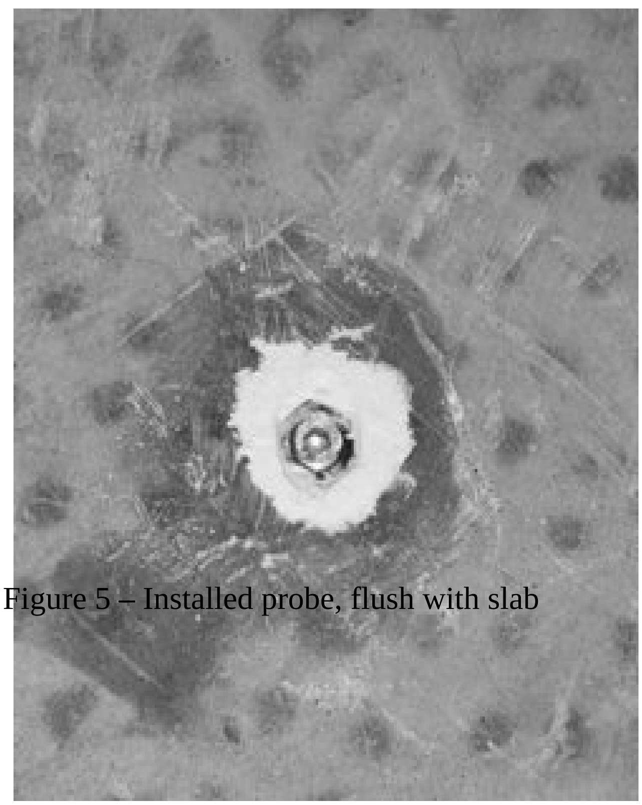


Figure 5 – Installed probe, flush with slab

Figure 6 – Installed probe with sample tube

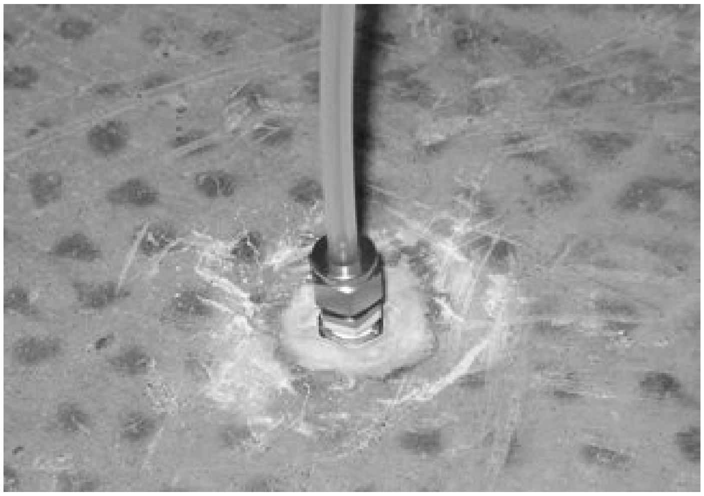
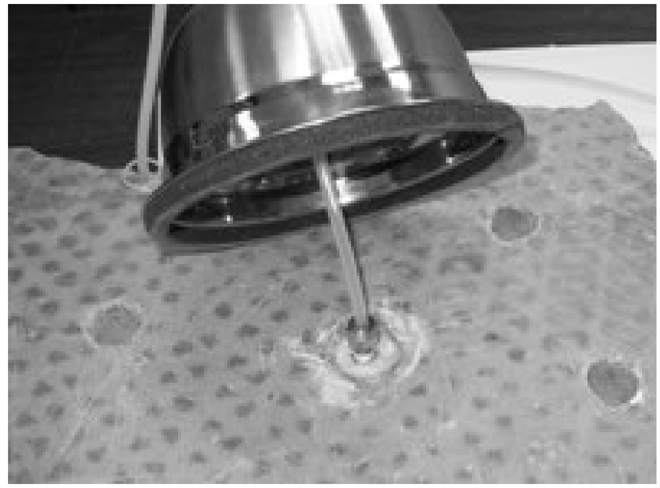


Figure 7 - Installing the helium leak check assembly



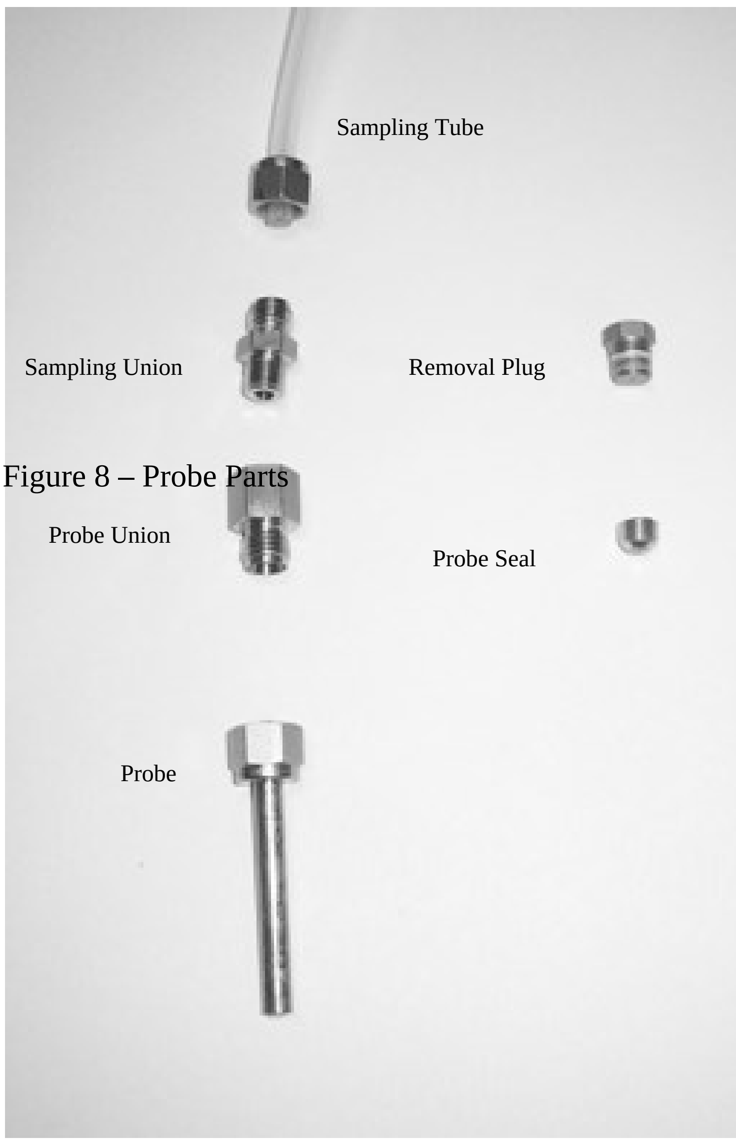


Figure 8 – Probe Parts

Figure 9 –Helium Leak Check Assembly

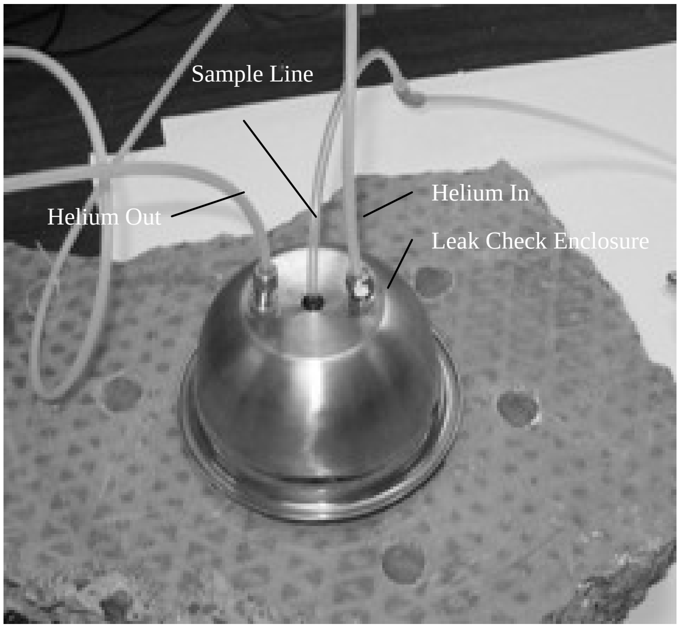
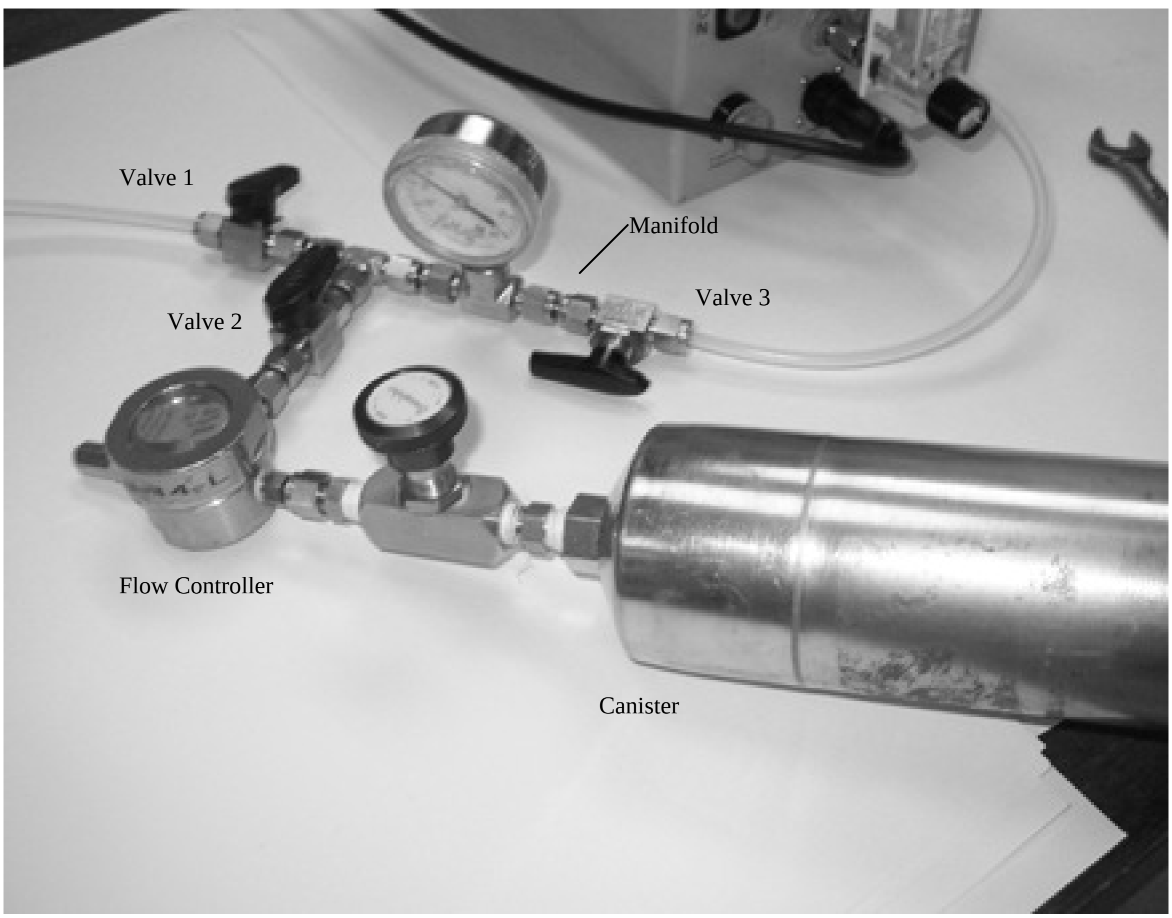


Figure 10 – Sampling Manifold



CH2MHILL

Indoor Vapor Intrusion Assessment
Sub-slab Vapor Field Sampling Log - Summa Canister Method

Project Info

Project Name: ______________________ **Project # :** __________

By: ______________________ **Date:** __________

Structure

Identification: ______________________

Address: ______________________

Slab Information:

- ☐ Concrete slab on grade (directly on top of soil)
- ☐ Other (describe) __________
- ☐ Concrete slab on gravel underlayment __________

Condition of slab __________

Type of Sub Slab Soil __________

Is water present in the soil __________

Sub-slab Probe Installation, Leak Checking, Probe Purging, & Sampling Log

	Sample location (show in diagram)	1	2	3	4
	Sample Identification (field ID)				
Probe Installation	Depth of slab (inches)				
	Depth of hole drilled (inches below slab surface)				
	Depth of installed probe (inches below slab surface)				
Manifold Leak check	Leak check (sampling manifold) - Pass/No Pass				
Probe Purge	Purge rate, cc/min.				
	Purge Start (time of day)				
	Purge vacuum, " Hg				
	Purge completed (time of day)				
Helium Leak Check (optional)	Leak check (Helium) - %				
Field Analysis (optional)	Gem 2000 (O2 / CO2 / CH4) - %				
	PID - ppmv				
Canister Sampling	Canister & flow controller ID (if used)				
	Initial Canister Pressure (" Hg)				
	Sampling rate, cc/min				
	Sampling period started (time of day)				
	Sampling vacuum, " Hg				
	Sampling period ended (time of day)				
	Final Canister Pressure (" Hg)				

Observations and Comments: ______________________

CH2MHILL

Indoor Vapor Intrusion Assessment
Sub-slab Vapor Field Sampling Log - Summa Canister Method

Project Info

Project Name: .... **Project # :** ....

By: .... **Date:** ....

Structure

Identification: ....

Address: ....

Slab Information:

☐ Concrete slab on grade (directly on top of soil) ☐ Other (describe) ....

☐ Concrete slab on gravel underlayment ....

Condition of slab ....

Type of Sub Slab Soil ....

Is water present in the soil ....

Sub-slab Probe Installation, Leak Checking, Probe Purging, & Sampling Log

	Sample location (show in diagram)	1	2	3	4
	Sample Identification (field ID)				
Probe Installation	Depth of slab (inches)				
	Depth of hole drilled (inches below slab surface)				
	Depth of installed probe (inches below slab surface)				
Manifold Leak check	Leak check (sampling manifold) - Pass/No Pass				
Probe Purge	Purge rate, cc/min.				
	Purge Start (time of day)				
	Purge vacuum, " Hg				
	Purge completed (time of day)				
Helium Leak Check (optional)	Leak check (Helium) - %				
Field Analysis (optional)	Gem 2000 (O2 / CO2 / CH4) - %				
	PID - ppmv				
Canister Sampling	Canister & flow controller ID (if used)				
	Initial Canister Pressure (" Hg)				
	Sampling rate, cc/min				
	Sampling period started (time of day)				
	Sampling vacuum, " Hg				
	Sampling period ended (time of day)				
	Final Canister Pressure (" Hg)				

Observations and Comments: ....

CH2MHILL ***Applied Sciences Group***

Indoor Vapor Intrusion Assessment
Sub-slab Vapor Sampling Field Log

Diagram - Outline of Structure Foundation & Location of Sub-slab Sampling Probes

N

Note:
Show the location of each soil probe and indicate distances from the foundation edge and other significant features.
Note location of sumps, drains, cleanouts, cracks, etc.

Other observations and comments: ....

This SOP is to be used in conjunction with a work plan developed specifically for each project. Please obtain appropriate senior review before implementing this SOP in the field.

Integrated Ambient Indoor, Outdoor, and Crawl Space Air Sampling Method for Trace VOCs Using SUMMA Canisters

1. Scope and Application

This sampling method describes the procedure for collecting ambient air samples for targeted volatile organic compounds (VOCs). Reporting limits for these samples are usually very low and extremely prone to positive bias from interfering VOC sources. The method presented here is based on 'clean' sampling techniques. The requirements of 'clean' sampling dictate that sampling and sample handling are done by trained personnel. A building survey must be performed before sample collection. It is the responsibility of the project team to make sure this procedure meets all applicable regulatory standards and receives approval/concurrence from the leading regulatory agency for the project.

2. Summary of Method

A sample of air is withdrawn, using clean technique, into a certified clean and evacuated SUMMA canister using a certified clean flow controller. Sample collection can be integrated over time by adjusting the flow controller. Project-specific sample periods as short as 10 minutes to as long as 24 hours can be achieved based on the size of canister used and the sampling rate selected (see Table 1). Generally, 6-liter canisters are used for ambient air sampling. In cases where the crawl space is most conveniently sampled by access through crawl space vents, a sampling probe (sample delivery line made of Teflon or stainless steel) of sufficient length is attached to the inlet of the flow controller.

3. Apparatus and Materials

3.1. Canister, SUMMA polished, certified clean and evacuated. (Canisters are typically provided by the laboratory.)

3.2. Flow controller, certified clean and set at desired sampling rate. (Flow controllers are typically provided and set by the laboratory.)

3.3. Shipping container suitable for protection of canister during shipping. Typically, strong cardboard boxes are used for canister shipment. The canisters should be shipped back to the laboratory in the same shipping container in which they were received.

3.4. Wrenches and screw driver (clean and free of contaminants), various sizes as needed for connecting fittings and making adjustment to the flow controller A 9/16-inch wrench fits the ¼-inch Swagelok® fittings, which most canisters and flow controllers have.

3.5. Negative pressure gauge, oil-free and clean, to check canister pressure. (The pressure gauges are typically provided by the laboratory.) The laboratory may either provide one pressure gauge to be used with all of the canisters, or a pressure gauge for each canister to be left on during sample collection. Sometimes the canisters are fitted with built-in pressure gauges that are not removable.

3.6. Sampling probe, new Teflon or stainless steel tubing, fitted with compression fittings. (For crawl space samples)

4. Sample Collection

4.1. 'Clean' sampling protocols must be followed when handling and collecting samples. This requires care in the shipping, storage, and use of sampling equipment. Cleanliness of personnel who come in contact with the sampling equipment is also important: no smoking, no eating, no drinking, no perfumes, no deodorants, no dry cleaned clothing, etc. Canisters should not be transported in vehicles with gas-powered equipment or gasoline cans. Sharpie markers should not be used for labeling or note- taking during sampling.

4.2. The SUMMA canisters are certified clean and evacuated by the laboratory to near absolute zero pressure. Care should be used at all times to prevent inadvertent loss of canister vacuum. ***Never open the canister's valve unless the intent is to collect a sample or check the canister pressure.***

4.3. Prior to taking indoor air samples, be sure to complete an indoor air building survey [see the vapor intrusion standard operating procedure (SOP) on Building Surveys]. When taking outdoor or crawl space samples, be sure to note on the field log any items that might bias analytical results (such as gasoline cans, garbage, fresh paint, etc.)

4.4. Inspect the canister for damage and do not use a canister that has visible damage.

4.5. Verify that the vacuum pressure of the canister is between 28 – 30 inches mercury(Hg). Do not use a canister that has an initial pressure less than 28 inches Hg because that canister likely leaked during shipment.

4.5.1. Remove the protective cap from the valve on the canister.

4.5.2. If using an external gauge, attach the gauge to the canister and open the valve. If the pressure gauge has two openings, make sure that the other opening is closed; the canister cap can be used for this. After taking the reading, close the canister and remove the gauge.

4.5.3. If using assigned pressure gauges, attach the pressure gauge to the canister, then attach the flow controller. When sample collection begins, record the initial pressure.

4.6. Flow controllers (if used) should come pre-set by the laboratory to sample at a pre-determined rate based on specific project requirements (see Table 1 for the most common options). In some cases [that is, project-specific quality assurance (QA)], the flow rate will need to be verified in the field prior to use. This is accomplished with a bubble meter, vacuum source, and instructions supplied by the laboratory.

4.7. In the field log record the canister identification (ID), flow controller ID, initial vacuum, desired flow rate, sample location information, and all other information pertinent to the sampling effort. The indoor and outdoor temperature and barometric pressure should be recorded when sampling is begun and completed.

4.8. Connect the flow controller to the canister.

4.8.1. The flow controller fitting denoted "LP" or "OUT" is connected to the canister. Tighten the fitting to be leak free but do not over-tighten (a ¼ turn past snug is usually enough.) When tightening the fitting, be sure that the valve assembly does not rotate by using your other hand to hold the valve steady.

4.8.2. If an assigned pressure gauge is used for each canister, the pressure gauge should be attached to the canister first and then the flow controller should be attached to the pressure gauge.

4.8.3. When the flow controller and pressure gauge are attached correctly they will not move separately from the canister (they will not spin around).

4.9. For outdoor samples, be sure that the inlet to the flow controller is protected from precipitation. Either place the canister and flow controller under a shelter/enclosure, or use a clean piece of aluminum foil to build a tent over the flow controller inlet.

4.10. For sampling in public areas, outdoor air sample canisters should be secured to an immovable structure to ensure security. A bicycle lock or piece of chain and Master lock can be used. It may be a good idea to attach a label to the canister explaining that it is an environmental sample and should not be tampered with. The label can also include contact information.

4.11. If crawl spaces are being sampled remotely through a crawl space vent, adjust the length of the sampling probe to achieve the desired sampling location and place an inert spacer near the end of the probe to keep the probe tip opening suspended ~ 3 inches above the ground level. Now connect the sampling probe to the inlet of the flow controller.

4.12. Remove all work articles from the sampling area.

4.13. To begin sampling, slowly open the canister valve one full turn.

4.14. For canisters with built-in or assigned pressure gauges, monitor the vacuum pressure change several times during the course of the selected sample period to ensure the canister is filling at the desired rate.

4.15. At the end of the sample period, close the canister valve finger tight.

4.16. Remove the flow controller (and assigned pressure gauge) and replace the protective cap on the canister valve fitting.

4.17. If using an external vacuum gauge, re-attach it, open the canister valve, and record the final pressure. Then close the valve, remove the vacuum gauge, and replace the protective cap. Ideal pressure in the canister is between 2 - 10 inches Hg. More than 10 inches Hg can greatly increase reporting limits. No measurable vacuum can invalidate the sample. Immediately consult with the project team if either one of these conditions is encountered.

4.18. If the flow controller is going to be used for more than one sample collection, be sure to purge it between uses. To do this, attach the flow controller to a vacuum source and draw clean air or gas (ultra-high purity) through it for several minutes before attaching it to the canister.

5. Sample Handling and Shipping

5.1. Fill out all appropriate documentation (chain of custody, sample tags) and return canisters and equipment to the laboratory.

5.2. The canisters should be shipped back to the laboratory in the same shipping container in which they were received. The samples do not need to be cooled during shipment. DO NOT put ice in the shipping container.

5.3. When packing the canisters for shipment, verify that the valve (just past finger tight) and valve caps are snug (1/4 turn past finger tight), and use sufficient clean packing to prevent the valves from rubbing against any hard surfaces. Never pack the cans with other objects or materials that could cause them to be punctured or damaged.

5.4. **Do not place sticky labels or tape on any surface of the canister!**

5.5. Place a custody seal over the openings to the shipping container.

5.6. Make sure to insure the package for the value of the sample containers and flow controllers.

5.7. Ship canisters for overnight delivery.

6. Quality Control

6.1. Canisters supplied by the laboratory must follow the performance criteria and quality assurance prescribed in U.S. Environmental Protection Agency (EPA) Method TO-14/15 for canister cleaning, certification of cleanliness, and leak checking. SOPs are required.

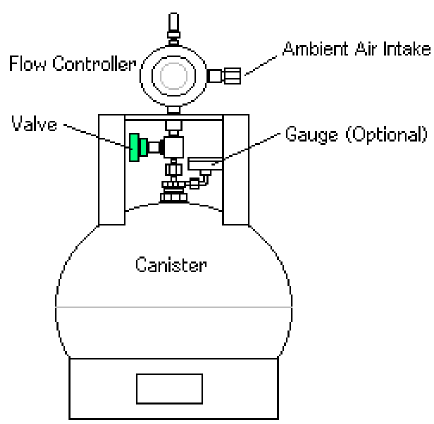
6.2. Flow controllers supplied by the laboratory must follow the performance criteria and QA prescribed in EPA Method TO-14/15 for flow controller cleaning and adjustment. SOPs are required.

Table 1 – Common Sampling Rates for Ambient Air Sampling

Can Size	Length of sampling time	Sampling Flow Rate (ml/min)
6 Liter	1 hour	90
6 Liter	8 hours	11.25
6 Liter	24 hours	3.75
1 Liter	5 minutes	180
1 Liter	1 hour	15
850 ml	5 minutes	150
850 ml	1 hour	12

FIGURE 1

Assembled Canister Sampler for Integrated Sample Collection



This SOP is to be used in conjunction with a work plan developed specifically for each project. Please obtain appropriate senior review before implementing this SOP in the field.

CH2M HILL **Applied Sciences Laboratory**

Sheet 1 of __

Ambient Air, Outdoor Air & Crawl Space Air Sampling Log (Summa Canister)

Project Information

Project Name: ____________________ Project # : ____________________

By: ____________________ Date: ____________________

Sampling Data Log

Sample Location	Field ID	Canister ID	Flow Controller ID	Initial Canister Pressure ("Hg)	Initial Flow Controller Rate (ml/min)	Start Date & Time	End Data & Time	Final Pressure ("Hg)	Final Flow Controller Rate (ml/min)

Sample Location Diagram

N

Note:
Draw in outline the structure's foundation and interior walls, identify rooms, and note other defining features. Show location of canister relative to physical objects, etc.

Other Observations and Comments (note any unique circumstances): ____________________

____

CH2M HILL **_Applied Sciences Laboratory_**

Ambient Air, Outdoor Air & Crawl Space Air Sampling Log (Summa Canister)

Project Information

Project Name: ______________________ Project # : ______________

By: ______________ Date: ______________

Sampling Data Log

Sample Location	Field ID	Canister ID	Flow Controller ID	Initial Canister Pressure ("Hg)	Initial Flow Controller Rate (ml/min)	Start Date & Time	End Data & Time	Final Pressure ("Hg)	Final Flow Controller Rate (ml/min)

Sample Location Diagram

N

Note:
Draw in outline the structure's foundation and interior walls, identify rooms, and note other defining features. Show location of canister relative to physical objects, etc.

Other Observations and Comments (note any unique circumstances): ______________________

STANDARD OPERATING PROCEDURE

Field Rinse Blank Preparation

I. Purpose

To prepare a blank to determine adequacy of decon procedures and whether any cross-contamination is occurring during sampling.

II. Scope

The general protocols for preparing the rinse blank are outlined. The actual equipment to be rinsed will depend on the requirements of the specific sampling procedure.

III. Equipment and Materials

- Blank liquid (use ASTM Type II grade water)
- Sample bottles as appropriate
- Gloves
- Preservatives as appropriate

IV. Procedures and Guidelines

A. Decontaminate all sampling equipment that has come in contact with sample according to SOP Decontamination of Personnel and Equipment.

B. To collect the sample for volatiles analysis, pour blank water over one piece of equipment and into 40-ml vials until there is a positive meniscus and seal vials. Note the sample number and associated piece of equipment in the field notebook.

For non-volatiles, one aliquot is to be used for equipment. For example, if a pan and trowel are used, place trowel in pan and pour blank fluid in pan such that pan and trowel surfaces which contacted the sample are contacted by the blank fluid. Pour blank fluid from pan into appropriate sample bottles.

Do not let the blank fluid come in contact with any equipment that has not been decontaminated.

C. Document and ship samples in accordance with the procedures for other samples.

D. Collect next field sample.

V. Attachments

None.

VI. Key Checks and Items

- Wear gloves.
- Do not use any non-decontaminated equipment to prepare blank.
- Use ASTM-Type II grade water.

Attachment C
Laboratory Standard Operating Procedures (Provided to Navy Chemist only—Proprietary Laboratory Procedures)

Laboratory SOPs are proprietary and confidential.
They are provided upon request at the discretion of the Project Manager.

Attachment D
ESS Waiver

Procedures for Communicating Potentially Live
Munitions and Explosives of Concern (MEC) to Navy

The following are procedures designed to effectively communicate the finding of potentially live munitions and explosives of concern (MEC) that could be encountered during investigative, avoidance and / or remedial work at St. Juliens Creek Annex (SJCA). Communicating in a fast, accurate, and calm manner is critical in keeping the situation under control. During all intrusive investigations, a qualified MEC Technician with expertise and knowledge in dealing with MEC will be on-call. Only the MEC Technician will determine whether an item is considered live or inert. If the MEC Technician can not make a determination regarding the found item or if the item is determined to be live, the following steps should be taken:

1. Stop all work. Under no circumstances should work continue near the item (Norfolk Naval Shipyard [NNSY] security typically does not permit any work to occur at a site even if it is some distance away from the item).

2. Contact the NNSY Security dispatcher at (757) 396-5111. If the field team lead reports to the NNSY he / she should discuss the situation with the MEC Technician prior to making the call. It is imperative to communicate whether the situation is an emergency, that activities have stopped, and that people will not have access to the area.

3. Immediately following notification to NNSY Security, a phone call should be placed to the CH2M HILL activity manager/project manager. The CH2M HILL activity manager/project manager will be responsible for contacting the NAVFAC Mid-Atlantic project manager Ms. Agnes Sullivan @ 444-4120.

4. If the project is a construction project that includes the NNSY Resident Office In Charge Of Construction (ROICC), contact the ROICC office at (757) 396-5121.

5. From the moment that NNSY security arrives, they are in charge and there are no exceptions.

6. Naval Ordnance Safety & Security Activity (NOSSA) will be notified by in accordance with Navy policy.

The MEC Technician will review and as necessary, discuss this procedure with CH2M HILL, the Navy, and other contractors working on the site

DEPARTMENT OF THE NAVY
NAVAL ORDNANCE SAFETY & SECURITY ACTIVITY
FARRAGUT HALL BLDG D-323
23 STRAUSS AVENUE
INDIAN HEAD MD 20640-5555

8020
Ser N539/1185
19 Jul 06

From: Commanding Officer, Naval Ordnance Safety and Security Activity
To: Commanding Officer, Naval Facilities Engineering Command Mid-Atlantic

Subj: EXPLOSIVES SAFETY SUBMISSION DETERMINATION FOR IRP SITE 21, ST JULIEN'S CREEK ANNEX, CHESAPEAKE, VIRGINIA

Ref: (a) NAVFACMIDLANT (EV3AS) memo of 13 Jul 06 (w/encl)
(b) NOSSAINST 8020.15, Military Munitions Response Program Oversight, of 8 Mar 04
(c) NAVSEA OP 5, Revision 7

1. The Naval Ordnance Safety and Security Activity (NOSSA) reviewed the reference (a) e-mail and its enclosed NOSSA Explosives Safety Submission (ESS) determination request for a project that includes the installation of three permanent groundwater monitoring wells, as well as the collection of depth-specific groundwater samples utilizing direct push technology. Based on the information presented in reference (a), and on the ESS criteria in references (b) and (c), NOSSA determines that an ESS is not required for this project.

2. NOSSA understands that your operational risk/hazard assessment of the proposed actions concluded the probability of encountering Munitions and Explosives of Concern (MEC) is negligible, but that you will maintain a qualified MEC technician on call for the duration of the project.

3. In the event you or your contractor encounter MEC during the project, avoid intentional physical contact with it, note its type and location, and request the responsible EOD unit to respond. Then report the find to NOSSA using enclosure (1) of reference (b). NOSSA will evaluate the report and may direct you to submit an ESS at that time.

Subj: EXPLOSIVES SAFETY SUBMISSION DETERMINATION FOR IRP SITE 21, ST JULIEN'S CREEK ANNEX, CHESAPEAKE, VIRGINIA

4. The NOSSA point of contact for this ESS determination is Mr. Douglas Murray, who can be contacted at DSN 354-4450 or commercial at 301-744-4450.

R. S. Barcus

R. S. BARCUS

Copy to:
CNO (N411; N45C)
NAVFAC HQ (ENV)
NOSSA ESSOLANT (N5L)

Attachment E
Navy CLEAN Data Management Plan

DRAFT

DATA MANAGEMENT PROCESS OVERVIEW FOR THE NAVY CLEAN PROGRAM

Prepared 5 May 2006

Prepared by

CH2MHILL

Contents

1.0 Introduction

This Data Management Process Overview summarizes CH2M HILL's data management protocol in support of the Navy Clean Program.

The Overview is broadly applicable to the management and dissemination of data generated during environmental investigations. It is intended to be a living document and will be amended or revised to accommodate changes in the scope of environmental investigation or data management requirements.

During field investigations for the Navy Clean Program, CH2M HILL will collect a variety of environmental information that will support data analysis, reporting, and presentation. To ensure quality assurance/quality control (QA/QC) and meet current regulatory requirements, a complete audit trail of the information flow must be established. Each step in the data management process (data collection, storage, and analysis) must be adequately planned, executed, and documented. This Overview will describe in detail the specific processes that will be used by the Data Management team to capture, perform QA/QC reviews, manage/track and report the data associated with the Navy Clean Program.

This DMP is composed of 8 sections. Section 1 of this document introduces the Data Management Process. Section 2 discusses the organization of the CH2M HILL EIMS team. Section 3 discusses the data management role in Project Planning and Setup. Section 4 describes the data management role in Sample Collection and Management. Section 5 discussses the data management activities involved in Lab Analysis. Section 6 describes the data management role in Data Validation. Section 7 discusses the activities involved in Data Management. Section 8 describes Data Evaluation and Reporting procedures. Appendix A presents tables summarizing and assessing current data management materials.

2.0 Data Management Team Organization

The CH2M HILL data management team will work together to properly execute the data management process. The team model presented here is based on a Project Manager supported directly by key technology staff. The functional responsibilities of the team are described below. The responsibilities are identified by titles but not necessarily individual staff positions. The workflow among the members of the data management team is shown in Figure 1.

The Activity Manager (AM) and **the Project Manager (PM)** are responsible for preparing the work plan, schedule, milestones, and coordinating efforts with the client. The AM/PM may or may not have adequate skills to guide the data management driven aspects of their project. While the AM/PM must be willing to accept guidance from the technology leaders, they do not need to possess the technology skills as a background. The PM also responsible for ensuring data quality and is brought into the team to perform data QA/QC at various times during the data management process.

The Environmental Information Specialist (EIS) assigned to the project team is responsible for the coordination of new or existing data generated by field activities or provided by laboratory analyses. The EIS oversees contracted analytical and data validation services, ensures that analytical data are complete and consistent, enters field data results into the **Field Data Entry Tool(FDETool)**, and assists the Database Specialist in resolving any data ambiguities. The EIS will conduct verification activities following receipt of electronic data and participate in QA/QC activities to resolve inconsistencies as necessary. The EIS acts as a liaison between the Database Specialist, the PM, and the Project Chemist.

Database Specialists load data into the Environmental database. This includes analytical results from laboratory electronic data deliverables and field data results that have been entered by the EIS into the **FDETool**. The Database Specialists work with the EIS, Program Database Coordinator, and Program Data Management Coordinator to ensure that the data are loaded successfully and following established program standards and procedures.

The Field Team Leaders (FTLs) help prepare the work plan and implement the plan in the field. FTLs assign staff members to sampling teams; assign responsibilities to team members; prepare for and coordinate sampling activities; oversee the collection, recording, and documentation of the field data; and ensure that the chain-of-custody form is completed correctly.

The Project Chemist prepares the laboratory and data validation subcontracts, ensures that the electronic data deliverable was provided in accordance with the contract, assists the EIS in communicating with laboratories and data validators as needed, assists the EIS in interpreting analytical results, assists in designating CAS Numbers to new analytes, and maintains the regulatory criteria in the database.

A Program Database Coordinator (DBC) has overall responsibility for the design, operation, and maintenance of the Environmental Database. The DBC is responsible for the implementation, and evaluation of standard operating procedures to ensure integrity of the enterprise-wide database system. The DBC works directly with the Database Specialist to coordinate the different activity data and to enhance the database tools, and structure as required to increase performance and efficiency for the entire program

The Program Data Management Coordinator (DMC) is responsible for the CH2M HILL data management process at all Navy bases. The DMC manages and tracks data management personnel schedules and deliverables for the Navy program; interacts with the EIS on all aspects of data management activities; provides guidance and coordination to the EIS during resolution of data inconsistencies; coordinates completion of data queries for reports; coordinates database modification efforts with the DBC; is responsible for designing, developing, and implementing standard data entry and data retrieval tools; and leads the data management continuous process improvement investigation.

The IS Operations Lead monitors workload across all IS activities (GIS, Web, and Database) for resource and schedule conflicts, and works with IS resources to make recommendations for process change and improvement.

The IS Program Lead serves as the primary point of contact for the Navy regarding IS issues, coordinates resource requirements with regional the IS Staffing Lead, and provides direction and management to the DBC, DMC, and IS Operations Lead.

3.0 Project Planning & Setup

3.1 Attend the Kick-Off Meeting

Review the **Project Instructions**, assign sample nomenclature, go over the EIS level of effort needed and budget with the PM. Complete **the EIS Questions to Ask at Start of Project** Form and **EIS DM Budget Tracking** Form. Enter project information into the **Projects Currently in DM Tracking Table** at the link \\orion\proj\CLEANII\DATAMGMT\EIS\Projects_Currently_in_DM.xls. This tracking table should be updated/verified daily throughout the data management process.

3.2 Aid in Lab and Data Validator Acquisition

As requested, assist with the creation of the Lab Engineers Estimate, Lab Bidsheet, Lab RFP, Lab Statement of Work (SOW), and the Data Validation Engineers Estimate, Data Validation Bidsheet, Data Validation RFP, and Data Validation SOW based on the **BOA Rates Spreadsheet** and **Established Document Templates**. Submit these documents to the site Project Chemist for review and approval before they are submitted to Contracts.

3.3 Aid in Field Preparation

Inform the lab of sampling schedule. Coordinate with the lab how and when samples will be delivered to the lab (pick up, overnight, drop off). Ensure that the lab is aware of the required turn around times. If requested, order bottle ware and create sample labels. If requested, once the bottles have arrived, review the order to ensure the proper amount and type of equipment has arrived.

Tools Involved in Project Planning and Setup
BOA Rates Spreadsheet EIS Questions to Ask at Start of Project Form EIS DM Budget Tracking Form Established Document Templates Project Instructions Projects Currently in DM Tracking Table

4.0 Sample Collection & Management

4.1 Communication with Field Staff and Lab

Communicate with field staff daily during the field event. Help resolve issues that arise in the field (bottle ware shortage, equipment failure, etc). Inform the lab of the shipment dates and the number of coolers or samples being sent. Ensure samples were received in good condition (no breakage, within holding time, within designated temperature). Notify field crew and PM if there were problems with shipment.

4.2 Sample and Documentation Tracking

Create a **Sample Tracking Sheet** and update it as samples are collected using Project Instruction Tables, Chains of Custody (COC), and Lab Login Reports. The **Sample Tracking Sheet** should be updated and kept current throughout the data management process. Perform a 100% Quality Check (QC) on COCs received from the field crew. Inform field crew and/or lab if corrections need to be made. Verify that confirmation sheets/login reports from the lab contain correct information. Coordinate efforts with the lab if information needs to be corrected. As needed, create and file a **Corrections-To-File Letter**. Track samples throughout the data management process. Ensure that labs and validators deliver the Sample Delivery Groups (SDG) on time. Inform the PM if SDGs are late, and remind the lab of late penalties (if any are in place).

All documentation acquired during the data management process, including SOWs, Bids, COCs, Field Notes, **Sample Tracking Sheets**, Login Reports, **Corrections-to-File Letters**, FDETool QC tables, **Post Load Reports**, Invoices, and Communication Logs shall be compiled throughout the process and stored in the appropriate Activity's Project Notebook.

4.3 Field Data Entry Tool

The **FDETool** can be completed at any time during the sampling event timeline, and will be turned in with the data load. After the lab has received the samples and submitted login reports, complete the **Data Request/Needs Form** and email it to the Database Specialist and copy the DMC and back-up Database Specialist to request the **FDETool**. Enter data into the **FDETool** using the **Sample Tracking Sheet**, field log books and COCs. Be as specific as possible with the information entered (check with the PM and/or FTLs if information to be entered is unclear). Once all field data has been entered, run the **FDETool** output reports and QC them according to the **FDET Instructions for Data QC Form** (\\orion\proj\CLEANII\DATAMGMT\EIS\EIS_Reference_Documents). Send the reports to another EIS or PM to review for accuracy.

Northing and Easting information should be requested from the PM, if it is missing in the **FDETool**. This data should be entered into the **FDETool. However, if the FDETool is not**

being utilized, the Northing and Easting data can be formatted into a spreadsheet format, which can be sent along with the load. All stations that have coordinates must be loaded into EnDat, even if GIS has received the coordinates. See the **Survey Coordinates Flowchart** at \\orion\proj\CLEANII\DATAMGMT\EIS\EIS_Forms.

4.4 Track EIS Budget

Use the **EIS DM Budget Tracking Form** to track the number of hours spent on each task as they are performed. Inform the PM if the budget may be exceeded.

Tools Involved in Sample Collection & Management
Corrections to File Letter
Data Request/Needs Form
EIS DM Budget Tracking Form
FDET Instructions for Data QC Form
Field Data Entry Tool (FDETool)
Sample Tracking Sheet
Survey Coordinates Flowchart

5.0 Lab Analysis

5.1 QC Lab Data

Verify that the hard copy data and **Electronic Data Deliverables (EDDs)** are complete and acceptable as outlined in the **EIS QC Checklist for Unvalidated and Validated EDDs and Hard Copy Data Form**. Run a quality check on the EDD columns to ensure basic quality. Perform a 10% check of the analysis results. Ensure that the hard copy data matches the EDD. If errors are found, inform the PM and request corrected data from the lab.

5.2 Communicate with the Lab

Should the EDD be missing data, contact the PM and coordinate efforts with the lab to receive the missing data.

5.3 Run Tables

Communicate with the PM to determine if preliminary raw and detects tables are needed. Should tables be desired, verify the requirements and formatting (i.e. headers, footers, or other special needs) to be included on the table. Run the **Raw & Detects Tables from Unvalidated or Validated EDD Macro** on data in the EDD to create tables to assist the PM with a preliminary data analysis. A separate table must be created for EACH matrix (solid/aqueous) and sample purpose (Normal, Blanks). Ask the PM how the tables should be run before beginning.

5.4 Hard Copy Management

If data are to be validated, follow the instructions for Hard Copy Management in the Data Validation section, below. If data are not to be validated, hold on to the hard copies until project closeout/completion. After all corrections identified through the data management process have been completed (if any), the final report written, and the project determined complete, gain approval from the PM to archive the hard copy. Note, skip to section 7.0, Data Management, for EDDs that are not to be validated.

5.5 Hard Copy Archiving

If data will not be validated, fill out the **Data Archiving (List of Contents) Form,** located at the link \\Orion\PROJ\CLEANII\DATAMGMT\EIS\Data_Archiving, for each SDG, and attach it to the data packages. Once the PM has granted approval for hard copy archiving at project completion, give the boxes of data to the Data Archiving Specialist. The data will be prepped for archiving and filed within the building until the Data Archiving Specialist has received authorization to send the data to storage.

Tools Involved in Lab Analysis
Data Archiving (List of Contents) Form EDD EIS QC Checklist for Unvalidated and Validated EDDs and Hard Copy Data Form Raw & Detects Tables from Unvalidated or Validated EDD Macro

6.0 Data Validation

6.1 Hard Copy Management

If data are to be validated, the hard copy data, **EDDs**, and a **QC Association Table** will need to be mailed or emailed to the data validator. Photo copy the Form I Summary Package (which should be provided by the lab) before mailing the hard copy, to keep on file while the complete packages is with the validator. Fill out the **Data Archiving (List of Contents) Form** for each SDG, and attach it to the data packages. The **QC Association Table** is created using the COCs, field notes, and the field crew to ensure accuracy. Further instructions on the QC table are located in the form "**QC Association Table**", under

\\orion\proj\CLEANII\DATAMGMT\EIS\EIS_Forms. The **QC Association Table** can be emailed to the data validator along with the EDD. If sending more than one EDD, prepare the EDDs to the validator's preference (i.e. one large file or divided by SDG).

6.2 Communicate with Validator

Let the data validator know ahead of time when to expect data. Inform the validator of any samples or analyses that should not be validated. (i.e. grain size should not be validated). Work with the data validator to coordinate the return of the data package to CH2M HILL for archiving. Once the data package has been returned to CH2M HILL, follow the Hard Copy Archiving procedure above.

6.3 Post-Validation

Review and QC the validated data according to the **EIS QC Checklist for Unvalidated and Validated EDDs and Hard Copy Data Form**. Verify that the validated hard copy data and EDDs are complete and acceptable. Data validators should have added qualifiers to the DV_QUAL and DV_QUAL_CODE fields only. Check the values in the DV_QUAL field against the valid value choices. Perform a 100% check of the DV_QUAL and DV_QUAL_CODE fields. Ensure that the hard copy values match the EDD. Ensure that every record requiring a data validation qualifier has one (i.e. if the Lab_Qual field has a U qualifier then there MUST be a qualifier in the DV_QUAL field).

Run raw and detects tables of the combined EDD using the **Raw & Detects Tables from Unvalidated or Validated EDD Macro**. Check to make sure there are no duplicate results for any of the samples. Send the raw and detects tables, validation report, and validated EDD to the Project Chemist for a "Pre-Load Check."

Tools Involved in Data Validation
Data Archiving (List of Contents) Form EDD EIS QC Checklist for Unvalidated and Validated EDDs and Hard Copy Data Form QC Association Table

7.0 Data Management

7.1 Load Preparation

Compile the validated SDG **EDDs** into one Excel file, if they are not formatted as such already. Add in and populate the additional columns CTO, Lab, and Validated at the end of the EDD. Add in a column before Prep_Method called Preparation. Copy and paste the data from Analysis_Method into the Preparation column. Rename the Prep_Method to CH2M_Code, and populate with appropriate valid values. Save the Excel file as an 'Archive EDD' under a new name with the project or event and the date sampling (i.e. "3_CP_CTO-244_GW&SO_103103_ ARCHIVE.xls"). Be as specific as possible when saving the file, as it will become the Archive EDD file.

Create a duplicate copy of the Archive EDD file and save it as the Load EDD (i.e. "3_CP_CTO-244_GW&SO_103103_ LOAD.xls"). In the Load EDD, delete out the surrogate records by deleting ALL records that have a value in the "Result_Type" column. Delete Lab QC Records by deleting ALL records that have a value in the "Lab_QC_Type" column. Remember to save the Load EDD once the modifications are complete.

After the data has been loaded, incorporate any corrections made to the Load EDD by the Database Specialist into the Archive EDD. Mail a copy of the Archive EDD to the DMC to be stored in the archive file (\\orion\proj\CLEANII\DATAMGMT\EDD_Archive).

7.2 Run a Pivot Table

As needed, follow the **Analyte Pivot Table Instructions** file to determine if any analytes are classified under more than one analysis group in the Load EDD. (This step is considered a backup check, as a 'Preferred Analysis Group Check' was performed on the unvalidated EDD, as specified on the **EIS QC Checklist for Unvalidated and Validated EDD and Hard Copy Data Form**.) Use the **Preferred Analysis Group Form** as a reference to assign UNREJECTED results to the correct analysis group for these analytes. If an analyte is not on this list then ask a chemist for assistance and update the **Preferred Analysis Group Form** accordingly.

7.3 PM Review of Data Load

Provide the PM with the cross-tabulated raw and detects tables created from the validated data above, and the Load EDD file. Also ask the PM if they would like a copy of the **Sample Tracking Sheet** or **Project Instructions** to assist with the review.

7.4 Email Data Load

Send the QC'd Load EDD file (the version WITHOUT the surrogate and QC data) and **FDETool** in an email to the Database Specialist for loading into EnDat, and copy the DMC and back-up Database Specialist. In the email, attach an electronic copy of the completed **Data Request/Needs Form** with the following information completed:

- Program Name (ex: Clean II)
- Activity (ex: Little Creek)
- Contract Task Order (CTO)
- Prime Contractor (company responsible for providing a product to the Navy)

- Field Contractor (company who performed the field work)
- Was the data upload scheduled with the DB staff?
- Is the data validated?
- Data Validator Name (If no DV then who within CH2M HILL evaluated the data?)
- Number of samples
- Dates of the sampling event
- Number of records in EDD
- Requested Due Date
- Any Reports Requested?

The Database specialist will then conduct any additional formatting modifications to the EDD as needed to load the data into EnDat.

7.5 Post Load

The Database Specialist shall generate **Post Load Reports** and provide them to the EIS for review and QC. Once the **Post Load Reports** have been QC'd by the EIS, the EIS will then send the reports to the PM for review. Inform the PM of any corrections that need to be made, and coordinate these changes with the Database Specialist. Any changes made to the data by the Database Specialist prior to load, or that will be completed after the load should be tracked, and incorporated into the hard copy and EDD files that are to be archived after project completion.

Tools Involved in Data Management
Data Request/Needs Form
EDD
Field Data Entry Tool (FDETool)
Pivot Table Instructions
Preferred Analysis Group Form
Project Instructions
Raw & Detects Tables from Unvalidated or Validated EDD Macro
Sample Tracking Sheet
Post Load Reports

8.0 Data Evaluation & Reporting

8.1 Run Tables

Meet with the PM to verify table requirements and formatting (i.e. headers, footers, or other special needs). Raw and detects tables must be created for EACH matrix (solid/aqueous). Pull the data from **EnStat**. There are three macro templates that can be utilized to assist with the formatting of EnStat output files. These include the **Raw, Detects, & Exceedance Tables from EnStat Output Macro**, **HHRA Tables from EnStat Output Macro**, and **EcoRisk Tables from EnStat Output Macro**.

Run the **Raw, Detects & Exceedance Tables from EnStat Macro**, and send the completed tables to the Project Chemist for a final quality check. Provide the completed, QC'd tables to the PM. Other tables can be generated from the remaining macros as requested.

8.2 Review Laboratory and Validator Invoices

Laboratory invoices should be submitted once the laboratory has completed requested analyses, and submitted all results and requested corrections. Data validation invoices should be submitted shortly after the validation has been completed, and the report submitted to CH2M HILL. Invoices will be submitted to the PM through AP Workflow for approval. The PM should then consult the EIS for invoice review before submitting approval. The EIS should review the invoices, and noting any late charges, etc, and update the **Sample Tracking Sheet** accordingly.

8.3 Complete EIS DM Budget Tracking Form

Meet with the PM and the DMC to review the **EIS DM Budget Tracking Form** and discuss lessons learned.

Tools Involved in Data Evaluation & Reporting
EcoRisk Tables from EnStat Output Macro
EIS DM Budget Tracking Form
EnStat
HHRA Tables from EnStat Output Macro
Raw, Detects, & Exceedance Tables from EnStat Output Macro
Sample Tracking Sheet

Appendix A

Summary & Assessment of Data Management Materials

Summary Of Tools Involved In The Data Management Process

Tools	Assessment
BOA Rates Spreadsheet	This is only updated every 5 years. We need an SOP to remind EISs to add a 10% increase for each year after the update year until it is updated again.
Corrections to File Letter	
Data Archiving (List of Contents) Form	Kevin McGarvey, the Archiving Expert will be working in the WDC office through June, and will be stopping by here. He could be tasked to write up an SOP. We might have some mini-SOPs to work from too.
Data Request/Needs Form	Good
EcoRisk Tables from EnStat Output Macro	Good
EDD	Good, though primary keys need revision.
EIS QC Checklist for Unvalidated and Validated EDDs and Hard Copy Data Form	This is a good procedure checklist, and could easily be made into a formal SOP.
EIS Questions to Ask at Start of Project Form	This could use a few formatting tweaks, but is generally good as is.
EIS DM Budget Tracking Form	This should be updated to incorporate all the aspects of the data management process for more accurate tracking
EnDat Post Load Reports	Good. Used to assess and QC data loaded into EnDat to ensure data load accuracy and completeness
EnStat	This needs work to get it running better/correctly. There is a ppt presentation on using this that could serve as a SOP.
Established Document Templates	Currently we work off of pre-existing docs, which vary. Templates must be established.
FDET Instructions for Data QC Form	Needs evaluation
Field Data Entry Tool (FDETool)	Could use a bulk upload function, and built in QC checks

Tools	Assessment
HHRA Tables from EnStat Output Macro	Needs evaluation
Pivot Table Instructions	Could easily be made into a good SOP
Preferred Analysis Group Form	Good
Project Instructions	From PM
Projects Currently in DM Tracking Table	Good
QC Association Table	The example on the server is intended to use as a template, and could use a little tweaking
Raw & Detects Tables from Unvalidated or Validated EDD Macro	This macro could use formatting updates. There is no SOP for this, but I do have a rough mini-SOP that Felicia wrote up.
Raw, Detects, & Exceedance Tables from EnStat Output Macro	Needs evaluation
Sample Tracking Sheet	Need to develop template
Survey Coordinates Flowchart	Good

Summary of Documentation in the Reference Manuals

Document	Assessment for Current DMP	Assessment for NIRIS
IS Personnel 11-2006	Current	Good
Load Process Step by Step	Generic overview, not SOP. Need Bhavana to write a formal SOP if desired	Need New Document
Navy Clean IS Organization	Out of Date	Need New Document
Reference Manual Binder Covers	Current	Good
Ref Manual Page Dividers	Current	Good
Project Manager Role in IS-DM Process	Current	Good
Environmental Information Specialist Role 1	Current	Good
Data Management Coordinator Role	Current	Good
Navy Clean Data Management Process Flowchart	Current	Good
Survey Coordinates Flowchart	Good	Needs Revision
Life of a Sample Flowchart	Needs Revision	Needs Revision
Chemicals in EnDat 010306	Needs periodic updates	Need New Document
Chemical Synonyms in EnDat	Needs periodic evaluation	Need New Document
Common Chemical Synonyms & Abbreviations	Good	Good
Analyses and Methods Commonly Used	Needs periodic updates	Needs periodic updates
FDET Valid Values	Good	Need New Document
Lab Valid Values	Good	Need New Document
DV Valid Values	Good	Need New Document
Field Sample Naming Scheme	Needs Revision (to Sample Nomenclature Protocol for all Bases)	Uncertain
Field Station Naming Scheme	Needs Revision (to Station Nomenclature Protocol for all Bases)	Uncertain
EDD Format CH2M Navy 120605	Needs Updates	Need New Document

Document	Assessment for Current DMP	Assessment for NIRIS
DCLT Manual	None – This is no longer used, as the Tool is broken	Delete
STS Example	Need to develop template	Need to develop template
Corrections To File	Good	Uncertain
Corrections to File Example	Good	Uncertain
FDET Instructions	Good	Delete
FDET Screen Shot	Good	Delete
FDET Stations Report Example	File does not exist	Delete
FDET Sample Report Example	File does not exist	Delete
FDET Field Results Report Example	File does not exist	Delete
FDET Full Detail Report Example	File does not exist	Delete
FDET Result Report in XL Example	Good	Delete
FDET Instructions for Data QC	Needs Evaluation	Delete
Data Management Checklist _rev0306	Needs Revision	Needs Total Revison/Rewrite
Analyte Pivot Table Instructions	Good	Uncertain
Analyte Pivot Table Example	Can not locate file	Uncertain
Preferred Analysis Group	Needs evaluation – have older version (ABL) too	Uncertain
Ex of Pre-Load QC Raw & Detects Tables	Good	Need new document
Ex of Post-Load Station Check Confirmation Rpt from DB Specialist	Cannot locate file	Uncertain
Ex of Post-Load Sample Check Confirmation Rpt from DB Specialist	Cannot locate file	Uncertain
Ex of Post-Load Field Result Check Confirmation Rpt from DB Specialist	Cannot locate file	Uncertain
Ex of Post-Load Analysis Check Confirmation Rpt from DB Specialist	Cannot locate file	Uncertain
EnStat Tool Instructions	PPT, not SOP. Could easily be made into SOP	Need New Tool
EnDat Threshold Criteria	Needs Evaluation	Need New Document
Definitions of RBC & MCL Threshold Variations	Unable to locate Email Doc	Uncertain

Document	Assessment for Current DMP	Assessment for NIRIS
Ex of Unformatted EnStat Post-Load Tables	Good	Need New Document
Ex of Formatted EnStat Post-Load Tables	Good	Need New Document
IS Costing Template 2006Rates 042506	Needs to be Updates	Needs Updating
IS Data Request-Needs Form	Good	Needs Update/New Document
Quarterly Sampling Projection Forms Example	Good	Good
EIS Project Startup Questions_rev0905	Good	Needs Revision
EIS DM Budget Tracking Form	This should be updated to incorporate all the aspects of the data management process for more accurate tracking	Needs Revision
EIS QC Checklist for Unval & Val EDD & Hard Copy Data	Unable to locate document	Needs Revision
EIS Training Checklist	Good	Needs Revision