219098

QUALITY ASSURANCE PROJECT PLAN
Cabo Rojo Site
Cabo Rojo, Puerto Rico
Revision 1

Prepared for:
United States Environmental Protection Agency/Environmental Response Team
Edison, NJ

By:
Lockheed Martin/Scientific, Engineering, Response and Analytical Service (SERAS)
Work Assignment Number: SERAS-130

Based on the Intergovernmental Data Quality Task Force Uniform
Federal Policy for Quality Assurance Project Plans
(Final Version 1.1, June 2006)

February 27, 2012

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QAPP Worksheet #1
Title and Approval Page

Site Name/Project Name: Cabo Rojo
Site Location: Cabo Rojo, Puerto Rico

Document Title: Quality Assurance Project Plan for the Cabo Rojo Site

Lead Organization: Environmental Protection Agency/Environmental Response Team (EPA/ERT)

Preparer's Name and Organizational Affiliation: Jon McBurney - Lockheed Martin/Scientific Engineering Response Analytical Service (SERAS). Revision 1-Philip Solinski Lockheed Martin/SERAS

Preparer's Address, Telephone Number, and E-mail Address: 2890 Woodbridge Avenue, Edison, NJ 08837, (732)321-4244, jonathan.d.mcburney@lmco.com Revision 1 - 2890 Woodbridge Avenue, Edison, NJ 08837, (732)321-4283, philip.j.solinski@lmco.com

Preparation Date (Day/Month/Year): June 6, 2011. Revision 1 – February ~~27, 2012~~

Investigative Organization's Project Manager/Date: _____ Signature 2/27/12

Printed Name/Organization: Jeff Catanzarita/ERT Work Assignment Manager

Investigative Organization's Project QA Officer/Date: _____ Signature 2/28/12

Printed Name/Organization: Stephen Blaze/ERT Quality Coordinator

Lead Organization's Project Manager/Date: _____ Signature 2/27/12

Printed Name/Organization: Mike Cartwright/SERAS Task Leader

Approval Signatures/Date: _____ Signature 2/24/12

Printed Name/Title: Deborah A. Killeen/SERAS QA/QC Officer

Approval Authority: Lockheed Martin/SERAS

Other Approval Signatures/Date: _____ Signature 2/28/12

Printed Name/Title: Dennis A. Miller/SERAS Program Manager

Document Control Numbering System: SERAS-130-DQAPPR1-022712

QAPP Worksheet #2
QAPP Identifying Information

Site Name/Project Name: Cabo Rojo
Site Location: Cabo Rojo, Puerto Rico
Site Number/Code: A244
Operable Unit:
Contractor Name: Lockheed Martin
Contractor Number: EP-W-09-031

Contract Title: SERAS
Work Assignment Number: SERAS-130

1. Identify regulatory program: Comprehensive Environmental Response and Compensation Liability Act (CERCLA)
2. Identify approval entity: EPA/ERT
3. The QAPP is (select one): ☐Generic ☒Project Specific
4. List dates of scoping sessions that were held: April 20, 2011 and February 23, 2012
5. List dates and titles of QAPP documents written for previous site work, if applicable:

Title	Approval Date
Quality Assurance Project Plan, Cabo Rojo Site,Cabo Rojo, Puerto Rico SERAS document number SERAS-0130-DQAPP-060611	06/06/2011

6. List organizational partners (stakeholders) and connection with lead organization:
   EPA Region 2
7. List data users:
   EPA Region 2
8. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusions below:

   Worksheet 37 is not applicable. EPA Region II will decide the usability of project data.

QAPP Worksheet #2
QAPP Identifying Information
(Continued)

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
Project Management and Objectives		
2.1 Title and Approval Page	- Title and Approval Page	1
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	- Table of Contents - QAPP Identifying Information	2
2.3 Distribution List and Project Personnel Sign-Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	- Distribution List - Project Personnel Sign-Off Sheet	3 4
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications Table - Special Personnel Training Requirements Table	5 6 7 8
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	- Project Planning Session Documentation (including Data Needs tables) - Project Scoping Session Participants Sheet - Problem Definition, Site History, and Background - Site Maps (historical and present)	9 10
2.6 Project Quality Objectives and Measurement Performance Criteria 2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	- Site-Specific PQOs - Measurement Performance Criteria Table	11 12

QAPP Worksheet #2
QAPP Identifying Information
(continued)

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
2.7 Secondary Data Evaluation	- Sources of Secondary Data and Information - Secondary Data Criteria and Limitations Table	13
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	- Summary of Project Tasks - Reference Limits and Evaluation Table - Project Schedule/Timeline Table	14 15 16
Measurement/Data Acquisition		
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume, and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.3 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures 3.1.2.4 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	- Sampling Design and Rationale - Sample Location Map - Sampling Locations and Methods/SOP Requirements Table - Analytical Methods/SOP Requirements Table - Field Quality Control Sample Summary Table - Sampling SOPs - Project Sampling SOP References Table - Field Equipment Calibration, Maintenance, Testing, and Inspection Table	17 18 19 20 21 22
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	- Analytical SOPs - Analytical SOP References Table - Analytical Instrument Calibration Table - Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	23 24 25

QAPP Worksheet #2
QAPP Identifying Information
(continued)

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Required Documents
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	- Sample Collection Documentation Handling, Tracking, and Custody SOPs - Sample Container Identification - Sample Handling Flow Diagram - Example Chain-of-Custody Form and Seal	26 27
3.4 Quality Control Samples 3.4.1 Sampling Quality Control Samples 3.4.2 Analytical Quality Control Samples	- QC Samples Table - Screening/Confirmatory Analysis Decision Tree	28
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	- Project Documents and Records Table - Analytical Services Table - Data Management SOPs	29 30
Assessment/Oversight		
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	- Assessments and Response Actions - Planned Project Assessments Table - Audit Checklists - Assessment Findings and Corrective Action Responses Table	31 32
4.2 QA Management Reports	- QA Management Reports Table	33
4.3 Final Project Report		

QAPP Worksheet #2
QAPP Identifying Information
(continued)

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
Data Review		
5.1 Overview		
5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	- Verification (Step I) Process Table - Validation (Steps IIa and IIb) Process Table - Validation (Steps IIa and IIb) Summary Table - Usability Assessment	34 35 36 NA
5.3 Streamlining Data Review 5.3.1 Data Review Steps To Be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining		

QAPP Worksheet #3-1
Distribution List

QAPP Recipients	Title	Organization	Telephone Number	Fax Number	E-mail Address	Document Control Number
Jeff Catanzarita	Work Assignment Manager	EPA/ERT	732-906-6929	732-321-6724	catanzarita.jeff@epa.gov	SERAS-130-DQAPP-060611
Stephen Blaze	Quality Coordinator	EPA/ERT	732-906-6921	732-321-6724	blaze.stephen@epa.gov	SERAS-130-DQAPP-060611
Jon McBurney	Project Engineer/ Task Leader	SERAS	732-321-4244	732-494-4021	jonathan.d.mcburney@lmco.com	SERAS-130-DQAPP-060611
Deborah Killeen	QA/QC Officer	SERAS	732-321-4245	732-494-4021	deborah.a.killeen@lmco.com	SERAS-130-DQAPP-060611
Dennis Miller	Program Manager	SERAS	732-321-4216	732-494-4021	dennis.a.miller@lmco.com	SERAS-130-DQAPP-060611

QAPP Worksheet #3-2 (February 2012 Mobilization)
Distribution List

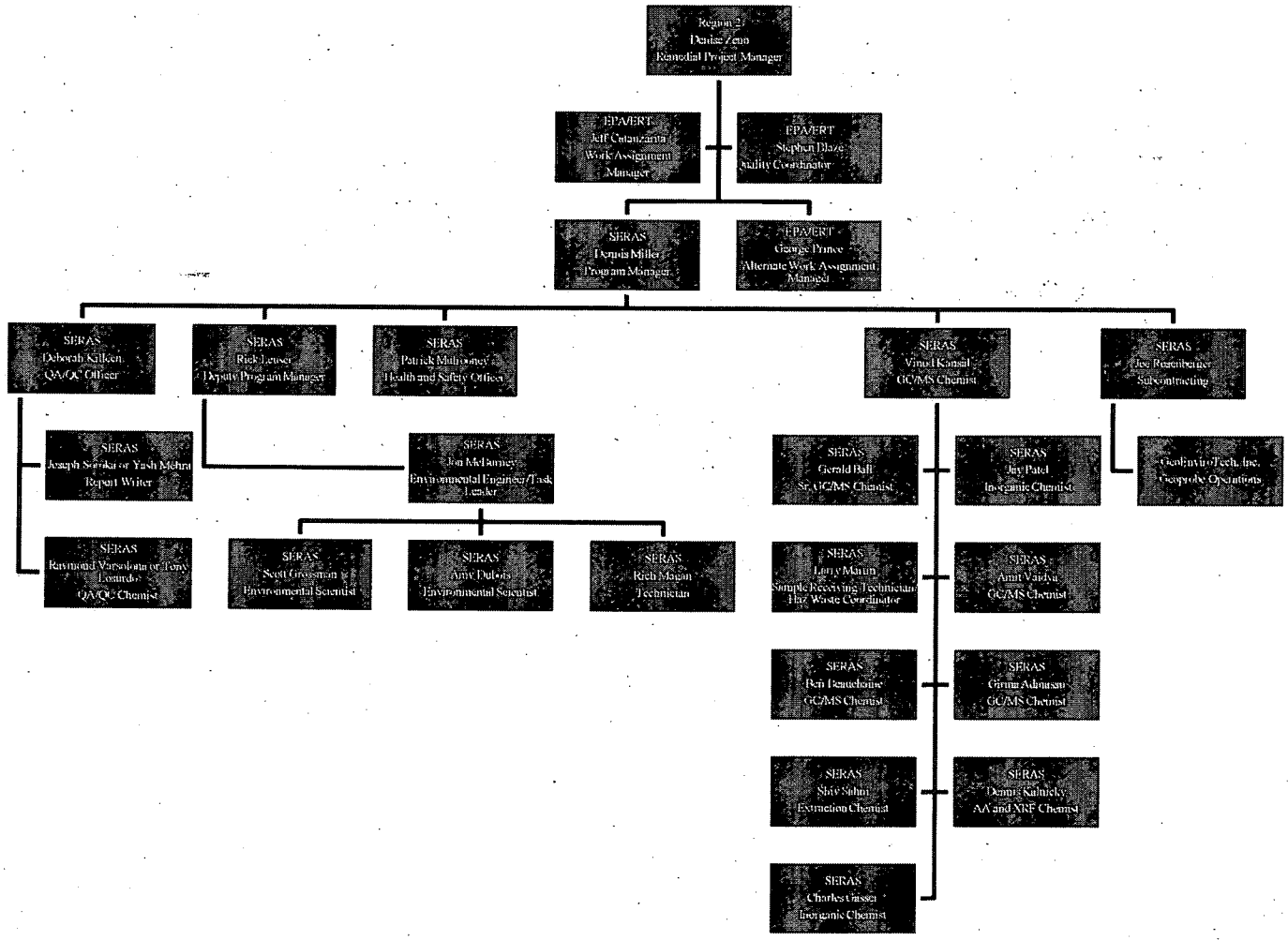
QAPP Recipients	Title	Organization	Telephone Number	Fax Number	E-mail Address	Document Control Number
Jeff Catanzarita	Work Assignment Manager	EPA/ERT	732-906-6929	732-321-6724	catanzarita.jeff@epa.gov	SERAS-130-DQAPPR1-022712
Stephen Blaze	Quality Coordinator	EPA/ERT	732-906-6921	732-321-6724	blaze.stephen@epa.gov	SERAS-130-DQAPPR1-022712
Mike Cartwright	Environmental Scientist/Task Leader	SERAS	732-321-4284	732-494-4021	michael.w..cartwright@lmco.com	SERAS-130-DQAPPR1-022712
Deborah Killeen	QA/QC Officer	SERAS	732-321-4245	732-494-4021	deborah.a.killeen@lmco.com	SERAS-130-DQAPPR1-022712
Dennis Miller	Program Manager	SERAS	732-321-4216	732-494-4021	dennis.a.miller@lmco.com	SERAS-130-DQAPPR1-022712

QAPP Worksheet #4 (February 2012 Mobilization)
Project Personnel Sign-Off Sheet

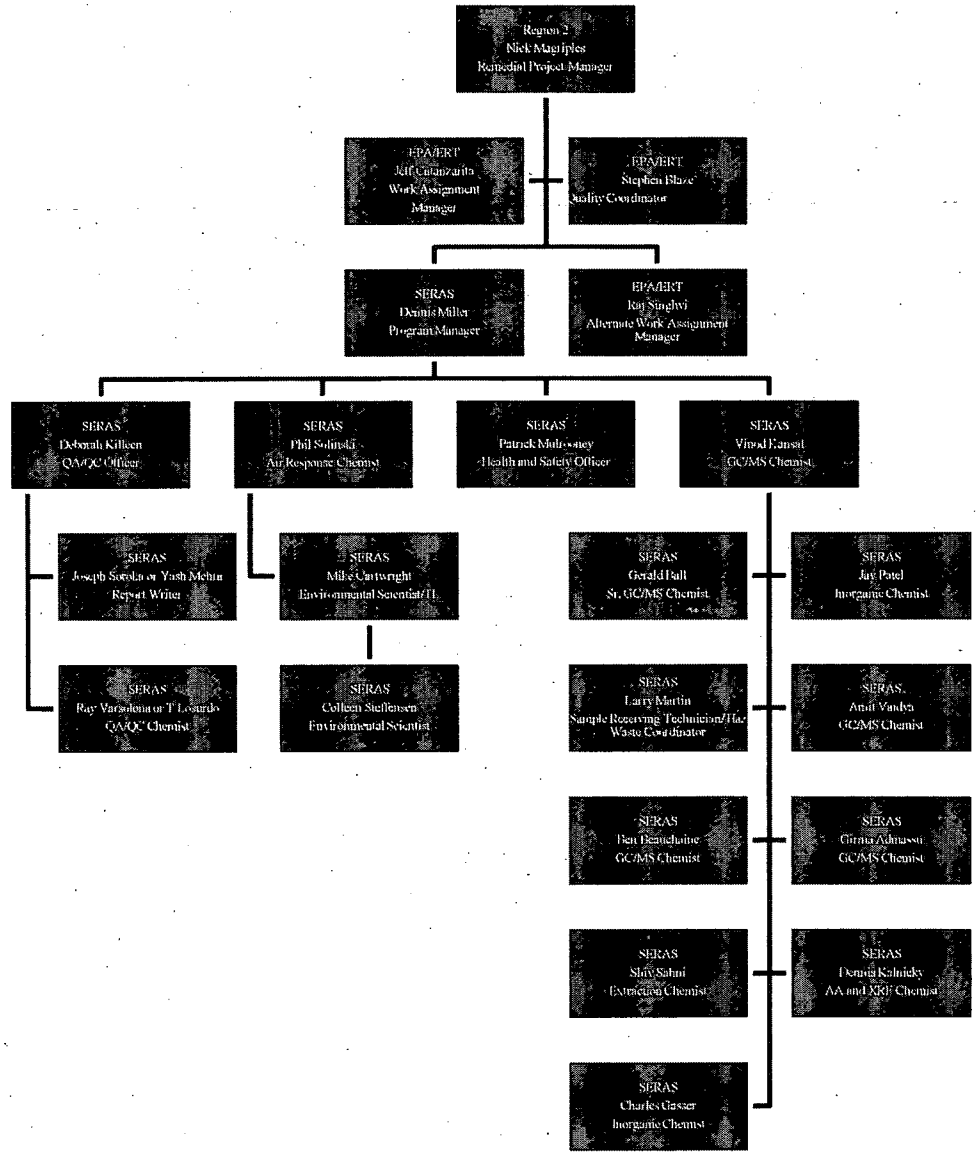
Organization: ERT/EPA/SERAS

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Jeff Catanzarita	EPA/ERT Work Assignment Manager (WAM)	732-906-6929		2/27/12
Arlene Anderson	EPA Region 2 On-Scene Coordinator (OSC)	732-906-6930		2/27/12
Nick Magriples	EPA Region 2 OSC	732-906-6930		
Denise Zeno	EPA Region 2 Remedial Project Manager (RPM)	212-637-4319		
Colleen Steffensen	SERAS Environmental Scientist	732-321-4202		2/27/12
Mike Cartwright	SERAS Environmental Scientist/Task Leader	732-321-4284		2/27/12

QAPP Worksheet #5-1
Project Organizational Chart



QAPP Worksheet #5-2 (February 2012 Mobilization)
Project Organizational Chart



QAPP Worksheet #6
Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Approval of initial QAPP and any amendments	ERT Work Assignment Manager ERT Quality Coordinator SERAS Program Manager SERAS QA/QC Officer SERAS Task Leader-Air	Jeff Catanzarita Stephen Blaze Dennis A. Miller Deborah Killeen Mike Cartwright	(732) 906-6929 (732) 906-6921 (732) 321-4216 (732) 321-4245 (732) 321-4284	SERAS internal peer review, followed by ERT approval, implementation of changes effective only with approved QAPP or QAPP Change Form.
Nonconformance and Corrective Action	SERAS Task Leader-Air ERT Work Assignment Manager SERAS QA/QC Officer	Mike Cartwright Jeff Catanzarita Deborah Killeen Amit Vaidya Gerald Ball Ben Beauchaine Girma Admassu Shiv Sahni Charles Gasser Dennis Kalnicky Larry Martin	(732) 321-4284 (732) 906-6929 (732) 321-4245 (732) 321-4251 (732) 321-4286 (732) 494-4006 (732) 321-4394 (732) 321-9312 (732) 321-4297 (732) 321-4214 (732) 321 4213	Use of the Work Assignment Field Change Form for field issues. Use of the laboratory nonconformance memo for laboratory deviations/deficiencies
Posting of Deliverables to the ERT IMS website	SERAS Task Leader-Air SERAS QA/QC Officer SERAS Deputy Program Manager SERAS Administrative Support	Mike Cartwright Deborah Killeen Richard Leuser Eileen Ciambotti	(732) 321-4284 (732) 321-4245 (732) 494-4060 (732) 321-4255	As per work assignment, posting of deliverables to ERT-Information Management System (IMS) website constitutes delivery to the WAM.
Work Assignment	SERAS Program Manager	Dennis A. Miller	(732) 321-4216	Describes scope of work to SERAS personnel from the ERT WAM.
Health and Safety On-Site Meeting	SERAS Task Leader – Air	Mike Cartwright	(732) 321-4284	Describe potential site hazards, required personal protective equipments, and access to local emergency services.

QAPP Worksheet #7
Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Mike Cartwright	Environmental Scientist	SERAS	Task Leader, Project Supervision, Reporting, Document Preparation	Minimum B.S. degree plus 3 years of related experience/Lockheed Martin Employee Files
Nesya Belyarchik	Computer Assisted Design (ACAD)	SERAS	Map Creation	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Mingling Li	Geographic Information System (GIS) Specialist	SERAS	GIS/Map Creation	Minimum B.S. degree plus 3 years of related experience/Lockheed Martin Employee Files
Scott Grossman	Environmental Engineer/Scientist	SERAS	Field Investigation, Field Sampling	Minimum B.S degree plus 8 years of related experience//Lockheed Martin Employee Files
Amy Dubois	Environmental Scientist (Air/Response)	SERAS	Field Sampling, Sample Documentation	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Rich Magan	Environmental Technician	SERAS	Field Sampling, Sample Documentation, Mobilization	Environmental sampling experience/Lockheed Martin Employee Files
Deborah Killeen	QA/QC Officer	SERAS	Quality Assurance/Validation Oversight and Deliverable Review	Minimum B.S. degree plus 14 years of related experience/Lockheed Martin Employee Files
Ray Varsolona	QA/QC Chemist	SERAS	Data Validation	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Yash Mehra	Report Writer	SERAS	Report & EDD Preparation	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Colleen Steffensen	Environmental Scientist	SERAS	Field Sampling, Sample Documentation	Minimum B.S. degree plus 3 years of related experience/Lockheed Martin Employee Files
Jeff Catanzarita	Work Assignment Manager	EPA/ERT	Technical Direction/Field Oversight	EPA Job-related qualifications/EPA Files
George Prince	Alternate Work Assignment Manager	EPA/ERT	Technical Direction/Field Oversight	EPA Job-related qualifications/EPA Files
Stephen Blaze	Quality Coordinator	ERT	QA Oversight	EPA job-related qualifications/EPA Files
Nick Magriples	Remedial Program Manager	EPA Region 2	Technical and Logistical Support	EPA job-related qualifications/EPA Files
Gerald Ball	Sr. GC/MS Chemist	SERAS	Sample Analysis	Minimum B.S. degree plus 14 years of related experience/Lockheed Martin Employee Files
Jay Patel	ICP and ICP-MS Chemist	SERAS	Sample Analysis	Minimum B.S. degree plus 14 years of related experience/Lockheed Martin Employee Files
Larry Martin	Sample Receiving Technician/Hazardous Waste Coordinator	SERAS	Sample Receiving/Hazardous Waste Management	Minimum B.S. degree plus 3 years of related experience/Lockheed Martin Employee Files

QAPP Worksheet #7
Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Amit Vaidya	GC/MS Chemist	SERAS	Sample Analysis	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Ben Beauchaine	GC/MS Chemist	SERAS	Sample Analysis	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Girma Admassu	GC/MS Chemist	SERAS	Sample Analysis	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Shiv Sahni	Extraction Chemist	SERAS	Sample Extraction	Minimum B.S. degree plus 3 years of related experience/Lockheed Martin Employee Files
Charles Gasser	Extraction Chemist	SERAS	Sample Digestion	Minimum B.S. degree plus 3 years of related experience/Lockheed Martin Employee Files
Dennis Kalnicky	AA and XRF Chemist	SERAS	Sample Analysis	Minimum B.S. degree plus 14 years of related experience/Lockheed Martin Employee Files

QAPP Worksheet #8-1
Special Personnel Training Requirements Table

Project Function	Specialized Training – Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Project Oversight	Health & Safety Training	SERAS	December 2010	Jon McBurney	Project Engineer/ Task Leader/SERAS	SERAS H&S Files
Field Sampling	Health & Safety Training	SERAS	December 2010	Rich Magan	Environmental Technician/SERAS	SERAS H&S Files
Field Sampling	Health & Safety Training	SERAS	August 2010	Amy Dubois	Environmental Scientist/SERAS	SERAS H&S Files
Field Sampling	Health & Safety Training	SERAS	November 2009	Scott Grossman	Project Engineer/SERAS	SERAS H&S Files
Field Chemist	Health & Safety Training	SERAS	November 2010	Gerald Ball	Sr. GC/MS Chemist	SERAS H&S Files
Validation Support	Data Integrity/Peak Integration	SERAS	July 2010	Raymond Varsolona or Tony Losurdo	QA/QC Chemist	Quality Files
Validation Support	Data Integrity/Peak Integration	SERAS	July 2010	Joseph Soroka or Yash Mehra	QA/QC Chemist	Quality Files
Laboratory Analysis	Data Integrity Training	SERAS	July 2010	Jay Patel Dennis Kalnicky Charles Gasser	ICP and ICP-MS Chemist AA and XRF Chemist Digestion Chemist	Quality Files
Laboratory Analysis	Data Integrity/Peak Integration Training			Shiv Sahni Amit Vaidya Ben Beauchaine Girma Admassu Larry Martin	Extraction Chemist GC/MS Chemist GC/MS Chemist Extraction Chemist Sample Receiving Tech.	
QA Oversight	Data Review & Validation	Laboratory Data Consultants	January 2007	Deborah Killeen	QA/QC Officer/SERAS	Quality Files
QA Oversight	Lead Auditor Training	IT Corporation	September 1991	Deborah Killeen	QA/QC Officer, SERAS	Quality Files
QA Oversight	Uniform Federal Policy for Quality Assurance Project Plans	Advanced Systems	January 2006	Deborah Killeen	QA/QC Officer/SERAS	Quality Files

QAPP Worksheet #8-2 (February 2012 Mobilization)
Special Personnel Training Requirements Table

Project Function	Specialized Training – Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Project Oversight	Health & Safety Training	SERAS	December 2011	Mike Cartwright	Task Leader-Air/SERAS	SERAS H&S Files
Field Sampling	Health & Safety Training	SERAS	December 2011	Colleen Steffensen	Environmental Scientist/SERAS	SERAS H&S Files
Validation Support	Data Integrity/Peak Integration	SERAS	June 2011	Raymond Varsolona or Tony Losurdo	QA/QC Chemist	Quality Files
Validation Support	Data Integrity/Peak Integration	SERAS	June 2011	Joseph Soroka or Yash Mehra	QA/QC Chemist	Quality Files
Laboratory Analysis	Data Integrity Training	SERAS	June 2011	Jay Patel Dennis Kalnicky Charles Gasser	ICP and ICP-MS Chemist AA and XRF Chemist Digestion Chemist	Quality Files
Laboratory Analysis	Data Integrity/Peak Integration Training			Shiv Sahni Amit Vaidya Ben Beauchaine Girma Admassu Larry Martin	Extraction Chemist GC/MS Chemist GC/MS Chemist Extraction Chemist Sample Receiving Tech.	
QA Oversight	Data Review & Validation	Laboratory Data Consultants	January 2007	Deborah Killeen	QA/QC Officer/SERAS	Quality Files
QA Oversight	Lead Auditor Training	IT Corporation	September 1991	Deborah Killeen	QA/QC Officer, SERAS	Quality Files
QA Oversight	Uniform Federal Policy for Quality Assurance Project Plans	Advanced Systems	January 2006	Deborah Killeen	QA/QC Officer/SERAS	Quality Files

QAPP Worksheet #9-1
Project Scoping Session Participants Sheet

Project Name: Cabo Rojo **Projected Date(s) of Sampling:** June 13, 2011 **Project Manager:** Jon McBurney	**Site Name:** Cabo Rojo **Site Location:** Cabo Rojo, Puerto Rico

Date of Session: 4/20/2011
Scoping Session Purpose: Initial Scoping Meeting

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Jon McBurney	Environmental Engineer/ Task Leader	SERAS	732-321-4244	jonathan.d.mcburney@lmco.com	Task Lead
Jeff Catanzarita	Work Assignment Manager	ERT	732-906-6929	catanzarita.jeff@epa.gov	Work Assignment Manager
George Prince	Assistant Work Assignment Manager	ERT	732-321-6649	prince.george@epa.gov	Asst. Work Assignment Manager
Rick Leuser	Deputy Program Manager	SERAS	732-494-4060	richard.m.leuser@lmco.com	Project Oversight
Amy Dubois	Environmental Scientist (Air)	SERAS	732-494-4007	amy.e.dubois@lmco.com	Sampling

Comments/Decisions:

1. Travel should be to the BQN Airport in Western Puerto Rico.
2. Soil gas sampling will be the primary sampling type for the first sampling event. Approximately 8 locations have been identified as possible sources. At each, approximately 3 indoor samples and 4 to 5 outdoor soil gas samples will be collected. SUMMA grab samples will be taken at a rate of 1 in 10 as verification samples. A Geoprobe will be on call for soil gas sampling.
3. Other sampling methods will be for groundwater and soil. Groundwater would be collected either from dedicated sample ports on municiple wells, from pre-installed monitoring wells, or from temporary SP-16 wells installed by Geoprobe. Water samples other than SP-16 must be for definitive data. SP-16 can be screening data only. Low flow will be used where possible. All soil sampling will be definitive data.
4. All Soil gas data will be screening only.

5. Less than half of all water samples will be submitted for BNA, VOC, PCB and Pesticides as well as VOCs.
6. Benchmarks will be Federal MCLs. If Federal MCLs are not available, use NYS drinking water criteria.

Action Items: None.

Consensus Decisions: See Comments/Decisions section.

QAPP Worksheet #9-2 (February 2012 Mobilization)
Project Scoping Session Participants Sheet

Project Name: Cabo Rojo **Projected Date(s) of Sampling:** February 28, 2012 **Project Manager:** Mike Cartwright	**Site Name:** Cabo Rojo **Site Location:** Cabo Rojo, Puerto Rico

Date of Session: 2/23/2012
Scoping Session Purpose: Scoping Meeting

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Mike Cartwright	Environmental Scientist/ Task Leader	SERAS	732-321-4844	michael.w.cartright@lmco.com	Task Lead
Phil Solinski	Air Response Chemist	SERAS	732-321-4283	Philip.j.solinski@lmco.com	Project Oversight
Debbie Killeen	QA Officer	SERAS	732-321-4245	Deborah.a.killeen@lmco.com	QA Officer
Gerald Ball	Sr GC/MS Chemist	SERAS	732-321-4286	Gerald.a.ball@lmco.com	Sample Analysis

Comments/Decisions:

1. Ambient air, indoor air and soil gas sampling will be performed during this sampling event. Six locations have been identified for sampling based upon previous sample events. Approximately 66 Summa samples will be collected for VOC analysis. Approximately 25 samples from a school and a near-by print shop will be analyzed for a full TO-15 list. Of thise 25 sample approximately 6 will be ambient air samples, 8 will be soil gas samples and 10 will be indoor air samples. The trip blank will also be analyzed for a full TO-15 list. The remaing 41 samples will be collected at four other locations and analyzed fro PCE, TCE and six other breakdown products. Approximately 9 ambient air samples, 20 soil gas samples and 12 indoor air samples will be collected.
2. Summa sampling eqipment and analysis will be performed by the SERAS Laboratories.

QAPP Worksheet #10
Problem Definition

The problem to be addressed by the project: The purpose of this project is to provide technical support to the Environmental Protection Agency/Environmental Response Team (EPA/ERT) and EPA Region II in conducting a preliminary remedial investigation (RI) in the town of Cabo Rojo, Puerto Rico (PR). The objectives of the RI are to confirm or negate possible sources of groundwater contamination and to collect groundwater samples for a RI/Risk Assessment (RA).
The environmental questions being asked: 1. What possible sources can be found for the tetrachloroethylene (PCE) and trichloroethylene (TCE) contamination being found in the groundwater? 2. What are the relative impacts from the different possible sources? 3. Is indoor air being impacted by soil vapor intrusion? 4. Are nearby industrial sources adversely impacting indoor air quality?
Observations from any site reconnaissance reports: See secondary Data, Worksheet 13.
A synopsis of secondary data or information from site reports: Secondary data available for this site include the preliminary investigations at the site as detailed in the Hazard Ranking System (HRS) Documentation Record as prepared by EPA and Weston Solutions Region 2 Site Assessment Team (SAT) contractor dated October, 2010. This document can be found at: http://www.epa.gov/superfund/sites/docrec/pdoc1823.pdf
The possible classes of contaminants and the affected matrices: Contaminants affecting the site are PCE and TCE. These contaminants are believed to be affecting Groundwater, Subsurface Soils, Soil Gases, Indoor Air and Ambient Air.
The rationale for inclusion of chemical and nonchemical analyses: 1. On-site screening of soil vapors will be used to direct the investigation towards possible source areas. 2. Off-site water analysis for TCE and PCE will be used to determine the magnitude of the source area and will be used in the RI/RA and Conceptual Site Model (CSM). 3. Analysis of site soils will be used along with the water analysis to determine the extent of the source contamination for use in the RI/RA and CSM. 4. Previous sampling has shown elevated concentrations of PCE, TCE and some of their breakdown products in soil gas.
Information concerning various environmental indicators: There have been no environmental indicators to date.
Project decision conditions ("If..., then..." statements): 1. If the soil gas samples analyzed on site indicate the presence of TCE or PCE, then additional soil gas samples will be taken to determine the location of the source of the contamination. 2. If an elevated level of PCE or TCE is measured in the soil gas, then soil and groundwater samples will be collected at a later date to determine the nature and extent of the source area. 3. If the results of the soil samples exceed the New York State (NYS) Part 375 Protection of Groundwater Standards, then EPA Region 2 will evaluate the data and determine what further courses of action are required. 4. If the results of the groundwater samples exceed the federal Maximum Contaminant Levels (MCLs) or the NYS MCLs for those compounds without federal MCLs, then EPA Region 2 will evaluate the data and determine what further courses of action are required. 5. If Indoor Air and or Ambient Air concentrations exceed action levels, data will be evaluated by EPA Region 2 to determine if further investigations and/or futher actions are taken.

QAPP Worksheet #11
Project Quality Objectives /Systematic Planning Process Statements

Who will use the data? The EPA Region 2, EPA Environmental Response Team (ERT), and Lockheed Martin SERAS

What will the data be used for?
1. Determine or negate potential sources for the ground water contamination based on soil-gas (SG) sampling to locate elevated volatile organic compound (VOC) vapor concentrations. The benchmark will be determined by the results of a limit of detection (LOD) study for PCE and TCE using a Voyager portable gas-chromatograph (GC) to ascertain the absence or presence and magnitude of the contaminants.
2. Collect current groundwater data for the creation of a conceptual site model (CSM) of the groundwater regime from pre-established monitoring wells and drinking water wells, and answer RI/RA objectives. Federal drinking water maximum contaminant levels (MCLs) will be used as benchmarks for groundwater sampling. When no Federal MCL exists for a contaminant of concern (COC), New York State Department of Environmental Conservation (NYSDEC) drinking water standards will be used.
3. Determine VOC levels in soils at or near suspected source locations. New York State 375 Regulations for impact to groundwater will be utilized as benchmarks.
4. Along with historical data, the CSM will be created for use with the RI.
5. To determine if action needs to be taken to preserve indoor air quality.

What type of data is needed? (target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques)
1. On-site screening of soil gas samples will be performed by a field chemist using a Voyager portable GC. The analytes will be PCE, TCE and cis 1,2 DCE. Samples will be collected by temporary soil gas points (outdoor samples) and by sub-slab sampling (indoor samples) into dedicated Tedlar bags. A subset of 10% of all soil gas locations will be sampled by collecting a grab sample into a SUMMA canister. The SUMMA canisters will be analyzed for VOCs at the ERT/SERAS laboratory in Edison, New Jersey (NJ). The SUMMA canister results will be used to verify the on-site screening results. Soil gas sample points may be screened using a MultiRAE photoionization detector (PID) prior to sampling to screen the vapors.
2. Off-site analysis of soil samples collected in suspected source areas for VOCs.
3. Off-site analysis of water samples collected from existing monitoring wells for VOCs. A subset of the samples will be analyzed for Target Analyte List (TAL) Metals, Polychlorinated Biphenyls (PCBs), SVOCs, and Pesticides. Groundwater samples collected from temporary well points by Geoprobe SP-16 methodology will be screening data only. All data from existing monitoring wells or potable water sources will be definitive data.
4. Water samples may be collected from temporary well points using Geoprobe SP-16 sampling methodology. These points may be field screened for VOCs on the Voyager Portable GC or analyzed at the ERT/SERAS Laboratory in Edison, NJ.
5. Water quality readings (screening data) may be collected for low-flow groundwater sampling methodology.
6. All sample locations will be located using Global Positioning System (GPS) technology.
7. Twenty-four hour soil gas, indoor air and ambient air samples will be collected to determine if chemicals present in the soil gas or nearby industrial sources are affecting indoor air or ambient air. Samples collected with a suspected industrial source in the vicinity will be analyzed for a full VOC list. Samples collected in areas with suspected PCE and TCE in groundwater or soil gas will be analyzed for PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, 1,1-dichloroethane (DCA), 1,2-DCA and vinyl chloride. All samples will be collected in SUMMA canisters and will be shipped to an off-site laboratory (SERAS) for analysis.

How "good" do the data need to be in order to support the environmental decision? All soil gas results generated by the Voyager portable GC will be considered screening data. The data will be used to direct further sampling in an attempt to locate possible sources of VOCs impacting groundwater. Soil, soil gas and groundwater results will be used for further RI evaluation, with the exception of temporary SP-16 wells which will be for screening purposes only. The soil and groundwater results will be definitive data. All GPS, water quality (YSI or equivalent) and air quality (MultiRAE or equivalent) readings will be for screening purposes only. All samples collected for the February 2012 mobilization must meet definitive data requirements.

How much data are needed? (number of samples for each analytical group, matrix, and concentration) Approximately 60 soil gas locations will be sampled for on-site screening of PCE, TCE and cis 1,2 DCE. Of the 60 samples, 25 are expected to be indoor sub-slab samples, and the remaining 35 are expected to be outdoor temporary sample points. Approximately 50 groundwater and 50 soil samples have been planned for collection and analysis for VOCs. Of the 50 groundwater samples, approximately half (25) will be submitted for Metals, PCBs, Pesticides and SVOCs.

For the February 2012 mobilization, ambient air, indoor air and soil gas sampling will be performed during this sampling event. Six locations have been identified for sampling based upon previous sample events. Approximately 66 SUMMAa samples will be collected for VOC analysis. Approximately 25 samples from a school and a near-by print shop will be analyzed for a full TO-15 list. Of these 25 samples, approximately 6 will be ambient air samples, 8 will be soil gas samples and 10 will be indoor air samples. The trip blank will also be analyzed for a full TO-15 list. The remaing 41 samples will be collected at four other locations and analyzed for PCE, TCE and six other breakdown products. Approximately 9 ambient air samples, 20 soil gas samples and 12 indoor air samples will be collected.

Where, when, and how should the data be collected/generated? Soil gas samples will be collected during the week of June 13, 2011 from locations determined by the RPM and WAM. The samples will be collected using SERAS Standard Operating Procedure (SOP) #2102, *Tedlar Bag Sampling* and #1704, *SUMMA Canister Sampling*. See Worksheets 18 and 19 for details. The collection date of the groundwater samples and soil samples will be determined after the June 13 sampling event. Groundwater samples will be collected using SERAS SOP# 2007, *Groundwater Well Sampling*. Soil samples will be collected using SERAS SOP# 2012, *Soil Sampling*.

For the February 2012 mobilization soil gas, indoor air and ambient air samples will be collected during the week of February 27, 2012 from locations determined by the RPM and WAM. The samples will be collected using SERAS Standard Operating Procedure (SOP) #1704, *SUMMA Canister Sampling*. See Worksheets 18 and 19 for details.

Who will collect and generate the data? SERAS field personnel will collect all samples and a SERAS field chemist will generate all field screening data. ERT/SERAS Laboratory chemists will generate all soil, groundwater and soil gas confirmation data.

For the February 2012 mobilization, SERAS field personnel will collect all samples and ERT/SERAS Laboratory chemists will analyzed the samples collected.

How will the data be reported? The SERAS field laboratory will provide VOC analytical results for all soil gas samples. Results will be reported daily to the RPM and WAM in an electronic spreadsheet. Final ERT/SERAS Laboratory generated validated data will be reported in accordance with SERAS SOP #4020, *Analytical Report Preparation*. A SERAS Final Report containing all data will be generated in accordance with SOP #4021, *Preparation of Final Report*. The final report will be the final deliverable to the EPA/ERT WAM. Data will be disseminated to EPA Region 2 by the WAM.

How will the data be archived? Data will be archived in electronic *.pdf format. Data packages from the ERT/SERAS Laboratory will be archived by the SERAS QA/QC Group both in hard copy and electronically. Hard copies of all deliverables will be stored in SERAS Central Files and e-copies will be archived on the SERAS Local Area Network (LAN) in accordance with Administrative Procedure (AP) #34, *Archiving Electronic Files*. Data will be imported into a SCRIBE database and posted to the ERT-Information Management System (IMS) website.

QAPP Worksheet #12-1
Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	VOA
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2007	SERAS SOP #1806 (EPA SW-846 Method 8260B)	Precision (Field)	RPD ± 20%	Field Duplicates	S & A
		Precision (Laboratory)	1,1-Dichloroethene (RPD ±14%) Trichloroethene (RPD ±14%) Benzene (RPD ±11%) Toluene (RPD ±13%) Chlorobenzene (RPD ±13%)	MS/MSD	A
		Accuracy/Bias (Field) Contamination	<RL	Field Blank Trip Blank	S & A
		Accuracy (Laboratory)	%R = Within control chart limits	LCS	A
		Accuracy/Bias	-50% to +100%	Internal Standards	A
		Accuracy/Bias	1,1-Dichloroethene (%R=61-145%) Trichloroethene (%R=71-120%) Benzene (%R=76-127%) Toluene (%R=76-125%) Chlorobenzene (%R=75-130%)	MS	A
		Accuracy/Bias Contamination	<RL	Method Blank	A
		Accuracy/Bias	1,2-Dichloroethane-d4 (%R=76-114%) Toluene-d8 (%R=88-110%) p-Bromofluorobenzene (%R=86-115%)	Surrogates	A
		Completeness	> 90% sampling completed > 90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet #12-2
Measurement Performance Criteria Table

Matrix	Soil
Analytical Group	VOA
Concentration Level	Low/Medium

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2012	EPA SW-846 Method 8260B/ SERAS SOP #1807	Precision	1,1-Dichloroethene (RPD ±22%) Trichloroethene (RPD ±24%) Benzene (RPD ±21%) Toluene (RPD ±21%) Chlorobenzene (RPD ±21%)	MS/MSD	A
		Accuracy/Bias	%R = Within control limits	LCS	A
		Precision	RPD±35%	Field Duplicates	S & A
		Accuracy/Bias	-50% to +100%	Internal Standards	A
		Accuracy/Bias	1,1-Dichloroethene (%R=59-172) Trichloroethene (%R=62-137) Benzene (%R=66-142) Toluene (%R=59-139) Chlorobenzene (%R=60-133)	Matrix Spikes	A
		Accuracy/Bias Contamination	<RL	Method Blank	A
		Accuracy/Bias	1,2-Dichloroethane-d4 (%R=70-121) Toluene-d8 (%R=84-138) p-Bromofluorobenzene (%R=59-113%)	Surrogates	A
		Completeness	> 90% sampling completed > 90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet #12-3
Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	PCBs
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2007	SERAS SOP #1801	Precision (Field)	RPD: ±20%	Field Duplicates	S&A
		Accuracy/Bias	Within control chart limits	LCS	A
		Accuracy/Bias	%R=30-150 (advisory limits)	Surrogate Spike	A
		Accuracy/Bias	No limits defined	Matrix Spike	A
		Accuracy/Bias	<RL	Method Blank	A
				Field Blank	S&A
		Precision	RPD ±20%	MS/MSD	A
		Accuracy/Bias	50-150%	Internal Standards	A
		Completeness	> 90% sampling completed > 90% laboratory analysis	Data Completeness Check	S&A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet #12-4
Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	Pesticides
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2007	SERAS SOP #1808	Precision (Field)	RPD ±20%	Field Duplicates	S&A
		Accuracy/Bias	70-130% or within control chart limits	LCS	A
		Accuracy/Bias	%R=30-150 (advisory limits)	Surrogate Spike	A
		Accuracy/Bias	Gamma-BHC (%R=56-123) Heptachlor (%R=40-131) Aldrin (%R=40-120) Dieldrin (%R=52-126) Endrin (%R=56-121) 4,4'-DDT (%R=38-127)	Matrix Spike	A
		Accuracy/Bias	< RL	Method Blank	A
				Field Blank	S&A
		Precision	Gamma-BHC (RPD±15%) Heptachlor (RPD±20%) Aldrin (RPD±22%) Dieldrin (RPD±18%) Endrin (RPD±21%) 4,4'-DDT (RPD±27%)	MS/MSD	A
		Accuracy/Bias	50-150%	Internal Standards	A
		Completeness	> 90% sampling completed > 90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet #12-5
Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	SVOC
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP	Data Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2007	SERAS SOP #1804	Precision (Field)	RPD ±20%	Field Duplicate	S&A
		Accuracy/Bias	Phenol (%R=12-110) 2-Chlorophenol (%R=27-123) 1,4-dichlorobenzene (%R=36-97) N-Nitroso-di-n-propylamine (%R=41-116) 1,2,4 Trichlorobenzene (%R= 39-98) 4-Chloro-3-methylphenol (%R=23-97) Acenaphthene (%R=46-118) 4-Nitrophenol (%R=10-80) 4-Dinitotoluene (%R=24-96) Pentachlorophenol (%R=9-103) Pyrene (%R=26-127)	MS	A
		Precision	Phenol RPD ±42% 2-Chlorophenol RPD ±40% 1,4-Dichlorobenzene RPD ±28% N-Nitroso-di-n-propylamine RPD ±38% 1,2,4 Trichlorobenzene RPD ±28% 4-Chloro-3-methylphenol RPD ±42% Acenaphthene RPD ±31% 4-Nitrophenol RPD ±50% 2,4-Dinitotoluene RPD ±38% Pentachlorophenol RPD ±50% Pyrene RPD ±31%	MS/MSD	A
		Accuracy/Bias	%R=Within control chart limits	LCS	A

QAPP Worksheet #12-5
Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	SVOC
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP	Data Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
		Accuracy/Bias	Nitrobenzene-d5 (%R=35-114%) 2-Fluorobiphenyl (%R=43-116%) Terphenyl-d14 (%R=33-141%) Phenol-d5 (%R=10-110%) 2-Fluorophenol (%R=21-110%) 2,4,6-Tribromophenol (%R=10-123%)	Surrogate Spikes	A
		Accuracy/Bias Contamination	<RL	Method Blank	A
				Field Blank	S & A
		Accuracy/Bias	-50% to +100%	Internal Standards	A
		Completeness	> 90% sampling completed > 90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet #12-6
Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	Metals
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2007	SERAS SOP #1811	Precision (Field)	RPD ±20%	Field Duplicates	S & A
		Precision (Laboratory)	RPD ±20%	MS/MSD	A
		Accuracy/Bias (Field) Contamination	<RL	Field Blank	S & A
		Accuracy/Bias	%R=75-125 or within performance acceptance limits	LCS	A
		Accuracy/Bias Contamination	<RL	Method Blank	A
		Accuracy/Bias	%R=75-125	Matrix Spike	A
		Completeness	> 90% sampling completed > 90% laboratory analysis	Data Completeness Check	S & A
		Accuracy/Bias	%D ±20	ICS	A
		Precision	%D ±10	Serial Dilution	A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet #12-7
Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	Mercury
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2007	SERAS SOP #1832	Precision (Field)	RPD ±20%	Field Duplicates	S & A
		Precision (Laboratory)	RPD ±20%	MS/MSD	A
		Accuracy/Bias (Field) Contamination	<RL	Field Blank	S & A
		Accuracy/Bias	%R=75-125 or within performance acceptance limits	LCS	A
		Accuracy/Bias Contamination	<RL	Method Blank	A
		Accuracy/Bias	%R=75-125	Matrix Spike	A
		Completeness	> 90% sampling completed > 90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet 12-8
Measurement Performance Criteria Table

Matrix	Soil Gas (SUMMA® Canister)
Analytical Group	VOA
Concentration Level	Low Level

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP 1704	TO-15 (SERAS SOP # 1814)	Precision	RPD ± 25%	Laboratory Duplicates	A
		Accuracy/Bias	±30% Recovery or within control chart limits	Laboratory Control Sample (LCS)	A
		Accuracy/Bias	±40% of mean area response	Internal Standards	A
		Accuracy/Bias Contamination	No target compound ≥ RL	Method Blanks	A
		Sensitivity	±50% or within control chart limits	Limit of Quantitation	A
		Completeness	> 90% SUMMA sampling, > 90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet 12-9
Measurement Performance Criteria Table

Matrix	Indoor and Ambient Air (SUMMA® Canister)
Analytical Group	VOA
Concentration Level	Low Level

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP 1704	TO-15 (SERAS SOP # 1814)	Precision	RPD ± 25%	Laboratory Duplicates	A
		Accuracy/Bias	±30% Recovery or within control chart limits	Laboratory Control Sample (LCS)	A
		Accuracy/Bias	±40% of mean area response	Internal Standards	A
		Accuracy/Bias Contamination	No target compound ≥ RL	Method Blanks	A
		Sensitivity	±50% or within control chart limits	Limit of Quantitation	A
		Completeness	> 90% SUMMA sampling, > 90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet #13
Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	How Data Will Be Used	Limitations on Data Use
Locations for Sampling	Hazard Ranking System (HRS) Documentation Record	EPA and Weston Solutions Region 2 SAT Contract, dated October, 2010	For review and planning sample locations.	None
Location Reconnaisance	Final Preliminary Assessment/Site Inspection (PA/SI) Work Assignment No.: 065, Abandoned Mechanic – PA/SI	Weston Solutions, EPA Region 2 SAT Contract, June 8, 2007	Review	None

QAPP Worksheet #14
Summary of Project Tasks

Sampling Tasks:
1. Soil Gas Sampling. SERAS will collect up to 60 soil gas samples as detailed in Worksheet 18 and 19.
2. Groundwater Sampling. SERAS will collect up to 50 groundwater samples as detailed in Worksheet 18 and 19.
3. Soil Sampling. SERAS will collect up to 50 soil samples from suspected contaminated boring locations as detailed in Worksheet 18 and 19.
4. Screening of soil gas. A MultiRae gas analyzer will be used to screen soil gas points prior to sampling.
5. Groundwater parameters such as pH, temperature, dissolved oxygen(DO), oxidation reduction potential (ORP) may be collected during sampling for low flow sampling method.
6. All sample locations will be located using Global Positioning Satellite (GPS) technology.
7. Twenty-four hour soil gas, indoor air and ambient air samples will be collected to determine if chemicals present in the soil gas or nearby industrial sources are affecting indoor air or ambient air. Samples (~25) collected with a suspected industrial source in the vicinity will be analyzed for a full VOC list. Samples (~41) collected in areas with suspected PCE and TCE in groundwater or soil gas will be analyzed for PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, 1,1-dichloroethane (DCA), 1,2-DCA and vinyl chloride. All samples will be collected in SUMMA canisters and will be shipped to an off-site laboratory (SERAS) for analysis.

Analysis Tasks: All samples will be analyzed per the details in Worksheet 19, Analytical SOP Requirements.

Quality Control Tasks: Refer to Worksheet #20 for field QC Samples and Worksheets #12 and #28 for analytical QC Samples based on SERAS SOPs.

Secondary Data: Secondary data will be used as described in Worksheet 13.

Data Management Tasks: Field data will be recorded in field notebooks. SCRIBE will be used for data management. A Final Report will be posted to the ERT/Information Management System (IMS) website for this WA. Posting of the reports will be considered as completion of the deliverable. Hard copies of the deliverables will be archived in the SERAS central Files. Electronic copies of the deliverables will be saved on the SERAS archive drive, and archived in accordance with AP #34, *Archiving Electronic Files*.

Documentation and Records: Observations noted during field efforts will be documented in accordance with SERAS SOP #4001, *Logbook Documentation* and SERAS SOP #2002, *Sample Documentation*. Documents and records that will be generated during this project include: Work Plan (WP), QAPP, Field Logbooks, Sample Labels, Chain of Custody Forms, Custody Seals, Analytical Results and Field Change Forms, if necessary. The Final Report will present the results of groundwater investigation and include all field activities including well sampling records, injection records, and field observations. The final report will be prepared in accordance with SERAS SOP# 4021, *Preparation of Final Reports*.

Assessment/Audit Tasks: A performance audit of field operations is not anticipated for this project. The tasks associated with the QAPP are assessed using peer review and management system review. Peer review enables the task leader to identify and correct reporting errors before reports are submitted. Management system reviews establish compliance with prevailing management structure, policies and procedures, and ensures that the required data are obtained.

Data Review Tasks: Analytical data generated by the ERT/SERAS Laboratory in Edison, NJ with the exception of water samples collected by SP-16 methodology will be validated by SERAS QA/QC chemists per SERAS SOPs. Data validation will be conducted in accordance with the SOPs listed in Worksheet #36. Analytical data generated by the SERAS field chemist will not be validated. All SERAS project deliverables will receive an internal peer review prior to release as per the guidelines established in SERAS Administrative Procedure (AP) #22, *Peer Review of SERAS Deliverables*.

QAPP Worksheet #15-1
Reference Limits and Evaluation Table

Matrix: Soil

Analytical Group: VOA

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/kg) (NYS 375 Protection of Groundwater[2])	Project Quantitation Limit (µg/kg)	SERAS Method 1807/ EPA/SW846 8000B and 8260B Analytical Method		Achievable Laboratory Limits	
				MDLs (µg/kg)	Method QLs (µg/kg)	MDLs[1] (µg/kg)	QLs (µg/kg)
Dichlorodifluoromethane	75-71-8	NS	5.00	NS	5.00	1.12	5.00
Chloromethane	74-87-3	NS	5.00	NS	5.00	0.766	5.00
Vinyl chloride	75-01-4	20	5.00	NS	5.00	0.786	5.00
Bromomethane	74-83-9	NS	5.00	NS	5.00	1.09	5.00
Chloroethane	75-00-3	NS	5.00	NS	5.00	0.957	5.00
Trichlorofluoromethane	75-69-4	NS	5.00	NS	5.00	0.974	5.00
Acetone	67-64-1	50	20.0	NS	20.0	0.97	20.0
1,1-Dichloroethene	75-35-4	330	5.00	NS	5.00	1.27	5.00
Methylene chloride	75-09-2	50	5.00	NS	5.00	2.88	5.00
Carbon disulfide	75-15-0	NS	5.00	NS	5.00	1.37	5.00
Methyl tert-butyl ether	1634-04-4	930	5.00	NS	5.00	0.620	5.00
trans-1,2-Dichloroethene	156-60-5	190	5.00	NS	5.00	0.843	5.00
1,1-Dichloroethane	75-34-3	20	5.00	NS	5.00	0.686	5.00
2-Butanone	78-93-3	NS	5.00	NS	5.00	0.641	5.00
2,2-Dichloropropane	594-20-7	NS	5.00	NS	5.00	0.705	5.00
cis-1,2-Dichloroethene	156-59-2	250	5.00	NS	5.00	0.724	5.00
Chloroform	67-66-3	370	5.00	NS	5.00	0.677	5.00
1,1-Dichloropropene	563-58-6	NS	5.00	NS	5.00	0.728	5.00
1,2-Dichloroethane	107-06-2	20	5.00	NS	5.00	0.604	5.00
1,1,1-Trichloroethane	71-55-6	680	5.00	NS	5.00	0.693	5.00
Carbon tetrachloride	56-23-5	760	5.00	NS	5.00	0.665	5.00
Benzene	71-43-2	60	5.00	NS	5.00	0.785	5.00
Trichloroethene	79-01-6	470	5.00	NS	5.00	0.685	5.00
1,2-Dichloropropane	78-87-5	NS	5.00	NS	5.00	0.652	5.00
Bromodichloromethane	75-27-4	NS	5.00	NS	5.00	0.522	5.00
Dibromomethane	74-95-3	NS	5.00	NS	5.00	0.716	5.00

QAPP Worksheet #15-1
Reference Limits and Evaluation Table

Matrix: Soil

Analytical Group: VOA

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/kg) (NYS 375 Protection of Groundwater[2])	Project Quantitation Limit (µg/kg)	SERAS Method 1807/ EPA/SW846 8000B and 8260B Analytical Method		Achievable Laboratory Limits	
				MDLs (µg/kg)	Method QLs (µg/kg)	MDLs[1] (µg/kg)	QLs (µg/kg)
cis-1,3-Dichloropropene	10061-01-5	NS	5.00	NS	5.00	0.625	5.00
trans-1,3-Dichloro-propene	10061-02-6	NS	5.00	NS	5.00	0.700	5.00
1,1,2-Trichloroethane	79-00-5	NS	5.00	NS	5.00	0.577	5.00
1,3-Dichloropropane	142-28-9	NS	5.00	NS	5.00	0.633	5.00
Dibromochloromethane	124-48-1	NS	5.00	NS	5.00	0.553	5.00
1,2-Dibromoethane	106-93-4	NS	5.00	NS	5.00	0.687	5.00
Bromoform	75-25-2	NS	5.00	NS	5.00	0.545	5.00
4-Methyl-2-pentanone	108-10-1	NS	5.00	NS	5.00	0.498	5.00
Toluene	108-88-3	700	5.00	NS	5.00	1.87	5.00
2-Hexanone	591-78-6	NS	5.00	NS	5.00	0.668	5.00
Tetrachloroethene	127-18-4	1,300	5.00	NS	5.00	0.755	5.00
Chlorobenzene	108-90-7	1,100	5.00	NS	5.00	0.698	5.00
1,1,1,2-Tetrachloro-ethane	630-20-6	NS	5.00	NS	5.00	0.832	5.00
Ethylbenzene	100-41-4	1,000	5.00	NS	5.00	0.819	5.00
m,p-Xylene	108-38-3/ 106-42-3	NS	10.0	NS	10.0	1.70	10.0
o-Xylene	95-47-6	NS	5.00	NS	5.00	0.888	5.00
Styrene	100-42-5	NS	5.00	NS	5.00	0.888	5.00
Isopropylbenzene	98-82-8	NS	5.00	NS	5.00	0.647	5.00
1,1,2,2-Tetrachloro-ethane	79-34-5	NS	5.00	NS	5.00	0.723	5.00
1,2,3-Trichloropropane	96-18-4	NS	5.00	NS	5.00	0.826	5.00
n-Propylbenzene	103-65-1	3,900	5.00	NS	5.00	0.811	5.00
Bromobenzene	108-86-1	NS	5.00	NS	5.00	0.907	5.00
1,3,5-Trimethylbenzene	108-67-8	8,400	5.00	NS	5.00	0.862	5.00

QAPP Worksheet #15-1
Reference Limits and Evaluation Table

Matrix: Soil

Analytical Group: VOA

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/kg) (NYS 375 Protection of Groundwater[2])	Project Quantitation Limit (µg/kg)	SERAS Method 1807/ EPA/SW846 8000B and 8260B Analytical Method		Achievable Laboratory Limits	
				MDLs (µg/kg)	Method QLs (µg/kg)	MDLs[1] (µg/kg)	QLs (µg/kg)
2-Chlorotoluene	95-49-8	NS	5.00	NS	5.00	0.647	5.00
4-Chlorotoluene	106-43-4	NS	5.00	NS	5.00	0.815	5.00
tert-Butylbenzene	98-06-6	5,900	5.00	NS	5.00	0.939	5.00
1,2,4-Trimethylbenzene	95-63-6	3,600	5.00	NS	5.00	0.781	5.00
sec-Butylbenzene	135-98-8	11,000	5.00	NS	5.00	0.710	5.00
p-Isopropyltoluene	99-87-6	NS	5.00	NS	5.00	0.713	5.00
1,3-Dichlorobenzene	541-73-1	2,400	5.00	NS	5.00	0.563	5.00
1,4-Dichlorobenzene	106-46-7	1,800	5.00	NS	5.00	0.754	5.00
n-Butylbenzene	104-51-8	12,000	5.00	NS	5.00	0.832	5.00
1,2-Dichlorobenzene	95-50-1	1,100	5.00	NS	5.00	0.744	5.00
1,2-Dibromo-3 -chloropropane	96-12-8	NS	5.00	NS	5.00	0.551	5.00
1,2,4-Trichlorobenzene	120-82-1	NS	5.00	NS	5.00	0.929	5.00
Hexachlorobutadiene	87-68-3	NS	5.00	NS	5.00	1.18	5.00
Naphthalene	91-20-3	NS	5.00	NS	5.00	0.971	5.00
1,2,3-Trichlorobenzene	87-61-6	NS	5.00	NS	5.00	0.867	5.00

NS = Not Specified

[1] Based on LOD Study dated 4/28/11 for VOC Instrument "B"

[2] New York State Table 375-6.8(b): Restricted Use Soil Cleanup Objectives – Protection of Groundwater.

QAPP Worksheet #15-2
Reference Limits and Evaluation Table

Matrix: Groundwater
Analytical Group: VOA
Concentration Level: Trace

Analyte	CAS Number	Project Action Limit (µg/L) Federal Drinking Water MCLs	Project Action Limit (µg/L) NYS Drinking Water MCLs	Project Quantitation Limit[2] (µg/L)	SERAS Method 1806/ EPA/SW846/8000B and 8260B Analytical Method		Achievable Laboratory Limits	
					MDLs (µg/L)	Method QLs (µg/L)	MDLs[1] (µg/L)	QLs (µg/L)
Dichlorodifluoromethane	75-71-8	NS	5	0.50	NS	5.00	0.412	0.50
Chloromethane	74-87-3	NS	5	1.00	NS	5.00	0.546	1.00
Vinyl chloride	75-01-4	2	2	0.50	NS	5.00	0.453	0.50
Bromomethane	74-83-9	NS	5	1.00	NS	5.00	0.660	1.00
Chloroethane	75-00-3	NS	5	0.50	NS	5.00	0.492	0.50
Trichlorofluoromethane	75-69-4	NS	5	1.00	NS	5.00	0.504	1.00
1,1-Dichloroethene	75-35-4	NS	5	0.50	NS	5.00	0.066	0.50
Methylene chloride	75-09-2	NS	5	0.50	NS	5.00	0.077	0.50
Carbon disulfide	75-15-0	NS	50	0.50	NS	5.00	0.079	0.50
Methyl tert-butyl ether	1634-04-4	NS	10	0.50	NS	5.00	0.038	0.50
trans-1,2-Dichloroethene	156-60-5	100	5	0.50	NS	5.00	0.040	0.50
1,1-Dichloroethane	75-34-3	5	5	0.50	NS	5.00	0.065	0.50
2,2-Dichloropropane	594-20-7	NS	5	0.50	NS	5.00	0.151	0.50
cis-1,2-Dichloroethene	156-59-2	70	5	0.50	NS	5.00	0.042	0.50
Chloroform	67-66-3	80	50	0.50	NS	5.00	0.062	0.50
1,1-Dichloropropene	563-58-6	NS	5	0.50	NS	5.00	0.076	0.50
1,2-Dichloroethane	107-06-2	5	5	0.50	NS	5.00	0.087	0.50
1,1,1-Trichloroethane	71-55-6	20	5	0.50	NS	5.00	0.078	0.50
Carbon tetrachloride	56-23-5	5	5	0.50	NS	5.00	0.077	0.50
Benzene	71-43-2	5	5	0.50	NS	5.00	0.062	0.50
Trichloroethene	79-01-6	5	5	0.50	NS	5.00	0.073	0.50
1,2-Dichloropropane	78-87-5	5	5	0.50	NS	5.00	0.062	0.50
Bromodichloromethane	75-27-4	80	50	0.50	NS	5.00	0.054	0.50
Dibromomethane	74-95-3	NS	5	0.50	NS	5.00	0.057	0.50
cis-1,3-Dichloropropene	10061-01-5	NS	5	0.50	NS	5.00	0.067	0.50
trans-1,3-Dichloropropene	10061-02-6	NS	5	0.50	NS	5.00	0.107	0.50

QAPP Worksheet #15-2
Reference Limits and Evaluation Table

Matrix: Groundwater
Analytical Group: VOA
Concentration Level: Trace

Analyte	CAS Number	Project Action Limit (µg/L) Federal Drinking Water MCLs	Project Action Limit (µg/L) NYS Drinking Water MCLs	Project Quantitation Limit[2] (µg/L)	SERAS Method 1806/ EPA/SW846/8000B and 8260B Analytical Method		Achievable Laboratory Limits	
					MDLs (µg/L)	Method QLs (µg/L)	MDLs[1] (µg/L)	QLs (µg/L)
1,1,2-Trichloroethane	79-00-5	5	5	0.50	NS	5.00	0.097	0.50
1,3-Dichloropropane	142-28-9	NS	5	0.50	NS	5.00	0.057	0.50
Dibromochloromethane	124-48-1	80	50	0.50	NS	5.00	0.065	0.50
1,2-Dibromoethane	106-93-4	NS	50	0.50	NS	5.00	0.083	0.50
Bromoform	75-25-2	80	50	0.50	NS	5.00	0.081	0.50
Toluene	108-88-3	1,000	5	0.50	NS	5.00	0.072	0.50
Tetrachloroethene	127-18-4	5	5	0.50	NS	5.00	0.060	0.50
Chlorobenzene	108-90-7	NS	5	0.50	NS	5.00	0.057	0.50
1,1,1,2-Tetrachloroethane	630-20-6	NS	5	0.50	NS	5.00	0.071	0.50
Ethylbenzene	100-41-4	700	5	0.50	NS	5.00	0.049	0.50
m,p-Xylene	108-38-3/ 106-42-3	NS	5	1.00	NS	10.0	0.108	1.00
o-Xylene	95-47-6	NS	5	0.50	NS	5.00	0.031	0.50
Styrene	100-42-5	100	5	0.50	NS	5.00	0.050	0.50
Isopropylbenzene	98-82-8	NS	5	0.50	NS	5.00	0.056	0.50
1,1,2,2-Tetrachloroethane	79-34-5	NS	5	0.50	NS	5.00	0.072	0.50
1,2,3-Trichlorpropane	96-18-4	NS	5	0.50	NS	5.00	0.130	0.50
n-Propylbenzene	103-65-1	NS	5	0.50	NS	5.00	0.057	0.50
Bromobenzene	108-86-1	NS	5	0.50	NS	5.00	0.042	0.50
1,3,5-Trimethylbenzene	108-67-8	NS	5	0.50	NS	5.00	0.048	0.50
2-Chlorotoluene	95-49-8	NS	5	0.50	NS	5.00	0.081	0.50
4-Chlorotoluene	106-43-4	NS	5	0.50	NS	5.00	0.111	0.50
tert-Butylbenzene	98-06-6	NS	5	0.50	NS	5.00	0.048	0.50
1,2,4-Trimethylbenzene	95-63-6	NS	5	0.50	NS	5.00	0.051	0.50
sec-Butylbenzene	135-98-8	NS	5	0.50	NS	5.00	0.046	0.50
p-Isopropyltoluene	99-87-6	NS	5	0.50	NS	5.00	0.050	0.50

QAPP Worksheet #15-2
Reference Limits and Evaluation Table

Matrix: Groundwater
Analytical Group: VOA
Concentration Level: Trace

Analyte	CAS Number	Project Action Limit (µg/L) Federal Drinking Water MCLs	Project Action Limit (µg/L) NYS Drinking Water MCLs	Project Quantitation Limit[2] (µg/L)	SERAS Method 1806/ EPA/SW846/8000B and 8260B Analytical Method		Achievable Laboratory Limits	
					MDLs (µg/L)	Method QLs (µg/L)	MDLs[1] (µg/L)	QLs (µg/L)
1,3-Dichlorobenzene	541-73-1	NS	5	0.50	NS	5.00	0.047	0.50
1,4-Dichlorobenzene	106-46-7	NS	5	0.50	NS	5.00	0.070	0.50
n-Butylbenzene	104-51-8	NS	5	0.50	NS	5.00	0.065	0.50
1,2-Dichlorobenzene	95-50-1	0.2 [2]	5	0.50	NS	5.00	0.056	0.50
1,2,4-Trichlorobenzene	120-82-1	70	5	0.50	NS	5.00	0.069	0.50
Hexachlorobutadiene	87-68-3	NS	5	0.50	NS	5.00	0.090	0.50
Naphthalene	91-20-3	NS	50	0.50	NS	5.00	0.073	0.50
1,2,3-Trichlorobenzene	87-61-6	NS	5	0.50	NS	5.00	0.075	0.50

NS = Not Specified
[1] Based on LOD Study dated 1/14/11 on system C
[2] Since the benchmark for this compound is a magnitude less than the lowest benchmark, concentrations between the MDL and the RL will be flagged "J" – estimated.

QAPP Worksheet #15-3
Reference Limits and Evaluation Table

Matrix: Groundwater collected by SP-16 methodology for screening only.
Analytical Group: VOA
Concentration Level: Trace

Analyte	CAS Number	Project Action Limit (µg/L) For Screening Only	Project Quantitation Limit[2] (µg/L)	SERAS Method 1806/ EPA/SW846/8000B and 8260B Analytical Method		Achievable Laboratory Limits	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs[1] (µg/L)	QLs (µg/L)
Dichlorodifluoromethane	75-71-8	NS	0.50	NS	5.00	0.412	0.50
Chloromethane	74-87-3	NS	1.00	NS	5.00	0.546	1.00
Vinyl chloride	75-01-4	NS	0.50	NS	5.00	0.453	0.50
Bromomethane	74-83-9	NS	1.00	NS	5.00	0.660	1.00
Chloroethane	75-00-3	NS	0.50	NS	5.00	0.492	0.50
Trichlorofluoromethane	75-69-4	NS	1.00	NS	5.00	0.504	1.00
1,1-Dichloroethene	75-35-4	NS	0.50	NS	5.00	0.066	0.50
Methylene chloride	75-09-2	NS	0.50	NS	5.00	0.077	0.50
Carbon disulfide	75-15-0	NS	0.50	NS	5.00	0.079	0.50
Methyl tert-butyl ether	1634-04-4	NS	0.50	NS	5.00	0.038	0.50
trans-1,2-Dichloroethene	156-60-5	NS	0.50	NS	5.00	0.040	0.50
1,1-Dichloroethane	75-34-3	NS	0.50	NS	5.00	0.065	0.50
2,2-Dichloropropane	594-20-7	NS	0.50	NS	5.00	0.151	0.50
cis-1,2-Dichloroethene	156-59-2	NS	0.50	NS	5.00	0.042	0.50
Chloroform	67-66-3	NS	0.50	NS	5.00	0.062	0.50
1,1-Dichloropropene	563-58-6	NS	0.50	NS	5.00	0.076	0.50
1,2-Dichloroethane	107-06-2	NS	0.50	NS	5.00	0.087	0.50
1,1,1-Trichloroethane	71-55-6	NS	0.50	NS	5.00	0.078	0.50
Carbon tetrachloride	56-23-5	NS	0.50	NS	5.00	0.077	0.50
Benzene	71-43-2	NS	0.50	NS	5.00	0.062	0.50
Trichloroethene	79-01-6	NS	0.50	NS	5.00	0.073	0.50
1,2-Dichloropropane	78-87-5	NS	0.50	NS	5.00	0.062	0.50
Bromodichloromethane	75-27-4	NS	0.50	NS	5.00	0.054	0.50
Dibromomethane	74-95-3	NS	0.50	NS	5.00	0.057	0.50
cis-1,3-Dichloropropene	10061-01-5	NS	0.50	NS	5.00	0.067	0.50
trans-1,3-Dichloropropene	10061-02-6	NS	0.50	NS	5.00	0.107	0.50

QAPP Worksheet #15-3
Reference Limits and Evaluation Table

Matrix: Groundwater collected by SP-16 methodology for screening only.
Analytical Group: VOA
Concentration Level: Trace

Analyte	CAS Number	Project Action Limit (µg/L) For Screening Only	Project Quantitation Limit[2] (µg/L)	SERAS Method 1806/ EPA/SW846/8000B and 8260B Analytical Method		Achievable Laboratory Limits	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs[1] (µg/L)	QLs (µg/L)
1,1,2-Trichloroethane	79-00-5	NS	0.50	NS	5.00	0.097	0.50
1,3-Dichloropropane	142-28-9	NS	0.50	NS	5.00	0.057	0.50
Dibromochloromethane	124-48-1	NS	0.50	NS	5.00	0.065	0.50
1,2-Dibromoethane	106-93-4	NS	0.50	NS	5.00	0.083	0.50
Bromoform	75-25-2	NS	0.50	NS	5.00	0.081	0.50
Toluene	108-88-3	NS	0.50	NS	5.00	0.072	0.50
Tetrachloroethene	127-18-4	NS	0.50	NS	5.00	0.060	0.50
Chlorobenzene	108-90-7	NS	0.50	NS	5.00	0.057	0.50
1,1,1,2-Tetrachloroethane	630-20-6	NS	0.50	NS	5.00	0.071	0.50
Ethylbenzene	100-41-4	NS	0.50	NS	5.00	0.049	0.50
m,p-Xylene	108-38-3/ 106-42-3	NS	1.00	NS	10.0	0.108	1.00
o-Xylene	95-47-6	NS	0.50	NS	5.00	0.031	0.50
Styrene	100-42-5	NS	0.50	NS	5.00	0.050	0.50
Isopropylbenzene	98-82-8	NS	0.50	NS	5.00	0.056	0.50
1,1,2,2-Tetrachloroethane	79-34-5	NS	0.50	NS	5.00	0.072	0.50
1,2,3-Trichlorpropane	96-18-4	NS	0.50	NS	5.00	0.130	0.50
n-Propylbenzene	103-65-1	NS	0.50	NS	5.00	0.057	0.50
Bromobenzene	108-86-1	NS	0.50	NS	5.00	0.042	0.50
1,3,5-Trimethylbenzene	108-67-8	NS	0.50	NS	5.00	0.048	0.50
2-Chlorotoluene	95-49-8	NS	0.50	NS	5.00	0.081	0.50
4-Chlorotoluene	106-43-4	NS	0.50	NS	5.00	0.111	0.50
tert-Butylbenzene	98-06-6	NS	0.50	NS	5.00	0.048	0.50
1,2,4-Trimethylbenzene	95-63-6	NS	0.50	NS	5.00	0.051	0.50
sec-Butylbenzene	135-98-8	NS	0.50	NS	5.00	0.046	0.50
p-Isopropyltoluene	99-87-6	NS	0.50	NS	5.00	0.050	0.50

QAPP Worksheet #15-3
Reference Limits and Evaluation Table

Matrix: Groundwater collected by SP-16 methodology for screening only.
Analytical Group: VOA
Concentration Level: Trace

Analyte	CAS Number	Project Action Limit (µg/L) For Screening Only	Project Quantitation Limit[2] (µg/L)	SERAS Method 1806/ EPA/SW846/8000B and 8260B Analytical Method		Achievable Laboratory Limits	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs[1] (µg/L)	QLs (µg/L)
1,3-Dichlorobenzene	541-73-1	NS	0.50	NS	5.00	0.047	0.50
1,4-Dichlorobenzene	106-46-7	NS	0.50	NS	5.00	0.070	0.50
n-Butylbenzene	104-51-8	NS	0.50	NS	5.00	0.065	0.50
1,2-Dichlorobenzene	95-50-1	NS	0.50	NS	5.00	0.056	0.50
1,2,4-Trichlorobenzene	120-82-1	NS	0.50	NS	5.00	0.069	0.50
Hexachlorobutadiene	87-68-3	NS	0.50	NS	5.00	0.090	0.50
Naphthalene	91-20-3	NS	0.50	NS	5.00	0.073	0.50
1,2,3-Trichlorobenzene	87-61-6	NS	0.50	NS	5.00	0.075	0.50

NS = Not Specified
[1] Based on LOD Study dated 1/14/11 on system C

QAPP Worksheet #15-4
Reference Limits and Evaluation Table

Matrix: Water
Analytical Group: Pesticides/PCBs
Concentration Level: Low

Analyte	CAS Number	Project Action Limit [1] (µg/L) NYS Drinking Water MCLs[1]	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Methods 8081A & 8082 SERAS SOP #1801/1808		Achievable Laboratory Limits	
				MDLs(µg/L)	Method QLs(µg/L)	MDLs[2] (µg/L)	QLs (µg/L)
Aroclor 1016	12674-11-2	0.5	0.250	NS	0.250	0.0533	0.250
Aroclor 1221	11104-28-2	0.5	0.500	NS	0.500	NA	0.500
Aroclor 1232	11141-16-5	0.5	0.250	NS	0.250	NA	0.250
Aroclor 1242	53469-21-9	0.5	0.250	NS	0.250	NA	0.250
Aroclor 1248	12672-29-6	0.5	0.250	NS	0.250	NA	0.250
Aroclor 1254	11097-69-1	0.5	0.250	NS	0.250	NA	0.250
Aroclor 1260	11096-82-5	0.5	0.250	NS	0.250	NA	0.250
Aroclor 1268	11100-14-4	0.5	0.250	NS	0.250	0.0781	0.250
Toxaphene	8001-35-2	3	0.500	NS	0.500	0.142	0.500
a-BHC	319-84-6	NS	0.0200	NS	0.0200	0.00401	0.0200
g-BHC	58-89-9	NS	0.0200	NS	0.0200	0.00590	0.0200
b-BHC	319-85-7	NS	0.0200	NS	0.0200	0.00547	0.0200
d-BHC	319-86-8	NS	0.0200	NS	0.0200	0.00250	0.0200
Heptachlor	76-44-8	0.4	0.0200	NS	0.0200	0.00455	0.0200
Aldrin	309-00-2	NS	0.0200	NS	0.0200	0.00433	0.0200
Heptachlor epoxide	1024-57-3	0.2	0.0200	NS	0.0200	0.00571	0.0200
g-Chlordane	5103-74-2	2	0.0200	NS	0.0200	0.00683	0.0200
a-Chlordane	5104-71-9	2	0.0200	NS	0.0200	0.00731	0.0200
Endosulfan I	959-98-8	NS	0.0200	NS	0.0200	0.00485	0.0200
p,p'-DDE	72-55-9	NS	0.0200	NS	0.0200	0.00622	0.0200
Dieldrin	60-57-1	NS	0.0200	NS	0.0200	0.00601	0.0200
Endrin	72-20-8	2	0.0200	NS	0.0200	0.00600	0.0200
p,p'-DDD	72-54-8	NS	0.0200	NS	0.0200	0.00685	0.0200
Endosulfan II	33213-65-9	NS	0.0200	NS	0.0200	0.00504	0.0200
Endrin aldehyde	7421-93-4	2	0.0200	NS	0.0200	0.0166	0.0200
p,p'-DDT	50-29-3	NS	0.0200	NS	0.0200	0.00487	0.0200

QAPP Worksheet #15-4
Reference Limits and Evaluation Table

Matrix: Water
Analytical Group: Pesticides/PCBs
Concentration Level: Low

Analyte	CAS Number	Project Action Limit [1] (µg/L) NYS Drinking Water MCLs[1]	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Methods 8081A & 8082 SERAS SOP #1801/1808		Achievable Laboratory Limits	
				MDLs(µg/L)	Method QLs(µg/L)	MDLs[2] (µg/L)	QLs (µg/L)
Endosulfan sulfate	1031-07-8	NS	0.0200	NS	0.0200	0.00411	0.0200
Methoxychlor	72-43-5	40	0.0200	NS	0.0200	0.00705	0.0200
Endrin ketone	53494-70-5	2	0.0200	NS	0.0200	0.00857	0.0200

NA = Not Available
NS = Not Specified
1. Maximum Contaminant Levels as detailed in New York State Regulations Part 5, Subpart 5-1 Public Water Systems, Table 3.
2. From LOD Study on ECD4, column XLB, 01/10/11

QAPP Worksheet #15-5
Reference Limits and Evaluation Table

Matrix: Water – Collected using SP-16 methodology for screening only.
Analytical Group: Pesticides/PCBs
Concentration Level: Low

Analyte	CAS Number	Project Action Limit [1] (µg/L)	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Methods 8081A & 8082 SERAS SOP #1801/1808		Achievable Laboratory Limits	
		Screening Only		MDLs(µg/L)	Method QLs(µg/L)	MDLs[2] (µg/L)	QLs (µg/L)
Aroclor 1016	12674-11-2	NS	0.250	NS	0.250	0.0533	0.250
Aroclor 1221	11104-28-2	NS	0.500	NS	0.500	NA	0.500
Aroclor 1232	11141-16-5	NS	0.250	NS	0.250	NA	0.250
Aroclor 1242	53469-21-9	NS	0.250	NS	0.250	NA	0.250
Aroclor 1248	12672-29-6	NS	0.250	NS	0.250	NA	0.250
Aroclor 1254	11097-69-1	NS	0.250	NS	0.250	NA	0.250
Aroclor 1260	11096-82-5	NS	0.250	NS	0.250	NA	0.250
Aroclor 1268	11100-14-4	NS	0.250	NS	0.250	0.0781	0.250
Toxaphene	8001-35-2	NS	0.500	NS	0.500	0.142	0.500
a-BHC	319-84-6	NS	0.0200	NS	0.0200	0.00401	0.0200
g-BHC	58-89-9	NS	0.0200	NS	0.0200	0.00590	0.0200
b-BHC	319-85-7	NS	0.0200	NS	0.0200	0.00547	0.0200
d-BHC	319-86-8	NS	0.0200	NS	0.0200	0.00250	0.0200
Heptachlor	76-44-8	NS	0.0200	NS	0.0200	0.00455	0.0200
Aldrin	309-00-2	NS	0.0200	NS	0.0200	0.00433	0.0200
Heptachlor epoxide	1024-57-3	NS	0.0200	NS	0.0200	0.00571	0.0200
g-Chlordane	5103-74-2	NS	0.0200	NS	0.0200	0.00683	0.0200
a-Chlordane	5104-71-9	NS	0.0200	NS	0.0200	0.00731	0.0200
Endosulfan I	959-98-8	NS	0.0200	NS	0.0200	0.00485	0.0200
p,p'-DDE	72-55-9	NS	0.0200	NS	0.0200	0.00622	0.0200
Dieldrin	60-57-1	NS	0.0200	NS	0.0200	0.00601	0.0200
Endrin	72-20-8	NS	0.0200	NS	0.0200	0.00600	0.0200
p,p'-DDD	72-54-8	NS	0.0200	NS	0.0200	0.00685	0.0200
Endosulfan II	33213-65-9	NS	0.0200	NS	0.0200	0.00504	0.0200
Endrin aldehyde	7421-93-4	NS	0.0200	NS	0.0200	0.0166	0.0200
p,p'-DDT	50-29-3	NS	0.0200	NS	0.0200	0.00487	0.0200

QAPP Worksheet #15-5
Reference Limits and Evaluation Table

Matrix: Water – Collected using SP-16 methodology for screening only.
Analytical Group: Pesticides/PCBs
Concentration Level: Low

Analyte	CAS Number	Project Action Limit [1] (µg/L) Screening Only	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Methods 8081A & 8082 SERAS SOP #1801/1808		Achievable Laboratory Limits	
				MDLs(µg/L)	Method QLs(µg/L)	MDLs[2] (µg/L)	QLs (µg/L)
Endosulfan sulfate	1031-07-8	NS	0.0200	NS	0.0200	0.00411	0.0200
Methoxychlor	72-43-5	NS	0.0200	NS	0.0200	0.00705	0.0200
Endrin ketone	53494-70-5	NS	0.0200	NS	0.0200	0.00857	0.0200

NA = Not Available
NS = Not Specified
1. Maximum Contaminant Levels as detailed in New York State Regulations Part 5, Subpart 5-1 Public Water Systems, Table 3.
2. From LOD study on ECD4, column XLB, 01/10/11

QAPP Worksheet #15-6
Reference Limits and Evaluation Table

Matrix: Water
Analytical Group: SVOC
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Federal MCLs	Project Action Limit (µg/L) NYS Drinking Water MCLs[1]	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Method 8270C SERAS SOP #1804		Achievable Laboratory Limits	
					MDLs	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
Phenol	108-95-2	NS	50	10	NA	10	1.65	10
bis(-2-Chloroethyl)Ether	111-44-4	NS	50	10	NA	10	2.34	10
2-Chlorophenol	95-57-8	NS	50	10	NA	10	2.08	10
1,3-Dichlorobenzene	541-73-1	NS	5[4]	10	NA	10	1.47	10
1,4-Dichlorobenzene	106-46-7	NS	5[4]	10	NA	10	1.44	10
Benzyl alcohol	100-51-6	NS	50	10	NA	10	1.95	10
1,2-Dichlorobenzene	95-50-1	NS	5[4]	10	NA	10	1.59	10
2-Methylphenol	95-48-7	NS	50	10	NA	10	1.67	10
bis(2-Chloroisopropyl)ether	39638-32-9	NS	50	10	NA	10	2.57	10
4-Methylphenol	106-44-5	NS	50	10	NA	10	1.73	10
N-Nitroso-Di-n-propylamine	621-64-7	NS	50	10	NA	10	3.01	10
Hexachloroethane	67-72-1	NS	50	10	NA	10	1.87	10
Nitrobenzene	98-95-3	NS	50	10	NA	10	2.37	10
Isophorone	78-59-1	NS	50	10	NA	10	2.34	10
2-Nitrophenol	88-75-5	NS	50	10	NA	10	2.37	10
2,4-Dimethylphenol	105-67-9	NS	50	10	NA	10	3.33	10
bis(2-Chloroethoxy)methane	111-91-1	NS	50	10	NA	10	2.55	10
2,4-Dichlorophenol	120-83-2	NS	50	10	NA	10	2.01	10
1,2,4-Trichlorobenzene	120-82-1	70	5[4]	10	NA	10	1.80	10
Naphthalene	91-20-3	NS	50	10	NA	10	2.04	10
4-Chloroaniline	106-47-8	NS	50	10	NA	10	1.57	10
Hexachlorobutadiene	87-68-3	NS	5[4]	10	NA	10	1.86	10
4-Chloro-3-methylphenol	59-50-7	NS	50	10	NA	10	2.07	10
2-Methylnaphthalene	91-57-6	NS	50	10	NA	10	1.97	10

QAPP Worksheet #15-6
Reference Limits and Evaluation Table

Matrix: Water
Analytical Group: SVOC
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Federal MCLs	Project Action Limit (µg/L) NYS Drinking Water MCLs[1]	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Method 8270C SERAS SOP #1804		Achievable Laboratory Limits	
					MDLs	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
Hexachlorocyclopentadiene	77-47-4	50	50	10	NA	10	1.60	10
2,4,6-Trichlorophenol	88-06-2	NS	50	10	NA	10	1.86	10
2,4,5-Trichlorophenol	95-95-4	NS	50	10	NA	10	1.97	10
2-Chloronaphthalene	91-58-7	NS	50	10	NA	10	1.93	10
2-Nitroaniline	88-74-4	NS	50	10	NA	10	1.82	10
Dimethylphthalate	131-11-3	NS	50	10	NA	10	1.72	10
Acenaphthylene	208-96-8	NS	50	10	NA	10	1.91	10
2,6-Dinitrotoluene	606-20-2	NS	50	10	NA	10	1.94	10
3-Nitroaniline	99-09-2	NS	50	10	NA	10	1.57	10
Acenaphthene	88-32-9	NS	50	10	NA	10	1.93	10
2,4-Dinitrophenol	51-28-5	NS	50	10	NA	10	8.39	10
4-Nitrophenol	10-02-7	NS	50	10	NA	10	1.64	10
Dibenzofuran	132-64-7	NS	50	10	NA	10	1.76	10
2,4-Dinitrotoluene	121-14-2	NS	50	10	NA	10	2.44	10
Diethylphthalate	84-66-2	NS	50	10	NA	10	1.57	10
4-Chlorophenyl-phenylether	7005-72-3	NS	50	10	NA	10	1.66	10
Fluorene	86-73-7	NS	50	10	NA	10	1.78	10
4-Nitroaniline	100-01-6	NS	50	10	NA	10	1.92	10
4,6-Dinitro-2-methylphenol	534-30-6	NS	50	10	NA	10	4.60	10
N-Nitrosodiphenylamine	88-30-6	NS	50	10	NA	10	1.80	10
4-Bromophenyl-phenylether	101-55-3	NS	50	10	NA	10	1.36	10
Hexachlorobenzene	118-74-1	1[3]	1[3]	10	NA	10	1.60	10
Pentachlorophenol	87-86-5	1[3]	1[3]	10	NA	10	3.41	10
Phenanthrene	85-01-8	NS	50	10	NA	10	1.61	10

QAPP Worksheet #15-6
Reference Limits and Evaluation Table

Matrix: Water
Analytical Group: SVOC
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Federal MCLs	Project Action Limit (µg/L) NYS Drinking Water MCLs[1]	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Method 8270C SERAS SOP #1804		Achievable Laboratory Limits	
					MDLs	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
Anthracene	120-12-7	NS	50	10	NA	10	1.57	10
Carbazole	86-74-8	NS	50	10	NA	10	2.02	10
Di-n-butylphthalate	84-74-2	NS	50	10	NA	10	1.69	10
Fluoranthene	206-44-0	NS	50	10	NA	10	1.74	10
Pyrene	129-00-0	NS	50	10	NA	10	1.99	10
Butylbenzylphthalate	85-68-7	NS	50	10	NA	10	1.43	10
Benzo(a)anthracene	55-55-3	NS	50	10	NA	10	1.55	10
3,3'-Dichlorobenzidine	91-94-1	NS	50	10	NA	10	2.60	10
Chrysene	218-01-9	NS	50	10	NA	10	1.44	10
Bis(2-Ethylhexyl)phthalate	117-81-7	NS	50	10	NA	10	1.10	10
Di-n-octylphthalate	117-84-0	NS	50	10	NA	10	1.35	10
Benzo(b)fluoranthene	205-99-2	NS	50	10	NA	10	2.32	10
Benzo(k)fluoranthene	207-08-9	NS	50	10	NA	10	2.26	10
Benzo(a)pyrene	50-32-8	0.2[3]	0.2[3]	10	NA	10	1.90	10
Indeno(1,2,3-cd)pyrene	465-73-6	NS	NS	10	NA	10	1.30	10
Dibenzo(a,h)anthracene	53-70-3	NS	NS	10	NA	10	1.65	10
Benzo(g,h,i)perylene	191-24-2	NS	NS	10	NA	10	1.45	10

1. Referenced for NYS DW MCLs
2. From MDL study 1/20/11 on instrument Smyrna II
3. Since the benchmark is < both the MDL and the RL, any concentration found in the samples between the MDL and the RL will be flagged "J" – estimated.
4. Since the benchmark is < the RL but > the MDL, any concentration found in the samples between the MDL and the RL will be flagged "J" – estimated.

NS = Not Specified
NA = Not Available

QAPP Worksheet #15-7
Reference Limits and Evaluation Table

Matrix: Water – Collected by SP-16 methodology for screening only
Analytical Group: SVOC
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Screening Only	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Method 8270C SERAS SOP #1804		Achievable Laboratory Limits	
				MDLs	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
Phenol	108-95-2	NS	10	NA	10	1.65	10
bis(-2-Chloroethyl)Ether	111-44-4	NS	10	NA	10	2.34	10
2-Chlorophenol	95-57-8	NS	10	NA	10	2.08	10
1,3-Dichlorobenzene	541-73-1	NS	10	NA	10	1.47	10
1,4-Dichlorobenzene	106-46-7	NS	10	NA	10	1.44	10
Benzyl alcohol	100-51-6	NS	10	NA	10	1.95	10
1,2-Dichlorobenzene	95-50-1	NS	10	NA	10	1.59	10
2-Methylphenol	95-48-7	NS	10	NA	10	1.67	10
bis(2-Chloroisopropyl)ether	39638-32-9	NS	10	NA	10	2.57	10
4-Methylphenol	106-44-5	NS	10	NA	10	1.73	10
N-Nitroso-Di-n-propylamine	621-64-7	NS	10	NA	10	3.01	10
Hexachloroethane	67-72-1	NS	10	NA	10	1.87	10
Nitrobenzene	98-95-3	NS	10	NA	10	2.37	10
Isophorone	78-59-1	NS	10	NA	10	2.34	10
2-Nitrophenol	88-75-5	NS	10	NA	10	2.37	10
2,4-Dimethylphenol	105-67-9	NS	10	NA	10	3.33	10
bis(2-Chloroethoxy)methane	111-91-1	NS	10	NA	10	2.55	10
2,4-Dichlorophenol	120-83-2	NS	10	NA	10	2.01	10
1,2,4-Trichlorobenzene	120-82-1	NS	10	NA	10	1.80	10
Naphthalene	91-20-3	NS	10	NA	10	2.04	10
4-Chloroaniline	106-47-8	NS	10	NA	10	1.57	10
Hexachlorobutadiene	87-68-3	NS	10	NA	10	1.86	10
4-Chloro-3-methylphenol	59-50-7	NS	10	NA	10	2.07	10
2-Methylnaphthalene	91-57-6	NS	10	NA	10	1.97	10
Hexachlorocyclopentadiene	77-47-4	NS	10	NA	10	1.60	10

QAPP Worksheet #15-7
Reference Limits and Evaluation Table

Matrix: Water – Collected by SP-16 methodology for screening only
Analytical Group: SVOC
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Screening Only	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Method 8270C SERAS SOP #1804		Achievable Laboratory Limits	
				MDLs	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
2,4,6-Trichlorophenol	88-06-2	NS	10	NA	10	1.86	10
2,4,5-Trichlorophenol	95-95-4	NS	10	NA	10	1.97	10
2-Chloronaphthalene	91-58-7	NS	10	NA	10	1.93	10
2-Nitroaniline	88-74-4	NS	10	NA	10	1.82	10
Dimethylphthalate	131-11-3	NS	10	NA	10	1.72	10
Acenaphthylene	208-96-8	NS	10	NA	10	1.91	10
2,6-Dinitrotoluene	606-20-2	NS	10	NA	10	1.94	10
3-Nitroaniline	99-09-2	NS	10	NA	10	1.57	10
Acenaphthene	88-32-9	NS	10	NA	10	1.93	10
2,4-Dinitrophenol	51-28-5	NS	10	NA	10	8.39	10
4-Nitrophenol	10-02-7	NS	10	NA	10	1.64	10
Dibenzofuran	132-64-7	NS	10	NA	10	1.76	10
2,4-Dinitrotoluene	121-14-2	NS	10	NA	10	2.44	10
Diethylphthalate	84-66-2	NS	10	NA	10	1.57	10
4-Chlorophenyl-phenylether	7005-72-3	NS	10	NA	10	1.66	10
Fluorene	86-73-7	NS	10	NA	10	1.78	10
4-Nitroaniline	100-01-6	NS	10	NA	10	1.92	10
4,6-Dinitro-2-methylphenol	534-30-6	NS	10	NA	10	4.60	10
N-Nitrosodiphenylamine	88-30-6	NS	10	NA	10	1.80	10
4-Bromophenyl-phenylether	101-55-3	NS	10	NA	10	1.36	10
Hexachlorobenzene	118-74-1	NS	10	NA	10	1.60	10
Pentachlorophenol	87-86-5	NS	10	NA	10	3.41	10
Phenanthrene	85-01-8	NS	10	NA	10	1.61	10
Anthracene	120-12-7	NS	10	NA	10	1.57	10
Carbazole	86-74-8	NS	10	NA	10	2.02	10

QAPP Worksheet #15-7
Reference Limits and Evaluation Table

Matrix: Water – Collected by SP-16 methodology for screening only
Analytical Group: SVOC
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Screening Only	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Method 8270C SERAS SOP #1804		Achievable Laboratory Limits	
				MDLs	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
Di-n-butylphthalate	84-74-2	NS	10	NA	10	1.69	10
Fluoranthene	206-44-0	NS	10	NA	10	1.74	10
Pyrene	129-00-0	NS	10	NA	10	1.99	10
Butylbenzylphthalate	85-68-7	NS	10	NA	10	1.43	10
Benzo(a)anthracene	55-55-3	NS	10	NA	10	1.55	10
3,3'-Dichlorobenzidine	91-94-1	NS	10	NA	10	2.60	10
Chrysene	218-01-9	NS	10	NA	10	1.44	10
Bis(2-Ethylhexyl)phthalate	117-81-7	NS	10	NA	10	1.10	10
Di-n-octylphthalate	117-84-0	NS	10	NA	10	1.35	10
Benzo(b)fluoranthene	205-99-2	NS	10	NA	10	2.32	10
Benzo(k)fluoranthene	207-08-9	NS	10	NA	10	2.26	10
Benzo(a)pyrene	50-32-8	0.2	10	NA	10	1.90	10
Indeno(1,2,3-cd)pyrene	465-73-6	NS	10	NA	10	1.30	10
Dibenzo(a,h)anthracene	53-70-3	NS	10	NA	10	1.65	10
Benzo(g,h,i)perylene	191-24-2	NS	10	NA	10	1.45	10

From MDL study 1/20/11 on instrument Smyrna II
NS = Not Specified
NA = Not Available

QAPP Worksheet #15-8
Reference Limits and Evaluation Table

Matrix: Groundwater
Analytical Group: ICP Metals
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Federal MCLs	Project Action Limit [1] (µg/L) NYS Drinking Water MCLs	Project Quantitation Limit (µg/L)	Analytical Method SERAS SOP 1811, Rev. 4.0		Achievable Laboratory Limits (µg/L) [a]	
					MDLs (µg/L)	Method QLs (µg/L)	MDLs[2] (µg/L)	QLs (µg/L)
Aluminum	7429-90-5	NS	NS	90	NS	100	22.4	90
Antimony	7440-36-0	6 [3]	6 [3]	10	NS	10	1.91	10
Arsenic	7440-38-2	10 [3]	10 [3]	19	NS	20	2.45	19
Barium	7440-39-3	2,000	2,000	3	NS	2	0.31	3
Beryllium	7440-41-7	4	4	2	NS	2	0.18	2
Boron	7440-42-8	NS	NS	10	NS	10	0.65	10
Cadmium	7440-43-9	5	5	2	NS	2	0.1	2
Calcium	7440-70-2	NS	NS	100	NS	60	44.3	100
Chromium	7440-47-3	100	100	3	NS	3	0.48	3
Cobalt	7440-48-4	NS	NS	2	NS	2	0.16	2
Copper	7440-50-8	1,300	NS	8	NS	5	0.48	8
Iron (2599)	7439-89-6	NS	300	40	NS	35	9.03	40
Iron (2714)	7439-89-6	NS	300	300	NS	300	48.0	300
Lead	7439-92-1	15	NS	10	NS	10	1.76	10
Magnesium	7439-95-4	NS	NS	200	NS	160	15.6	200
Manganese	7439-96-5	NS	300	2	NS	2	0.11	2
Mercury	7439-97-6	2	2	0.200	NS	0.200	NA	0.200
Molybdenum	7439-98-7	NS	NS	5	NS	5	0.39	5
Nickel	7440-02-0	NS	NS	3	NS	3	0.64	3
Potassium	7440-09-7	NS	NS	250	NS	250	52.1	250
Selenium	7782-49-2	50	50	18	NS	15	4.43	18
Silver	7440-22-4	NS	100	8	NS	5	0.84	8
Sodium	7440-23-5	NS	NS	200	NS	200	10.4	200
Strontium	7440-24-6	NS	NS	2	NS	2	0.15	2
Thallium	7440-28-0	2 [3]	2 [3]	17	NS	17	1.26	17
Tin	7440-31-5	NS	NS	10	NS	10	0.76	10

QAPP Worksheet #15-8
Reference Limits and Evaluation Table

Matrix: Groundwater
Analytical Group: ICP Metals
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Federal MCLs	Project Action Limit [1] (µg/L) NYS Drinking Water MCLs	Project Quantitation Limit (µg/L)	Analytical Method SERAS SOP 1811, Rev. 4.0		Achievable Laboratory Limits (µg/L) [a]	
					MDLs (µg/L)	Method QLs (µg/L)	MDLs[2] (µg/L)	QLs (µg/L)
Vanadium	7440-62-2	NS	NS	3	NS	2	0.75	3
Zinc	7440-66-6	NS	5,000	22	NS	20	5.05	22

[a] Achievable Laboratory Limits based on digestion of 45 mL sample to 50 mL final volume.
NS = Not Specified
NA = Not Applicable
[1] Maximum Contaminant Levels as detailed in New York State Regulations Part 5, Subpart 5-1 Public Water Systems, Table 3.
[2] Based on LOD Study dated 12/16/10 for the iCAP 6500 using hot block digestion
[3] QLs exceed the benchmarks. For the first round of sampling, the QLs will be reported even though they exceed the benchmarks.

QAPP Worksheet #15-9
Reference Limits and Evaluation Table

Matrix: Groundwater – Collected using SP-16 Methodology for screening only.
Analytical Group: ICP Metals
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Screening Only	Project Quantitation Limit (µg/L)	Analytical Method SERAS SOP 1811, Rev. 4.0		Achievable Laboratory Limits (µg/L) [a]	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs[1] (µg/L)	QLs (µg/L)
Aluminum	7429-90-5	NS	90	NS	100	22.4	90
Antimony	7440-36-0	NS	10	NS	10	1.91	10
Arsenic	7440-38-2	NS	19	NS	20	2.45	19
Barium	7440-39-3	NS	3	NS	2	0.31	3
Beryllium	7440-41-7	NS	2	NS	2	0.18	2
Boron	7440-42-8	NS	10	NS	10	0.65	10
Cadmium	7440-43-9	NS	2	NS	2	0.1	2
Calcium	7440-70-2	NS	100	NS	60	44.3	100
Chromium	7440-47-3	NS	3	NS	3	0.48	3
Cobalt	7440-48-4	NS	2	NS	2	0.16	2
Copper	7440-50-8	NS	8	NS	5	0.48	8
Iron (2599)	7439-89-6	NS	40	NS	35	9.03	40
Iron (2714)	7439-89-6	NS	300	NS	300	48.0	300
Lead	7439-92-1	NS	10	NS	10	1.76	10
Magnesium	7439-95-4	NS	200	NS	160	15.6	200
Manganese	7439-96-5	NS	2	NS	2	0.11	2
Mercury		NS	0.200	NS	0.200	NA	0.200
Molybdenum	7439-98-7	NS	5	NS	5	0.39	5
Nickel	7440-02-0	NS	3	NS	3	0.64	3
Potassium	7440-09-7	NS	250	NS	250	52.1	250
Selenium	7782-49-2	NS	18	NS	15	4.43	18
Silver	7440-22-4	NS	8	NS	5	0.84	8
Sodium	7440-23-5	NS	200	NS	200	10.4	200
Strontium	7440-24-6	NS	2	NS	2	0.15	2
Thallium	7440-28-0	NS	17	NS	17	1.26	17

QAPP Worksheet #15-9
Reference Limits and Evaluation Table

Matrix: Groundwater – Collected using SP-16 Methodology for screening only.
Analytical Group: ICP Metals
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Screening Only	Project Quantitation Limit (µg/L)	Analytical Method SERAS SOP 1811, Rev. 4.0		Achievable Laboratory Limits (µg/L) [a]	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs[1] (µg/L)	QLs (µg/L)
Tin	7440-31-5	NS	10	NS	10	0.76	10
Vanadium	7440-62-2	NS	3	NS	2	0.75	3
Zinc	7440-66-6	NS	22	NS	20	5.05	22

[a] Achievable Laboratory Limits based on digestion of 45 mL sample to 50 mL final volume.
NS = Not Specified
NA = Not Applicable
[1] Based on LOD Study dated 12/16/10 for the iCAP 6500 using hot block digestion

QAPP Worksheet #15-10
Reference Limits and Evaluation Table

Matrix: Air
Analytical Group: VOCs by Photovac GC
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (applicable units) See Note 2	Project Quantitation Limit (ppbv)	Analytical Method		Achievable Laboratory Limits	
				MDL	Method QL	MDL[1] (ppbv)	QL (ppbv)
cis-1,2-Dichloroethene	156-59-2	10	10	NA	NA	2.71	10
Trichloroethene	79-01-6	10	10	NA	NA	3.73	10
Tetrachloroethene	127-18-4	10	10	NA	NA	3.53	10

[1] Based on LOD/LOQ Study conducted on 5/20/11 on the Voyager GC using the probe
[2] Project Action limit is based on presence/absence of contaminants of concern in vapor stream, and is therefore equal to the quantitation limit.

QAPP Worksheet 15-11
Reference Limits and Evaluation Table

Matrix: Soil Gas (SUMMA® Canister)

Analytical Group: VOA

Concentration Level: Low Level Scan

Analyte	CAS Number	Project Action Limit [1] (ppbv)	Project Quantitation Limit (ppbv)	SERAS SOP 1814 Analytical Method		Achievable Laboratory Limits	
				MDLs[2]	Method QLs	MDL s[3]	QLs
Trichloroethene	79-01-6	13.9	0.070	NS	0.030 ppbv	0.0070 ppbv	0.030 ppbv
Tetrachloroethene	127-18-4	3.7	0.070	NS	0.030 ppbv	0.0048 ppbv	0.030 ppbv
1,1-Dichloroethene	75-35-4	NS	0.070	NS	0.030 ppbv	0.0082 ppbv	0.030 ppbv
1,1-Dichloroethane	75-34-3	NS	0.070	NS	0.030 ppbv	0.0076 ppbv	0.030 ppbv
1,2-Dichloroethane	107-06-2	NS	0.070	NS	0.030 ppbv	0.0056 ppbv	0.030 ppbv
cis-1,2-Dichloroethene	156-59-2	NS	0.070	NS	0.030 ppbv	0.0084 ppbv	0.030 ppbv
trans-1,2-Dichloroethene	156-60-5	NS	0.070	NS	0.030 ppbv	0.0066 ppbv	0.030 ppbv
Vinyl chloride	75-01-4	NS	0.070	NS	0.030 ppbv	0.0078 ppbv	0.030 ppbv

[1] Based on correspondence between ERT and Region II. NS = not specified.
[2] Not Specified in SOP 1814.
[3] Based on LOD study conducted on Instrument#2 Air Toxics dated 8/19/11
$\mu g/m^3$ = microgram per cubic meter ppbv = parts per billion by volume NL = Not listed in Table 4 of Method TO-15

QAPP Worksheet 15-12 (February 2012 Mobilization)
Reference Limits and Evaluation Table

Matrix: Indoor and Ambient Air (SUMMA® Canister)

Analytical Group: VOA

Concentration Level: Low Level Scan

Analyte	CAS Number	Project Action Limit [1] (ppbv)	Project Quantitation Limit (ppbv)	SERAS SOP 1814 Analytical Method		Achievable Laboratory Limits	
				MDLs[2]	Method QLs	MDL s[3]	QLs
Trichloroethene	79-01-6	1.39	0.070	NS	0.030 ppbv	0.0070 ppbv	0.030 ppbv
Tetrachloroethene	127-18-4	0.37	0.070	NS	0.030 ppbv	0.0048 ppbv	0.030 ppbv
1,1-Dichloroethene	75-35-4	NS	0.070	NS	0.030 ppbv	0.0082 ppbv	0.030 ppbv
1,1-Dichloroethane	75-34-3	NS	0.070	NS	0.030 ppbv	0.0076 ppbv	0.030 ppbv
1,2-Dichloroethane	107-06-2	NS	0.070	NS	0.030 ppbv	0.0056 ppbv	0.030 ppbv
cis-1,2-Dichloroethene	156-59-2	NS	0.070	NS	0.030 ppbv	0.0084 ppbv	0.030 ppbv
trans-1,2-Dichloroethene	156-60-5	NS	0.070	NS	0.030 ppbv	0.0066 ppbv	0.030 ppbv
Vinyl chloride	75-01-4	NS	0.070	NS	0.030 ppbv	0.0078 ppbv	0.030 ppbv

[1] Based on correspondence between ERT and Region II. NS = not specified.
[2] Not Specified in SOP 1814.
[3] Based on LOD study conducted on Instrument#2 Air Toxics dated 8/19/11
$\mu g/m^3$ = microgram per cubic meter ppbv = parts per billion by volume NL = Not listed in Table 4 of Method TO-15

QAPP Worksheet 15-13
Reference Limits and Evaluation Table

Matrix: Soil Gas

Analytical Group: VOA

Concentration Level: Low

Analyte	CAS Number	Project Action Limit * (ppbv)	Project Quantitation Limit (ppbv)	SERAS SOP 1814 Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs (ppbv)	MDLs[1] (ppbv)	QLs (ppbv)
Trichloroethene	79-01-6	3.7	0.070	NS	0.030	0.0070	0.030
Tetrachloroethene	127-18-4	13.9	0.070	NS	0.030	0.0048	0.030
1,1-Dichloroethane	75-34-3	NS	0.070	NS	0.030	0.0076	0.030
1,1-Dichloroethene	75-35-4	NS	0.070	NS	0.030	0.0082	0.030
Cis-1,2-Dichloroethene	156-59-2	NS	0.070	NS	0.030	0.0084	0.030
Trans-1,2-Dichloroethene	156-60-5	NS	0.070	NS	0.030	0.0066	0.030
1,1,1-Trichloroethane	71-55-6	NS	0.070	NS	0.030	0.0068	0.030
Methylene chloride	75-09-2	NS	0.070	NS	0.030	0.0071	0.030
1,2-Dichlorobenzene	95-50-1	NS	0.070	NS	0.030	0.0089	0.030
1,2-Dichloropropane	78-87-5	NS	0.070	NS	0.030	0.0103	0.030
1,3-Dichlorobenzene	541-73-1	NS	0.070	NS	0.030	0.0088	0.030
1,4-Dichlorobenzene	106-46-7	NS	0.070	NS	0.030	0.0127	0.030
cis-1,3-Dichloropropene	10061-01-5	NS	0.070	NS	0.030	0.0091	0.030
Trichlorofluoromethane	75-69-4	NS	0.070	NS	0.030	0.0070	0.030
trans-1,3-Dichloropropene	10061-02-6	NS	0.070	NS	0.030	0.0092	0.030
Propylene	115-07-1	NS	0.070	NS	0.030	0.0240	0.030
Dichlorodifluoromethane	75-71-8	NS	0.070	NS	0.030	0.0143	0.030
Chloromethane	74-87-3	NS	0.070	NS	0.030	0.0096	0.030
Dichlorotetrafluoroethane	76-14-2	NS	0.070	NS	0.030	0.0056	0.030
Vinyl Chloride	75-01-4	NS	0.070	NS	0.030	0.0111	0.030
1,3-Butadiene	106-99-0	NS	0.070	NS	0.030	0.0040	0.030
Bromomethane	74-83-9	NS	0.070	NS	0.030	0.0117	0.030
Chloroethane	75-00-3	NS	0.070	NS	0.030	0.0162	0.030

QAPP Worksheet 15-13
Reference Limits and Evaluation Table

Matrix: Soil Gas

Analytical Group: VOA

Concentration Level: Low

Analyte	CAS Number	Project Action Limit * (ppbv)	Project Quantitation Limit (ppbv)	SERAS SOP 1814 Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs (ppbv)	MDLs[1] (ppbv)	QLs (ppbv)
Acetone	67-64-1	NS	0.070	NS	0.030	0.0179	0.030
Isopropyl Alcohol	78-83-1	NS	0.070	NS	0.030	0.0141	0.030
Trichlorotrifluoroethane	76-13-1	NS	0.070	NS	0.030	0.0053	0.030
MTBE	1634-04-4	NS	0.070	NS	0.030	0.0068	0.030
Vinyl Acetate	108-05-4	NS	0.070	NS	0.030	0.0111	0.030
2-Butanone	78-93-3	NS	0.070	NS	0.030	0.0054	0.030
Ethyl Acetate	141-78-6	NS	0.070	NS	0.030	0.0040	0.030
Hexane	110-54-3	NS	0.070	NS	0.030	0.0119	0.030
Chloroform	67-66-3	NS	0.070	NS	0.030	0.0101	0.030
Tetrahydrofuran	109-99-9	NS	0.070	NS	0.030	0.0108	0.030
Benzene	71-43-2	NS	0.070	NS	0.030	0.0059	0.030
Carbon Tetrachloride	56-23-5	NS	0.070	NS	0.030	0.0035	0.030
Cyclohexane	110-82-7	NS	0.070	NS	0.030	0.0083	0.030
1,4-Dioxane	123-91-1	NS	0.070	NS	0.030	0.0083	0.030
Heptane	142-82-5	NS	0.070	NS	0.030	0.0090	0.030
Methyl Isobutyl Ketone	108-10-1	NS	0.070	NS	0.030	0.0110	0.030
1,1,2-Trichloroethane	79-00-5	NS	0.070	NS	0.030	0.0036	0.030
Toluene	108-88-3	NS	0.070	NS	0.030	0.0041	0.030
2-Hexanone	591-78-6	NS	0.070	NS	0.030	0.0145	0.030
Dibromochloromethane	124-48-1	NS	0.070	NS	0.030	0.083	0.030
1,2-Dibromoethane	106-93-4	NS	0.070	NS	0.030	0.0040	0.030
Chlorobenzene	108-90-7	NS	0.070	NS	0.030	0.0060	0.030
Ethylbenzene	100-41-4	NS	0.070	NS	0.030	0.0058	0.030

QAPP Worksheet 15-13
Reference Limits and Evaluation Table

Matrix: Soil Gas

Analytical Group: VOA

Concentration Level: Low

Analyte	CAS Number	Project Action Limit * (ppbv)	Project Quantitation Limit (ppbv)	SERAS SOP 1814 Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs (ppbv)	MDLs[1] (ppbv)	QLs (ppbv)
m&p-Xylene	108-38-3/ 106-42-3	NS	0.070	NS	0.030	0.0065	0.030
Bromoform(Tribromomethane)	75-25-2	NS	0.070	NS	0.030	0.0080	0.030
Styrene	100-42-5	NS	0.070	NS	0.030	0.0069	0.030
1,1,2,2-Tetrachloroethane	79-34-5	NS	0.070	NS	0.030	0.0080	0.030
o-Xylene	95-47-6	NS	0.070	NS	0.030	0.0051	0.030
Ethyltoluene	622-96-8	NS	0.070	NS	0.030	0.0062	0.030
1,3,5-trimethylbenzene	108-67-8	NS	0.070	NS	0.030	0.0073	0.030
1,2,4-Trimethylbenzene	95-63-6	NS	0.070	NS	0.030	0.0084	0.030

[1] Based on correspondence between ERT and Region II. NS = not specified.
[2] Not Specified in SOP 1814.
[3] Based on LOD study conducted on Instrument#2 Air Toxics dated 8/19/11
$\mu g/m^3$ = microgram per cubic meter ppbv = parts per billion by volume NL = Not listed in Table 4 of Method TO-15

QAPP Worksheet 15-14
Reference Limits and Evaluation Table

Matrix: Indoor and Ambient Air

Analytical Group: VOA

Concentration Level: Low

Analyte	CAS Number	Project Action Limit * (ppbv)	Project Quantitation Limit (ppbv)	SERAS SOP 1814 Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs (ppbv)	MDLs[1] (ppbv)	QLs (ppbv)
Trichloroethene	79-01-6	0.37	0.070	NS	0.030	0.0070	0.030
Tetrachloroethene	127-18-4	1.39	0.070	NS	0.030	0.0048	0.030
1,1-Dichloroethane	75-34-3	NS	0.070	NS	0.030	0.0076	0.030
1,1-Dichloroethene	75-35-4	NS	0.070	NS	0.030	0.0082	0.030
Cis-1,2-Dichloroethene	156-59-2	NS	0.070	NS	0.030	0.0084	0.030
Trans-1,2-Dichloroethene	156-60-5	NS	0.070	NS	0.030	0.0066	0.030
1,1,1-Trichloroethane	71-55-6	NS	0.070	NS	0.030	0.0068	0.030
Methylene chloride	75-09-2	NS	0.070	NS	0.030	0.0071	0.030
1,2-Dichlorobenzene	95-50-1	NS	0.070	NS	0.030	0.0089	0.030
1,2-Dichloropropane	78-87-5	NS	0.070	NS	0.030	0.0103	0.030
1,3-Dichlorobenzene	541-73-1	NS	0.070	NS	0.030	0.0088	0.030
1,4-Dichlorobenzene	106-46-7	NS	0.070	NS	0.030	0.0127	0.030
cis-1,3-Dichloropropene	10061-01-5	NS	0.070	NS	0.030	0.0091	0.030
Trichlorofluoromethane	75-69-4	NS	0.070	NS	0.030	0.0070	0.030
trans-1,3-Dichloropropene	10061-02-6	NS	0.070	NS	0.030	0.0092	0.030
Propylene	115-07-1	NS	0.070	NS	0.030	0.0240	0.030
Dichlorodifluoromethane	75-71-8	NS	0.070	NS	0.030	0.0143	0.030
Chloromethane	74-87-3	NS	0.070	NS	0.030	0.0096	0.030
Dichlorotetrafluoroethane	76-14-2	NS	0.070	NS	0.030	0.0056	0.030
Vinyl Chloride	75-01-4	NS	0.070	NS	0.030	0.0111	0.030
1,3-Butadiene	106-99-0	NS	0.070	NS	0.030	0.0040	0.030
Bromomethane	74-83-9	NS	0.070	NS	0.030	0.0117	0.030

QAPP Worksheet 15-14
Reference Limits and Evaluation Table

Matrix: Indoor and Ambient Air

Analytical Group: VOA

Concentration Level: Low

Analyte	CAS Number	Project Action Limit * (ppbv)	Project Quantitation Limit (ppbv)	SERAS SOP 1814 Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs (ppbv)	MDLs[1] (ppbv)	QLs (ppbv)
Chloroethane	75-00-3	NS	0.070	NS	0.030	0.0162	0.030
Acetone	67-64-1	NS	0.070	NS	0.030	0.0179	0.030
Isopropyl Alcohol	78-83-1	NS	0.070	NS	0.030	0.0141	0.030
Trichlorotrifluoroethane	76-13-1	NS	0.070	NS	0.030	0.0053	0.030
MTBE	1634-04-4	NS	0.070	NS	0.030	0.0068	0.030
Vinyl Acetate	108-05-4	NS	0.070	NS	0.030	0.0111	0.030
2-Butanone	78-93-3	NS	0.070	NS	0.030	0.0054	0.030
Ethyl Acetate	141-78-6	NS	0.070	NS	0.030	0.0040	0.030
Hexane	110-54-3	NS	0.070	NS	0.030	0.0119	0.030
Chloroform	67-66-3	NS	0.070	NS	0.030	0.0101	0.030
Tetrahydrofuran	109-99-9	NS	0.070	NS	0.030	0.0108	0.030
Benzene	71-43-2	NS	0.070	NS	0.030	0.0059	0.030
Carbon Tetrachloride	56-23-5	NS	0.070	NS	0.030	0.0035	0.030
Cyclohexane	110-82-7	NS	0.070	NS	0.030	0.0083	0.030
1,4-Dioxane	123-91-1	NS	0.070	NS	0.030	0.0083	0.030
Heptane	142-82-5	NS	0.070	NS	0.030	0.0090	0.030
Methyl Isobutyl Ketone	108-10-1	NS	0.070	NS	0.030	0.0110	0.030
1,1,2-Trichloroethane	79-00-5	NS	0.070	NS	0.030	0.0036	0.030
Toluene	108-88-3	NS	0.070	NS	0.030	0.0041	0.030
2-Hexanone	591-78-6	NS	0.070	NS	0.030	0.0145	0.030
Dibromochloromethane	124-48-1	NS	0.070	NS	0.030	0.083	0.030
1,2-Dibromoethane	106-93-4	NS	0.070	NS	0.030	0.0040	0.030
Chlorobenzene	108-90-7	NS	0.070	NS	0.030	0.0060	0.030

QAPP Worksheet 15-14
Reference Limits and Evaluation Table

Matrix: Indoor and Ambient Air

Analytical Group: VOA

Concentration Level: Low

Analyte	CAS Number	Project Action Limit * (ppbv)	Project Quantitation Limit (ppbv)	SERAS SOP 1814 Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs (ppbv)	MDLs[1] (ppbv)	QLs (ppbv)
Ethylbenzene	100-41-4	NS	0.070	NS	0.030	0.0058	0.030
m&p-Xylene	108-38-3/ 106-42-3	NS	0.070	NS	0.030	0.0065	0.030
Bromoform(Tribromomethane)	75-25-2	NS	0.070	NS	0.030	0.0080	0.030
Styrene	100-42-5	NS	0.070	NS	0.030	0.0069	0.030
1,1,2,2-Tetrachloroethane	79-34-5	NS	0.070	NS	0.030	0.0080	0.030
o-Xylene	95-47-6	NS	0.070	NS	0.030	0.0051	0.030
Ethyltoluene	622-96-8	NS	0.070	NS	0.030	0.0062	0.030
1,3,5-trimethylbenzene	108-67-8	NS	0.070	NS	0.030	0.0073	0.030
1,2,4-Trimethylbenzene	95-63-6	NS	0.070	NS	0.030	0.0084	0.030

[1] Based on correspondence between ERT and Region II. NS = not specified.
[2] Not Specified in SOP 1814.
[3]Based on LOD study conducted on Instrument#2 Air Toxics dated 8/19/11
$\mu g/m^3$ = microgram per cubic meter ppbv = parts per billion by volume NL = Not listed in Table 4 of Method TO-15

QAPP Worksheet #16-1
Project Schedule Timeline Table

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Preparation of QAPP	SERAS	5/2/2011	6/5/2011	UFP-QAPP	6/6/2011
Health and Safety Plan	SERAS	6/3/2011	6/6/2011	Health and Safety Plan	6/6/2011
RFQ for Geoprobe Sampling Assistance	SERAS	5/2/2011	5/9/2011	RFQ	5/9/2011
Preliminary Work Assignment	SERAS	6/2/2011	6/2/2011	PWA	6/2/2011
Soil Gas Sampling Event	SERAS	6/13/2011	6/17/2011	NA	NA
Groundwater/Soil Sampling Event	SERAS	TBD	TBD	NA	NA
Preliminary Data Package	SERAS	Upon receipt of Samples	2 weeks from receipt of last sample.	Unvalidated Data Package	2 weeks from receipt of last sample.
Final Validated Analytical Results	SERAS	Receipt of Unvalidated Data Package	2 weeks from receipt of Unvalidated Data Package	Validated Data Package	2 weeks from receipt of Unvalidated Data Package
Draft Final Report	SERAS	Receipt of Validated Data Package	2 weeks from receipt of Validated Data Package	Draft Final Report	2 weeks from receipt of Validated Data Package
Final Report	SERAS	Receipt of comments from WAM regarding Draft Final Report	1 week from receipt of comments from WAM	Final Report	1 week from receipt of comments from WAM
Conceptual Site Model	SERAS	TBD	TBD	CSM	TBD

QAPP Worksheet #16-2 (February 2012 Mobilization)
Project Schedule Timeline Table

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Preparation of QAPP	SERAS	2/23/2011	2/27/2012	UFP-QAPP	2/27/2012
Health and Safety Plan	SERAS	2/24/2012	2/24/2012	Health and Safety Plan	2/24/2012
Preliminary Work Assignment	SERAS	2/23/2012	2/23/2012	PWA	2/23/2012
Sampling Event	SERAS	2/28/2012	3/3/2012	NA	NA
Preliminary Data Package	SERAS	Upon receipt of Samples	5 Business days from receipt of last sample.	Unvalidated Data Package	5 Business days from receipt of last sample.
Final Validated Analytical Results	SERAS	Receipt of Unvalidated Data Package	1 weeks from receipt of Unvalidated Data Package	Validated Data Package	1 week from receipt of Unvalidated Data Package
Draft Final Report	SERAS	Receipt of Validated Data Package	2 weeks from receipt of Validated Data Package	Draft Final Report	2 weeks from receipt of Validated Data Package
Final Report	SERAS	Receipt of comments from WAM regarding Draft Final Report	1 week from receipt of comments from WAM	Final Report	1 week from receipt of comments from WAM

QAPP Worksheet #17
Sampling Design and Rationale

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach): Sampling locations will be judgmentally chosen by the Region 2 RPM and WAM based on historical research into possible contamination sources. At each suspected source, soil gas samples will be collected from both inside (sub-slab soil gas) or around the property. When the field screening results indicate the presence of PCE, TCE or cis 1,2 DCE content, further sampling may be requested by the WAM or RPM. Results from field screening soil gas samples will also be used to determine future sampling of sub-surface soils for use in the CSM. Groundwater samples will be collected from previously installed monitoring wells and public water sources. These will be determined by the Region 2 RPM and WAM. Temporary well points using SP-16 methodology may be used to collect groundwater samples around suspected source areas. Groundwater results will be used to augment existing data for the RI and will assist in the generation of the CSM.

For the February 2012 sampling event, previous soil gas sampling results have indicated the presence of PCE, TCE and some of the breakdown products at the properties to be sampled.

Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be taken, and the sampling frequency (including seasonal considerations) [May refer to map or Worksheet #18 for details]:
Soil gas is the primary matrix to be sampled during the initial field event. The soil gas will be collected in Tedlar bags and analyzed on-site. Ten percent of the soil gas locations will be sampled by collecting a grab sample in a SUMMA canister and submitted to the ERT/SERAS Laboratory ofr confirmation analysis. Approximately 60 soil gas locations have been planned, as detailed in Worksheets 18 and 19. Samples will be located at approximately 8 separate areas within the city of Cabo Rojo.

Groundwater samples will be collected from approximately 50 locations (exact details to be determined by RPM and WAM). Water samples may contain VOC levels from trace to high. Should the source be located, it would be assumed that percent levels of contaminant could be present.

Soil samples will be collected (up to 50) from suspected source areas to assist with the delineation of the source area as well as the quantity of impacted soils.

For the February 2012 mobilization, ambient air, indoor air and soil gas sampling will be performed during this sampling event. Six locations have been identified for sampling based upon previous sample events. Approximately 66 Summa samples will be collected for VOC analysis. Approximately 25 samples from a school and a near-by print shop will be analyzed for a full TO-15 list. Of thise 25 sample approximately 6 will be ambient air samples, 8 will be soil gas samples and 10 will be indoor air samples. The trip blank will also be analyzed for a full TO-15 list. The remaing 41 samples will be collected at four other locations and analyzed fro PCE, TCE and six other breakdown products. Approximately 9 ambient air samples, 20 soil gas samples and 12 indoor air samples will be collected.

QAPP Worksheet #18-1
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth ( )	Analytical Group	Concentration Level	Number of Samples (identify field duplicates	Sampling SOP Reference[1]	Rationale for Sampling Location
To Be Determined	Soil Gas	TBD	PCE, TCE, cis 1,2 DCE	Low	35(4)	SERAS SOP #2042	Judgmental
To Be Determined	Soil Gas	Sub-Slab	PCE, TCE, cis 1,2 DCE	Low	25(3)	SERAS SOP #2082	Judgmental
To Be Determined	Soil Gas	Varies	VOCs	Low	6	SERAS SOP #1704	Judgmental
To Be Determined	Groundwater	Varies	VOCs	Trace	50(5)	SERAS SOP #2007	Judgmental
		Varies	TAL Metals	Low	25(3)	SERAS SOP #2007	Judgmental
		Varies	PCBs/Pesticides	Low	25(3)	SERAS SOP #2007	Judgmental
		Varies	SVOCs	Low	25(3)	SERAS SOP #2007	Judgmental
To Be Determined	Soil	Varies (<20 feet)	VOC	Low	20(2)	SERAS SOP #2012	Judgmental

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #21)

QAPP Worksheet #18-2 (February 2012 Mobilization)
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth ( )	Analytical Group	Concentration Level	Number of Samples (identify field duplicates	Sampling SOP Reference[1]	Rationale for Sampling Location
S2A	Soil Gas	Sub-Slab	PCE, TCE, VC, 1,1-DCE, 1,1-DCA, 1,2-DCA, cis-1,2- DCE, trans-1,2-DCE	ppb to ppm levels	3 to 4	SERAS SOP #1704	Judgmental
	Indoor Air	Breathing height		Low	2 to 3		
	Ambient Air	Breathing height		Low	2		
S2B	Soil Gas	Sub-Slab	PCE, TCE, VC, 1,1-DCE, 1,1-DCA, 1,2-DCA, cis-1,2- DCE, trans-1,2-DCE	ppb to ppm levels	4 to 5	SERAS SOP #1704	Judgmental
	Indoor Air	Breathing height		Low	3		
	Ambient Air	Breathing height		Low	2		
DEC	Soil Gas	Sub-Slab	PCE, TCE, VC, 1,1-DCE, 1,1-DCA, 1,2-DCA, cis-1,2- DCE, trans-1,2-DCE	ppb to ppm levels	4 to 5	SERAS SOP #1704	Judgmental
	Indoor Air	Breathing height		Low	3		
	Ambient Air	Breathing height		Low	1 to 2		
CRPDC	Soil Gas	Sub-Slab	PCE, TCE, VC, 1,1-DCE, 1,1-DCA, 1,2-DCA, cis-1,2- DCE, trans-1,2-DCE	ppb to ppm levels	5 to 6	SERAS SOP #1704	Judgmental
	Indoor Air	Breathing height		Low	3		
	Ambient Air	Breathing height		Low	2 to 3		
EQP	Soil Gas	Sub-Slab	VOCs	ppb to ppm levels	7 to 9	SERAS SOP #1704	Judgmental
	Indoor Air	Breathing height		Low	8 to 10		
	Ambient Air	Breathing height		Low	5 to 6		

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #21)

QAPP Worksheet #19
Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference [1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Soil Gas	VOA	Low	EPA Method TO-15/SERAS SOP #1814	4-5 Liters	1, 6-L SUMMA®, Grab and 24-hour	none	30 days
Soil Gas	VOA	Low	Voyager Portable Gas Chromatograph User's Manual	5-50 mL	1-L Tedlar bag (1)	Protect from light	24 hours
Soil	VOA	Low	EPA SW-846 Method 8260B/SERAS SOP#1807	5 g (Terracore)	3 40-mL preweighed VOA vials with stirring bar + 4oz jar for Moisture content	4C	14 Days
Groundwater	VOA	Trace	SERAS SOP #1806	120 mL	3 – 40 mL VOA vials	1:1 HCl to pH <2, 4C	14 Days
Groundwater	PCBs	Low	SERAS SOP #1801	1 Liter	1, 1-Liter Amber Round Bottle	4C, Protected from light	Sample -7 Days Extract – 40 Days
Groundwater	SVOCs	Low	SERAS SOP #1804	1 Liter	1, 1-Liter Amber Round Bottle	4C, Protected from light	Sample -7 Days Extract – 40 Days
Groundwater	Pesticides	Low	SERAS SOP #1808	1 Liter	1, 1-Liter Amber Round Bottle	4C, Protected from light	Sample -7 Days Extract – 40 Days
Groundwater	TAL Metals (Including Hg)	Low	SERAS SOP #1811/SOP #1832	1 Liter	1 Liter Poly Bottle	HNO_3 to pH <2 4C	6 Months 28 days (Hg)
Indoor and Ambient Air	VOA	Low	EPA Method TO-15/SERAS SOP #1814	4-5 Liters	1, 6-L SUMMA®, 24-hour	none	30 days

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23)

QAPP Worksheet #20
Field Quality Control Sample Summary Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference[1]	No. of Sampling Locations	No. of Field Duplicate Pairs	No. of MS	No. of Field Blanks	No. of Trip Blanks	No. of PT Samples	Total No. of Samples to Lab
Soil Gas	VOA	Low	EPA Method TO-15	6	NA	NA	NA	1	NA	7
Soil Gas	VOA	Low	Voyager Portable Gas Chromatograph User's Manual	60	6	NA	NA	NA	NA	66
Soil	VOA	Low	EPA SW-846 Method 8260B/SERAS SOP#1807	20	1	2	NA	NA	NA	23
Groundwater	VOA	Trace	SERAS SOP #1806	50	3	5	1 per day	1 per shipment	NA	Up to 68
Groundwater	PCBs	Low	SERAS SOP #1801	25	2	3	1 per day	NA	NA	Up to 35
Groundwater	SVOCs	Low	SERAS SOP #1804	25	2	3	1 per day	NA	NA	Up to 35
Groundwater	Pesticides	Low	SERAS SOP #1808	25	2	3	1 per day	NA	NA	Up to 35
Groundwater	TAL Metals (Including Hg)	Low	SERAS SOP #1811/SOP #1832	25	2	3	1 per day	NA	NA	Up to 35
Soil Gas	VOA	Low	EPA Method TO-15	29	NA	NA	NA	NA	NA	29
Indoor and Ambient Air	VOA	Low	EPA Method TO-15	36	NA	NA	NA	1	NA	37

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23)

QAPP Worksheet #21
Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Check if yes)	Comments
1704	*SUMMA® Canister Sampling*	SERAS	6-L SUMMA®	☐	
2001	*General Field Sampling Guidelines*	SERAS	General Sampling	☐	
2002	*Sample Documentation*	SERAS	NA	☐	
2003	*Sample Storage, Preservation and Handling*	SERAS	Sample Handling	☐	
2004	*Sample Packaging and Shipment*	SERAS	Sample Handling	☐	
2005	*Quality Assurance/Quality Control Samples*	SERAS	NA	☐	
2006	*Sampling Equipment Decontamination*	SERAS	Sampling Equipment	☐	
2007	*Groundwater Well Sampling*	SERAS	Sampling Equipment	☐	
2012	*Soil Sampling*	SERAS	Direct Push	☐	
2042	*Soil Gas Sampling*	SERAS	1-L Tedlar Bag	☐	
2082	*Construction and Installation of Permanent Sub-Slab Soil Gas Wells*	SERAS	Ports	☐	
2102	*Tedlar Bag Sampling*	SERAS	1-L Tedlar Bag	☐	
4001	*Logbook Documentation*	SERAS	Site Activities	☐	
4005	*Chain of Custody Procedures*	SERAS	Sample Handling	☐	

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

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
SUMMA® canisters	NA	Clean/Certify canister	Analyze*	Check for leaks	As cleaned and tested	< RL	Reclean and reanalyze	GC/MS Chemist	EPA Method TO-15
MultiRAE 10.6eV PID	Zero and Span Cal	Clean PID sensor and lamp as needed	Bump	Check keypad, LCD screen working, Check datalogger	Calibrate before use/monthly/ as needed	+/- 10%	Check gas concentration. Recalibrate, or clean sensor and lamp and recalibrate	Field Personnel	
Global Position System Receiver	NA	Keep GPS Clean and Charged	Verify operation	Prior to deployment in field, visual inspection	Daily	Varies with satellite reception.	Charge Batteries/ Replace	Task Leader	Per Manufacturer's instructions
YSI 650 MDS	Temperature		Compare temperature sensor reading to NIST thermometer measurement		Annually	±0.15 degree celsius	Contact manufacturer	Biologist	Manufacturer's manual
YSI 650 MDS	pH	Calibrate probe using standards that bracket expected values (pH 4, 7 and 10)	After performing 3-point calibration, immerse probe I pH 7 buffer to make sure it is reading correctly		As necessary	±0.05	Recalibrate	Biologist	Manufacturer's manual
YSI 650 MDS	Specific Conductance	Calibrate at a temperature of 25 degree Celsius			As necessary	±10%	Recalibrate	Biologist	Manufacturer's manual
YSI 650 MDS	Turbidity	2-point calibration	Insert probe in 10.0 NTU standard		As necessary	Between 9.5 and 10.0 NTU	Recalibrate	Biologist	Manufacturer's manual

[1]Specify the appropriate reference letter or number from the Project Sampling SOP References table (Worksheet #21)

QAPP Worksheet #23
Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
Part No. 380301, Rev C	Voyager Portable Digital Gas Chromatograph User's Manual	Screening	VOA	Voyager GC	ERT/SERAS	☐
SERAS SOP#1811	Determination of Metals by Inductively Coupled Plasma (ICP) Methods, 3/17/06	Definitive	TAL Metals	ICP-AES	ERT/SERAS Laboratory, Edison, NJ	☐
SERAS SOP#1832	Determination of Mercury by Cold-Vapor Atomic Absorption (CVAA) 3/17/06	Definitive	Mercury	CVAA	ERT/SERAS Laboratory, Edison, NJ	☐
SERAS SOP#1807	Volatile Organic Analysis in Soil/Sediment by GC/MS, 1/23/06	Definitive	VOA	GC/MS	ERT/SERAS Laboratory, Edison, NJ	☐
SERAS SOP#1806	Volatile Organic Analysis in Water Samples by GC/MS, 1/12/06	Definitive	VOA	GC/MS	ERT/SERAS Laboratory, Edison, NJ	☐
SERAS SOP#1801	Routine Analysis of PCBs in Water and Soil/Sediment Samples by GC/ECD 1/23/06	Definitive	PCBs	GC/ECD	ERT/SERAS Laboratory, Edison, NJ	☐
SERAS SOP#1808	Routine Analysis of Pesticides in Water Samples by GC/ECD 1/23/06	Definitive	Pesticides	GC/ECD	ERT/SERAS Laboratory, Edison, NJ	☐
SERAS SOP#1804	Routine Analysis of Semi-volatiles in Water by GC/MS 1/23/06	Definitive	SVOCs	GC/MS	ERT/SERAS Laboratory, Edison, NJ	☐
SERAS SOP #1814	GC/MS Analysis of Sorbent Tubes and Canisters	Definitive	VOAs	GC/MS	ERT/SERAS Laboratory, Edison, NJ	☐

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
Photovac Voyager GC (Air)	Initial calibration (IC), minimum 4-points	Each day	r>0.995	Inspect system for problems; perform maintenance. Rerun IC	Analyst	Photovac Voyager Digital gas Chromatograph User's Manual/ Attachment 1
Photovac Voyager GC (Air)	Continuing calibration (CC)	Every 20 samples	Percent difference (%D) ±40%,	Rerun CC once. If needed, inspect system for problems, perform maintenance, rerun IC	Analyst	Photovac Voyager Digital gas Chromatograph User's Manual/ Attachment 1
GC/MS (Air)	Initial calibration (IC), minimum 5-points	Initially	Relative standard deviation (RSD) =< 30%, two compounds may exceed up to 40%	Inspect system for problems; perform maintenance (i.e. ion source cleaning, column replacement, etc.). Rerun IC	Analyst	SERAS SOP #1814
GC/MS (Air)	Daily continuing calibration check (CCC)	Every 24 hours	Percent difference (%D) = ±30%	Rerun CCC. If needed, inspect system for problems, perform maintenance (i.e. ion source cleaning, column replacement, etc.), rerun IC	Analyst	SERAS SOP #1814
GC/MS (GW SVOCs)	Initial calibration (IC), minimum 5-points	Initially	Relative standard deviation (RSD) =< 15%, calibration check compounds (CCC) compounds RSD< 30%, or r^2>0.98. Relative response factor (RRF) >0.05.	Inspect system for problems; perform maintenance (i.e. ion source cleaning, column replacement, etc.). Rerun IC	Analyst	SERAS SOP #1804

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
GC/MS (GW SVOCs)	Daily continuing calibration check (CCC)	Every 12 hours	Percent difference (%D) ±20%, RRF>0.05	Rerun CCC. If needed, inspect system for problems, perform maintenance (i.e. ion source cleaning, column replacement, etc.), rerun IC	Analyst	SERAS SOP #1804
GC/MS (GW VOAs)	Initial calibration (IC), minimum 5-points	Initially	Relative standard deviation (RSD) =< 15%, calibration check compounds (CCC) compounds RSD< 30%, or r^2>0.98. Relative response factor (RRF) >0.05, except system performance check compounds (SPCC)	Inspect system for problems; perform maintenance (i.e. ion source cleaning, column replacement, etc.). Rerun IC	Analyst	SERAS SOP #1806
GC/MS (GW VOAs)	Daily continuing calibration check (CCC)	Every 12 hours	Percent difference (%D) ±20%, RRF>0.05, except SPCC	Rerun CCC. If needed, inspect system for problems, perform maintenance (i.e. ion source cleaning, column replacement, etc.), rerun IC	Analyst	SERAS SOP #1806
ICP - Metals	Blank and high standard, ICV/CCV every 10 samples	Each day of use	ICV/CCV ±10%	Perform maintenance, rerun calibration	SERAS Analyst	SERAS SOP #1811
CVAA (Mercury)	Initial 5-point, ICV/CCV after every 10 samples	Each day of use	r>0.995 (initial), ICV = ±10%, CCV = ±20%	Perform maintenance, rerun calibration	SERAS Analyst	SERAS SOP #1832

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
GC/ECD - Pesticides	Initial 5-point, daily mid level continuing cal check and cal check after every 12 Hours	Every 12 hours	%RSD $\leq$ 20%, continuing cal check %D $\leq$ 15%	Perform maintenance, rerun initial cal	Analyst	SERAS SOP #1808
GC/ECD - PCBs	Initial 5-point, daily mid level continuing cal check and cal check after every 12 Hours	Every 12 hours	%RSD $\leq$ 20%, continuing cal check %D $\leq$ 15%	Perform maintenance, rerun initial cal	Analyst	SERAS SOP #1801

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23)

QAPP 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[1]
ICP	Check Argon Supply	NA	NA	With each use	Sufficient Argon for ICP operation	Change tank	Analyst	SERAS SOP# 1811
	Inspect Drainage Container	NA	NA	With each use	Sufficient space	Empty	Analyst	
	Check Cooling System	NA	NA	With each use	Normal operation	Call Service Engineer	Analyst	
	Check RF Power Supply	NA	NA	With each use	Normal operation	Call Service Engineer	Analyst	
	Check Pump Winding Tubing	NA	NA	With each use	NA	Replace as necessary	Analyst	
	Check Argon Pressure to Instrument	NA	NA	With each use	70 psig	Call Service Engineer	Analyst	
	Check Nebulizer Pressure	NA	NA	With each use	Normal spray	Call Service Engineer	Analyst	
	Check Nebulizer Connection to Spray Chamber	NA	NA	With each use	NA	Clean and/or replace spray chamber/O-rings	Analyst	
	Check Torch, Nebulizer, Spray Chamber	NA	NA	As needed	Clean	Ultrasonic, acid or mild soap cleaning as appropriate	Analyst	
	Check exhaust system	NA	NA	With each use	Normal operation	Call Building Maintenance	Analyst	

QAPP 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[1]
GC/MS	Check gas supply daily, bake or change trap as needed, manual tune if 4-Bromofluorobenzene (BFB) not within criteria, cut or change column, change septum as needed.	VOC Analysis	Check ion source, gas supply, septum seal, vacuum, trap	Prior to sample analysis or when instrument does not meet criteria	BFB criteria achieved, Relative standard deviation (RSD) = ≤ 30%, two compounds may exceed up to 40% RSD in the IC	Recalibrate and/or perform necessary instrument maintenance, check calibration standards, re-analyze affected samples.	Analyst	SERAS SOP #1814
Voyager Portable GC	Check reservoir level			Weekly		Fill when necessary	Analyst	Voyager User's Manual
	Check MS ionization gauge			Weekly			Analyst	
	Check purge and trap pressure			Weekly		Adjust	Analyst	
	Check gas pressure			Weekly		Adjust/replace	Analyst	
	Check purge and trap			As needed		Replace	Analyst	
	Check vacuum pump oil level			Monthly		Fill	Analyst	
	Check purge vessel			Monthly		Replace	Analyst	
	GC column			Monthly		Clean	Analyst	
	Ion Source			As needed		Clean	Analyst	
VOA GC/MS	Check reservoir level			Weekly		Fill when necessary	Analyst	SERAS SOP #4001, Logbook Documentation

QAPP 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[1]
VOA GC/MS	Check MS ionization gauge			Weekly			Analyst	SERAS SOP #4001, Logbook Documentation
VOA GC/MS	Check Tekmar pressure			Weekly		Adjust	Analyst	SERAS SOP #4001, Logbook Documentation
VOA GC/MS	Check gas pressure			Weekly		Adjust/replace	Analyst	SERAS SOP #4001, Logbook Documentation
VOA GC/MS	Check Tekmar trap			As needed		Replace	Analyst	SERAS SOP #4001, Logbook Documentation
VOA GC/MS	Check vacuum pump oil level			Monthly		Fill	Analyst	SERAS SOP #4001, Logbook Documentation
VOA GC/MS	Check purge vessel			Monthly		Replace	Analyst	SERAS SOP #4001, Logbook Documentation
VOA GC/MS	GC column			Monthly		Clean	Analyst	SERAS SOP #4001, Logbook Documentation
VOA GC/MS	Ion Source			As needed		Clean	Analyst	SERAS SOP #4001, Logbook Documentation
SVOC GC/MS	Check pump fluid			Weekly		Fill when necessary	Analyst	SERAS SOP #4001, Logbook Documentation
SVOC GC/MS	Check MS ionization gauge			Weekly		Adjust	Analyst	SERAS SOP #4001, Logbook Documentation
SVOC GC/MS	Replace pump fluid			Every 6 months		Replace	Analyst	SERAS SOP #4001, Logbook Documentation

QAPP 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[1]
SVOC GC/MS	Check gas pressure			Weekly		Adjust/replace	Analyst	SERAS SOP #4001, Logbook Documentation
SVOC GC/MS	Check carrier gas trap			As needed		Replace	Analyst	SERAS SOP #4001, Logbook Documentation
SVOC GC/MS	Check diffusion pump fluid			Annual		Replace	Analyst	SERAS SOP #4001, Logbook Documentation
SVOC GC/MS	Check injection port			As needed		Clean	Analyst	SERAS SOP #4001, Logbook Documentation
SVOC GC/MS	GC column			Monthly		Clean	Analyst	SERAS SOP #4001, Logbook Documentation
SVOC GC/MS	Ion Source			As needed		Clean	Analyst	SERAS SOP #4001, Logbook Documentation
Leeman Hg Analyzer	Check argon supply	NA	NA	With each use	NA	Replace	Analyst	SERAS SOP #1832
Leeman Hg Analyzer	Drainage Container	NA	NA	With each use	NA	Empty	Analyst	SERAS SOP #1832
Leeman Hg Analyzer	Check sampling probe	NA	NA	With each use	NA	Replace	Analyst	SERAS SOP #1832
Leeman Hg Analyzer	Check stannous chloride line to pump	NA	NA	With each use	NA	Replace line/clean	Analyst	SERAS SOP #1832
Leeman Hg Analyzer	Check pump winding tube	NA	NA	With each use	NA	Clean/replace	Analyst	SERAS SOP #1832
Leeman Hg Analyzer	Check optical cell	NA	NA	As required	NA	Clean	Analyst	SERAS SOP #1832
Leeman Hg Analyzer	Check autosampler arm	NA	NA	As Required	NA	Lubricate	Analyst	SERAS SOP #1832

QAPP 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[1]
Leeman Hg Analyzer	Check Lamp Alignment	NA	NA	As required	NA	Adjust	Analyst	SERAS SOP #1832
Leeman Hg Analyzer	Check Drying Tube	NA	NA	As required	NA	Replace	Analyst	SERAS SOP #1832
GC/ECD	Check carrier gas pressure			With each use		Replace/adjust	Analyst	SERAS SOP #4001, Logbook Documentation
GC/ECD	Check column			With each use		Cut/clean	Analyst	SERAS SOP #4001, Logbook Documentation
GC/ECD	Check inlet seals			With each use		Replace	Analyst	SERAS SOP #4001, Logbook Documentation
GC/ECD	Check liner			With each user		Clean/replace	Analyst	SERAS SOP #4001, Logbook Documentation
GC/ECD	Check septa			With each use		Replace	Analyst	SERAS SOP #4001, Logbook Documentation
GC/ECD	Check pressure of make-up gas			With each use		Replace	Analyst	SERAS SOP #4001, Logbook Documentation

[1]Specify the appropriate reference letter or number from Analytical SOP References table (Worksheet #23)

QAPP Worksheet #26
Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Jon McBurney, Scott Grossman, Amy Dubois, Rich Magan, Mike Cartwright, Colleen Steffensen / SERAS Personnel
Sample Packaging (Personnel/Organization): Jon McBurney, Scott Grossman, Amy Dubois, Rich Magan, Mike Cartwright, Colleen Steffensen / SERAS Personnel
Coordination of Shipment (Personnel/Organization): Jon McBurney, Mike Cartwright, Colleen Steffensen / SERAS Personnel
Type of Shipment/Carrier: Hand Carried to Field Laboratory or Federal Express to ERT/SERAS Laboratory in Edison, NJ
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Field Laboratory - Gerald Ball (SERAS), ERT/SERAS Laboratory - Larry Martin (SERAS)
Sample Custody and Storage (Personnel/Organization): Field Laboratory - Gerald Ball (SERAS), ERT/SERAS Laboratory - Larry Martin (SERAS)
Sample Preparation (Personnel/Organization): ERT/SERAS Laboratory - SERAS Chemists
Sample Determinative Analysis (Personnel/Organization): Field Laboratory - Gerald Ball (SERAS), ERT/SERAS Laboratory - SERAS Chemists
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): Samples will be delivered to the Field Laboratory daily. Samples will be shipped to the ERT/SERAS laboratory at the end of the sampling event (5 days) with the exception of Soil and/or groundwater VOA samples. VOA samples will be shipped daily.
Sample Extract/Digestate Storage (No. of days from extraction/digestion): As Per Method Requirements. All samples are to be extracted, digested, and analyzed within holding times mandated by each analytical method.
Biological Sample Storage (No. of days from sample collection): NA
SAMPLE DISPOSAL
Personnel/Organization: Hazardous Waste Coordinator - ERT/SERAS
Number of Days from Analysis: As per laboratory standard procedures. Not less than 60 days for samples shipped to the ERT/SERAS Laboratory in Edison, NJ

QAPP Worksheet #27
Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory): Each sample will be individually identified and labeled after collection and hand delivered to the field laboratory. The sample information will be recorded on chain-of-custody (COC) forms. The EPA Scribe program will be used for field documentation, generating labels and COC forms. The sample information will be recorded on chain-of-custody (COC) forms, and the samples shipped to the appropriate laboratory via overnight delivery service, courier, or hand delivered. The EPA Scribe program will be used for field documentation,
Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal): Field laboratory personnel will accept custody of the shipped samples. Disposal of the samples will occur only after analyses and QA/QC checks are completed. Samples shipped to the ERT/SERAS Laboratory will be accepted by the sample receiving technician. Samples will be checked for discrepancies, proper preservation, integrity, etc. If noted, issues will be forwarded to the Analytical Support Leader for corrective action. The sample custodian will relinquish custody to the appropriate department for analysis. At this time, no samples will be archived at the laboratory. Disposal of the samples will occur only after analyses and QA/QC checks are completed.
Sample Identification Procedures: Samples will be identified with unique location identifier based on location (property) name. Also included in sample identification will be SG for soil gas, GW for groundwater, SS for sub-slab soil gas, S for Soil. A progressive number XX will be added for multiple samples collected at a location. Example: Charlie's Cleaners would use CC-SG-01.
Chain-of-custody Procedures: All samples will be documented with SCRIBE and assigned to uniquely numbered chains of custody per SERAS SOP# 4005, *Chain of Custody Procedures.*

QAPP Worksheet #28-1
QC Samples Table

Matrix	Soil
Analytical Group	Volatile Organic Compounds
Concentration Level	Low
Sampling SOP	SERAS SOP #2012
Analytical Method (SOP Reference)	EPA SW-846 Method 6010B/SERAS SOP #1807
Sampler Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS
No. of Sample Locations	20

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1:20 samples	NA	Document in final deliverable	Task Leader	Precision	RPD ±35%
Matrix Spike	1:10 samples	1,1-Dichloroethene (%R=59-172) Trichloroethene (%R=62-137) Benzene (%R=66-142) Toluene (%R=59-139) Chlorobenzene (%R=60-133)	Document outliers in case narrative. Rerun if necessary	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Surrogate Spike	Each sample	1,2-Dichloroethane-d4 (%R=70-121) Toluene-d8 (%R=84-138) p-Bromofluorobenzene (%R=59-113)	Reanalyze sample to confirm matrix effects	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Internal Standard	Each sample	-50% to +100%	Reanalyze sample to confirm	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Laboratory Control Sample	1:20 samples	%R= Within control chart limits	Flag outliers and/or reanalyze	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-1
QC Samples Table

Matrix	Soil
Analytical Group	Volatile Organic Compounds
Concentration Level	Low
Sampling SOP	SERAS SOP #2012
Analytical Method (SOP Reference)	EPA SW-846 Method 6010B/SERAS SOP #1807
Sampler Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS
No. of Sample Locations	20

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
MS/MSD	1:10 samples	1,1-Dichloroethene (RPD ±22%) Trichloroethene (RPD ±24%) Benzene (RPD ±21%) Toluene (RPD ±21%) Chlorobenzene (RPD ±21%)	Advisory - No Action required	Analyst	Precision	Same as Method/SOP QC Acceptance Limits
Method Blank	Every 12 hour shift	<RL	Reanalyze, flag data	Analyst	Accuracy/Bias (Contamination)	Same as Method/SOP QC Acceptance Limits
LOD/LOQ Study	Annual	LOD - Standard deviation multiplied by 5 must be less than the Reporting Limit LOQ – Second source standard must fall within control chart limits	Adjust RLs	Analyst	Sensitivity	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-2
QC Samples Table

Matrix	Groundwater
Analytical Group	VOA
Concentration Level	Low
Sampling SOP	SERAS SOP #2007
Analytical Method/ SOP Reference	SERAS SOP #1806
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS
No. of Sample Locations	50

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Internal Standards	Each sample	-50% to +100%	Reanalyze sample to confirm	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
LCS	1:20 samples	%R= Within control chart limits	Flag outliers/reanalyze	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
MS/MSD	1:10 samples	1,1-Dichloroethene (RPD ±14%) Trichloroethene (RPD ±14%) Benzene (RPD ±11%) Toluene (RPD ±13%) Chlorobenzene (RPD ±13%)	Advisory - No Action required	Analyst	Precision	Same as Method/SOP QC Acceptance Limits
Method Blank	Every 12 hour shift	<RL	Reanalyze, flag data	Analyst	Accuracy/Bias (Contamination)	Same as Method/SOP QC Acceptance Limits
LOD/LOQ Study	Annual	LOD - Standard deviation multiplied by 5 must be less than the Reporting Limit LOQ – Second source standard must fall within control chart limits	Adjust RLs	Analyst	Sensitivity	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-2
QC Samples Table

Matrix	Groundwater
Analytical Group	VOA
Concentration Level	Low
Sampling SOP	SERAS SOP #2007
Analytical Method/ SOP Reference	SERAS SOP #1806
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS
No. of Sample Locations	50

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spike	1:10	1,1-Dichloroethene (%R=61-145) Trichloroethene (%R=71-120) Benzene (%R=76-127) Toluene (%R=76-125) Chlorobenzene (75-130)	Document outliers in case narrative. Rerun if necessary	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Surrogate Spike	Every Sample	1,2-Dichloroethane-d4 (%R=76-114) Toluene-d8 (%R=88-110) p-Bromofluorobenzene ((%R=86-115)	Reanalyze to confirm matrix effects	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Field Duplicate	1:20	NA	NA	NA	Precision	RPD ±20%
Field Blank	1 per day	NA	Flag data	QA/QC Chemist or Task Leader	Accuracy/Bias (Contamination)	<RL
Trip Blank	1 per shipment	NA	Flag data	QA/QC Chemist or Task Leader	Accuracy/Bias (Contamination)	<RL

QAPP Worksheet #28-3
QC Samples Table

Matrix	Water
Analytical Group	Pesticides
Concentration Level	Low
Sampling SOP	SERAS SOP #2007
Analytical Method/ SOP Reference	SERAS SOP #1808
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS
No. of Sample Locations	25

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spikes	1:10	Gamma-BHC (%R=56-123) Heptachlor (%R=40-131) Aldrin (%R=40-120) Dieldrin (%R=52-126) Endrin (%R=56-121) 4,4'-DDT (%R=38-127)	If more than half out, the MS/MSD should be reanalyzed	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Surrogate Spike	Each sample	%R=30-150	Reanalyze sample	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Internal Standards	Each sample	50-150%	Reanalyze sample	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
LCS	1:20	Within control chart limits	Reanalyze if more than 3 are out	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
MS/MSD	1:10	Gamma-BHC (RPD±15%) Heptachlor (RPD±20%) Aldrin (RPD±22%) Dieldrin (RPD±18%) Endrin (RPD±21%) 4,4'-DDT (RPD±27%)	Advisory - No Action required	Analyst	Precision	Same as Method/SOP QC Acceptance Limits
Method Blank	1:20	<RL	Reanalyze	Analyst	Accuracy/Bias (Contamination)	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-3
QC Samples Table

Matrix	Water
Analytical Group	Pesticides
Concentration Level	Low
Sampling SOP	SERAS SOP #2007
Analytical Method/ SOP Reference	SERAS SOP #1808
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS
No. of Sample Locations	25

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1:20	NA	Document in report	Task Leader	Precision	RPD ±20%
Field Blank	1 per day	NA	Flag data	QA/QC Chemist Or Task Leader	Accuracy/Bias (Contamination)	<RL

QAPP Worksheet #28-4
QC Samples Table

Matrix	Water
Analytical Group	SVOC
Concentration Level	Low
Sampling SOP	SERAS SOP #2007
Analytical Method/ SOP Reference	SERAS SOP #1804
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS Laboratory
No. of Sample Locations	25

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spike	1:20 samples	Phenol (%R=12-110) 2-Chlorophenol (%R=27-123) 1,4-dichlorobenzene (%R=36-97) N-Nitroso-di-n-propylamine (%R=41-116) 1,2,4 Trichlorobenzene (%R=39-98) 4-Chloro-3-methylphenol (%R=23-97) Acenaphthene (%R=46-118) 4-Nitrophenol (%R=10-80) 4-Dinitotoluene (%R=24-96) Pentachlorophenol (%R=9-103) Pyrene (%R=26-127)	If more than half out, the MS/MSD should be reanalyzed	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-4
QC Samples Table

Matrix	Water
Analytical Group	SVOC
Concentration Level	Low
Sampling SOP	SERAS SOP #2007
Analytical Method/ SOP Reference	SERAS SOP #1804
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS Laboratory
No. of Sample Locations	25

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spike duplicate	1:20 samples	Phenol RPD ±42% 2-Chlorophenol RPD ±40% 1,4-dichlorobenzene RPD ±28% N-Nitroso-di-n-propylamine RPD ±38% 1,2,4 Trichlorobenzene RPD ±28% 4-Chloro-3-methylphenol RPD ±42% Acenaphthene RPD ±31% 4-Nitrophenol RPD ±50% 2,4-Dinitotoluene RPD ±38% Pentachlorophenol RPD ±50% Pyrene RPD ±31%	If more than half out, the MS/MSD should be reanalyzed	Analyst	Precision	Same as Method/SOP QC Acceptance Limits
Internal Standards	Each sample	50-200%	Reanalyze sample	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Method Blank	1:20 samples	<RL	Reextract batch or flag data	Analyst	Accuracy/Bias (Contamination)	Same as Method/SOP QC Acceptance Limits
Surrogate Spikes	Each Sample	Nitrobenzene-d5 (%R=35-114%) 2-Fluorobiphenyl (%R=43-116%) Terphenyl-d14 (%R=33-141%) Phenol-d5 (%R=10-110%) 2-Fluorophenol (%R=21-110%) 2,4,6-Tribromophenol (%R=10-123%)	Reanalyze sample	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-4
QC Samples Table

Matrix	Water
Analytical Group	SVOC
Concentration Level	Low
Sampling SOP	SERAS SOP #2007
Analytical Method/ SOP Reference	SERAS SOP #1804
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS Laboratory
No. of Sample Locations	25

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
LCS	1:20 samples	%R= 70-130% or within control chart limits	Qualify data	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Field Blank	1 per day	NA	Flag Data	QA/QC Chemist or Task Leader	Accuracy/Bias (Contamination)	<RL

QAPP Worksheet #28-5
QC Samples Table

Matrix	Water
Analytical Group	Metals
Concentration Level	Low
Sampling SOP	SERAS SOP #2007
Analytical Method/ SOP Reference	SERAS SOP #1811
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS Laboratory
No. of Sample Locations	25

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spike	Every 10 samples	%R = 75-125%	Rerun - no reprep is necessary; Qualify data	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
MS/MSD	Every 10 samples (between MS/MSD)	RPD ±20%	Rerun first, reprep if necessary or Qualify data	Analyst	Precision	Same as Method/SOP QC Acceptance Limits
LCS	Every 20 samples of same matrix	%R = 75-125%	Reanalyze first, then rerun batch or Qualify data	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
ICS (Interference Check Sample)	Once each 8-hour shift	± 20%	Rerun or recalibrate	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Method Blank	One per batch of 20 samples/same matrix	< RL	Reprep if concentration in samples is not at least 10X concentration in blank, investigate source of contamination	Analyst	Accuracy/Bias (Contamination)	Same as Method/SOP QC Acceptance Limits
Serial Dilution	5%	%D ±10%	Flag data	Analyst	Precision	Same as Method/SOP QC Acceptance Limits
Field Duplicate	5%	NA	Document in final deliverable	Task Leader	Precision	RPD ±20%
Field Blank	1 per day	NA	Flag or qualify data	QA/QC Chemist or Task Leader	Accuracy/Bias (Contamination)	<RL

QAPP Worksheet #28-6
QC Samples Table

Matrix	Groundwater
Analytical Group	Mercury
Concentration Level	Low
Sampling SOP	SERAS SOP #2007
Analytical Method/ SOP Reference	SERAS SOP #1832
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS
No. of Sample Locations	25

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spike	1:10	%R=75-125	Rerun - no reprep is necessary	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
MS/MSD	1:10	RPD ±20 %	Rerun first, reprep if necessary	Analyst/Group Leader	Precision	Same as Method/SOP QC Acceptance Limits
LCS	1:20	%R=75-125% or within vendor PALs	Reanalyze first, then rerun batch	Analyst/Group Leader	Accuracy/Precision	Same as Method/SOP QC Acceptance Limits
Method Blank	One per batch of 20 samples/same matrix	< RL	Reprep if concentration in samples is not at least 10X concentration in blank, investigate source of contamination	Analyst	Accuracy/Bias (Contamination)	Same as Method/SOP QC Acceptance Limits
Field Duplicate	5%	NA	Document in final deliverable	Task Leader	Precision	RPD ±20%
Field Blank	1 per day	NA	Flag or qualify data	QA/QC Chemist or Task Leader	Accuracy/Bias (Contamination)	<RL

QAPP Worksheet #28-7
QC Samples Table

Matrix	Soil Gas (SUMMA® Canister)

Analytical Group	VOA
Concentration Level	Low
Sampling SOP	SERAS SOP #1704
Analytical Method/ SOP Reference	SERAS SOP #1814
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS Laboratory
No. of Sample Locations	~6

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Internal Standard	Each sample	±40% of daily calibration IS response	Re-analyze sample	Analyst	Precision/Accuracy/Bias	±40% of daily calibration IS response
Instrument Performance Check Samples	Every 24 hours	As per specified method	Clean, repair, re-analyze	Analyst	Sensitivity	As per specified method
LCS	5% of samples	± 30% R or within control chart limits	Clean, repair, re-analyze	Analyst	Accuracy/Bias	± 30% R or within control chart limits
Method Blank	1/24-hour clock	< Reporting Limit	Clean, repair, re-analyze	Analyst	Accuracy/Bias Contamination	< Reporting Limit
Trip Blank	1/shipment	< Reporting Limit	NA	NA	Accuracy/Bias Contamination	< Reporting Limit
LOD/LOQ Study	Annual	LOD = < Reporting Limit LOQ = ±50% or within control chart limits	Clean, repair, re-analyze.	Analyst	Sensitivity	LOD = < Reporting Limit LOQ = ±50% or within control chart limits
Laboratory Duplicates	10%	RPD ± 25%	Reanalyze	Analyst	Precision	RPD ± 25%

NA = Not applicable

QAPP Worksheet #28-8 (February 2012 Mobilization)
QC Samples Table

Matrix	Soil Gas (SUMMA® Canister)
Analytical Group	VOA
Concentration Level	Low
Sampling SOP	SERAS SOP #1704
Analytical Method/ SOP Reference	SERAS SOP #1814
Sampler's Name	Mike Cartwright, Colleen Steffensen
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS Laboratory
No. of Sample Locations	~29

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Internal Standard	Each sample	±40% of daily calibration IS response	Re-analyze sample	Analyst	Precision/Accuracy/Bias	±40% of daily calibration IS response
Instrument Performance Check Samples	Every 24 hours	As per specified method	Clean, repair, re-analyze	Analyst	Sensitivity	As per specified method
LCS	5% of samples	± 30% R or within control chart limits	Clean, repair, re-analyze	Analyst	Accuracy/Bias	± 30% R or within control chart limits
Method Blank	1/24-hour clock	< Reporting Limit	Clean, repair, re-analyze	Analyst	Accuracy/Bias Contamination	< Reporting Limit
Trip Blank	1/shipment	< Reporting Limit	NA	NA	Accuracy/Bias Contamination	< Reporting Limit
LOD/LOQ Study	Annual	LOD = < Reporting Limit LOQ = ±50% or within control chart limits	Clean, repair, re-analyze.	Analyst	Sensitivity	LOD = < Reporting Limit LOQ = ±50% or within control chart limits
Laboratory Duplicates	10%	RPD ± 25%	Reanalyze	Analyst	Precision	RPD ± 25%

NA = Not applicable

QAPP Worksheet #28-9 (February 2012 Mobilization)
QC Samples Table

Matrix	Indoor and Ambient Air (SUMMA® Canister)
Analytical Group	VOA
Concentration Level	Low
Sampling SOP	SERAS SOP #1704
Analytical Method/ SOP Reference	SERAS SOP #1814
Sampler's Name	Mike Cartwright, Colleen Steffensen
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS Laboratory
No. of Sample Locations	~37

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Internal Standard	Each sample	±40% of daily calibration IS response	Re-analyze sample	Analyst	Precision/Accuracy/Bias	±40% of daily calibration IS response
Instrument Performance Check Samples	Every 24 hours	As per specified method	Clean, repair, re-analyze	Analyst	Sensitivity	As per specified method
LCS	5% of samples	± 30% R or within control chart limits	Clean, repair, re-analyze	Analyst	Accuracy/Bias	± 30% R or within control chart limits
Method Blank	1/24-hour clock	< Reporting Limit	Clean, repair, re-analyze	Analyst	Accuracy/Bias Contamination	< Reporting Limit
Trip Blank	1/shipment	< Reporting Limit	NA	NA	Accuracy/Bias Contamination	< Reporting Limit
LOD/LOQ Study	Annual	LOD = < Reporting Limit LOQ = ±50% or within control chart limits	Clean, repair, re-analyze.	Analyst	Sensitivity	LOD = < Reporting Limit LOQ = ±50% or within control chart limits
Laboratory Duplicates	10%	RPD ± 25%	Reanalyze	Analyst	Precision	RPD ± 25%

NA = Not applicable

QAPP Worksheet #29
Project Documents and Records Table

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records	Other
Site and Field Logbooks COC Forms Well Sampling Purge Logs Map for sampling locations	Instrument Run Logs Preventive Maintenance Logs Instrument Printouts Data Reduction Records Data Review Records	Sample Receipt Logs Internal and External COC forms Equipment Calibration Logs Sample Analysis Worksheets/Run Logs Laboratory Final Data Package Corrective Action Documents	Review forms for electronic entry of data into database Data Validation Package Data Assessment Forms (SERAS) Data Validation Check Records (SERAS)	Well Installation Logs Equipment Calibration logs/checks Corrective Action Documentation Well Sample Purge Logs Field Change Form, if required Final Report

QAPP Worksheet #30
Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Location/ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number
Soil Gas	VOA	Low/High	Refer to Worksheet 18	Voyager GC User's Manual	NA	ERT/SERAS Laboratory 2890 Woodbridge Avenue Edison, NJ 08837 Gerald Ball 732-321-4204	NA
Soil Gas	VOA	Low	Per Worksheet 18	EPA Method TO-15/ SERAS SOP #1814	3 Weeks	ERT/SERAS Laboratory 2890 Woodbridge Avenue Edison, NJ Attn: Vinod Kansal 732-321-4200	NA
Groundwater	VOCs	Low	Per Worksheet 18	SERAS SOP #1806	3 Weeks	ERT/SERAS Laboratory 2890 Woodbridge Avenue Edison, NJ Attn: Vinod Kansal 732-321-4200	NA
Groundwater	TAL Metals/Mercury	Low	Per Worksheet 18	SERAS SOP#1811/ SERAS SOP#1832	3 Weeks	ERT/SERAS Laboratory 2890 Woodbridge Avenue Edison, NJ Attn: Vinod Kansal 732-321-4200	NA
Groundwater	PCBs	Low	Per Worksheet 18	SERAS SOP#1801	3 Weeks	ERT/SERAS Laboratory 2890 Woodbridge Avenue Edison, NJ Attn: Vinod Kansal 732-321-4200	NA
Groundwater	Pesticides	Low	Per Worksheet 18	SERAS SOP#1808	3 Weeks	ERT/SERAS Laboratory 2890 Woodbridge Avenue Edison, NJ Attn: Vinod Kansal 732-321-4200	NA

QAPP Worksheet #30
Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Location/ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number
Groundwater	SVOCs	Low	As per Worksheet 18	SERAS SOP#1804	3 Weeks	ERT/SERAS Laboratory 2890 Woodbridge Avenue Edison, NJ Attn: Vinod Kansal 732-321-4200	NA
Soil	VOCs	Low	As per Worksheet 18	SERAS SOP#1807	3 Weeks	ERT/SERAS Laboratory 2890 Woodbridge Avenue Edison, NJ Attn: Vinod Kansal 732-321-4200	NA
Soil Gas	VOA	Low	Per Worksheet 18	EPA Method TO-15/ SERAS SOP #1814	5 Business Days for Preliminary data	ERT/SERAS Laboratory 2890 Woodbridge Avenue Edison, NJ Attn: Vinod Kansal 732-321-4200	NA
Indoor and Ambient Air	VOA	Low	Per Worksheet 18	EPA Method TO-15/ SERAS SOP #1814	5 Business Days for Preliminary data	ERT/SERAS Laboratory 2890 Woodbridge Avenue Edison, NJ Attn: Vinod Kansal 732-321-4200	NA

QAPP Worksheet #31
Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
Laboratory Accreditation Audit	Every 2 years	External	NELAC Accreditation Agency	NJDEP	Deborah Killeen, QA/QC Officer, SERAS	Vinod Kansal, GC/MS Chemist, ERT/SERAS Laboratory	NELAC Accreditation Agency
Laboratory Audit	Annual	Internal	ERT/SERAS Laboratory	Deborah Killeen, QA/QC Officer, SERAS	Vinod Kansal, GC/MS Chemist, ERT/SERAS Laboratory	Laboratory Chemists ERT/SERAS Laboratory	Deborah Killeen, QA/QC Officer, SERAS
Performance Evaluation Sample	Biannual	Internal	ERT/SERAS Laboratory	Deborah Killeen, QA/QC Officer, SERAS	Vinod Kansal, GC/MS Chemist, ERT/SERAS Laboratory	Laboratory Chemists ERT/SERAS Laboratory	Deborah Killeen, QA/QC Officer, SERAS

QAPP Worksheet #32-1
Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Field Observations/ Deviations from Work Plan	Logbook	Jon McBurney/Task Leader/SERAS	Immediately	Field Change Form	Jon McBurney/Task Leader SERAS	Within 24 hours of change
Lab Performance Audits	Audit report	ERT/SERAS Laboratory	Within 30 days	Corrective Action Plan	Regulatory Agency	Within 30 days
Peer Review	In the deliverable	Jon McBurney/Task Leader/SERAS	Prior to deliverable due date	Comments directly in the deliverable	Jon McBurney/Task Leader SERAS	Prior to deliverable due date
Internal Lab Performance Audits	Audit report	Vinod Kansal, GC/MS Chemist, SERAS	Within 45 days	Corrective Action Plan	Deborah Killeen, QA/QC Officer, SERAS	Within 45 days

QAPP Worksheet #32-2 (February 2012 Mobilization)
Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Field Observations/ Deviations from Work Plan	Logbook	Mike Cartwright/Task Leader/SERAS	Immediately	Field Change Form	Mike Cartwright/Task Leader SERAS	Within 24 hours of change
Lab Performance Audits	Audit report	ERT/SERAS Laboratory	Within 30 days	Corrective Action Plan	Regulatory Agency	Within 30 days
Peer Review	In the deliverable	Mike Cartwright/Task Leader/SERAS	Prior to deliverable due date	Comments directly in the deliverable	Mike Cartwright/Task Leader SERAS	Prior to deliverable due date
Internal Lab Performance Audits	Audit report	Vinod Kansal, GC/MS Chemist, SERAS	Within 45 days	Corrective Action Plan	Deborah Killeen, QA/QC Officer, SERAS	Within 45 days

QAPP Worksheet #33
QA Management Reports Table

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Technical Report	Monthly	10th of the month following performance period	Task Leader/SERAS	ERT Project Officer and Work Assignment Manager
QA Report	Quarterly	February, May, August, November	QA/QC Officer/SERAS	ERT Project Officer and Quality Coordinator

QAPP Worksheet #34
Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Chain of Custody Record	Reviewed by Field Sampling Personnel in field and QA/QC Group prior to final analytical report preparation	Internal	SERAS
Laboratory Data Package	Reviewed for measurement performance criteria	Internal	ERT/SERAS Laboratory and SERAS QA/QC Group
Analytical Report	Reviewed for accuracy	Internal	Peer Review Team
Trip Report	Reviewed for accuracy	Internal	Peer Review Team
Completeness Check	Review of Planning Documents, Analytical Data package, Sampling Documents and External Reports, as applicable, using the UFP-QAPP Checklist	Internal	SERAS Task Leader

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

Step IIa/IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
IIa	SOPs	Ensure that the sampling methods/procedures outlined in the QAPP were followed and any deviations noted	SERAS Task Leader, Work Assignment Manager
IIa	COC Records	Examine COC records and match with requested analyses.	SERAS Task Leader SERAS Sr. Field GC/MS Chemist SERAS QA/QC Group
IIa	Lab Data Package	Examine packages against COC records (holding times, sample handling, methods, sample identifications, qualifiers).	SERAS QA/QC Group
IIb	Lab Data Package	Qualify data based on QC deficiencies (precision/accuracy, %RSD, %D, etc.)	SERAS QA/QC Chemist SERAS QA/QC Officer
IIb	Field Duplicates	Compare results of field duplicate (or replicate) analyses with RPD criteria	SERAS Task Leader, Jon McBurney/Mike Cartwright

QAPP Worksheet #36
Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
IIb	Soil Gas (SUMMA® Canister)	VOA	Low	Draft SERAS SOP #1021, *Data Validation for Routine Volatile Organic Compounds in Air by TO-15/TO-17 Analysis*	SERAS QA/QC Group
IIb	Groundwater	VOA	Trace	SERAS SOP #1015, *Data Validation Procedures for Routine Volatile Organic Analysis*	SERAS QA/QC Group
IIb	Groundwater	PCBs	Low	Draft SERAS SOP#1020, *Data Validation Procedures for Routine PCB/Aroclor Analysis*	SERAS QA/QC Group
IIb	Groundwater	Pesticides	Low	Draft SERAS SOP#1018, *Data Validation Procedures for Routine Pesticide Analysis*	SERAS QA/QC Group
IIb	Groundwater	SVOCs	Low	SERAS SOP #1016, *Data Validation Procedures for Routine Semi-Volatile Analysis*	SERAS QA/QC Group
IIb	Groundwater	TAL Metals	Low	SERAS SOP #1017, *Data Validation Procedures for Routine Inorganic Analysis*	SERAS QA/QC Group

X **Worksheet Not Applicable** EPA Region II will be responsible for assessing the usability of the data.

QAPP 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:
Describe the evaluative procedures used to assess overall measurement error associated with the project:
Identify the personnel responsible for performing the usability assessment:
Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

QUALITY ASSURANCE PROJECT PLAN
Cabo Rojo Site
Cabo Rojo, Puerto Rico

Prepared for:
United States Environmental Protection Agency/Environmental Response Team
Edison, NJ

By:
Lockheed Martin/Scientific, Engineering, Response and Analytical Service (SERAS)
Work Assignment Number: SERAS-130

Based on the Intergovernmental Data Quality Task Force Uniform
Federal Policy for Quality Assurance Project Plans
(Final Version 1.1, June 2006)

June 6, 2011

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QAPP Worksheet #1
Title and Approval Page

Site Name/Project Name: Cabo Rojo
Site Location: Cabo Rojo, Puerto Rico

Document Title: Quality Assurance Project Plan for the Cabo Rojo Site

Lead Organization: Environmental Protection Agency/Environmental Response Team (EPA/ERT)

Preparer's Name and Organizational Affiliation: Jon McBurney - Lockheed Martin/Scientific Engineering Response Analytical Service (SERAS)

Preparer's Address, Telephone Number, and E-mail Address: 2890 Woodbridge Avenue, Edison, NJ 08837, (732)321-4244, jonathan.d.mcburney@lmco.com

Preparation Date (Day/Month/Year): June 6, 2011

Investigative Organization's Project Manager/Date: _____ Signature 6/9/11
Printed Name/Organization: Jeff Catanzarita/ERT Work Assignment Manager

Investigative Organization's Project QA Officer/Date: _____ Signature 6/10/11
Printed Name/Organization: Stephen Blaze/ERT Quality Coordinator

Lead Organization's Project Manager/Date: _____ Signature 6/9/11
Printed Name/Organization: Jon McBurney/SERAS Task Leader

Approval Signatures/Date: _____ Signature 6/9/11
Printed Name/Title: Deborah A. Killeen/SERAS QA/QC Officer

Approval Authority: Lockheed Martin/SERAS

Other Approval Signatures/Date: _____ Signature 6/9/11
Printed Name/Title: Dennis A. Miller/SERAS Program Manager

Document Control Numbering System: SERAS-130-DQAPP-060611

QAPP Worksheet #2
QAPP Identifying Information

Site Name/Project Name: Cabo Rojo
Site Location: Cabo Rojo, Puerto Rico
Site Number/Code: A244
Operable Unit:
Contractor Name: Lockheed Martin
Contractor Number: EP-W-09-031

Contract Title: SERAS
Work Assignment Number: SERAS-130

1. Identify regulatory program: Comprehensive Environmental Response and Compensation Liability Act (CERCLA)
2. Identify approval entity: EPA/ERT
3. The QAPP is (select one): ☐Generic ☒Project Specific
4. List dates of scoping sessions that were held: April 20, 2011
5. List dates and titles of QAPP documents written for previous site work, if applicable:

Title	Approval Date

6. List organizational partners (stakeholders) and connection with lead organization:
   EPA Region 2
7. List data users:
   EPA Region 2
8. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusions below:

   Worksheet 37 is not applicable. EPA Region II will decide the usability of project data.

QAPP Worksheet #2
QAPP Identifying Information
(Continued)

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
Project Management and Objectives		
2.1 Title and Approval Page	- Title and Approval Page	1
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	- Table of Contents - QAPP Identifying Information	2
2.3 Distribution List and Project Personnel Sign-Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	- Distribution List - Project Personnel Sign-Off Sheet	3 4
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications Table - Special Personnel Training Requirements Table	5 6 7 8
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	- Project Planning Session Documentation (including Data Needs tables) - Project Scoping Session Participants Sheet - Problem Definition, Site History, and Background - Site Maps (historical and present)	9 10
2.6 Project Quality Objectives and Measurement Performance Criteria 2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	- Site-Specific PQOs - Measurement Performance Criteria Table	11 12

QAPP Worksheet #2
QAPP Identifying Information
(continued)

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
2.7 Secondary Data Evaluation	- Sources of Secondary Data and Information - Secondary Data Criteria and Limitations Table	13
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	- Summary of Project Tasks - Reference Limits and Evaluation Table - Project Schedule/Timeline Table	14 15 16
Measurement/Data Acquisition		
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume, and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.3 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures 3.1.2.4 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	- Sampling Design and Rationale - Sample Location Map - Sampling Locations and Methods/SOP Requirements Table - Analytical Methods/SOP Requirements Table - Field Quality Control Sample Summary Table - Sampling SOPs - Project Sampling SOP References Table - Field Equipment Calibration, Maintenance, Testing, and Inspection Table	17 18 19 20 21 22
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	- Analytical SOPs - Analytical SOP References Table - Analytical Instrument Calibration Table - Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	23 24 25

QAPP Worksheet #2
QAPP Identifying Information
(continued)

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Required Documents
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	- Sample Collection Documentation Handling, Tracking, and Custody SOPs - Sample Container Identification - Sample Handling Flow Diagram - Example Chain-of-Custody Form and Seal	26 27
3.4 Quality Control Samples 3.4.1 Sampling Quality Control Samples 3.4.2 Analytical Quality Control Samples	- QC Samples Table - Screening/Confirmatory Analysis Decision Tree	28
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	- Project Documents and Records Table - Analytical Services Table - Data Management SOPs	29 30
Assessment/Oversight		
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	- Assessments and Response Actions - Planned Project Assessments Table - Audit Checklists - Assessment Findings and Corrective Action Responses Table	31 32
4.2 QA Management Reports	- QA Management Reports Table	33
4.3 Final Project Report		

QAPP Worksheet #2
QAPP Identifying Information
(continued)

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
Data Review		
5.1 Overview		
5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	- Verification (Step I) Process Table - Validation (Steps IIa and IIb) Process Table - Validation (Steps IIa and IIb) Summary Table - Usability Assessment	34 35 36 NA
5.3 Streamlining Data Review 5.3.1 Data Review Steps To Be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining		

QAPP Worksheet #3
Distribution List

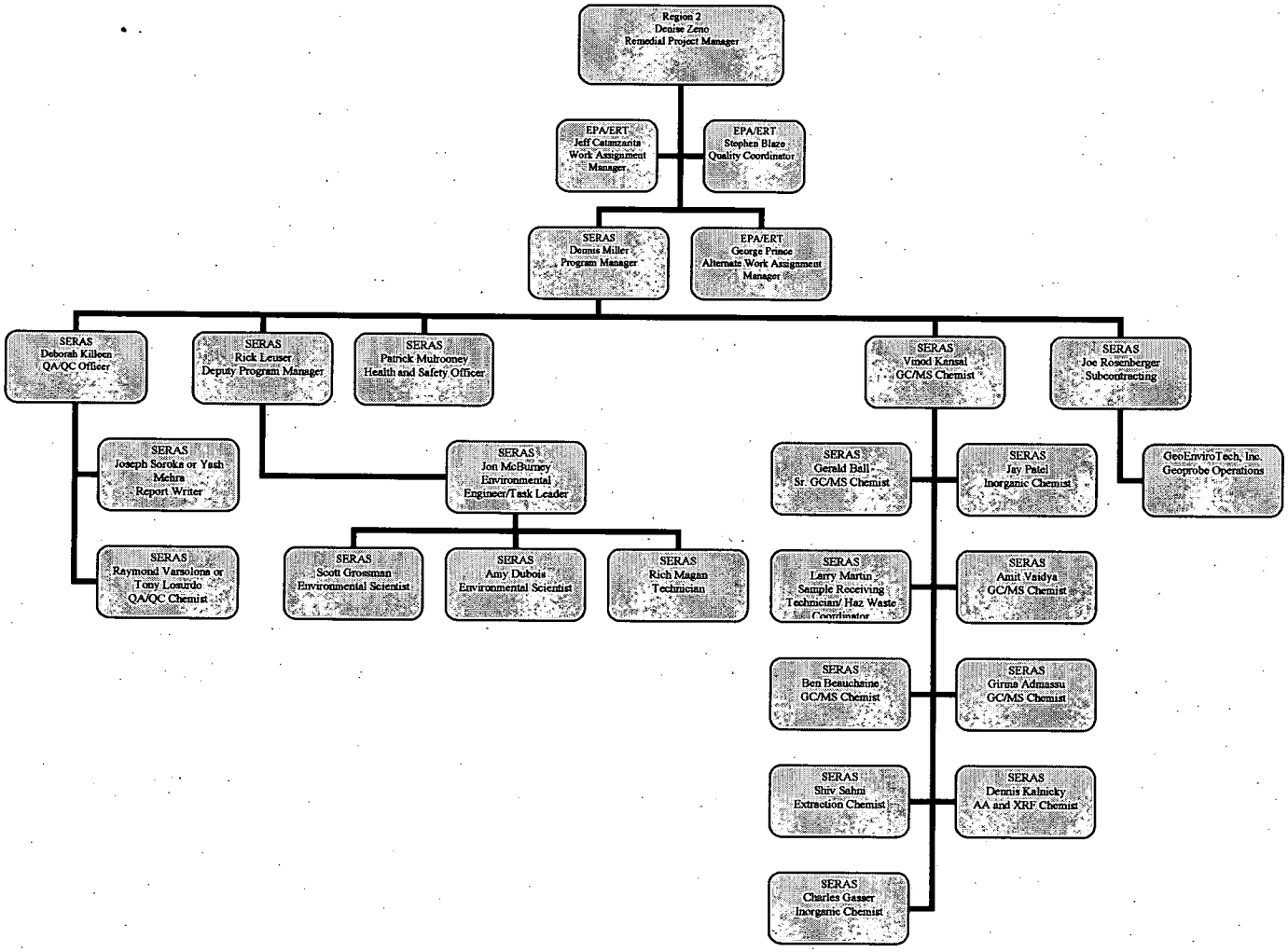
QAPP Recipients	Title	Organization	Telephone Number	Fax Number	E-mail Address	Document Control Number
Jeff Catanzarita	Work Assignment Manager	EPA/ERT	732-906-6929	732-321-6724	catanzarita.jeff@epa.gov	SERAS-130-DQAPP-060611
Stephen Blaze	Quality Coordinator	EPA/ERT	732-906-6921	732-321-6724	blaze.stephen@epa.gov	SERAS-130-DQAPP-060611
Jon McBurney	Project Engineer/ Task Leader	SERAS	732-321-4244	732-494-4021	jonathan.d.mcburney@lmco.com	SERAS-130-DQAPP-060611
Deborah Killeen	QA/QC Officer	SERAS	732-321-4245	732-494-4021	deborah.a.killeen@lmco.com	SERAS-130-DQAPP-060611
Dennis Miller	Program Manager	SERAS	732-321-4216	732-494-4021	dennis.a.miller@lmco.com	SERAS-130-DQAPP-060611

QAPP Worksheet #4
Project Personnel Sign-Off Sheet

Organization: ERT/EPA/SERAS

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Jeff Catanzarita	EPA/ERT Work Assignment Manager (WAM)	732-906-6929		6/13/11
George Prince	EPA/ERT Environmental Scientist	732-321-6649		6/13/11
Denise Zeno	EPA Region 2 Remedial Project Manager (RPM)	212-637-4319		
Jon McBurney	SERAS Project Engineer/ Task Leader (TL)	732-321-4244/ 609-937-9116		6/13/2011
Amy Dubois	SERAS Environmental Scientist (Air/Response)	732-494-4007/ 609-865-9304		6/13/11
Scott Grossman	SERAS Environmental Scientist	732-321-4230/ 609-937-9120		6/13/11
Rich Magan	SERAS Technician (Environmental Scientist)	732-321-4234/ 732-691-7114	Rich Magan	6/13/11
Gerald Ball	SERAS Sr. Gas Chromatography/ Mass Spectrometry (GC/MS) Chemist	732-321-4286/ 609-760-7506		6/13/2011

QAPP Worksheet #5
Project Organizational Chart



QAPP Worksheet #6
Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Approval of initial QAPP and any amendments	ERT Work Assignment Manager ERT Quality Coordinator SERAS Program Manager SERAS QA/QC Officer SERAS Task Leader	Jeff Catanzarita Stephen Blaze Dennis A. Miller Deborah Killeen Jon McBurney	(732) 906-6929 (732) 906-6921 (732) 321-4216 (732) 321-4245 (732) 321-4244	SERAS internal peer review, followed by ERT approval, implementation of changes effective only with approved QAPP or QAPP Change Form.
Nonconformance and Corrective Action	SERAS Project Engineer ERT Work Assignment Manager SERAS QA/QC Officer	Jon McBurney Jeff Catanzarita Deborah Killeen Amit Vaidya Gerald Ball Ben Beauchaine Girma Admassu Shiv Sahni Charles Gasser Dennis Kalnicky Larry Martin	(732) 321-4244 (732) 906-6929 (732) 321-4245 (732) 321-4251 (732) 321-4286 (732) 494-4006 (732) 321-4394 (732) 321-9312 (732) 321-4297 (732) 321-4214 (732) 321 4213	Use of the Work Assignment Field Change Form for field issues. Use of the laboratory nonconformance memo for laboratory deviations/deficiencies
Posting of Deliverables to the ERT IMS website	SERAS Task Leader SERAS QA/QC Officer SERAS Deputy Program Manager SERAS Administrative Support	Jon McBurney Deborah Killeen Richard Leuser Eileen Ciambotti	(732) 321-4244 (732) 321-4245 (732) 494-4060 (732) 321-4255	As per work assignment, posting of deliverables to ERT-Information Management System (IMS) website constitutes delivery to the WAM.
Work Assignment	SERAS Program Manager	Dennis A. Miller	(732) 321-4216	Describes scope of work to SERAS personnel from the ERT WAM.
Contract/Purchasing Communications	SERAS Task Leader SERAS Contract/Purchasing Liason	Jon McBurney Joe Rosenberger	(732) 321-4244 (732) 321-4215	SERAS TL will communicate with Contract/Purchasing Liason
Health and Safety On-Site Meeting	SERAS Project Engineer	Jon McBurney	(732) 321-4244	Describe potential site hazards, required personal protective equipments, and access to local emergency services.

QAPP Worksheet #7
Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Jon McBurney	Project Engineer	SERAS	Task Leader, Project Supervision, Reporting, Document Preparation	Minimum B.S. degree plus 14 years of related experience/Lockheed Martin Employee Files
Nesya Belyarchik	Computer Assisted Design (ACAD)	SERAS	Map Creation	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Mingling Li	Geographic Information System (GIS) Specialist	SERAS	GIS/Map Creation	Minimum B.S. degree plus 3 years of related experience/Lockheed Martin Employee Files
Scott Grossman	Environmental Engineer/Scientist	SERAS	Field Investigation, Field Sampling	Minimum B.S degree plus 8 years of related experience//Lockheed Martin Employee Files
Amy Dubois	Environmental Scientist (Air/Response)	SERAS	Field Sampling, Sample Documentation	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Rich Magan	Environmental Technician	SERAS	Field Sampling, Sample Documentation, Mobilization	Environmental sampling experience/Lockheed Martin Employee Files
Deborah Killeen	QA/QC Officer	SERAS	Quality Assurance/Validation Oversight and Deliverable Review	Minimum B.S. degree plus 14 years of related experience/Lockheed Martin Employee Files
Ray Varsolona	QA/QC Chemist	SERAS	Data Validation	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Yash Mehra	Report Writer	SERAS	Report & EDD Preparation	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Joe Rosenberger	Procurement Agent	SERAS	Contractor Procurement	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Jeff Catanzarita	Work Assignment Manager	EPA/ERT	Technical Direction/Field Oversight	EPA Job-related qualifications/EPA Files
George Prince	Alternate Work Assignment Manager	EPA/ERT	Technical Direction/Field Oversight	EPA Job-related qualifications/EPA Files
Stephen Blaze	Quality Coordinator	ERT	QA Oversight	EPA job-related qualifications/EPA Files
Denise Zeno	Remedial Program Manager	EPA Region 2	Technical and Logistical Support	EPA job-related qualifications/EPA Files
Gerald Ball	Sr. GC/MS Chemist	SERAS	Sample Analysis	Minimum B.S. degree plus 14 years of related experience/Lockheed Martin Employee Files
Jay Patel	ICP and ICP-MS Chemist	SERAS	Sample Analysis	Minimum B.S. degree plus 14 years of related experience/Lockheed Martin Employee Files
Larry Martin	Sample Receiving Technician/Hazardous Waste Coordinator	SERAS	Sample Receiving/Hazardous Waste Management	Minimum B.S. degree plus 3 years of related experience/Lockheed Martin Employee Files

QAPP Worksheet #7
Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Amit Vaidya	GC/MS Chemist	SERAS	Sample Analysis	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Ben Beauchaine	GC/MS Chemist	SERAS	Sample Analysis	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Girma Admassu	GC/MS Chemist	SERAS	Sample Analysis	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Shiv Sahni	Extraction Chemist	SERAS	Sample Extraction	Minimum B.S. degree plus 3 years of related experience/Lockheed Martin Employee Files
Charles Gasser	Extraction Chemist	SERAS	Sample Digestion	Minimum B.S. degree plus 3 years of related experience/Lockheed Martin Employee Files
Dennis Kalnicky	AA and XRF Chemist	SERAS	Sample Analysis	Minimum B.S. degree plus 14 years of related experience/Lockheed Martin Employee Files

QAPP Worksheet #8
Special Personnel Training Requirements Table

Project Function	Specialized Training – Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Project Oversight	Health & Safety Training	SERAS	December 2010	Jon McBurney	Project Engineer/ Task Leader/SERAS	SERAS H&S Files
Field Sampling	Health & Safety Training	SERAS	December 2010	Rich Magan	Environmental Technician/SERAS	SERAS H&S Files
Field Sampling	Health & Safety Training	SERAS	August 2010	Amy Dubois	Environmental Scientist/SERAS	SERAS H&S Files
Field Sampling	Health & Safety Training	SERAS	November 2009	Scott Grossman	Project Engineer/SERAS	SERAS H&S Files
Field Chemist	Health & Safety Training	SERAS	November 2010	Gerald Ball	Sr. GC/MS Chemist	SERAS H&S Files
Validation Support	Data Integrity/Peak Integration	SERAS	July 2010	Raymond Varsolona or Tony Losurdo	QA/QC Chemist	Quality Files
Validation Support	Data Integrity/Peak Integration	SERAS	July 2010	Joseph Soroka or Yash Mehra	QA/QC Chemist	Quality Files
Laboratory Analysis	Data Integrity Training	SERAS	July 2010	Jay Patel Dennis Kalnicky Charles Gasser	ICP and ICP-MS Chemist AA and XRF Chemist Digestion Chemist	Quality Files
Laboratory Analysis	Data Integrity/Peak Integration Training			Shiv Sahni Amit Vaidya Ben Beauchaine Girma Admassu Larry Martin	Extraction Chemist GC/MS Chemist GC/MS Chemist Extraction Chemist Sample Receiving Tech.	
QA Oversight	Data Review & Validation	Laboratory Data Consultants	January 2007	Deborah Killeen	QA/QC Officer/SERAS	Quality Files
QA Oversight	Lead Auditor Training	IT Corporation	September 1991	Deborah Killeen	QA/QC Officer, SERAS	Quality Files
QA Oversight	Uniform Federal Policy for Quality Assurance Project Plans	Advanced Systems	January 2006	Deborah Killeen	QA/QC Officer/SERAS	Quality Files

QAPP Worksheet #9
Project Scoping Session Participants Sheet

Project Name: Cabo Rojo **Projected Date(s) of Sampling:** June 13, 2011 **Project Manager:** Jon McBurney	**Site Name:** Cabo Rojo **Site Location:** Cabo Rojo, Puerto Rico
Date of Session: 4/20/2011 **Scoping Session Purpose:** Initial Scoping Meeting	

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Jon McBurney	Environmental Engineer/ Task Leader	SERAS	732-321-4244	jonathan.d.mcburney@lmco.com	Task Lead
Jeff Catanzarita	Work Assignment Manager	ERT	732-906-6929	catanzarita.jeff@epa.gov	Work Assignment Manager
George Prince	Assistant Work Assignment Manager	ERT	732-321-6649	prince.george@epa.gov	Asst. Work Assignment Manager
Rick Leuser	Deputy Program Manager	SERAS	732-494-4060	richard.m.leuser@lmco.com	Project Oversight
Amy Dubois	Environmental Scientist (Air)	SERAS	732-494-4007	amy.e.dubois@lmco.com	Sampling

Comments/Decisions:

1. Travel should be to the BQN Airport in Western Puerto Rico.
2. Soil gas sampling will be the primary sampling type for the first sampling event. Approximately 8 locations have been identified as possible sources. At each, approximately 3 indoor samples and 4 to 5 outdoor soil gas samples will be collected. SUMMA grab samples will be taken at a rate of 1 in 10 as verification samples. A Geoprobe will be on call for soil gas sampling.
3. Other sampling methods will be for groundwater and soil. Groundwater would be collected either from dedicated sample ports on municiple wells, from pre-installed monitoring wells, or from temporary SP-16 wells installed by Geoprobe. Water samples other than SP-16 must be for definitive data. SP-16 can be screening data only. Low flow will be used where possible. All soil sampling will be definitive data.
4. All Soil gas data will be screening only.
5. Less than half of all water samples will be submitted for BNA, VOC, PCB and Pesticides as well as VOCs.

6. Benchmarks will be Federal MCLs. If Federal MCLs are not available, use NYS drinking water criteria.

Action Items: None.

Consensus Decisions: See Comments/Decisions section.

QAPP Worksheet #10
Problem Definition

The problem to be addressed by the project: The purpose of this project is to provide technical support to the Environmental Protection Agency/Environmental Response Team (EPA/ERT) and EPA Region II in conducting a preliminary remedial investigation (RI) in the town of Cabo Rojo, Puerto Rico (PR). The objectives of the RI are to confirm or negate possible sources of groundwater contamination and to collect groundwater samples for a RI/Risk Assessment (RA).
The environmental questions being asked: 1. What possible sources can be found for the tetrachloroethylene (PCE) and trichloroethylene (TCE) contamination being found in the groundwater? 2. What are the relative impacts from the different possible sources?
Observations from any site reconnaissance reports: See secondary Data, Worksheet 13.
A synopsis of secondary data or information from site reports: Secondary data available for this site include the preliminary investigations at the site as detailed in the Hazard Ranking System (HRS) Documentation Record as prepared by EPA and Weston Solutions Region 2 Site Assessment Team (SAT) contractor dated October, 2010. This document can be found at: http://www.epa.gov/superfund/sites/docrec/pdoc1823.pdf
The possible classes of contaminants and the affected matrices: Contaminants affecting the site are PCE and TCE. These contaminants are believed to be affecting Groundwater, Subsurface Soils, and Soil Gases.
The rationale for inclusion of chemical and nonchemical analyses: 1. On-site screening of soil vapors will be used to direct the investigation towards possible source areas. 2. Off-site water analysis for TCE and PCE will be used to determine the magnitude of the source area and will be used in the RI/RA and Conceptual Site Model (CSM). 3. Analysis of site soils will be used along with the water analysis to determine the extent of the source contamination for use in the RI/RA and CSM.
Information concerning various environmental indicators: There have been no environmental indicators to date.
Project decision conditions ("If..., then..." statements): 1. If the soil gas samples analyzed on site indicate the presence of TCE or PCE, then additional soil gas samples will be taken to determine the location of the source of the contamination. 2. If an elevated level of PCE or TCE is measured in the soil gas, then soil and groundwater samples will be collected at a later date to determine the nature and extent of the source area. 3. If the results of the soil samples exceed the New York State (NYS) Part 375 Protection of Groundwater Standards, then EPA Region 2 will evaluate the data and determine what further courses of action are required. 4. If the results of the groundwater samples exceed the federal Maximum Contaminant Levels (MCLs) or the NYS MCLs for those compounds without federal MCLs, then EPA Region 2 will evaluate the data and determine what further courses of action are required.

QAPP Worksheet #11
Project Quality Objectives /Systematic Planning Process Statements

Who will use the data? The EPA Region 2, EPA Environmental Response Team (ERT), and Lockheed Martin SERAS

What will the data be used for?

1. Determine or negate potential sources for the ground water contamination based on soil-gas (SG) sampling to locate elevated volatile organic compound (VOC) vapor concentrations. The benchmark will be determined by the results of a limit of detection (LOD) study for PCE and TCE using a Voyager portable gas-chromatograph (GC) to ascertain the absence or presence and magnitude of the contaminants.
2. Collect current groundwater data for the creation of a conceptual site model (CSM) of the groundwater regime from pre-established monitoring wells and drinking water wells, and answer RI/RA objectives. Federal drinking water maximum contaminant levels (MCLs) will be used as benchmarks for groundwater sampling. When no Federal MCL exists for a contaminant of concern (COC), New York State Department of Environmental Conservation (NYSDEC) drinking water standards will be used.
3. Determine VOC levels in soils at or near suspected source locations. New York State 375 Regulations for impact to groundwater will be utilized as benchmarks.
4. Along with historical data, the CSM will be created for use with the RI.

What type of data is needed? (target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques)

1. On-site screening of soil gas samples will be performed by a field chemist using a Voyager portable GC. The analytes will be PCE, TCE and cis 1,2 DCE. Samples will be collected by temporary soil gas points (outdoor samples) and by sub-slab sampling (indoor samples) into dedicated Tedlar bags. A subset of 10% of all soil gas locations will be sampled by collecting a grab sample into a SUMMA canister. The SUMMA canisters will be analyzed for VOCs at the ERT/SERAS laboratory in Edison, New Jersey (NJ). The SUMMA canister results will be used to verify the on-site screening results. Soil gas sample points may be screened using a MultiRAE photoionization detector (PID) prior to sampling to screen the vapors.
2. Off-site analysis of soil samples collected in suspected source areas for VOCs.
3. Off-site analysis of water samples collected from existing monitoring wells for VOCs. A subset of the samples will be analyzed for Target Analyte List (TAL) Metals, Polychlorinated Biphenyls (PCBs), SVOCs, and Pesticides. Groundwater samples collected from temporary well points by Geoprobe SP-16 methodology will be screening data only. All data from existing monitoring wells or potable water sources will be definitive data.
4. Water samples may be collected from temporary well points using Geoprobe SP-16 sampling methodology. These points may be field screened for VOCs on the Voyager Portable GC or analyzed at the ERT/SERAS Laboratory in Edison, NJ.
5. Water quality readings (screening data) may be collected for low-flow groundwater sampling methodology.
6. All sample locations will be located using Global Positioning System (GPS) technology.

How "good" do the data need to be in order to support the environmental decision? All soil gas results generated by the Voyager portable GC will be considered screening data. The data will be used to direct further sampling in an attempt to locate possible sources of VOCs impacting groundwater. Soil, soil gas and groundwater results will be used for further RI evaluation, with the exception of temporary SP-16 wells which will be for screening purposes only. The soil and groundwater results will be definitive data. All GPS, water quality (YSI or equivalent) and air quality (MultiRAE or equivalent) readings will be for screening purposes only.

How much data are needed? (number of samples for each analytical group, matrix, and concentration) Approximately 60 soil gas locations will be sampled for on-site screening of PCE, TCE and cis 1,2 DCE. Of the 60 samples, 25 are expected to be indoor sub-slab samples, and the remaining 35 are expected to be outdoor temporary sample points. Approximately 50 groundwater and 50 soil samples have been planned for collection and analysis for VOCs. Of the 50 groundwater samples, approximately half (25) will be submitted for Metals, PCBs, Pesticides and SVOCs.
Where, when, and how should the data be collected/generated? Soil gas samples will be collected during the week of June 13, 2011 from locations determined by the RPM and WAM. The samples will be collected using SERAS Standard Operating Procedure (SOP) #2102, *Tedlar Bag Sampling* and #1704, *SUMMA Canister Sampling*. See Worksheets 18 and 19 for details. The collection date of the groundwater samples and soil samples will be determined after the June 13 sampling event. Groundwater samples will be collected using SERAS SOP# 2007, *Groundwater Well Sampling*. Soil samples will be collected using SERAS SOP# 2012, *Soil Sampling*.
Who will collect and generate the data? SERAS field personnel will collect all samples and a SERAS field chemist will generate all field screening data. ERT/SERAS Laboratory chemists will generate all soil, groundwater and soil gas confirmation data.
How will the data be reported? The SERAS field laboratory will provide VOC analytical results for all soil gas samples. Results will be reported daily to the RPM and WAM in an electronic spreadsheet. Final ERT/SERAS Laboratory generated validated data will be reported in accordance with SERAS SOP #4020, *Analytical Report Preparation*. A SERAS Final Report containing all data will be generated in accordance with SOP #4021, *Preparation of Final Report*. The final report will be the final deliverable to the EPA/ERT WAM. Data will be disseminated to EPA Region 2 by the WAM.
How will the data be archived? Data will be archived in electronic *.pdf format. Data packages from the ERT/SERAS Laboratory will be archived by the SERAS QA/QC Group both in hard copy and electronically. Hard copies of all deliverables will be stored in SERAS Central Files and e-copies will be archived on the SERAS Local Area Network (LAN) in accordance with Administrative Procedure (AP) #34, *Archiving Electronic Files*. Data will be imported into a SCRIBE database and posted to the ERT-Information Management System (IMS) website.

QAPP Worksheet #12-1
Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	VOA
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2007	SERAS SOP #1806 (EPA SW-846 Method 8260B)	Precision (Field)	RPD ± 20%	Field Duplicates	S & A
		Precision (Laboratory)	1,1-Dichloroethene (RPD ±14%) Trichloroethene (RPD ±14%) Benzene (RPD ±11%) Toluene (RPD ±13%) Chlorobenzene (RPD ±13%)	MS/MSD	A
		Accuracy/Bias (Field) Contamination	<RL	Field Blank Trip Blank	S & A
		Accuracy (Laboratory)	%R = Within control chart limits	LCS	A
		Accuracy/Bias	-50% to +100%	Internal Standards	A
		Accuracy/Bias	1,1-Dichloroethene (%R=61-145%) Trichloroethene (%R=71-120%) Benzene (%R=76-127%) Toluene (%R=76-125%) Chlorobenzene (%R=75-130%)	MS	A
		Accuracy/Bias Contamination	<RL	Method Blank	A
		Accuracy/Bias	1,2-Dichloroethane-d4 (%R=76-114%) Toluene-d8 (%R=88-110%) p-Bromofluorobenzene (%R=86-115%)	Surrogates	A
		Completeness	> 90% sampling completed > 90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet #12-2
Measurement Performance Criteria Table

Matrix	Soil
Analytical Group	VOA
Concentration Level	Low/Medium

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2012	EPA SW-846 Method 8260B/ SERAS SOP #1807	Precision	1,1-Dichloroethene (RPD ±22%) Trichloroethene (RPD ±24%) Benzene (RPD ±21%) Toluene (RPD ±21%) Chlorobenzene (RPD ±21%)	MS/MSD	A
		Accuracy/Bias	%R = Within control limits	LCS	A
		Precision	RPD±35%	Field Duplicates	S & A
		Accuracy/Bias	-50% to +100%	Internal Standards	A
		Accuracy/Bias	1,1-Dichloroethene (%R=59-172) Trichloroethene (%R=62-137) Benzene (%R=66-142) Toluene (%R=59-139) Chlorobenzene (%R=60-133)	Matrix Spikes	A
		Accuracy/Bias Contamination	<RL	Method Blank	A
		Accuracy/Bias	1,2-Dichloroethane-d4 (%R=70-121) Toluene-d8 (%R=84-138) p-Bromofluorobenzene (%R=59-113%)	Surrogates	A
		Completeness	> 90% sampling completed > 90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet #12-3
Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	PCBs
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2007	SERAS SOP #1801	Precision (Field)	RPD: ±20%	Field Duplicates	S&A
		Accuracy/Bias	Within control chart limits	LCS	A
		Accuracy/Bias	%R=30-150 (advisory limits)	Surrogate Spike	A
		Accuracy/Bias	No limits defined	Matrix Spike	A
		Accuracy/Bias	<RL	Method Blank	A
				Field Blank	S&A
		Precision	RPD ±20%	MS/MSD	A
		Accuracy/Bias	50-150%	Internal Standards	A
		Completeness	> 90% sampling completed > 90% laboratory analysis	Data Completeness Check	S&A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet #12-4
Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	Pesticides
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2007	SERAS SOP #1808	Precision (Field)	RPD ±20%	Field Duplicates	S&A
		Accuracy/Bias	70-130% or within control chart limits	LCS	A
		Accuracy/Bias	%R=30-150 (advisory limits)	Surrogate Spike	A
		Accuracy/Bias	Gamma-BHC (%R=56-123) Heptachlor (%R=40-131) Aldrin (%R=40-120) Dieldrin (%R=52-126) Endrin (%R=56-121) 4,4'-DDT (%R=38-127)	Matrix Spike	A
		Accuracy/Bias	< RL	Method Blank	A
				Field Blank	S&A
		Precision	Gamma-BHC (RPD±15%) Heptachlor (RPD±20%) Aldrin (RPD±22%) Dieldrin (RPD±18%) Endrin (RPD±21%) 4,4'-DDT (RPD±27%)	MS/MSD	A
		Accuracy/Bias	50-150%	Internal Standards	A
		Completeness	> 90% sampling completed > 90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet #12-5
Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	SVOC
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP	Data Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2007	SERAS SOP #1804	Precision (Field)	RPD ±20%	Field Duplicate	S&A
		Accuracy/Bias	Phenol (%R=12-110) 2-Chlorophenol (%R=27-123) 1,4-dichlorobenzene (%R=36-97) N-Nitroso-di-n-propylamine (%R=41-116) 1,2,4 Trichlorobenzene (%R= 39-98) 4-Chloro-3-methylphenol (%R=23-97) Acenaphthene (%R=46-118) 4-Nitrophenol (%R=10-80) 4-Dinitotoluene (%R=24-96) Pentachlorophenol (%R=9-103) Pyrene (%R=26-127)	MS	A
		Precision	Phenol RPD ±42% 2-Chlorophenol RPD ±40% 1,4-Dichlorobenzene RPD ±28% N-Nitroso-di-n-propylamine RPD ±38% 1,2,4 Trichlorobenzene RPD ±28% 4-Chloro-3-methylphenol RPD ±42% Acenaphthene RPD ±31% 4-Nitrophenol RPD ±50% 2,4-Dinitotoluene RPD ±38% Pentachlorophenol RPD ±50% Pyrene RPD ±31%	MS/MSD	A
		Accuracy/Bias	%R=Within control chart limits	LCS	A

QAPP Worksheet #12-5
Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	SVOC
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP	Data Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
		Accuracy/Bias	Nitrobenzene-d5 (%R=35-114%) 2-Fluorobiphenyl (%R=43-116%) Terphenyl-d14 (%R=33-141%) Phenol-d5 (%R=10-110%) 2-Fluorophenol (%R=21-110%) 2,4,6-Tribromophenol (%R=10-123%)	Surrogate Spikes	A
		Accuracy/Bias Contamination	<RL	Method Blank	A
				Field Blank	S & A
		Accuracy/Bias	-50% to +100%	Internal Standards	A
		Completeness	> 90% sampling completed > 90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet #12-6
Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	Metals
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2007	SERAS SOP #1811	Precision (Field)	RPD ±20%	Field Duplicates	S & A
		Precision (Laboratory)	RPD ±20%	MS/MSD	A
		Accuracy/Bias (Field) Contamination	<RL	Field Blank	S & A
		Accuracy/Bias	%R=75-125 or within performance acceptance limits	LCS	A
		Accuracy/Bias Contamination	<RL	Method Blank	A
		Accuracy/Bias	%R=75-125	Matrix Spike	A
		Completeness	> 90% sampling completed > 90% laboratory analysis	Data Completeness Check	S & A
		Accuracy/Bias	%D ±20	ICS	A
		Precision	%D ±10	Serial Dilution	A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet #12-7
Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	Mercury
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2007	SERAS SOP #1832	Precision (Field)	RPD ±20%	Field Duplicates	S & A
		Precision (Laboratory)	RPD ±20%	MS/MSD	A
		Accuracy/Bias (Field) Contamination	<RL	Field Blank	S & A
		Accuracy/Bias	%R=75-125 or within performance acceptance limits	LCS	A
		Accuracy/Bias Contamination	<RL	Method Blank	A
		Accuracy/Bias	%R=75-125	Matrix Spike	A
		Completeness	> 90% sampling completed > 90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet 12-8
Measurement Performance Criteria Table

Matrix	Soil Gas (SUMMA® Canister)
Analytical Group	VOA
Concentration Level	Low Level

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP 1704	TO-15 (SERAS SOP # 1814)	Precision	RPD ± 25%	Laboratory Duplicates	A
		Accuracy/Bias	±30% Recovery or within control chart limits	Laboratory Control Sample (LCS)	A
		Accuracy/Bias	±40% of mean area response	Internal Standards	A
		Accuracy/Bias Contamination	No target compound ≥ RL	Method Blanks	A
		Sensitivity	±50% or within control chart limits	Limit of Quantitation	A
		Completeness	> 90% SUMMA sampling, > 90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet #13
Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	How Data Will Be Used	Limitations on Data Use
Locations for Sampling	Hazard Ranking System (HRS) Documentation Record	EPA and Weston Solutions Region 2 SAT Contract, dated October, 2010	For review and planning sample locations.	None
Location Reconnaisance	Final Preliminary Assessment/Site Inspection (PA/SI) Work Assignment No.: 065, Abandoned Mechanic – PA/SI	Weston Solutions, EPA Region 2 SAT Contract, June 8, 2007	Review	None

QAPP Worksheet #14
Summary of Project Tasks

Sampling Tasks: 1. Soil Gas Sampling. SERAS will collect up to 60 soil gas samples as detailed in Worksheet 18 and 19. 2. Groundwater Sampling. SERAS will collect up to 50 groundwater samples as detailed in Worksheet 18 and 19. 3. Soil Sampling. SERAS will collect up to 50 soil samples from suspected contaminated boring locations as detailed in Worksheet 18 and 19. 4. Screening of soil gas. A MultiRae gas analyzer will be used to screen soil gas points prior to sampling. 5. Groundwater parameters such as pH, temperature, dissolved oxygen(DO), oxidation reduction potential (ORP) may be collected during sampling for low flow sampling method. 6. All sample locations will be located using Global Positioning Satellite (GPS) technology.
Analysis Tasks: All samples will be analyzed per the details in Worksheet 19, Analytical SOP Requirements.
Quality Control Tasks: Refer to Worksheet #20 for field QC Samples and Worksheets #12 and #28 for analytical QC Samples based on SERAS SOPs.
Secondary Data: Secondary data will be used as described in Worksheet 13.
Data Management Tasks: Field data will be recorded in field notebooks. SCRIBE will be used for data management. A Final Report will be posted to the ERT/Information Management System (IMS) website for this WA. Posting of the reports will be considered as completion of the deliverable. Hard copies of the deliverables will be archived in the SERAS central Files. Electronic copies of the deliverables will be saved on the SERAS archive drive, and archived in accordance with AP #34, *Archiving Electronic Files*.
Documentation and Records: Observations noted during field efforts will be documented in accordance with SERAS SOP #4001, *Logbook Documentation* and SERAS SOP #2002, *Sample Documentation*. Documents and records that will be generated during this project include: Work Plan (WP), QAPP, Field Logbooks, Sample Labels, Chain of Custody Forms, Custody Seals, Analytical Results and Field Change Forms, if necessary. The Final Report will present the results of groundwater investigation and include all field activities including well sampling records, injection records, and field observations. The final report will be prepared in accordance with SERAS SOP# 4021, *Preparation of Final Reports*.
Assessment/Audit Tasks: A performance audit of field operations is not anticipated for this project. The tasks associated with the QAPP are assessed using peer review and management system review. Peer review enables the task leader to identify and correct reporting errors before reports are submitted. Management system reviews establish compliance with prevailing management structure, policies and procedures, and ensures that the required data are obtained.
Data Review Tasks: Analytical data generated by the ERT/SERAS Laboratory in Edison, NJ with the exception of water samples collected by SP-16 methodology will be validated by SERAS QA/QC chemists per SERAS SOPs. Data validation will be conducted in accordance with the SOPs listed in Worksheet #36. Analytical data generated by the SERAS field chemist will not be validated. All SERAS project deliverables will receive an internal peer review prior to release as per the guidelines established in SERAS Administrative Procedure (AP) #22, *Peer Review of SERAS Deliverables*.

QAPP Worksheet #15-1
Reference Limits and Evaluation Table

Matrix: Soil

Analytical Group: VOA

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/kg) (NYS 375 Protection of Groundwater[2])	Project Quantitation Limit (µg/kg)	SERAS Method 1807/ EPA/SW846 8000B and 8260B Analytical Method		Achievable Laboratory Limits	
				MDLs (µg/kg)	Method QLs (µg/kg)	MDLs[1] (µg/kg)	QLs (µg/kg)
Dichlorodifluoromethane	75-71-8	NS	5.00	NS	5.00	1.12	5.00
Chloromethane	74-87-3	NS	5.00	NS	5.00	0.766	5.00
Vinyl chloride	75-01-4	20	5.00	NS	5.00	0.786	5.00
Bromomethane	74-83-9	NS	5.00	NS	5.00	1.09	5.00
Chloroethane	75-00-3	NS	5.00	NS	5.00	0.957	5.00
Trichlorofluoromethane	75-69-4	NS	5.00	NS	5.00	0.974	5.00
Acetone	67-64-1	50	20.0	NS	20.0	0.97	20.0
1,1-Dichloroethene	75-35-4	330	5.00	NS	5.00	1.27	5.00
Methylene chloride	75-09-2	50	5.00	NS	5.00	2.88	5.00
Carbon disulfide	75-15-0	NS	5.00	NS	5.00	1.37	5.00
Methyl tert-butyl ether	1634-04-4	930	5.00	NS	5.00	0.620	5.00
trans-1,2-Dichloroethene	156-60-5	190	5.00	NS	5.00	0.843	5.00
1,1-Dichloroethane	75-34-3	20	5.00	NS	5.00	0.686	5.00
2-Butanone	78-93-3	NS	5.00	NS	5.00	0.641	5.00
2,2-Dichloropropane	594-20-7	NS	5.00	NS	5.00	0.705	5.00
cis-1,2-Dichloroethene	156-59-2	250	5.00	NS	5.00	0.724	5.00
Chloroform	67-66-3	370	5.00	NS	5.00	0.677	5.00
1,1-Dichloropropene	563-58-6	NS	5.00	NS	5.00	0.728	5.00
1,2-Dichloroethane	107-06-2	20	5.00	NS	5.00	0.604	5.00
1,1,1-Trichloroethane	71-55-6	680	5.00	NS	5.00	0.693	5.00
Carbon tetrachloride	56-23-5	760	5.00	NS	5.00	0.665	5.00
Benzene	71-43-2	60	5.00	NS	5.00	0.785	5.00
Trichloroethene	79-01-6	470	5.00	NS	5.00	0.685	5.00
1,2-Dichloropropane	78-87-5	NS	5.00	NS	5.00	0.652	5.00
Bromodichloromethane	75-27-4	NS	5.00	NS	5.00	0.522	5.00

QAPP Worksheet #15-1
Reference Limits and Evaluation Table

Matrix: Soil

Analytical Group: VOA

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/kg) (NYS 375 Protection of Groundwater[2])	Project Quantitation Limit (µg/kg)	SERAS Method 1807/ EPA/SW846 8000B and 8260B Analytical Method		Achievable Laboratory Limits	
				MDLs (µg/kg)	Method QLs (µg/kg)	MDLs[1] (µg/kg)	QLs (µg/kg)
Dibromomethane	74-95-3	NS	5.00	NS	5.00	0.716	5.00
cis-1,3-Dichloropropene	10061-01-5	NS	5.00	NS	5.00	0.625	5.00
trans-1,3-Dichloro-propene	10061-02-6	NS	5.00	NS	5.00	0.700	5.00
1,1,2-Trichloroethane	79-00-5	NS	5.00	NS	5.00	0.577	5.00
1,3-Dichloropropane	142-28-9	NS	5.00	NS	5.00	0.633	5.00
Dibromochloromethane	124-48-1	NS	5.00	NS	5.00	0.553	5.00
1,2-Dibromoethane	106-93-4	NS	5.00	NS	5.00	0.687	5.00
Bromoform	75-25-2	NS	5.00	NS	5.00	0.545	5.00
4-Methyl-2-pentanone	108-10-1	NS	5.00	NS	5.00	0.498	5.00
Toluene	108-88-3	700	5.00	NS	5.00	1.87	5.00
2-Hexanone	591-78-6	NS	5.00	NS	5.00	0.668	5.00
Tetrachloroethene	127-18-4	1,300	5.00	NS	5.00	0.755	5.00
Chlorobenzene	108-90-7	1,100	5.00	NS	5.00	0.698	5.00
1,1,1,2-Tetrachloro-ethane	630-20-6	NS	5.00	NS	5.00	0.832	5.00
Ethylbenzene	100-41-4	1,000	5.00	NS	5.00	0.819	5.00
m,p-Xylene	108-38-3/ 106-42-3	NS	10.0	NS	10.0	1.70	10.0
o-Xylene	95-47-6	NS	5.00	NS	5.00	0.888	5.00
Styrene	100-42-5	NS	5.00	NS	5.00	0.888	5.00
Isopropylbenzene	98-82-8	NS	5.00	NS	5.00	0.647	5.00
1,1,2,2-Tetrachloro-ethane	79-34-5	NS	5.00	NS	5.00	0.723	5.00
1,2,3-Trichloropropane	96-18-4	NS	5.00	NS	5.00	0.826	5.00
n-Propylbenzene	103-65-1	3,900	5.00	NS	5.00	0.811	5.00
Bromobenzene	108-86-1	NS	5.00	NS	5.00	0.907	5.00

QAPP Worksheet #15-1
Reference Limits and Evaluation Table

Matrix: Soil

Analytical Group: VOA

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/kg) (NYS 375 Protection of Groundwater[2])	Project Quantitation Limit (µg/kg)	SERAS Method 1807/ EPA/SW846 8000B and 8260B Analytical Method		Achievable Laboratory Limits	
				MDLs (µg/kg)	Method QLs (µg/kg)	MDLs[1] (µg/kg)	QLs (µg/kg)
1,3,5-Trimethylbenzene	108-67-8	8,400	5.00	NS	5.00	0.862	5.00
2-Chlorotoluene	95-49-8	NS	5.00	NS	5.00	0.647	5.00
4-Chlorotoluene	106-43-4	NS	5.00	NS	5.00	0.815	5.00
tert-Butylbenzene	98-06-6	5,900	5.00	NS	5.00	0.939	5.00
1,2,4-Trimethylbenzene	95-63-6	3,600	5.00	NS	5.00	0.781	5.00
sec-Butylbenzene	135-98-8	11,000	5.00	NS	5.00	0.710	5.00
p-Isopropyltoluene	99-87-6	NS	5.00	NS	5.00	0.713	5.00
1,3-Dichlorobenzene	541-73-1	2,400	5.00	NS	5.00	0.563	5.00
1,4-Dichlorobenzene	106-46-7	1,800	5.00	NS	5.00	0.754	5.00
n-Butylbenzene	104-51-8	12,000	5.00	NS	5.00	0.832	5.00
1,2-Dichlorobenzene	95-50-1	1,100	5.00	NS	5.00	0.744	5.00
1,2-Dibromo-3 -chloropropane	96-12-8	NS	5.00	NS	5.00	0.551	5.00
1,2,4-Trichlorobenzene	120-82-1	NS	5.00	NS	5.00	0.929	5.00
Hexachlorobutadiene	87-68-3	NS	5.00	NS	5.00	1.18	5.00
Naphthalene	91-20-3	NS	5.00	NS	5.00	0.971	5.00
1,2,3-Trichlorobenzene	87-61-6	NS	5.00	NS	5.00	0.867	5.00

NS = Not Specified

[1] Based on LOD Study dated 4/28/11 for VOC Instrument "B"

[2] New York State Table 375-6.8(b): Restricted Use Soil Cleanup Objectives – Protection of Groundwater.

QAPP Worksheet #15-2
Reference Limits and Evaluation Table

Matrix: Groundwater
Analytical Group: VOA
Concentration Level: Trace

Analyte	CAS Number	Project Action Limit (µg/L) Federal Drinking Water MCLs	Project Action Limit (µg/L) NYS Drinking Water MCLs	Project Quantitation Limit[2] (µg/L)	SERAS Method 1806/ EPA/SW846/8000B and 8260B Analytical Method		Achievable Laboratory Limits	
					MDLs (µg/L)	Method QLs (µg/L)	MDLs[1] (µg/L)	QLs (µg/L)
Dichlorodifluoromethane	75-71-8	NS	5	0.50	NS	5.00	0.412	0.50
Chloromethane	74-87-3	NS	5	1.00	NS	5.00	0.546	1.00
Vinyl chloride	75-01-4	2	2	0.50	NS	5.00	0.453	0.50
Bromomethane	74-83-9	NS	5	1.00	NS	5.00	0.660	1.00
Chloroethane	75-00-3	NS	5	0.50	NS	5.00	0.492	0.50
Trichlorofluoromethane	75-69-4	NS	5	1.00	NS	5.00	0.504	1.00
1,1-Dichloroethene	75-35-4	NS	5	0.50	NS	5.00	0.066	0.50
Methylene chloride	75-09-2	NS	5	0.50	NS	5.00	0.077	0.50
Carbon disulfide	75-15-0	NS	50	0.50	NS	5.00	0.079	0.50
Methyl tert-butyl ether	1634-04-4	NS	10	0.50	NS	5.00	0.038	0.50
trans-1,2-Dichloroethene	156-60-5	100	5	0.50	NS	5.00	0.040	0.50
1,1-Dichloroethane	75-34-3	5	5	0.50	NS	5.00	0.065	0.50
2,2-Dichloropropane	594-20-7	NS	5	0.50	NS	5.00	0.151	0.50
cis-1,2-Dichloroethene	156-59-2	70	5	0.50	NS	5.00	0.042	0.50
Chloroform	67-66-3	80	50	0.50	NS	5.00	0.062	0.50
1,1-Dichloropropene	563-58-6	NS	5	0.50	NS	5.00	0.076	0.50
1,2-Dichloroethane	107-06-2	5	5	0.50	NS	5.00	0.087	0.50
1,1,1-Trichloroethane	71-55-6	20	5	0.50	NS	5.00	0.078	0.50
Carbon tetrachloride	56-23-5	5	5	0.50	NS	5.00	0.077	0.50
Benzene	71-43-2	5	5	0.50	NS	5.00	0.062	0.50
Trichloroethene	79-01-6	5	5	0.50	NS	5.00	0.073	0.50
1,2-Dichloropropane	78-87-5	5	5	0.50	NS	5.00	0.062	0.50
Bromodichloromethane	75-27-4	80	50	0.50	NS	5.00	0.054	0.50
Dibromomethane	74-95-3	NS	5	0.50	NS	5.00	0.057	0.50
cis-1,3-Dichloropropene	10061-01-5	NS	5	0.50	NS	5.00	0.067	0.50

QAPP Worksheet #15-2
Reference Limits and Evaluation Table

Matrix: Groundwater
Analytical Group: VOA
Concentration Level: Trace

Analyte	CAS Number	Project Action Limit (µg/L) Federal Drinking Water MCLs	Project Action Limit (µg/L) NYS Drinking Water MCLs	Project Quantitation Limit[2] (µg/L)	SERAS Method 1806/ EPA/SW846/8000B and 8260B Analytical Method		Achievable Laboratory Limits	
					MDLs (µg/L)	Method QLs (µg/L)	MDLs[1] (µg/L)	QLs (µg/L)
trans-1,3-Dichloropropene	10061-02-6	NS	5	0.50	NS	5.00	0.107	0.50
1,1,2-Trichloroethane	79-00-5	5	5	0.50	NS	5.00	0.097	0.50
1,3-Dichloropropane	142-28-9	NS	5	0.50	NS	5.00	0.057	0.50
Dibromochloromethane	124-48-1	80	50	0.50	NS	5.00	0.065	0.50
1,2-Dibromoethane	106-93-4	NS	50	0.50	NS	5.00	0.083	0.50
Bromoform	75-25-2	80	50	0.50	NS	5.00	0.081	0.50
Toluene	108-88-3	1,000	5	0.50	NS	5.00	0.072	0.50
Tetrachloroethene	127-18-4	5	5	0.50	NS	5.00	0.060	0.50
Chlorobenzene	108-90-7	NS	5	0.50	NS	5.00	0.057	0.50
1,1,1,2-Tetrachloroethane	630-20-6	NS	5	0.50	NS	5.00	0.071	0.50
Ethylbenzene	100-41-4	700	5	0.50	NS	5.00	0.049	0.50
m,p-Xylene	108-38-3/ 106-42-3	NS	5	1.00	NS	10.0	0.108	1.00
o-Xylene	95-47-6	NS	5	0.50	NS	5.00	0.031	0.50
Styrene	100-42-5	100	5	0.50	NS	5.00	0.050	0.50
Isopropylbenzene	98-82-8	NS	5	0.50	NS	5.00	0.056	0.50
1,1,2,2-Tetrachloroethane	79-34-5	NS	5	0.50	NS	5.00	0.072	0.50
1,2,3-Trichlorpropane	96-18-4	NS	5	0.50	NS	5.00	0.130	0.50
n-Propylbenzene	103-65-1	NS	5	0.50	NS	5.00	0.057	0.50
Bromobenzene	108-86-1	NS	5	0.50	NS	5.00	0.042	0.50
1,3,5-Trimethylbenzene	108-67-8	NS	5	0.50	NS	5.00	0.048	0.50
2-Chlorotoluene	95-49-8	NS	5	0.50	NS	5.00	0.081	0.50
4-Chlorotoluene	106-43-4	NS	5	0.50	NS	5.00	0.111	0.50
tert-Butylbenzene	98-06-6	NS	5	0.50	NS	5.00	0.048	0.50
1,2,4-Trimethylbenzene	95-63-6	NS	5	0.50	NS	5.00	0.051	0.50
sec-Butylbenzene	135-98-8	NS	5	0.50	NS	5.00	0.046	0.50

QAPP Worksheet #15-2
Reference Limits and Evaluation Table

Matrix: Groundwater
Analytical Group: VOA
Concentration Level: Trace

Analyte	CAS Number	Project Action Limit (µg/L) Federal Drinking Water MCLs	Project Action Limit (µg/L) NYS Drinking Water MCLs	Project Quantitation Limit[2] (µg/L)	SERAS Method 1806/ EPA/SW846/8000B and 8260B Analytical Method		Achievable Laboratory Limits	
					MDLs (µg/L)	Method QLs (µg/L)	MDLs[1] (µg/L)	QLs (µg/L)
p-Isopropyltoluene	99-87-6	NS	5	0.50	NS	5.00	0.050	0.50
1,3-Dichlorobenzene	541-73-1	NS	5	0.50	NS	5.00	0.047	0.50
1,4-Dichlorobenzene	106-46-7	NS	5	0.50	NS	5.00	0.070	0.50
n-Butylbenzene	104-51-8	NS	5	0.50	NS	5.00	0.065	0.50
1,2-Dichlorobenzene	95-50-1	0.2 [2]	5	0.50	NS	5.00	0.056	0.50
1,2,4-Trichlorobenzene	120-82-1	70	5	0.50	NS	5.00	0.069	0.50
Hexachlorobutadiene	87-68-3	NS	5	0.50	NS	5.00	0.090	0.50
Naphthalene	91-20-3	NS	50	0.50	NS	5.00	0.073	0.50
1,2,3-Trichlorobenzene	87-61-6	NS	5	0.50	NS	5.00	0.075	0.50

NS = Not Specified
[1] Based on LOD Study dated 1/14/11 on system C
[2] Since the benchmark for this compound is a magnitude less than the lowest benchmark, concentrations between the MDL and the RL will be flagged "J" – estimated.

QAPP Worksheet #15-3
Reference Limits and Evaluation Table

Matrix: Groundwater collected by SP-16 methodology for screening only.
Analytical Group: VOA
Concentration Level: Trace

Analyte	CAS Number	Project Action Limit (µg/L) For Screening Only	Project Quantitation Limit[2] (µg/L)	SERAS Method 1806/ EPA/SW846/8000B and 8260B Analytical Method		Achievable Laboratory Limits	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs[1] (µg/L)	QLs (µg/L)
Dichlorodifluoromethane	75-71-8	NS	0.50	NS	5.00	0.412	0.50
Chloromethane	74-87-3	NS	1.00	NS	5.00	0.546	1.00
Vinyl chloride	75-01-4	NS	0.50	NS	5.00	0.453	0.50
Bromomethane	74-83-9	NS	1.00	NS	5.00	0.660	1.00
Chloroethane	75-00-3	NS	0.50	NS	5.00	0.492	0.50
Trichlorofluoromethane	75-69-4	NS	1.00	NS	5.00	0.504	1.00
1,1-Dichloroethene	75-35-4	NS	0.50	NS	5.00	0.066	0.50
Methylene chloride	75-09-2	NS	0.50	NS	5.00	0.077	0.50
Carbon disulfide	75-15-0	NS	0.50	NS	5.00	0.079	0.50
Methyl tert-butyl ether	1634-04-4	NS	0.50	NS	5.00	0.038	0.50
trans-1,2-Dichloroethene	156-60-5	NS	0.50	NS	5.00	0.040	0.50
1,1-Dichloroethane	75-34-3	NS	0.50	NS	5.00	0.065	0.50
2,2-Dichloropropane	594-20-7	NS	0.50	NS	5.00	0.151	0.50
cis-1,2-Dichloroethene	156-59-2	NS	0.50	NS	5.00	0.042	0.50
Chloroform	67-66-3	NS	0.50	NS	5.00	0.062	0.50
1,1-Dichloropropene	563-58-6	NS	0.50	NS	5.00	0.076	0.50
1,2-Dichloroethane	107-06-2	NS	0.50	NS	5.00	0.087	0.50
1,1,1-Trichloroethane	71-55-6	NS	0.50	NS	5.00	0.078	0.50
Carbon tetrachloride	56-23-5	NS	0.50	NS	5.00	0.077	0.50
Benzene	71-43-2	NS	0.50	NS	5.00	0.062	0.50
Trichloroethene	79-01-6	NS	0.50	NS	5.00	0.073	0.50
1,2-Dichloropropane	78-87-5	NS	0.50	NS	5.00	0.062	0.50
Bromodichloromethane	75-27-4	NS	0.50	NS	5.00	0.054	0.50
Dibromomethane	74-95-3	NS	0.50	NS	5.00	0.057	0.50
cis-1,3-Dichloropropene	10061-01-5	NS	0.50	NS	5.00	0.067	0.50

QAPP Worksheet #15-3
Reference Limits and Evaluation Table

Matrix: Groundwater collected by SP-16 methodology for screening only.
Analytical Group: VOA
Concentration Level: Trace

Analyte	CAS Number	Project Action Limit (µg/L) For Screening Only	Project Quantitation Limit[2] (µg/L)	SERAS Method 1806/ EPA/SW846/8000B and 8260B Analytical Method		Achievable Laboratory Limits	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs[1] (µg/L)	QLs (µg/L)
trans-1,3-Dichloropropene	10061-02-6	NS	0.50	NS	5.00	0.107	0.50
1,1,2-Trichloroethane	79-00-5	NS	0.50	NS	5.00	0.097	0.50
1,3-Dichloropropane	142-28-9	NS	0.50	NS	5.00	0.057	0.50
Dibromochloromethane	124-48-1	NS	0.50	NS	5.00	0.065	0.50
1,2-Dibromoethane	106-93-4	NS	0.50	NS	5.00	0.083	0.50
Bromoform	75-25-2	NS	0.50	NS	5.00	0.081	0.50
Toluene	108-88-3	NS	0.50	NS	5.00	0.072	0.50
Tetrachloroethene	127-18-4	NS	0.50	NS	5.00	0.060	0.50
Chlorobenzene	108-90-7	NS	0.50	NS	5.00	0.057	0.50
1,1,1,2-Tetrachloroethane	630-20-6	NS	0.50	NS	5.00	0.071	0.50
Ethylbenzene	100-41-4	NS	0.50	NS	5.00	0.049	0.50
m,p-Xylene	108-38-3/ 106-42-3	NS	1.00	NS	10.0	0.108	1.00
o-Xylene	95-47-6	NS	0.50	NS	5.00	0.031	0.50
Styrene	100-42-5	NS	0.50	NS	5.00	0.050	0.50
Isopropylbenzene	98-82-8	NS	0.50	NS	5.00	0.056	0.50
1,1,2,2-Tetrachloroethane	79-34-5	NS	0.50	NS	5.00	0.072	0.50
1,2,3-Trichlorpropane	96-18-4	NS	0.50	NS	5.00	0.130	0.50
n-Propylbenzene	103-65-1	NS	0.50	NS	5.00	0.057	0.50
Bromobenzene	108-86-1	NS	0.50	NS	5.00	0.042	0.50
1,3,5-Trimethylbenzene	108-67-8	NS	0.50	NS	5.00	0.048	0.50
2-Chlorotoluene	95-49-8	NS	0.50	NS	5.00	0.081	0.50
4-Chlorotoluene	106-43-4	NS	0.50	NS	5.00	0.111	0.50
tert-Butylbenzene	98-06-6	NS	0.50	NS	5.00	0.048	0.50
1,2,4-Trimethylbenzene	95-63-6	NS	0.50	NS	5.00	0.051	0.50
sec-Butylbenzene	135-98-8	NS	0.50	NS	5.00	0.046	0.50

QAPP Worksheet #15-3
Reference Limits and Evaluation Table

Matrix: Groundwater collected by SP-16 methodology for screening only.
Analytical Group: VOA
Concentration Level: Trace

Analyte	CAS Number	Project Action Limit (µg/L) For Screening Only	Project Quantitation Limit[2] (µg/L)	SERAS Method 1806/ EPA/SW846/8000B and 8260B Analytical Method		Achievable Laboratory Limits	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs[1] (µg/L)	QLs (µg/L)
p-Isopropyltoluene	99-87-6	NS	0.50	NS	5.00	0.050	0.50
1,3-Dichlorobenzene	541-73-1	NS	0.50	NS	5.00	0.047	0.50
1,4-Dichlorobenzene	106-46-7	NS	0.50	NS	5.00	0.070	0.50
n-Butylbenzene	104-51-8	NS	0.50	NS	5.00	0.065	0.50
1,2-Dichlorobenzene	95-50-1	NS	0.50	NS	5.00	0.056	0.50
1,2,4-Trichlorobenzene	120-82-1	NS	0.50	NS	5.00	0.069	0.50
Hexachlorobutadiene	87-68-3	NS	0.50	NS	5.00	0.090	0.50
Naphthalene	91-20-3	NS	0.50	NS	5.00	0.073	0.50
1,2,3-Trichlorobenzene	87-61-6	NS	0.50	NS	5.00	0.075	0.50

NS = Not Specified
[1] Based on LOD Study dated 1/14/11 on system C

QAPP Worksheet #15-4
Reference Limits and Evaluation Table

Matrix: Water
Analytical Group: Pesticides/PCBs
Concentration Level: Low

Analyte	CAS Number	Project Action Limit [1] (µg/L) NYS Drinking Water MCLs[1]	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Methods 8081A & 8082 SERAS SOP #1801/1808		Achievable Laboratory Limits	
				MDLs(µg/L)	Method QLs(µg/L)	MDLs[2] (µg/L)	QLs (µg/L)
Aroclor 1016	12674-11-2	0.5	0.250	NS	0.250	0.0533	0.250
Aroclor 1221	11104-28-2	0.5	0.500	NS	0.500	NA	0.500
Aroclor 1232	11141-16-5	0.5	0.250	NS	0.250	NA	0.250
Aroclor 1242	53469-21-9	0.5	0.250	NS	0.250	NA	0.250
Aroclor 1248	12672-29-6	0.5	0.250	NS	0.250	NA	0.250
Aroclor 1254	11097-69-1	0.5	0.250	NS	0.250	NA	0.250
Aroclor 1260	11096-82-5	0.5	0.250	NS	0.250	NA	0.250
Aroclor 1268	11100-14-4	0.5	0.250	NS	0.250	0.0781	0.250
Toxaphene	8001-35-2	3	0.500	NS	0.500	0.142	0.500
a-BHC	319-84-6	NS	0.0200	NS	0.0200	0.00401	0.0200
g-BHC	58-89-9	NS	0.0200	NS	0.0200	0.00590	0.0200
b-BHC	319-85-7	NS	0.0200	NS	0.0200	0.00547	0.0200
d-BHC	319-86-8	NS	0.0200	NS	0.0200	0.00250	0.0200
Heptachlor	76-44-8	0.4	0.0200	NS	0.0200	0.00455	0.0200
Aldrin	309-00-2	NS	0.0200	NS	0.0200	0.00433	0.0200
Heptachlor epoxide	1024-57-3	0.2	0.0200	NS	0.0200	0.00571	0.0200
g-Chlordane	5103-74-2	2	0.0200	NS	0.0200	0.00683	0.0200
a-Chlordane	5104-71-9	2	0.0200	NS	0.0200	0.00731	0.0200
Endosulfan I	959-98-8	NS	0.0200	NS	0.0200	0.00485	0.0200
p,p'-DDE	72-55-9	NS	0.0200	NS	0.0200	0.00622	0.0200
Dieldrin	60-57-1	NS	0.0200	NS	0.0200	0.00601	0.0200
Endrin	72-20-8	2	0.0200	NS	0.0200	0.00600	0.0200
p,p'-DDD	72-54-8	NS	0.0200	NS	0.0200	0.00685	0.0200
Endosulfan II	33213-65-9	NS	0.0200	NS	0.0200	0.00504	0.0200
Endrin aldehyde	7421-93-4	2	0.0200	NS	0.0200	0.0166	0.0200
p,p'-DDT	50-29-3	NS	0.0200	NS	0.0200	0.00487	0.0200

QAPP Worksheet #15-4
Reference Limits and Evaluation Table

Matrix: Water
Analytical Group: Pesticides/PCBs
Concentration Level: Low

Analyte	CAS Number	Project Action Limit [1] (µg/L) NYS Drinking Water MCLs[1]	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Methods 8081A & 8082 SERAS SOP #1801/1808		Achievable Laboratory Limits	
				MDLs(µg/L)	Method QLs(µg/L)	MDLs[2] (µg/L)	QLs (µg/L)
Endosulfan sulfate	1031-07-8	NS	0.0200	NS	0.0200	0.00411	0.0200
Methoxychlor	72-43-5	40	0.0200	NS	0.0200	0.00705	0.0200
Endrin ketone	53494-70-5	2	0.0200	NS	0.0200	0.00857	0.0200

NA = Not Available
NS = Not Specified
1. Maximum Contaminant Levels as detailed in New York State Regulations Part 5, Subpart 5-1 Public Water Systems, Table 3.
2. From LOD Study on ECD4, column XLB, 01/10/11

QAPP Worksheet #15-5
Reference Limits and Evaluation Table

Matrix: Water – Collected using SP-16 methodology for screening only.
Analytical Group: Pesticides/PCBs
Concentration Level: Low

Analyte	CAS Number	Project Action Limit [1] (µg/L) Screening Only	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Methods 8081A & 8082 SERAS SOP #1801/1808		Achievable Laboratory Limits	
				MDLs(µg/L)	Method QLs(µg/L)	MDLs[2] (µg/L)	QLs (µg/L)
Aroclor 1016	12674-11-2	NS	0.250	NS	0.250	0.0533	0.250
Aroclor 1221	11104-28-2	NS	0.500	NS	0.500	NA	0.500
Aroclor 1232	11141-16-5	NS	0.250	NS	0.250	NA	0.250
Aroclor 1242	53469-21-9	NS	0.250	NS	0.250	NA	0.250
Aroclor 1248	12672-29-6	NS	0.250	NS	0.250	NA	0.250
Aroclor 1254	11097-69-1	NS	0.250	NS	0.250	NA	0.250
Aroclor 1260	11096-82-5	NS	0.250	NS	0.250	NA	0.250
Aroclor 1268	11100-14-4	NS	0.250	NS	0.250	0.0781	0.250
Toxaphene	8001-35-2	NS	0.500	NS	0.500	0.142	0.500
a-BHC	319-84-6	NS	0.0200	NS	0.0200	0.00401	0.0200
g-BHC	58-89-9	NS	0.0200	NS	0.0200	0.00590	0.0200
b-BHC	319-85-7	NS	0.0200	NS	0.0200	0.00547	0.0200
d-BHC	319-86-8	NS	0.0200	NS	0.0200	0.00250	0.0200
Heptachlor	76-44-8	NS	0.0200	NS	0.0200	0.00455	0.0200
Aldrin	309-00-2	NS	0.0200	NS	0.0200	0.00433	0.0200
Heptachlor epoxide	1024-57-3	NS	0.0200	NS	0.0200	0.00571	0.0200
g-Chlordane	5103-74-2	NS	0.0200	NS	0.0200	0.00683	0.0200
a-Chlordane	5104-71-9	NS	0.0200	NS	0.0200	0.00731	0.0200
Endosulfan I	959-98-8	NS	0.0200	NS	0.0200	0.00485	0.0200
p,p'-DDE	72-55-9	NS	0.0200	NS	0.0200	0.00622	0.0200
Dieldrin	60-57-1	NS	0.0200	NS	0.0200	0.00601	0.0200
Endrin	72-20-8	NS	0.0200	NS	0.0200	0.00600	0.0200
p,p'-DDD	72-54-8	NS	0.0200	NS	0.0200	0.00685	0.0200
Endosulfan II	33213-65-9	NS	0.0200	NS	0.0200	0.00504	0.0200
Endrin aldehyde	7421-93-4	NS	0.0200	NS	0.0200	0.0166	0.0200
p,p'-DDT	50-29-3	NS	0.0200	NS	0.0200	0.00487	0.0200

QAPP Worksheet #15-5
Reference Limits and Evaluation Table

Matrix: Water – Collected using SP-16 methodology for screening only.
Analytical Group: Pesticides/PCBs
Concentration Level: Low

Analyte	CAS Number	Project Action Limit [1] (µg/L) Screening Only	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Methods 8081A & 8082 SERAS SOP #1801/1808		Achievable Laboratory Limits	
				MDLs(µg/L)	Method QLs(µg/L)	MDLs[2] (µg/L)	QLs (µg/L)
Endosulfan sulfate	1031-07-8	NS	0.0200	NS	0.0200	0.00411	0.0200
Methoxychlor	72-43-5	NS	0.0200	NS	0.0200	0.00705	0.0200
Endrin ketone	53494-70-5	NS	0.0200	NS	0.0200	0.00857	0.0200

NA = Not Available
NS = Not Specified
1. Maximum Contaminant Levels as detailed in New York State Regulations Part 5, Subpart 5-1 Public Water Systems, Table 3.
2. From LOD study on ECD4, column XLB, 01/10/11

QAPP Worksheet #15-6
Reference Limits and Evaluation Table

Matrix: Water
Analytical Group: SVOC
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Federal MCLs	Project Action Limit (µg/L) NYS Drinking Water MCLs[1]	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Method 8270C SERAS SOP #1804		Achievable Laboratory Limits	
					MDLs	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
Phenol	108-95-2	NS	50	10	NA	10	1.65	10
bis(-2-Chloroethyl)Ether	111-44-4	NS	50	10	NA	10	2.34	10
2-Chlorophenol	95-57-8	NS	50	10	NA	10	2.08	10
1,3-Dichlorobenzene	541-73-1	NS	5[4]	10	NA	10	1.47	10
1,4-Dichlorobenzene	106-46-7	NS	5[4]	10	NA	10	1.44	10
Benzyl alcohol	100-51-6	NS	50	10	NA	10	1.95	10
1,2-Dichlorobenzene	95-50-1	NS	5[4]	10	NA	10	1.59	10
2-Methylphenol	95-48-7	NS	50	10	NA	10	1.67	10
bis(2-Chloroisopropyl)ether	39638-32-9	NS	50	10	NA	10	2.57	10
4-Methylphenol	106-44-5	NS	50	10	NA	10	1.73	10
N-Nitroso-Di-n-propylamine	621-64-7	NS	50	10	NA	10	3.01	10
Hexachloroethane	67-72-1	NS	50	10	NA	10	1.87	10
Nitrobenzene	98-95-3	NS	50	10	NA	10	2.37	10
Isophorone	78-59-1	NS	50	10	NA	10	2.34	10
2-Nitrophenol	88-75-5	NS	50	10	NA	10	2.37	10
2,4-Dimethylphenol	105-67-9	NS	50	10	NA	10	3.33	10
bis(2-Chloroethoxy)methane	111-91-1	NS	50	10	NA	10	2.55	10
2,4-Dichlorophenol	120-83-2	NS	50	10	NA	10	2.01	10
1,2,4-Trichlorobenzene	120-82-1	70	5[4]	10	NA	10	1.80	10
Naphthalene	91-20-3	NS	50	10	NA	10	2.04	10
4-Chloroaniline	106-47-8	NS	50	10	NA	10	1.57	10
Hexachlorobutadiene	87-68-3	NS	5[4]	10	NA	10	1.86	10
4-Chloro-3-methylphenol	59-50-7	NS	50	10	NA	10	2.07	10

QAPP Worksheet #15-6
Reference Limits and Evaluation Table

Matrix: Water
Analytical Group: SVOC
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Federal MCLs	Project Action Limit (µg/L) NYS Drinking Water MCLs[1]	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Method 8270C SERAS SOP #1804		Achievable Laboratory Limits	
					MDLs	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
2-Methylnaphthalene	91-57-6	NS	50	10	NA	10	1.97	10
Hexachlorocyclopentadiene	77-47-4	50	50	10	NA	10	1.60	10
2,4,6-Trichlorophenol	88-06-2	NS	50	10	NA	10	1.86	10
2,4,5-Trichlorophenol	95-95-4	NS	50	10	NA	10	1.97	10
2-Chloronaphthalene	91-58-7	NS	50	10	NA	10	1.93	10
2-Nitroaniline	88-74-4	NS	50	10	NA	10	1.82	10
Dimethylphthalate	131-11-3	NS	50	10	NA	10	1.72	10
Acenaphthylene	208-96-8	NS	50	10	NA	10	1.91	10
2,6-Dinitrotoluene	606-20-2	NS	50	10	NA	10	1.94	10
3-Nitroaniline	99-09-2	NS	50	10	NA	10	1.57	10
Acenaphthene	88-32-9	NS	50	10	NA	10	1.93	10
2,4-Dinitrophenol	51-28-5	NS	50	10	NA	10	8.39	10
4-Nitrophenol	10-02-7	NS	50	10	NA	10	1.64	10
Dibenzofuran	132-64-7	NS	50	10	NA	10	1.76	10
2,4-Dinitrotoluene	121-14-2	NS	50	10	NA	10	2.44	10
Diethylphthalate	84-66-2	NS	50	10	NA	10	1.57	10
4-Chlorophenyl-phenylether	7005-72-3	NS	50	10	NA	10	1.66	10
Fluorene	86-73-7	NS	50	10	NA	10	1.78	10
4-Nitroaniline	100-01-6	NS	50	10	NA	10	1.92	10
4,6-Dinitro-2-methylphenol	534-30-6	NS	50	10	NA	10	4.60	10
N-Nitrosodiphenylamine	88-30-6	NS	50	10	NA	10	1.80	10
4-Bromophenyl-phenylether	101-55-3	NS	50	10	NA	10	1.36	10
Hexachlorobenzene	118-74-1	1[3]	1[3]	10	NA	10	1.60	10
Pentachlorophenol	87-86-5	1[3]	1[3]	10	NA	10	3.41	10

QAPP Worksheet #15-6
Reference Limits and Evaluation Table

Matrix: Water
Analytical Group: SVOC
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Federal MCLs	Project Action Limit (µg/L) NYS Drinking Water MCLs[1]	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Method 8270C SERAS SOP #1804		Achievable Laboratory Limits	
					MDLs	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
Phenanthrene	85-01-8	NS	50	10	NA	10	1.61	10
Anthracene	120-12-7	NS	50	10	NA	10	1.57	10
Carbazole	86-74-8	NS	50	10	NA	10	2.02	10
Di-n-butylphthalate	84-74-2	NS	50	10	NA	10	1.69	10
Fluoranthene	206-44-0	NS	50	10	NA	10	1.74	10
Pyrene	129-00-0	NS	50	10	NA	10	1.99	10
Butylbenzylphthalate	85-68-7	NS	50	10	NA	10	1.43	10
Benzo(a)anthracene	55-55-3	NS	50	10	NA	10	1.55	10
3,3'-Dichlorobenzidine	91-94-1	NS	50	10	NA	10	2.60	10
Chrysene	218-01-9	NS	50	10	NA	10	1.44	10
Bis(2-Ethylhexyl)phthalate	117-81-7	NS	50	10	NA	10	1.10	10
Di-n-octylphthalate	117-84-0	NS	50	10	NA	10	1.35	10
Benzo(b)fluoranthene	205-99-2	NS	50	10	NA	10	2.32	10
Benzo(k)fluoranthene	207-08-9	NS	50	10	NA	10	2.26	10
Benzo(a)pyrene	50-32-8	0.2[3]	0.2[3]	10	NA	10	1.90	10
Indeno(1,2,3-cd)pyrene	465-73-6	NS	NS	10	NA	10	1.30	10
Dibenzo(a,h)anthracene	53-70-3	NS	NS	10	NA	10	1.65	10
Benzo(g,h,i)perylene	191-24-2	NS	NS	10	NA	10	1.45	10

1. Referenced for NYS DW MCLs
2. From MDL study 1/20/11 on instrument Smyrna II
3. Since the benchmark is < both the MDL and the RL, any concentration found in the samples between the MDL and the RL will be flagged "J" – estimated.
4. Since the benchmark is < the RL but > the MDL, any concentration found in the samples between the MDL and the RL will be flagged "J" – estimated.

NS = Not Specified
NA = Not Available

QAPP Worksheet #15-7
Reference Limits and Evaluation Table

Matrix: Water – Collected by SP-16 methodology for screening only
Analytical Group: SVOC
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Screening Only	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Method 8270C SERAS SOP #1804		Achievable Laboratory Limits	
				MDLs	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
Phenol	108-95-2	NS	10	NA	10	1.65	10
bis(-2-Chloroethyl)Ether	111-44-4	NS	10	NA	10	2.34	10
2-Chlorophenol	95-57-8	NS	10	NA	10	2.08	10
1,3-Dichlorobenzene	541-73-1	NS	10	NA	10	1.47	10
1,4-Dichlorobenzene	106-46-7	NS	10	NA	10	1.44	10
Benzyl alcohol	100-51-6	NS	10	NA	10	1.95	10
1,2-Dichlorobenzene	95-50-1	NS	10	NA	10	1.59	10
2-Methylphenol	95-48-7	NS	10	NA	10	1.67	10
bis(2-Chloroisopropyl)ether	39638-32-9	NS	10	NA	10	2.57	10
4-Methylphenol	106-44-5	NS	10	NA	10	1.73	10
N-Nitroso-Di-n-propylamine	621-64-7	NS	10	NA	10	3.01	10
Hexachloroethane	67-72-1	NS	10	NA	10	1.87	10
Nitrobenzene	98-95-3	NS	10	NA	10	2.37	10
Isophorone	78-59-1	NS	10	NA	10	2.34	10
2-Nitrophenol	88-75-5	NS	10	NA	10	2.37	10
2,4-Dimethylphenol	105-67-9	NS	10	NA	10	3.33	10
bis(2-Chloroethoxy)methane	111-91-1	NS	10	NA	10	2.55	10
2,4-Dichlorophenol	120-83-2	NS	10	NA	10	2.01	10
1,2,4-Trichlorobenzene	120-82-1	NS	10	NA	10	1.80	10
Naphthalene	91-20-3	NS	10	NA	10	2.04	10
4-Chloroaniline	106-47-8	NS	10	NA	10	1.57	10
Hexachlorobutadiene	87-68-3	NS	10	NA	10	1.86	10
4-Chloro-3-methylphenol	59-50-7	NS	10	NA	10	2.07	10
2-Methylnaphthalene	91-57-6	NS	10	NA	10	1.97	10
Hexachlorocyclopentadiene	77-47-4	NS	10	NA	10	1.60	10

QAPP Worksheet #15-7
Reference Limits and Evaluation Table

Matrix: Water – Collected by SP-16 methodology for screening only
Analytical Group: SVOC
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Screening Only	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Method 8270C SERAS SOP #1804		Achievable Laboratory Limits	
				MDLs	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
2,4,6-Trichlorophenol	88-06-2	NS	10	NA	10	1.86	10
2,4,5-Trichlorophenol	95-95-4	NS	10	NA	10	1.97	10
2-Chloronaphthalene	91-58-7	NS	10	NA	10	1.93	10
2-Nitroaniline	88-74-4	NS	10	NA	10	1.82	10
Dimethylphthalate	131-11-3	NS	10	NA	10	1.72	10
Acenaphthylene	208-96-8	NS	10	NA	10	1.91	10
2,6-Dinitrotoluene	606-20-2	NS	10	NA	10	1.94	10
3-Nitroaniline	99-09-2	NS	10	NA	10	1.57	10
Acenaphthene	88-32-9	NS	10	NA	10	1.93	10
2,4-Dinitrophenol	51-28-5	NS	10	NA	10	8.39	10
4-Nitrophenol	10-02-7	NS	10	NA	10	1.64	10
Dibenzofuran	132-64-7	NS	10	NA	10	1.76	10
2,4-Dinitrotoluene	121-14-2	NS	10	NA	10	2.44	10
Diethylphthalate	84-66-2	NS	10	NA	10	1.57	10
4-Chlorophenyl-phenylether	7005-72-3	NS	10	NA	10	1.66	10
Fluorene	86-73-7	NS	10	NA	10	1.78	10
4-Nitroaniline	100-01-6	NS	10	NA	10	1.92	10
4,6-Dinitro-2-methylphenol	534-30-6	NS	10	NA	10	4.60	10
N-Nitrosodiphenylamine	88-30-6	NS	10	NA	10	1.80	10
4-Bromophenyl-phenylether	101-55-3	NS	10	NA	10	1.36	10
Hexachlorobenzene	118-74-1	NS	10	NA	10	1.60	10
Pentachlorophenol	87-86-5	NS	10	NA	10	3.41	10
Phenanthrene	85-01-8	NS	10	NA	10	1.61	10
Anthracene	120-12-7	NS	10	NA	10	1.57	10
Carbazole	86-74-8	NS	10	NA	10	2.02	10

QAPP Worksheet #15-7
Reference Limits and Evaluation Table

Matrix: Water – Collected by SP-16 methodology for screening only
Analytical Group: SVOC
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Screening Only	Project Quantitation Limit (µg/L)	Analytical Method SW-846 Method 8270C SERAS SOP #1804		Achievable Laboratory Limits	
				MDLs	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
Di-n-butylphthalate	84-74-2	NS	10	NA	10	1.69	10
Fluoranthene	206-44-0	NS	10	NA	10	1.74	10
Pyrene	129-00-0	NS	10	NA	10	1.99	10
Butylbenzylphthalate	85-68-7	NS	10	NA	10	1.43	10
Benzo(a)anthracene	55-55-3	NS	10	NA	10	1.55	10
3,3'-Dichlorobenzidine	91-94-1	NS	10	NA	10	2.60	10
Chrysene	218-01-9	NS	10	NA	10	1.44	10
Bis(2-Ethylhexyl)phthalate	117-81-7	NS	10	NA	10	1.10	10
Di-n-octylphthalate	117-84-0	NS	10	NA	10	1.35	10
Benzo(b)fluoranthene	205-99-2	NS	10	NA	10	2.32	10
Benzo(k)fluoranthene	207-08-9	NS	10	NA	10	2.26	10
Benzo(a)pyrene	50-32-8	0.2	10	NA	10	1.90	10
Indeno(1,2,3-cd)pyrene	465-73-6	NS	10	NA	10	1.30	10
Dibenzo(a,h)anthracene	53-70-3	NS	10	NA	10	1.65	10
Benzo(g,h,i)perylene	191-24-2	NS	10	NA	10	1.45	10

From MDL study 1/20/11 on instrument Smyrna II
NS = Not Specified
NA = Not Available

QAPP Worksheet #15-8
Reference Limits and Evaluation Table

Matrix: Groundwater
Analytical Group: ICP Metals
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Federal MCLs	Project Action Limit [1] (µg/L) NYS Drinking Water MCLs	Project Quantitation Limit (µg/L)	Analytical Method SERAS SOP 1811, Rev. 4.0		Achievable Laboratory Limits (µg/L) [a]	
					MDLs (µg/L)	Method QLs (µg/L)	MDLs[2] (µg/L)	QLs (µg/L)
Aluminum	7429-90-5	NS	NS	90	NS	100	22.4	90
Antimony	7440-36-0	6 [3]	6 [3]	10	NS	10	1.91	10
Arsenic	7440-38-2	10 [3]	10 [3]	19	NS	20	2.45	19
Barium	7440-39-3	2,000	2,000	3	NS	2	0.31	3
Beryllium	7440-41-7	4	4	2	NS	2	0.18	2
Boron	7440-42-8	NS	NS	10	NS	10	0.65	10
Cadmium	7440-43-9	5	5	2	NS	2	0.1	2
Calcium	7440-70-2	NS	NS	100	NS	60	44.3	100
Chromium	7440-47-3	100	100	3	NS	3	0.48	3
Cobalt	7440-48-4	NS	NS	2	NS	2	0.16	2
Copper	7440-50-8	1,300	NS	8	NS	5	0.48	8
Iron (2599)	7439-89-6	NS	300	40	NS	35	9.03	40
Iron (2714)	7439-89-6	NS	300	300	NS	300	48.0	300
Lead	7439-92-1	15	NS	10	NS	10	1.76	10
Magnesium	7439-95-4	NS	NS	200	NS	160	15.6	200
Manganese	7439-96-5	NS	300	2	NS	2	0.11	2
Mercury	7439-97-6	2	2	0.200	NS	0.200	NA	0.200
Molybdenum	7439-98-7	NS	NS	5	NS	5	0.39	5
Nickel	7440-02-0	NS	NS	3	NS	3	0.64	3
Potassium	7440-09-7	NS	NS	250	NS	250	52.1	250
Selenium	7782-49-2	50	50	18	NS	15	4.43	18
Silver	7440-22-4	NS	100	8	NS	5	0.84	8
Sodium	7440-23-5	NS	NS	200	NS	200	10.4	200
Strontium	7440-24-6	NS	NS	2	NS	2	0.15	2
Thallium	7440-28-0	2 [3]	2 [3]	17	NS	17	1.26	17

QAPP Worksheet #15-8
Reference Limits and Evaluation Table

Matrix: Groundwater
Analytical Group: ICP Metals
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Federal MCLs	Project Action Limit [1] (µg/L) NYS Drinking Water MCLs	Project Quantitation Limit (µg/L)	Analytical Method SERAS SOP 1811, Rev. 4.0		Achievable Laboratory Limits (µg/L) [a]	
					MDLs (µg/L)	Method QLs (µg/L)	MDLs[2] (µg/L)	QLs (µg/L)
Tin	7440-31-5	NS	NS	10	NS	10	0.76	10
Vanadium	7440-62-2	NS	NS	3	NS	2	0.75	3
Zinc	7440-66-6	NS	5,000	22	NS	20	5.05	22

[a] Achievable Laboratory Limits based on digestion of 45 mL sample to 50 mL final volume.
NS = Not Specified
NA = Not Applicable
[1] Maximum Contaminant Levels as detailed in New York State Regulations Part 5, Subpart 5-1 Public Water Systems, Table 3.
[2] Based on LOD Study dated 12/16/10 for the iCAP 6500 using hot block digestion
[3] QLs exceed the benchmarks. For the first round of sampling, the QLs will be reported even though they exceed the benchmarks.

QAPP Worksheet #15-9
Reference Limits and Evaluation Table

Matrix: Groundwater – Collected using SP-16 Methodology for screening only.
Analytical Group: ICP Metals
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Screening Only	Project Quantitation Limit (µg/L)	Analytical Method SERAS SOP 1811, Rev. 4.0		Achievable Laboratory Limits (µg/L) [a]	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs[1] (µg/L)	QLs (µg/L)
Aluminum	7429-90-5	NS	90	NS	100	22.4	90
Antimony	7440-36-0	NS	10	NS	10	1.91	10
Arsenic	7440-38-2	NS	19	NS	20	2.45	19
Barium	7440-39-3	NS	3	NS	2	0.31	3
Beryllium	7440-41-7	NS	2	NS	2	0.18	2
Boron	7440-42-8	NS	10	NS	10	0.65	10
Cadmium	7440-43-9	NS	2	NS	2	0.1	2
Calcium	7440-70-2	NS	100	NS	60	44.3	100
Chromium	7440-47-3	NS	3	NS	3	0.48	3
Cobalt	7440-48-4	NS	2	NS	2	0.16	2
Copper	7440-50-8	NS	8	NS	5	0.48	8
Iron (2599)	7439-89-6	NS	40	NS	35	9.03	40
Iron (2714)	7439-89-6	NS	300	NS	300	48.0	300
Lead	7439-92-1	NS	10	NS	10	1.76	10
Magnesium	7439-95-4	NS	200	NS	160	15.6	200
Manganese	7439-96-5	NS	2	NS	2	0.11	2
Mercury		NS	0.200	NS	0.200	NA	0.200
Molybdenum	7439-98-7	NS	5	NS	5	0.39	5
Nickel	7440-02-0	NS	3	NS	3	0.64	3
Potassium	7440-09-7	NS	250	NS	250	52.1	250
Selenium	7782-49-2	NS	18	NS	15	4.43	18
Silver	7440-22-4	NS	8	NS	5	0.84	8
Sodium	7440-23-5	NS	200	NS	200	10.4	200
Strontium	7440-24-6	NS	2	NS	2	0.15	2

QAPP Worksheet #15-9
Reference Limits and Evaluation Table

Matrix: Groundwater – Collected using SP-16 Methodology for screening only.
Analytical Group: ICP Metals
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L) Screening Only	Project Quantitation Limit (µg/L)	Analytical Method SERAS SOP 1811, Rev. 4.0		Achievable Laboratory Limits (µg/L) [a]	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs[1] (µg/L)	QLs (µg/L)
Thallium	7440-28-0	NS	17	NS	17	1.26	17
Tin	7440-31-5	NS	10	NS	10	0.76	10
Vanadium	7440-62-2	NS	3	NS	2	0.75	3
Zinc	7440-66-6	NS	22	NS	20	5.05	22

[a] Achievable Laboratory Limits based on digestion of 45 mL sample to 50 mL final volume.
NS = Not Specified
NA = Not Applicable
[1] Based on LOD Study dated 12/16/10 for the iCAP 6500 using hot block digestion

QAPP Worksheet #15-10
Reference Limits and Evaluation Table

Matrix: Air
Analytical Group: VOCs by Photovac GC
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (applicable units)	Project Quantitation Limit (ppbv)	Analytical Method		Achievable Laboratory Limits	
		See Note 2		MDL	Method QL	MDL[1] (ppbv)	QL (ppbv)
cis-1,2-Dichloroethene	156-59-2	10	10	NA	NA	2.71	10
Trichloroethene	79-01-6	10	10	NA	NA	3.73	10
Tetrachloroethene	127-18-4	10	10	NA	NA	3.53	10

[1] Based on LOD/LOQ Study conducted on 5/20/11 on the Voyager GC using the probe
[2] Project Action limit is based on presence/absence of contaminants of concern in vapor stream, and is therefore equal to the quantitation limit.

QAPP Worksheet 15-11
Reference Limits and Evaluation Table

Matrix: Soil Gas (SUMMA® Canister)

Analytical Group: VOA

Concentration Level: Low Level Scan

Analyte	CAS Number	Project Action Limit [1] (ppbv)	Project Quantitation Limit (ppbv)	SERAS SOP 1814 Analytical Method		Achievable Laboratory Limits	
				MDLs[2]	Method QLs	MDL s[3]	QLs
Trichloroethene	79-01-6	10	0.200	NS	0.0667 ppbv	0.0079 ppbv	0.200 ppbv
Tetrachloroethene	127-18-4	10	0.200	NS	0.0667 ppbv	0.0070 ppbv	0.200 ppbv
1,1-Dichloroethene	75-35-4	10	0.200	NS	0.0667 ppbv	0.0086 ppbv	0.200 ppbv
1,1-Dichloroethane	75-34-3	10	0.200	NS	0.0667 ppbv	0.0066 ppbv	0.200 ppbv
1,2-Dichloroethane	107-06-2	10	0.200	NS	0.0667 ppbv	0.0041 ppbv	0.200 ppbv
cis-1,2-Dichloroethene	156-59-2	10	0.200	NS	0.0667 ppbv	0.0068 ppbv	0.200 ppbv
trans-1,2-Dichloroethene	156-60-5	10	0.200	NS	0.0667 ppbv	0.0036 ppbv	0.200 ppbv
Vinyl chloride	75-01-4	10	0.200	NS	0.0667 ppbv	0.0060 ppbv	0.200 ppbv

[1] Based on Table 2b: Question 4 Generic Screening Levels and Summary Sheet of the *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils Subsurface Vapor Intrusion Guidance,* EPA, November 2002, Risk=$1x10^{-5}$.
[2] Not Specified in SOP 1814.
[3] Based on LOD study conducted on Instrument#1 Air Toxics dated 2/4/11
$\mu g/m^3$ = microgram per cubic meter ppbv = parts per billion by volume NL = Not listed in Table 4 of Method TO-15

QAPP Worksheet #16
Project Schedule Timeline Table

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Preparation of QAPP	SERAS	5/2/2011	6/5/2011	UFP-QAPP	6/6/2011
Health and Safety Plan	SERAS	6/3/2011	6/6/2011	Health and Safety Plan	6/6/2011
RFQ for Geoprobe Sampling Assistance	SERAS	5/2/2011	5/9/2011	RFQ	5/9/2011
Preliminary Work Assignment	SERAS	6/2/2011	6/2/2011	PWA	6/2/2011
Soil Gas Sampling Event	SERAS	6/13/2011	6/17/2011	NA	NA
Groundwater/Soil Sampling Event	SERAS	TBD	TBD	NA	NA
Preliminary Data Package	SERAS	Upon receipt of Samples	2 weeks from receipt of last sample.	Unvalidated Data Package	2 weeks from receipt of last sample.
Final Validated Analytical Results	SERAS	Receipt of Unvalidated Data Package	2 weeks from receipt of Unvalidated Data Package	Validated Data Package	2 weeks from receipt of Unvalidated Data Package
Draft Final Report	SERAS	Receipt of Validated Data Package	2 weeks from receipt of Validated Data Package	Draft Final Report	2 weeks from receipt of Validated Data Package
Final Report	SERAS	Receipt of comments from WAM regarding Draft Final Report	1 week from receipt of comments from WAM	Final Report	1 week from receipt of comments from WAM
Conceptual Site Model	SERAS	TBD	TBD	CSM	TBD

QAPP Worksheet #17
Sampling Design and Rationale

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach): Sampling locations will be judgmentally chosen by the Region 2 RPM and WAM based on historical research into possible contamination sources. At each suspected source, soil gas samples will be collected from both inside (sub-slab soil gas) or around the property. When the field screening results indicate the presence of PCE, TCE or cis 1,2 DCE content, further sampling may be requested by the WAM or RPM. Results from field screening soil gas samples will also be used to determine future sampling of sub-surface soils for use in the CSM. Groundwater samples will be collected from previously installed monitoring wells and public water sources. These will be determined by the Region 2 RPM and WAM. Temporary well points using SP-16 methodology may be used to collect groundwater samples around suspected source areas. Groundwater results will be used to augment existing data for the RI and will assist in the generation of the CSM.
Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be taken, and the sampling frequency (including seasonal considerations) [May refer to map or Worksheet #18 for details]: Soil gas is the primary matrix to be sampled during the initial field event. The soil gas will be collected in Tedlar bags and analyzed on-site. Ten percent of the soil gas locations will be sampled by collecting a grab sample in a SUMMA canister and submitted to the ERT/SERAS Laboratory ofr confirmation analysis. Approximately 60 soil gas locations have been planned, as detailed in Worksheets 18 and 19. Samples will be located at approximately 8 separate areas within the city of Cabo Rojo. Groundwater samples will be collected from approximately 50 locations (exact details to be determined by RPM and WAM). Water samples may contain VOC levels from trace to high. Should the source be located, it would be assumed that percent levels of contaminant could be present. Soil samples will be collected (up to 50) from suspected source areas to assist with the delineation of the source area as well as the quantity of impacted soils.

QAPP Worksheet #18
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth ( )	Analytical Group	Concentration Level	Number of Samples (identify field duplicates	Sampling SOP Reference[1]	Rationale for Sampling Location
To Be Determined	Soil Gas	TBD	PCE, TCE, cis 1,2 DCE	Low	35(4)	SERAS SOP #2042	Judgmental
To Be Determined	Soil Gas	Sub-Slab	PCE, TCE, cis 1,2 DCE	Low	25(3)	SERAS SOP #2082	Judgmental
To Be Determined	Soil Gas	Varies	VOCs	Low	6	SERAS SOP #1704	Judgmental
To Be Determined	Groundwater	Varies	VOCs	Trace	50(5)	SERAS SOP #2007	Judgmental
		Varies	TAL Metals	Low	25(3)	SERAS SOP #2007	Judgmental
		Varies	PCBs/Pesticides	Low	25(3)	SERAS SOP #2007	Judgmental
		Varies	SVOCs	Low	25(3)	SERAS SOP #2007	Judgmental
To Be Determined	Soil	Varies (<20 feet)	VOC	Low	20(2)	SERAS SOP #2012	Judgmental

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #21)

QAPP Worksheet #19
Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference [1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Soil Gas	VOA	Low	EPA Method TO-15/SERAS SOP #1814	4-5 Liters	1, 6-L SUMMA®, Grab	none	30 days
Soil Gas	VOA	Low	Voyager Portable Gas Chromatograph User's Manual	5-50 mL	1-L Tedlar bag (1)	Protect from light	24 hours
Soil	VOA	Low	EPA SW-846 Method 8260B/SERAS SOP#1807	5 g (Terracore)	3 40-mL preweighed VOA vials with stirring bar + 4oz jar for Moisture content	4C	14 Days
Groundwater	VOA	Trace	SERAS SOP #1806	120 mL	3 – 40 mL VOA vials	1:1 HCl to pH <2, 4C	14 Days
Groundwater	PCBs	Low	SERAS SOP #1801	1 Liter	1, 1-Liter Amber Round Bottle	4C, Protected from light	Sample -7 Days Extract – 40 Days
Groundwater	SVOCs	Low	SERAS SOP #1804	1 Liter	1, 1-Liter Amber Round Bottle	4C, Protected from light	Sample -7 Days Extract – 40 Days
Groundwater	Pesticides	Low	SERAS SOP #1808	1 Liter	1, 1-Liter Amber Round Bottle	4C, Protected from light	Sample -7 Days Extract – 40 Days
Groundwater	TAL Metals (Including Hg)	Low	SERAS SOP #1811/SOP #1832	1 Liter	1 Liter Poly Bottle	HNO_3 to pH <2 4C	6 Months 28 days (Hg)

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23)

QAPP Worksheet #20
Field Quality Control Sample Summary Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference[1]	No. of Sampling Locations	No. of Field Duplicate Pairs	No. of MS	No. of Field Blanks	No. of Trip Blanks	No. of PT Samples	Total No. of Samples to Lab
Soil Gas	VOA	Low	EPA Method TO-15	6	NA	NA	NA	1	NA	7
Soil Gas	VOA	Low	Voyager Portable Gas Chromatograph User's Manual	60	6	NA	NA	NA	NA	66
Soil	VOA	Low	EPA SW-846 Method 8260B/SERAS SOP#1807	20	1	2	NA	NA	NA	23
Groundwater	VOA	Trace	SERAS SOP #1806	50	3	5	1 per day	1 per shipment	NA	Up to 68
Groundwater	PCBs	Low	SERAS SOP #1801	25	2	3	1 per day	NA	NA	Up to 35
Groundwater	SVOCs	Low	SERAS SOP #1804	25	2	3	1 per day	NA	NA	Up to 35
Groundwater	Pesticides	Low	SERAS SOP #1808	25	2	3	1 per day	NA	NA	Up to 35
Groundwater	TAL Metals (Including Hg)	Low	SERAS SOP #1811/SOP #1832	25	2	3	1 per day	NA	NA	Up to 35

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23)

QAPP Worksheet #21
Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Check if yes)	Comments
1704	*SUMMA® Canister Sampling*	SERAS	6-L SUMMA®	☐	
2001	*General Field Sampling Guidelines*	SERAS	General Sampling	☐	
2002	*Sample Documentation*	SERAS	NA	☐	
2003	*Sample Storage, Preservation and Handling*	SERAS	Sample Handling	☐	
2004	*Sample Packaging and Shipment*	SERAS	Sample Handling	☐	
2005	*Quality Assurance/Quality Control Samples*	SERAS	NA	☐	
2006	*Sampling Equipment Decontamination*	SERAS	Sampling Equipment	☐	
2007	*Groundwater Well Sampling*	SERAS	Sampling Equipment	☐	
2012	*Soil Sampling*	SERAS	Direct Push	☐	
2042	*Soil Gas Sampling*	SERAS	1-L Tedlar Bag	☐	
2082	*Construction and Installation of Permanent Sub-Slab Soil Gas Wells*	SERAS	Ports	☐	
2102	*Tedlar Bag Sampling*	SERAS	1-L Tedlar Bag	☐	
4001	*Logbook Documentation*	SERAS	Site Activities	☐	
4005	*Chain of Custody Procedures*	SERAS	Sample Handling	☐	

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

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
SUMMA® canisters	NA	Clean/Certify canister	Analyze*	Check for leaks	As cleaned and tested	< RL	Reclean and reanalyze	GC/MS Chemist	EPA Method TO-15
MultiRAE 10.6eV PID	Zero and Span Cal	Clean PID sensor and lamp as needed	Bump	Check keypad, LCD screen working, Check datalogger	Calibrate before use/monthly/ as needed	+/- 10%	Check gas concentration. Recalibrate, or clean sensor and lamp and recalibrate	Field Personnel	
Global Position System Receiver	NA	Keep GPS Clean and Charged	Verify operation	Prior to deployment in field, visual inspection	Daily	Varies with satellite reception.	Charge Batteries/ Replace	Task Leader	Per Manufacturer's instructions
YSI 650 MDS	Temperature		Compare temperature sensor reading to NIST thermometer measurement		Annually	±0.15 degree celsius	Contact manufacturer	Biologist	Manufacturer's manual
YSI 650 MDS	pH	Calibrate probe using standards that bracket expected values (pH 4, 7 and 10)	After performing 3-point calibration, immerse probe I pH 7 buffer to make sure it is reading correctly		As necessary	±0.05	Recalibrate	Biologist	Manufacturer's manual
YSI 650 MDS	Specific Conductance	Calibrate at a temperature of 25 degree Celsius			As necessary	±10%	Recalibrate	Biologist	Manufacturer's manual
YSI 650 MDS	Turbidity	2-point calibration	Insert probe in 10.0 NTU standard		As necessary	Between 9.5 and 10.0 NTU	Recalibrate	Biologist	Manufacturer's manual

[1]Specify the appropriate reference letter or number from the Project Sampling SOP References table (Worksheet #21)

QAPP Worksheet #23
Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
Part No. 380301, Rev C	Voyager Portable Digital Gas Chromatograph User's Manual	Screening	VOA	Voyager GC	ERT/SERAS	☐
SERAS SOP#1811	Determination of Metals by Inductively Coupled Plasma (ICP) Methods, 3/17/06	Definitive	TAL Metals	ICP-AES	ERT/SERAS Laboratory, Edison, NJ	☐
SERAS SOP#1832	Determination of Mercury by Cold-Vapor Atomic Absorption (CVAA) 3/17/06	Definitive	Mercury	CVAA	ERT/SERAS Laboratory, Edison, NJ	☐
SERAS SOP#1807	Volatile Organic Analysis in Soil/Sediment by GC/MS, 1/23/06	Definitive	VOA	GC/MS	ERT/SERAS Laboratory, Edison, NJ	☐
SERAS SOP#1806	Volatile Organic Analysis in Water Samples by GC/MS, 1/12/06	Definitive	VOA	GC/MS	ERT/SERAS Laboratory, Edison, NJ	☐
SERAS SOP#1801	Routine Analysis of PCBs in Water and Soil/Sediment Samples by GC/ECD 1/23/06	Definitive	PCBs	GC/ECD	ERT/SERAS Laboratory, Edison, NJ	☐
SERAS SOP#1808	Routine Analysis of Pesticides in Water Samples by GC/ECD 1/23/06	Definitive	Pesticides	GC/ECD	ERT/SERAS Laboratory, Edison, NJ	☐
SERAS SOP#1804	Routine Analysis of Semi-volatiles in Water by GC/MS 1/23/06	Definitive	SVOCs	GC/MS	ERT/SERAS Laboratory, Edison, NJ	☐
SERAS SOP #1814	GC/MS Analysis of Sorbent Tubes and Canisters	Definitive	VOAs	GC/MS	ERT/SERAS Laboratory, Edison, NJ	☐

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
Photovac Voyager GC (Air)	Initial calibration (IC), minimum 4-points	Each day	r>0.995	Inspect system for problems; perform maintenance. Rerun IC	Analyst	Photovac Voyager Digital gas Chromatograph User's Manual/ Attachment 1
Photovac Voyager GC (Air)	Continuing calibration (CC)	Every 20 samples	Percent difference (%D) ±40%,	Rerun CC once. If needed, inspect system for problems, perform maintenance, rerun IC	Analyst	Photovac Voyager Digital gas Chromatograph User's Manual/ Attachment 1
GC/MS (Air)	Initial calibration (IC), minimum 5-points	Initially	Relative standard deviation (RSD) =< 30%, two compounds may exceed up to 40%	Inspect system for problems; perform maintenance (i.e. ion source cleaning, column replacement, etc.). Rerun IC	Analyst	SERAS SOP #1814
GC/MS (Air)	Daily continuing calibration check (CCC)	Every 24 hours	Percent difference (%D) = ±30%	Rerun CCC. If needed, inspect system for problems, perform maintenance (i.e. ion source cleaning, column replacement, etc.), rerun IC	Analyst	SERAS SOP #1814
GC/MS (GW SVOCs)	Initial calibration (IC), minimum 5-points	Initially	Relative standard deviation (RSD) =< 15%, calibration check compounds (CCC) compounds RSD< 30%, or r^2>0.98. Relative response factor (RRF) >0.05.	Inspect system for problems; perform maintenance (i.e. ion source cleaning, column replacement, etc.). Rerun IC	Analyst	SERAS SOP #1804

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
GC/MS (GW SVOCs)	Daily continuing calibration check (CCC)	Every 12 hours	Percent difference (%D) ±20%, RRF>0.05	Rerun CCC. If needed, inspect system for problems, perform maintenance (i.e. ion source cleaning, column replacement, etc.), rerun IC	Analyst	SERAS SOP #1804
GC/MS (GW VOAs)	Initial calibration (IC), minimum 5-points	Initially	Relative standard deviation (RSD) =< 15%, calibration check compounds (CCC) compounds RSD< 30%, or r^2>0.98. Relative response factor (RRF) >0.05, except system performance check compounds (SPCC)	Inspect system for problems; perform maintenance (i.e. ion source cleaning, column replacement, etc.). Rerun IC	Analyst	SERAS SOP #1806
GC/MS (GW VOAs)	Daily continuing calibration check (CCC)	Every 12 hours	Percent difference (%D) ±20%, RRF>0.05, except SPCC	Rerun CCC. If needed, inspect system for problems, perform maintenance (i.e. ion source cleaning, column replacement, etc.), rerun IC	Analyst	SERAS SOP #1806
ICP - Metals	Blank and high standard, ICV/CCV every 10 samples	Each day of use	ICV/CCV ±10%	Perform maintenance, rerun calibration	SERAS Analyst	SERAS SOP #1811
CVAA (Mercury)	Initial 5-point, ICV/CCV after every 10 samples	Each day of use	r>0.995 (initial), ICV = ±10%, CCV = ±20%	Perform maintenance, rerun calibration	SERAS Analyst	SERAS SOP #1832

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
GC/ECD - Pesticides	Initial 5-point, daily mid level continuing cal check and cal check after every 12 Hours	Every 12 hours	%RSD $\leq$ 20%, continuing cal check %D $\leq$ 15%	Perform maintenance, rerun initial cal	Analyst	SERAS SOP #1808
GC/ECD - PCBs	Initial 5-point, daily mid level continuing cal check and cal check after every 12 Hours	Every 12 hours	%RSD $\leq$ 20%, continuing cal check %D $\leq$ 15%	Perform maintenance, rerun initial cal	Analyst	SERAS SOP #1801

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23)

QAPP 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[1]
ICP	Check Argon Supply	NA	NA	With each use	Sufficient Argon for ICP operation	Change tank	Analyst	SERAS SOP# 1811
	Inspect Drainage Container	NA	NA	With each use	Sufficient space	Empty	Analyst	
	Check Cooling System	NA	NA	With each use	Normal operation	Call Service Engineer	Analyst	
	Check RF Power Supply	NA	NA	With each use	Normal operation	Call Service Engineer	Analyst	
	Check Pump Winding Tubing	NA	NA	With each use	NA	Replace as necessary	Analyst	
	Check Argon Pressure to Instrument	NA	NA	With each use	70 psig	Call Service Engineer	Analyst	
	Check Nebulizer Pressure	NA	NA	With each use	Normal spray	Call Service Engineer	Analyst	
	Check Nebulizer Connection to Spray Chamber	NA	NA	With each use	NA	Clean and/or replace spray chamber/O-rings	Analyst	
	Check Torch, Nebulizer, Spray Chamber	NA	NA	As needed	Clean	Ultrasonic, acid or mild soap cleaning as appropriate	Analyst	
	Check exhaust system	NA	NA	With each use	Normal operation	Call Building Maintenance	Analyst	

QAPP 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[1]
GC/MS	Check gas supply daily, bake or change trap as needed, manual tune if 4-Bromofluorobenzene (BFB) not within criteria, cut or change column, change septum as needed.	VOC Analysis	Check ion source, gas supply, septum seal, vacuum, trap	Prior to sample analysis or when instrument does not meet criteria	BFB criteria achieved, Relative standard deviation (RSD) = ≤ 30%, two compounds may exceed up to 40% RSD in the IC	Recalibrate and/or perform necessary instrument maintenance, check calibration standards, re-analyze affected samples.	Analyst	SERAS SOP #1814
Voyager Portable GC	Check reservoir level			Weekly		Fill when necessary	Analyst	Voyager User's Manual
	Check MS ionization gauge			Weekly			Analyst	
	Check purge and trap pressure			Weekly		Adjust	Analyst	
	Check gas pressure			Weekly		Adjust/replace	Analyst	
	Check purge and trap			As needed		Replace	Analyst	
	Check vacuum pump oil level			Monthly		Fill	Analyst	
	Check purge vessel			Monthly		Replace	Analyst	
	GC column			Monthly		Clean	Analyst	
	Ion Source			As needed		Clean	Analyst	
VOA GC/MS	Check reservoir level			Weekly		Fill when necessary	Analyst	SERAS SOP #4001, Logbook Documentation

QAPP 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[1]
VOA GC/MS	Check MS ionization gauge			Weekly			Analyst	SERAS SOP #4001, Logbook Documentation
VOA GC/MS	Check Tekmar pressure			Weekly		Adjust	Analyst	SERAS SOP #4001, Logbook Documentation
VOA GC/MS	Check gas pressure			Weekly		Adjust/replace	Analyst	SERAS SOP #4001, Logbook Documentation
VOA GC/MS	Check Tekmar trap			As needed		Replace	Analyst	SERAS SOP #4001, Logbook Documentation
VOA GC/MS	Check vacuum pump oil level			Monthly		Fill	Analyst	SERAS SOP #4001, Logbook Documentation
VOA GC/MS	Check purge vessel			Monthly		Replace	Analyst	SERAS SOP #4001, Logbook Documentation
VOA GC/MS	GC column			Monthly		Clean	Analyst	SERAS SOP #4001, Logbook Documentation
VOA GC/MS	Ion Source			As needed		Clean	Analyst	SERAS SOP #4001, Logbook Documentation
SVOC GC/MS	Check pump fluid			Weekly		Fill when necessary	Analyst	SERAS SOP #4001, Logbook Documentation
SVOC GC/MS	Check MS ionization gauge			Weekly		Adjust	Analyst	SERAS SOP #4001, Logbook Documentation
SVOC GC/MS	Replace pump fluid			Every 6 months		Replace	Analyst	SERAS SOP #4001, Logbook Documentation

QAPP 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[1]
SVOC GC/MS	Check gas pressure			Weekly		Adjust/replace	Analyst	SERAS SOP #4001, Logbook Documentation
SVOC GC/MS	Check carrier gas trap			As needed		Replace	Analyst	SERAS SOP #4001, Logbook Documentation
SVOC GC/MS	Check diffusion pump fluid			Annual		Replace	Analyst	SERAS SOP #4001, Logbook Documentation
SVOC GC/MS	Check injection port			As needed		Clean	Analyst	SERAS SOP #4001, Logbook Documentation
SVOC GC/MS	GC column			Monthly		Clean	Analyst	SERAS SOP #4001, Logbook Documentation
SVOC GC/MS	Ion Source			As needed		Clean	Analyst	SERAS SOP #4001, Logbook Documentation
Leeman Hg Analyzer	Check argon supply	NA	NA	With each use	NA	Replace	Analyst	SERAS SOP #1832
Leeman Hg Analyzer	Drainage Container	NA	NA	With each use	NA	Empty	Analyst	SERAS SOP #1832
Leeman Hg Analyzer	Check sampling probe	NA	NA	With each use	NA	Replace	Analyst	SERAS SOP #1832
Leeman Hg Analyzer	Check stannous chloride line to pump	NA	NA	With each use	NA	Replace line/clean	Analyst	SERAS SOP #1832
Leeman Hg Analyzer	Check pump winding tube	NA	NA	With each use	NA	Clean/replace	Analyst	SERAS SOP #1832
Leeman Hg Analyzer	Check optical cell	NA	NA	As required	NA	Clean	Analyst	SERAS SOP #1832
Leeman Hg Analyzer	Check autosampler arm	NA	NA	As Required	NA	Lubricate	Analyst	SERAS SOP #1832

QAPP 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[1]
Leeman Hg Analyzer	Check Lamp Alignment	NA	NA	As required	NA	Adjust	Analyst	SERAS SOP #1832
Leeman Hg Analyzer	Check Drying Tube	NA	NA	As required	NA	Replace	Analyst	SERAS SOP #1832
GC/ECD	Check carrier gas pressure			With each use		Replace/adjust	Analyst	SERAS SOP #4001, Logbook Documentation
GC/ECD	Check column			With each use		Cut/clean	Analyst	SERAS SOP #4001, Logbook Documentation
GC/ECD	Check inlet seals			With each use		Replace	Analyst	SERAS SOP #4001, Logbook Documentation
GC/ECD	Check liner			With each user		Clean/replace	Analyst	SERAS SOP #4001, Logbook Documentation
GC/ECD	Check septa			With each use		Replace	Analyst	SERAS SOP #4001, Logbook Documentation
GC/ECD	Check pressure of make-up gas			With each use		Replace	Analyst	SERAS SOP #4001, Logbook Documentation

[1]Specify the appropriate reference letter or number from Analytical SOP References table (Worksheet #23)

QAPP Worksheet #26
Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Jon McBurney, Scott Grossman, Amy Dubois, Rich Magan / SERAS Personnel
Sample Packaging (Personnel/Organization): Jon McBurney, Scott Grossman, Amy Dubois, Rich Magan / SERAS Personnel
Coordination of Shipment (Personnel/Organization): Jon McBurney / SERAS Personnel
Type of Shipment/Carrier: Hand Carried to Field Laboratory or Federal Express to ERT/SERAS Laboratory in Edison, NJ
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Field Laboratory - Gerald Ball (SERAS), ERT/SERAS Laboratory - Larry Martin (SERAS)
Sample Custody and Storage (Personnel/Organization): Field Laboratory - Gerald Ball (SERAS), ERT/SERAS Laboratory - Larry Martin (SERAS)
Sample Preparation (Personnel/Organization): ERT/SERAS Laboratory - SERAS Chemists
Sample Determinative Analysis (Personnel/Organization): Field Laboratory - Gerald Ball (SERAS), ERT/SERAS Laboratory - SERAS Chemists
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): Samples will be delivered to the Field Laboratory daily. Samples will be shipped to the ERT/SERAS laboratory at the end of the sampling event (5 days) with the exception of Soil and/or groundwater VOA samples. VOA samples will be shipped daily.
Sample Extract/Digestate Storage (No. of days from extraction/digestion): As Per Method Requirements. All samples are to be extracted, digested, and analyzed within holding times mandated by each analytical method.
Biological Sample Storage (No. of days from sample collection): NA
SAMPLE DISPOSAL
Personnel/Organization: Hazardous Waste Coordinator - ERT/SERAS
Number of Days from Analysis: As per laboratory standard procedures. Not less than 60 days for samples shipped to the ERT/SERAS Laboratory in Edison, NJ

QAPP Worksheet #27
Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory): Each sample will be individually identified and labeled after collection and hand delivered to the field laboratory. The sample information will be recorded on chain-of-custody (COC) forms. The EPA Scribe program will be used for field documentation, generating labels and COC forms. The sample information will be recorded on chain-of-custody (COC) forms, and the samples shipped to the appropriate laboratory via overnight delivery service, courier, or hand delivered. The EPA Scribe program will be used for field documentation,
Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal): Field laboratory personnel will accept custody of the shipped samples. Disposal of the samples will occur only after analyses and QA/QC checks are completed. Samples shipped to the ERT/SERAS Laboratory will be accepted by the sample receiving technician. Samples will be checked for discrepancies, proper preservation, integrity, etc. If noted, issues will be forwarded to the Analytical Support Leader for corrective action. The sample custodian will relinquish custody to the appropriate department for analysis. At this time, no samples will be archived at the laboratory. Disposal of the samples will occur only after analyses and QA/QC checks are completed.
Sample Identification Procedures: Samples will be identified with unique location identifier based on location (property) name. Also included in sample identification will be SG for soil gas, GW for groundwater, SS for sub-slab soil gas, S for Soil. A progressive number XX will be added for multiple samples collected at a location. Example: Charlie's Cleaners would use CC-SG-01.
Chain-of-custody Procedures: All samples will be documented with SCRIBE and assigned to uniquely numbered chains of custody per SERAS SOP# 4005, *Chain of Custody Procedures*.

QAPP Worksheet #28-1
QC Samples Table

Matrix	Soil
Analytical Group	Volatile Organic Compounds
Concentration Level	Low
Sampling SOP	SERAS SOP #2012
Analytical Method (SOP Reference)	EPA SW-846 Method 6010B/SERAS SOP #1807
Sampler Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS
No. of Sample Locations	20

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1:20 samples	NA	Document in final deliverable	Task Leader	Precision	RPD ±35%
Matrix Spike	1:10 samples	1,1-Dichloroethene (%R=59-172) Trichloroethene (%R=62-137) Benzene (%R=66-142) Toluene (%R=59-139) Chlorobenzene (%R=60-133)	Document outliers in case narrative. Rerun if necessary	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Surrogate Spike	Each sample	1,2-Dichloroethane-d4 (%R=70-121) Toluene-d8 (%R=84-138) p-Bromofluorobenzene (%R=59-113)	Reanalyze sample to confirm matrix effects	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Internal Standard	Each sample	-50% to +100%	Reanalyze sample to confirm	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Laboratory Control Sample	1:20 samples	%R= Within control chart limits	Flag outliers and/or reanalyze	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-1
QC Samples Table

Matrix	Soil
Analytical Group	Volatile Organic Compounds
Concentration Level	Low
Sampling SOP	SERAS SOP #2012
Analytical Method (SOP Reference)	EPA SW-846 Method 6010B/SERAS SOP #1807
Sampler Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS
No. of Sample Locations	20

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
MS/MSD	1:10 samples	1,1-Dichloroethene (RPD ±22%) Trichloroethene (RPD ±24%) Benzene (RPD ±21%) Toluene (RPD ±21%) Chlorobenzene (RPD ±21%)	Advisory - No Action required	Analyst	Precision	Same as Method/SOP QC Acceptance Limits
Method Blank	Every 12 hour shift	<RL	Reanalyze, flag data	Analyst	Accuracy/Bias (Contamination)	Same as Method/SOP QC Acceptance Limits
LOD/LOQ Study	Annual	LOD - Standard deviation multiplied by 5 must be less than the Reporting Limit LOQ – Second source standard must fall within control chart limits	Adjust RLs	Analyst	Sensitivity	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-2
QC Samples Table

Matrix	Groundwater
Analytical Group	VOA
Concentration Level	Low
Sampling SOP	SERAS SOP #2007
Analytical Method/ SOP Reference	SERAS SOP #1806
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS
No. of Sample Locations	50

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Internal Standards	Each sample	-50% to +100%	Reanalyze sample to confirm	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
LCS	1:20 samples	%R= Within control chart limits	Flag outliers/reanalyze	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
MS/MSD	1:10 samples	1,1-Dichloroethene (RPD ±14%) Trichloroethene (RPD ±14%) Benzene (RPD ±11%) Toluene (RPD ±13%) Chlorobenzene (RPD ±13%)	Advisory - No Action required	Analyst	Precision	Same as Method/SOP QC Acceptance Limits
Method Blank	Every 12 hour shift	<RL	Reanalyze, flag data	Analyst	Accuracy/Bias (Contamination)	Same as Method/SOP QC Acceptance Limits
LOD/LOQ Study	Annual	LOD - Standard deviation multiplied by 5 must be less than the Reporting Limit LOQ – Second source standard must fall within control chart limits	Adjust RLs	Analyst	Sensitivity	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-2
QC Samples Table

Matrix	Groundwater
Analytical Group	VOA
Concentration Level	Low
Sampling SOP	SERAS SOP #2007
Analytical Method/ SOP Reference	SERAS SOP #1806
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS
No. of Sample Locations	50

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spike	1:10	1,1-Dichloroethene (%R=61-145) Trichloroethene (%R=71-120) Benzene (%R=76-127) Toluene (%R=76-125) Chlorobenzene (75-130)	Document outliers in case narrative. Rerun if necessary	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Surrogate Spike	Every Sample	1,2-Dichloroethane-d4 (%R=76-114) Toluene-d8 (%R=88-110) p-Bromofluorobenzene ((%R=86-115)	Reanalyze to confirm matrix effects	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Field Duplicate	1:20	NA	NA	NA	Precision	RPD ±20%
Field Blank	1 per day	NA	Flag data	QA/QC Chemist or Task Leader	Accuracy/Bias (Contamination)	<RL
Trip Blank	1 per shipment	NA	Flag data	QA/QC Chemist or Task Leader	Accuracy/Bias (Contamination)	<RL.

QAPP Worksheet #28-3
QC Samples Table

Matrix	Water
Analytical Group	Pesticides
Concentration Level	Low
Sampling SOP	SERAS SOP #2007
Analytical Method/ SOP Reference	SERAS SOP #1808
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS
No. of Sample Locations	25

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spikes	1:10	Gamma-BHC (%R=56-123) Heptachlor (%R=40-131) Aldrin (%R=40-120) Dieldrin (%R=52-126) Endrin (%R=56-121) 4,4'-DDT (%R=38-127)	If more than half out, the MS/MSD should be reanalyzed	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Surrogate Spike	Each sample	%R=30-150	Reanalyze sample	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Internal Standards	Each sample	50-150%	Reanalyze sample	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
LCS	1:20	Within control chart limits	Reanalyze if more than 3 are out	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
MS/MSD	1:10	Gamma-BHC (RPD±15%) Heptachlor (RPD±20%) Aldrin (RPD±22%) Dieldrin (RPD±18%) Endrin (RPD±21%) 4,4'-DDT (RPD±27%)	Advisory - No Action required	Analyst	Precision	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-3
QC Samples Table

Matrix	Water
Analytical Group	Pesticides
Concentration Level	Low
Sampling SOP	SERAS SOP #2007
Analytical Method/ SOP Reference	SERAS SOP #1808
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS
No. of Sample Locations	25

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1:20	<RL	Reanalyze	Analyst	Accuracy/Bias (Contamination)	Same as Method/SOP QC Acceptance Limits
Field Duplicate	1:20	NA	Document in report	Task Leader	Precision	RPD ±20%
Field Blank	1 per day	NA	Flag data	QA/QC Chemist Or Task Leader	Accuracy/Bias (Contamination)	<RL

QAPP Worksheet #28-4
QC Samples Table

Matrix	Water
Analytical Group	SVOC
Concentration Level	Low
Sampling SOP	SERAS SOP #2007
Analytical Method/ SOP Reference	SERAS SOP #1804
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS Laboratory
No. of Sample Locations	25

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spike	1:20 samples	Phenol (%R=12-110) 2-Chlorophenol (%R=27-123) 1,4-dichlorobenzene (%R=36-97) N-Nitroso-di-n-propylamine (%R=41-116) 1,2,4 Trichlorobenzene (%R=39-98) 4-Chloro-3-methylphenol (%R=23-97) Acenaphthene (%R=46-118) 4-Nitrophenol (%R=10-80) 4-Dinitotoluene (%R=24-96) Pentachlorophenol (%R=9-103) Pyrene (%R=26-127)	If more than half out, the MS/MSD should be reanalyzed	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-4
QC Samples Table

Matrix	Water
Analytical Group	SVOC
Concentration Level	Low
Sampling SOP	SERAS SOP #2007
Analytical Method/ SOP Reference	SERAS SOP #1804
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS Laboratory
No. of Sample Locations	25

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spike duplicate	1:20 samples	Phenol RPD ±42% 2-Chlorophenol RPD ±40% 1,4-dichlorobenzene RPD ±28% N-Nitroso-di-n-propylamine RPD ±38% 1,2,4 Trichlorobenzene RPD ±28% 4-Chloro-3-methylphenol RPD ±42% Acenaphthene RPD ±31% 4-Nitrophenol RPD ±50% 2,4-Dinitotoluene RPD ±38% Pentachlorophenol RPD ±50% Pyrene RPD ±31%	If more than half out, the MS/MSD should be reanalyzed	Analyst	Precision	Same as Method/SOP QC Acceptance Limits
Internal Standards	Each sample	50-200%	Reanalyze sample	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Method Blank	1:20 samples	<RL	Reextract batch or flag data	Analyst	Accuracy/Bias (Contamination)	Same as Method/SOP QC Acceptance Limits
Surrogate Spikes	Each Sample	Nitrobenzene-d5 (%R=35-114%) 2-Fluorobiphenyl (%R=43-116%) Terphenyl-d14 (%R=33-141%) Phenol-d5 (%R=10-110%) 2-Fluorophenol (%R=21-110%) 2,4,6-Tribromophenol (%R=10-123%)	Reanalyze sample	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-4
QC Samples Table

Matrix	Water
Analytical Group	SVOC
Concentration Level	Low
Sampling SOP	SERAS SOP #2007
Analytical Method/ SOP Reference	SERAS SOP #1804
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS Laboratory
No. of Sample Locations	25

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
LCS	1:20 samples	%R= 70-130% or within control chart limits	Qualify data	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Field Blank	1 per day	NA	Flag Data	QA/QC Chemist or Task Leader	Accuracy/Bias (Contamination)	<RL

QAPP Worksheet #28-5
QC Samples Table

Matrix	Water
Analytical Group	Metals
Concentration Level	Low
Sampling SOP	SERAS SOP #2007
Analytical Method/ SOP Reference	SERAS SOP #1811
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS Laboratory
No. of Sample Locations	25

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spike	Every 10 samples	%R = 75-125%	Rerun - no reprep is necessary; Qualify data	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
MS/MSD	Every 10 samples (between MS/MSD)	RPD ±20%	Rerun first, reprep if necessary or Qualify data	Analyst	Precision	Same as Method/SOP QC Acceptance Limits
LCS	Every 20 samples of same matrix	%R = 75-125%	Reanalyze first, then rerun batch or Qualify data	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
ICS (Interference Check Sample)	Once each 8-hour shift	± 20%	Rerun or recalibrate	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Method Blank	One per batch of 20 samples/same matrix	< RL	Reprep if concentration in samples is not at least 10X concentration in blank, investigate source of contamination	Analyst	Accuracy/Bias (Contamination)	Same as Method/SOP QC Acceptance Limits
Serial Dilution	5%	%D ±10%	Flag data	Analyst	Precision	Same as Method/SOP QC Acceptance Limits
Field Duplicate	5%	NA	Document in final deliverable	Task Leader	Precision	RPD ±20%
Field Blank	1 per day	NA	Flag or qualify data	QA/QC Chemist or Task Leader	Accuracy/Bias (Contamination)	<RL

QAPP Worksheet #28-6
QC Samples Table

Matrix	Groundwater
Analytical Group	Mercury
Concentration Level	Low
Sampling SOP	SERAS SOP #2007
Analytical Method/ SOP Reference	SERAS SOP #1832
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS
No. of Sample Locations	25

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spike	1:10	%R=75-125	Rerun - no reprep is necessary	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
MS/MSD	1:10	RPD ±20 %	Rerun first, reprep if necessary	Analyst/Group Leader	Precision	Same as Method/SOP QC Acceptance Limits
LCS	1:20	%R=75-125% or within vendor PALs	Reanalyze first, then rerun batch	Analyst/Group Leader	Accuracy/Precision	Same as Method/SOP QC Acceptance Limits
Method Blank	One per batch of 20 samples/same matrix	< RL	Reprep if concentration in samples is not at least 10X concentration in blank, investigate source of contamination	Analyst	Accuracy/Bias (Contamination)	Same as Method/SOP QC Acceptance Limits
Field Duplicate	5%	NA	Document in final deliverable	Task Leader	Precision	RPD ±20%
Field Blank	1 per day	NA	Flag or qualify data	QA/QC Chemist or Task Leader	Accuracy/Bias (Contamination)	<RL

QAPP Worksheet #28-7
QC Samples Table

Matrix	Soil Gas (SUMMA® Canister)
Analytical Group	VOA
Concentration Level	Low
Sampling SOP	SERAS SOP #1704
Analytical Method/ SOP Reference	SERAS SOP #1814
Sampler's Name	Jon McBurney
Field Sampling Organization	SERAS
Analytical Organization	ERT/SERAS Laboratory
No. of Sample Locations	~6

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Initial Calibration	Initially	≤ 30% RSD with 2 compounds up to 40%	Clean, repair, re-analyze	Analyst	Accuracy	≤ 30% RSD with 2 compounds up to 40%
Continuing Calibration	Every 24 hours	± 30% D	Clean, repair, re-analyze	Analyst	Accuracy	± 30% D
Internal Standard	Each sample	±40% of daily calibration IS response	Re-analyze sample	Analyst	Precision/Accuracy/Bias	±40% of daily calibration IS response
Instrument Performance Check Samples	Every 24 hours	As per specified method	Clean, repair, re-analyze	Analyst	Sensitivity	As per specified method
LCS	5% of samples	± 30% R or within control chart limits	Clean, repair, re-analyze	Analyst	Accuracy/Bias	± 30% R or within control chart limits
Method Blank	1/24-hour clock	< Reporting Limit	Clean, repair, re-analyze	Analyst	Accuracy/Bias Contamination	< Reporting Limit
Trip Blank	1/shipment	< Reporting Limit	NA	NA	Accuracy/Bias Contamination	< Reporting Limit
LOD/LOQ Study	Annual	LOD = < Reporting Limit LOQ = ±50% or within control chart limits	Clean, repair, re-analyze.	Analyst	Sensitivity	LOD = < Reporting Limit LOQ = ±50% or within control chart limits
Laboratory Duplicates	10%	RPD ± 25%	Reanalyze	Analyst	Precision	RPD ± 25%

NA = Not applicable

QAPP Worksheet #29
Project Documents and Records Table

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records	Other
Site and Field Logbooks COC Forms Well Sampling Purge Logs Map for sampling locations	Instrument Run Logs Preventive Maintenance Logs Instrument Printouts Data Reduction Records Data Review Records	Sample Receipt Logs Internal and External COC forms Equipment Calibration Logs Sample Analysis Worksheets/Run Logs Laboratory Final Data Package Corrective Action Documents	Review forms for electronic entry of data into database Data Validation Package Data Assessment Forms (SERAS) Data Validation Check Records (SERAS)	Well Installation Logs Equipment Calibration logs/checks Corrective Action Documentation Well Sample Purge Logs Field Change Form, if required Final Report

QAPP Worksheet #30
Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Location/ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number
Soil Gas	VOA	Low/High	Refer to Worksheet 18	Voyager GC User's Manual	NA	ERT/SERAS Laboratory 2890 Woodbridge Avenue Edison, NJ 08837 Gerald Ball 732-321-4204	NA
Soil Gas	VOA	Low	Per Worksheet 18	EPA Method TO-15/ SERAS SOP #1814	3 Weeks	SERAS Laboratory 2890 Woodbridge Avenue Edison, NJ Attn: Vinod Kansal 732-321-4200	NA
Groundwater	VOCs	Low	Per Worksheet 18	SERAS SOP #1806	3 Weeks	ERT/SERAS Laboratory 2890 Woodbridge Avenue Edison, NJ Attn: Vinod Kansal 732-321-4200	NA
Groundwater	TAL Metals/Mercury	Low	Per Worksheet 18	SERAS SOP#1811/ SERAS SOP#1832	3 Weeks	ERT/SERAS Laboratory 2890 Woodbridge Avenue Edison, NJ Attn: Vinod Kansal 732-321-4200	NA
Groundwater	PCBs	Low	Per Worksheet 18	SERAS SOP#1801	3 Weeks	ERT/SERAS Laboratory 2890 Woodbridge Avenue Edison, NJ Attn: Vinod Kansal 732-321-4200	NA
Groundwater	Pesticides	Low	Per Worksheet 18	SERAS SOP#1808	3 Weeks	ERT/SERAS Laboratory 2890 Woodbridge Avenue Edison, NJ Attn: Vinod Kansal 732-321-4200	NA

QAPP Worksheet #30
Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Location/ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number
Groundwater	SVOCs	Low	As per Worksheet 18	SERAS SOP#1804	3 Weeks	ERT/SERAS Laboratory 2890 Woodbridge Avenue Edison, NJ Attn: Vinod Kansal 732-321-4200	NA
Soil	VOCs	Low	As per Worksheet 18	SERAS SOP#1807	3 Weeks	ERT/SERAS Laboratory 2890 Woodbridge Avenue Edison, NJ Attn: Vinod Kansal 732-321-4200	NA

QAPP Worksheet #31
Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
Laboratory Accreditation Audit	Every 2 years	External	NELAC Accreditation Agency	NJDEP	Deborah Killeen, QA/QC Officer, SERAS	Vinod Kansal, GC/MS Chemist, ERT/SERAS Laboratory	NELAC Accreditation Agency
Laboratory Audit	Annual	Internal	ERT/SERAS Laboratory	Deborah Killeen, QA/QC Officer, SERAS	Vinod Kansal, GC/MS Chemist, ERT/SERAS Laboratory	Laboratory Chemists ERT/SERAS Laboratory	Deborah Killeen, QA/QC Officer, SERAS
Performance Evaluation Sample	Biannual	Internal	ERT/SERAS Laboratory	Deborah Killeen, QA/QC Officer, SERAS	Vinod Kansal, GC/MS Chemist, ERT/SERAS Laboratory	Laboratory Chemists ERT/SERAS Laboratory	Deborah Killeen, QA/QC Officer, SERAS

QAPP Worksheet #32
Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Field Observations/ Deviations from Work Plan	Logbook	Jon McBurney/Task Leader/SERAS	Immediately	Field Change Form	Jon McBurney/Task Leader SERAS	Within 24 hours of change
Lab Performance Audits	Audit report	ERT/SERAS Laboratory	Within 30 days	Corrective Action Plan	Regulatory Agency	Within 30 days
Peer Review	In the deliverable	Jon McBurney/Task Leader/SERAS	Prior to deliverable due date	Comments directly in the deliverable	Jon McBurney/Task Leader SERAS	Prior to deliverable due date
Internal Lab Performance Audits	Audit report	Vinod Kansal, GC/MS Chemist, SERAS	Within 45 days	Corrective Action Plan	Deborah Killeen, QA/QC Officer, SERAS	Within 45 days

QAPP Worksheet #33
QA Management Reports Table

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Technical Report	Monthly	10th of the month following performance period	Task Leader/SERAS	ERT Project Officer and Work Assignment Manager
QA Report	Quarterly	February, May, August, November	QA/QC Officer/SERAS	ERT Project Officer and Quality Coordinator

QAPP Worksheet #34
Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Chain of Custody Record	Reviewed by Field Sampling Personnel in field and QA/QC Group prior to final analytical report preparation	Internal	SERAS
Laboratory Data Package	Reviewed for measurement performance criteria	Internal	ERT/SERAS Laboratory and SERAS QA/QC Group
Analytical Report	Reviewed for accuracy	Internal	Peer Review Team
Trip Report	Reviewed for accuracy	Internal	Peer Review Team

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

Step IIa/IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
IIa	SOPs	Ensure that the sampling methods/procedures outlined in the QAPP were followed and any deviations noted	SERAS Task Leader, Work Assignment Manager
IIa	COC Records	Examine COC records and match with requested analyses.	SERAS Task Leader SERAS Sr. Field GC/MS Chemist SERAS QA/QC Group
IIa	Lab Data Package	Examine packages against COC records (holding times, sample handling, methods, sample identifications, qualifiers).	SERAS QA/QC Group
IIb	Lab Data Package	Qualify data based on QC deficiencies (precision/accuracy, %RSD, %D, etc.)	SERAS QA/QC Chemist SERAS QA/QC Officer
IIb	Field Duplicates	Compare results of field duplicate (or replicate) analyses with RPD criteria	SERAS Task Leader, Jon McBurney

QAPP Worksheet #36
Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
IIb	Soil Gas (SUMMA® Canister)	VOA	Low	Draft SERAS SOP #1021, *Data Validation for Routine Volatile Organic Compounds in Air by TO-15/TO-17 Analysis*	SERAS QA/QC Group
IIb	Groundwater	VOA	Trace	SERAS SOP #1015, *Data Validation Procedures for Routine Volatile Organic Analysis*	SERAS QA/QC Group
IIb	Groundwater	PCBs	Low	Draft SERAS SOP#1020, *Data Validation Procedures for Routine PCB/Aroclor Analysis*	SERAS QA/QC Group
IIb	Groundwater	Pesticides	Low	Draft SERAS SOP#1018, *Data Validation Procedures for Routine Pesticide Analysis*	SERAS QA/QC Group
IIb	Groundwater	SVOCs	Low	SERAS SOP #1016, *Data Validation Procedures for Routine Semi-Volatile Analysis*	SERAS QA/QC Group
IIb	Groundwater	TAL Metals	Low	SERAS SOP #1017, *Data Validation Procedures for Routine Inorganic Analysis*	SERAS QA/QC Group

X **Worksheet Not Applicable** EPA Region II will be responsible for assessing the usability of the data.

QAPP 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:
Describe the evaluative procedures used to assess overall measurement error associated with the project:
Identify the personnel responsible for performing the usability assessment:
Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

SERAS Work Assignment Field Change Form

(must be completed to initiate any on-site change in the scope of a Work Assignment)

Date: 6/17/11	**Time:** 1600	**Location:** CABO ROJO
Work Assignment #: 0-130	**Person Initiating Change:** JON MCBURNEY/TL	
Work Assignment Title: CABO ROJO SITE		

Original Scope Being Changed (e.g., Work Assignment requests 5 samples):

QUAPP IDENTIFIES SUMMAS TO BE COLLECTED 1 IN 20.

Changed Scope (e.g., WAM requests 30 samples):

TOTAL SAMPLES COLLECTED WAS OVER 80, ONLY 2 SUMMAS WERE COLLECTED.

Task Leader Signature/Date: JMB / 6/17/11

Work Assignment Manager Signature/Date: 7/26/11

Other Applicable Signature(s)/Date:

cc: EPA Work Assignment Manager
Dennis Miller, SERAS Program Manager
Deborah Killeen, SERAS QA/QC Officer
Rickard Leuser, Deputy Program Manager

Please note: 1) Additional resources (hours and/or dollars) may be required to fulfill the requested change in scope, 2) the schedule and milestones for this project as well as other projects may be modified as a result of the requested change in scope, and 3) these requirements/changes will be communicated in writing to the WAM as soon as a resource evaluation is made.

SERAS Work Assignment Field Change Form

(must be completed to initiate any on-site change in the scope of a Work Assignment)

Date:6/14/11	**Time:18:00**	**Location: Cabo Rojo, Puerto Rico**
Work Assignment #:130	**Person Initiating Change: Gerald Ball**	
Work Assignment Title: Cabo Rojo Site		

Original Scope Being Changed (e.g., Work Assignment requests 5 samples):

1. Frequency of Calibration: Each Day for initial calibration.

2. Frequency of Calibration: Every 20 samples for continuing calibration check.

Changed Scope (e.g., WAM requests 30 samples):

1. Frequency of Calibration: Initial calibration of 4 points must be run on the first day of analyses with an acceptance criteria of R>0.995

2. Frequency of Calibration: A continuing calibration check must be run after 6 hours of the initial calibration, also a continuing calibration check can be run each day of analyses and after 6 hours of that calibration check when acceptance criteria of the calibration check %D is ± 40%

Task Leader Signature/Date: 6/23/11

Work Assignment Manager Signature/Date: 7/07/11

Other Applicable Signature(s)/Date:

cc: EPA Work Assignment Manager
Dennis Miller, SERAS Program Manager
Deborah Killeen, SERAS QA/QC Officer
Rickard Leuser, Deputy Program Manager

Please note: 1) Additional resources (hours and/or dollars) may be required to fulfill the requested change in scope, 2) the schedule and milestones for this project as well as other projects may be modified as a result of the requested change in scope, and 3) these requirements/changes will be communicated in writing to the WAM as soon as a resource evaluation is made.

Office Outlook Web Access | Type here to search | All Folders and Items | Address Book | Options | Log Off

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Container Status Reports
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White Plains Folder

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Back pak Vac USCG Base Cape May N.J.
Kathy Roach

Sent: Tuesday, March 27, 2012 2:56 PM
To: Dom Iuliano

Dom, The vacuum is made by Clarke, Model name comfort pak 10, Product # 9060707010, Ser # 101300532, 110-120v/50-60 Hz. The vacuum is in the original box.

Kathy Roach
Site Supervisor, ZERO WASTE SOLUTIONS, Inc.
USCG Training Center - Cape May
1 Munro Ave.
Cape May, NJ 08204
Cell 609 839 9264
Kathy@zerowastesolutions.com

Connected to Microsoft Exchange

Status: Open - Non-Billable **Edison ZWS Work Order** **Printed:** 3/28/2012

REQUEST ID:	12879	**REQUESTED BY:**	Dom Iulliano 510-461-1433 General
JOB LOCATION:	Edison ZWS 2890 Woodbridge Edison NJ 08837		Cost Center:
ENTERED BY:	Dom Iulliano 510-461-1433	**ASSIGNED TO:**	Dom Iulliano
TYPE:	Periodicals	**SUB TYPE:**	Hard Floors
RECEIVED:	3/28/2012 9:19:21 AM	**PRIORITY:**	Normal

STATEMENT OF WORK: Weds. 3/28 - Buffing Routine : Security Booth/B209B Pantry/B295B Pantry & copy Rm. also Building entrances @ B205A/B209 B & C.

START DATE/TIME: ____/____/____ - _____ **FINISH DATE/TIME:** ____/____/____ - _____

COMMENTS:

LABOR COST SUMMARY

Employee	Description	Account	Hours	Rate/Hr	Cost

MATERIAL COST SUMMARY

Item	Description	Account	Qty/Cost	Tax/S&H	Cost

Total Cost: _____

Approved By: _____ **Date:** _____ **Signature:** _____

Billable: ___ **Non-Billable:** ___ **TI:** ___

Chapter 8 - IMPACT OF MERCURY ON NJ'S ECOSYSTEMS

A. Introduction

Determining the impact of mercury or any contaminant on ecosystems is challenging. At high concentrations, some organisms may be severely impacted. At lower concentrations, however, the effects are often subtle and may require years to identify. Moreover, there can be multiple contaminants that co-occur, and identifying the influence of any single contaminant, much less its interactions with other contaminants, can be very difficult. Nonetheless, by combining data from a variety of sources, it is often possible to identify ecosystems or ecological resources that are at risk.

This section examines the levels and impacts of mercury on biota and ecosystems of NJ. NJ studies have played a prominent part in understanding mercury contamination and effects on a national basis. However, it will be apparent from this chapter that there remain many gaps in our knowledge.

B. Impacts of Mercury on Specific NJ Sites

There are a number of NJ hazardous waste sites with sufficiently high mercury levels that impacts on local ecosystems can be identified or anticipated. The NJDEP Site Remediation Program does not currently have a database of contaminated sites which can be sorted by contaminant. However, an informal screening of active sites indicates that the levels and extent of mercury contamination are highly variable. Mercury contamination ranges from limited amounts of contamination with few or no exposure pathways to ecological receptors (e.g., contamination under a building) to low-level, but extensive contamination (e.g., Passaic River) with multiple receptors. Aquatic systems are the principal ecosystems impacted by mercury contamination at these sites. Terrestrial habitat and wildlife species at many of these sites are somewhat limited due to the prior industrial character of the sites, resulting in fewer ecological receptors and exposure pathways. Several impacted sites are discussed below.

1. Berry's Creek-Ventron/Velsicol Site

Berry's Creek-Ventron/Velsicol Site, located in the Hackensack Meadowlands (Borough of Wood-Ridge, Bergen County), is one of the most heavily contaminated mercury sites in the world. The site is known as the Ventron/Velsicol Site and is listed on the National Priorities List (NPL). This site is an important example of the ecological consequences of mercury releases to an aquatic ecosystem. The primary source of mercury to this system was historical discharges (1930 to 1974) from a mercury processing plant. Testing conducted around 1970 indicated that the plant was discharging from two to four pounds of mercury per day into Berry's Creek (Lipsky et. al. 1980). Mercury contamination (primarily inorganic or elemental mercury) was found to be widespread at the site and included soils on and adjacent to the site, and the surface waters, sediments and wetland soils of Berry's Creek. (See Table 2.16) The Ventron/Velsicol Site has been administratively segregated from Berry's Creek and the Responsible Parties are focusing on remediation of the 38-acre site.

An early concern was the potential for mercury to move from this site into the ecosystem through erosion, ground water transport, volatilization, and biological transformation/uptake. Estimates of the amount of mercury contamination beneath the Ventron/Velsicol site have ranged from 30 tons to 289 tons (Lipsky et al. 1980).

Table 2.16. Mercury Concentrations at the Ventron/Velsicol Site and Berry's Creek.

Media	Maximum Mercury Concentration	Maximum Methyl-Mercury Concentration	% MeHg
Surface Soils	13,800 (μg/g)	0.322 (μg/g)	<.001%
Subsurface Soils	123,000 (μg/g)	-	-
Ground Water	8.2 (μg/L)	0.02 (μg/L)	0.2%
Surface Water	15.6 (μg/L)	0.00287 (μg/L)	0.02%
Berry's Creek Sediment (0-2 cm)	11,100 (μg/g)	0.0098 (μg/g)	<.001%
On-site Ditch Sediment (0-2 cm)	97.8 (μg/g)	0.020 (μg/g)	0.02%
On-site Basin Sediment (0-15 cm)	1,290 (μg/g)	0.126 (μg/g)	0.01%
Discharge Pipe (6-9 inches)	89,162 (μg/g)	-	-

Concentrations of total mercury have been detected historically up to 15.6 μg/L in surface waters of Berry's Creek. This compares with the mercury chronic surface water criterion of 0.012 μg/L. Methylmercury concentrations up to 2.87 ng/L have also been detected. More recent limited sampling indicate dissolved mercury concentrations of up to 0.24 μg/L and total mercury concentrations up to 17.6 μg/L adjacent to the site (Exponent 1998). The maximum total mercury concentration detected is greater than the acute and chronic water quality criteria values for mercury. Dissolved mercury concentrations have also exceeded the NJ chronic criteria. The observed mercury concentration indicates that there is potential risk to aquatic organisms from mercury in the surface waters of Berry's Creek.

Three studies were funded by the NJDEP for the period 1978 through 1980 to examine concentrations of mercury in the plants and animals of the general area (Lipsky et al. 1980). A 1978 study found mercury to range from 0.01 to 0.79 μg/g in Mummichogs (Common Killifish), and 0.30 to 1.9 μg/g in White Perch in Berry's Creek. A survey of nine locations in Berry's Creek in 1978 by the NJ Marine Sciences Consortium (NJMSC) found mercury at an average concentration of 0.08 to 0.32 μg/g in Mummichogs. Additional data collected by NJMSC indicated that the average concentration of mercury was 0.52 μg/g in Berry's Creek Mummichogs. The average concentrations of mercury for Grass Shrimp was 0.09 μg/g (Lipsky et al. 1980).

A summary of other tissue analyses (ERM-Southeast 1985) indicated that 51% of the invertebrate samples contained greater than 1 μg/g mercury with a maximum of 150 μg/g in snail tissue. These are extremely high values for lower trophic organisms. Forty-three percent of the bird tissue samples and 6% of the mammal tissues had mercury levels greater than 1 μg/g.

Seven species of plants were analyzed in Berry's Creek for mercury including Common Reed (*Phragmites),* Cord Grass *(Spartina alterniflora)*, and Cattail (*Typha).* Tissue levels exceeding 1 μg/g were widespread in the Berry's Creek area (ERM-Southeast 1985). Rhizome (root-like) tissue generally had the highest concentrations of mercury. Speciation was not performed, but other studies have found elevated MeHg levels in salt marsh vegetation (Windhou and Kendall 1978).

Current data suggest that sulfide (e.g., acid volatile sulfide, AVS) and sediment organic carbon are two important factors controlling the concentration and bioaccumulation of methylmercury from mercury-contaminated sediments. Berman and Bartha (1986) suggested that elevated sulfide concentrations (i.e., HgS) were the cause for low mercury methylation

activity in highly contaminated Berry's Creek sediments. Low dissolved oxygen in Berry's Creek indicates anoxic conditions, which favor production of HgS in the sediments. Therefore, the elevated sulfide concentrations in Berry's Creek sediments may be mitigating the impacts of elevated mercury concentrations by minimizing the mercury available for methylation. However, this "equilibrium" could shift if water quality changes. Ongoing studies of these processes are needed.

2. Pierson's Creek -Troy Chemical Company, Inc.

The Troy Chemical Site is located in Newark on an industrial tract that has been active since the early 1900s. Mercury use occurred from 1956 to the late 1980s. Mercury was purchased and reclaimed (via mercury recovery furnaces) for use in the production of organic mercuric compounds such as phenylmercuric acetate, chloromethoxypropyl mercuric acetate, phenyl mercuric sulfide, and phenylmercuric oleates. Pierson's Creek has been grossly contaminated with a number of contaminants including mercury from the Troy Chemical site and other sites in the area. (See Table 2.17) This man-made waterway discharges to Newark Bay just south of the mouth of the Passaic River.

Process discharges from the Troy Chemical site prior to 1965 went directly to Pierson's Creek. Partial treatment occurred from 1965 to 1976 and an on-site wastewater treatment plant was installed in 1976. In 1979 an investigation indicated that an estimated 327 pounds of mercury per day were discharged into the sanitary sewer system. Due to the inefficient primary treatment level of the Passaic Valley Sewage Commission treatment plant at that time, it was estimated that approximately 90% of the mercury were being discharged into Newark Bay with the plant's effluent.

Pierson's Creek has been contaminated with Hg, with maximum concentrations of 607,000 μg/g in sediment, and 886 μg/L in surface water detected by studies conducted in the late 1970's and 1980's. Mercury was detected in 1979 up to 83,200 μg/g in sediment of an adjacent tributary, and a maximum of 25,290 μg/L of Hg was detected in ground water at the Troy Chemical site. More recent data indicates that Hg concentrations are still elevated in all media (Table 2.17).

The impact of this contamination is primarily on the aquatic ecosystem of Pierson's Creek and Newark Bay. The elevated concentrations and mass of contaminants potentially result in toxic impacts on the benthic invertebrate communities. The downstream transport of contaminants can lead to exposure and bioaccumulation by mobile species (e.g., fish) via direct contact and food chain pathways. In addition, cumulative loadings from similar industrial sites result in the widespread distribution of mercury in the surrounding aquatic systems (e.g., Newark Bay).

The City of Newark plans to dredge sections of Pierson's Creek for the purpose of flood control. Dredging has the potential to increase the availability of mercury that is currently sequestered in the sediment. Remediation of the highly contaminated section of the creek adjacent to Troy Chemical is planned but not currently scheduled. Any dredging should include some mechanism for controlling or removing resuspended materials. To date there is essentially no information on either mercury concentrations or impacts on biota in this area.

3. DuPont Chemicals, Pompton Lakes Works

The Pompton Lakes Works (PLW) site is located in Passaic County and was operated by DuPont between 1908 and 1994 for the manufacture of explosives (Exponent 1999). Acid Brook flows

Table 2.17. Mercury Concentrations in Various Media Associated with Pierson's Creek and the Troy Chemical Company Site.

Media/Location	Maximum Hg Concentration – 1997	Average of Hg Concentrations – 1997	Notes
Sediment: Pierson's Creek – Upstream of Troy Chemical site	138 μg/g	64 μg/g	From EMCON 1998. Data reported from 5 samples.
Sediment: Pierson's Creek –Troy Chemical Site	3,030 μg/g	1,470 μg/g	From NJDEP files. Data reported from 6 samples reported.
Sediment: Tributary to Pierson's Creek by Troy Chemical Site	6,200 μg/g	2,110 μg/g	From NJDEP files. Data reported from 4 samples reported..
Sediment: Pierson's Creek – Downstream of site	5,020 μg/g	1,020 μg/g	Data reported from 11 samples reported..
Soil: Troy Chemical Site	4,300 μg/g	Range: 0.6-4,300 μg/g	Data from 5 on-site sampling locations.
Surface Water: Pierson's Creek	5.2 μg/L	Range: ND – 5.2 μg/L	Data from 7 sampling locations.
Ground Water: Troy Chemical Site	2,500 μg/L	Range: ND – 2,500 μg/L	Data from 5 on-site monitoring wells. 25,290 μg/L reported from 1 well in 1982 (NJDEP files).

ND - not detected

through the facility and discharges to Pompton Lake where it has formed a delta (i.e., Acid Brook delta). DuPont has been investigating the site, Acid Brook, and the Acid Brook delta since 1988 under an Administrative Consent Order with the NJDEP. Soil contamination was detected in both on-site and off-site areas affecting both commercial and residential properties. Acid Brook sediments contained elevated levels of mercury. Due to the contamination found, DuPont conducted remediation of on-site and off-site soils, as well as remediation of sections of Acid Brook sediments. Additional remediation is planned in Acid Brook and upland areas.

DuPont conducted a Phase I and Phase II ecological study (Exponent 1999) that examined the impacts of mercury contamination in the Acid Brook delta where it empties into Pompton Lake. Sediments in the delta have maximum levels of mercury of 1,450 mg/kg. Mercury concentrations in algal mats, phytoplankton, zooplankton and benthic invertebrates of the delta are much higher compared to presumably unimpacted reference sites in Pompton Lakes. In addition, fish tissue MeHg concentrations were higher in all seven species of fish (e.g., sunfish, white perch, largemouth bass) captured at the delta as compared to the reference area of the lake. The delta serves as a source for the bioaccumulation of mercury within the food chain of Pompton Lake.

When comparing similar sized fish, average mercury concentrations ranged from 27-33 ng/g for reference Pumpkinseed and 71-140 ng/g for Delta Pumpkinseed. A similar trend was observed for Yellow Perch (130 ng/g versus 440 ng/g) and Largemouth Bass (83-390 ng/g versus 200-1,200 ng/g) for various areas of Pompton Lake.

4. Passaic River Study Area

Another type of site that represents more diffuse contamination of an aquatic system is the lower Passaic River. This section of the river has been subject to multiple point discharges from local industry and non-point discharges for the past one hundred years. The Passaic River Study Area consists of the lower six miles of the river and encompasses the area alongside the Diamond Alkali Superfund Site, a former pesticide manufacturing facility located approximately 2 miles upstream of the river mouth (US EPA 1999c).

Several investigations have collected numerous sediment cores along this reach of the Passaic River. Average mercury concentrations in surface sediments (e.g., $\leq$ 15cm) of the river (452 samples) were 2.1 mg/kg with a range of 0.005 to 15 mg/kg (NOAA 1999). In contrast, sediments at depth (>15 cm to several meters) exhibited a higher average concentration (9.4 mg/kg) and range (0.11 mg/kg to 29.6 mg/kg). These average mercury levels exceed sediment benchmarks for ecological effect (ER-L of 0.15 mg/kg and ER-M of 0.71 mg/kg) indicating potential adverse effects to aquatic biota. Although mercury concentrations may be at a level causing impacts, other contaminants (e.g., dioxin) may be causing equal or more severe impacts (e.g., toxicity) making it difficult to identify specific effects of mercury. This situation is typical of many waterbodies in highly urbanized/industrial areas that have multiple contaminants and sources.

5. Environmental Research Parks

Pioneered by the US Department of Energy in 1971 (USDOE 1994), the National Environmental Research Parks (NERPs) are public lands "open to the researchers for ecological studies and the general public for environmental education". DOE sets aside parts of its large nuclear weapons development sites to study the impact of weapons development, nuclear reactors, and radioactive waste, on surrounding ecosystems. The NERPs address national concern about environmental change, remediation and recovery, and the ability of land to adapt to and recover from contamination. The results from research on NERPs has been used to improve landuse planning, develop site-specific remediation goals and methodologies, and develop an information network for studying biodiversity and managing public lands and improving environmental quality (USDOE 1994).

6. Summary and Conclusions: Impacts of Mercury on Specific NJ Sites

There are a number of sites within the State that are highly contaminated with mercury and which may impact adjacent ecosystems. These include sites with low-level, extensive contamination (e.g., Passaic River) with multiple receptors, and sites with high-level contamination (e.g., Troy Chemical, Berry's Creek). Aquatic systems are the principal ecosystems impacted by mercury contamination at these types of sites. For none of these sites is there adequate characterization of the fate and transport of mercury through the food chain, nor are there adequate studies that would reveal impacts on behavior, biochemistry, reproduction, health, survival, or population dynamics of organisms.

Mercury discharges to the Berry's Creek ecosystem have led to widespread contamination of the soil and sediment in the area. There is evidence of increased bioaccumulation of mercury

in proximity to the site. Paradoxically, more severe impacts may occur if water quality improves, thus allowing a greater utilization of the habitat by higher trophic level aquatic species (e.g., fish). Due to the large quantity of mercury in the Berry's Creek ecosystem and the potential for water quality changes and mercury release, it is recommended that additional study and monitoring of this ecosystem be conducted. Characterization of the transport and bioaccumulation of mercury in Berry's Creek and downstream waters is needed to determine the potential future impacts from the site.

C. Mercury Occurrence and Levels in NJ Fish

The bioaccumulation of mercury in aquatic food chains and most specifically its concentration in higher trophic level fish poses a potential ecological impact to the piscivorous biota and to the fish themselves. This section provides an overview of mercury levels in NJ freshwater and saltwater fish, presents the available data on the impact of those levels to the fish and to their predators.

1. Freshwater Fish

Finfish contamination results primarily from bioaccumulation of pollutants through the food chain. Mercury accumulation is widespread across species and trophic levels, with generally higher levels in larger individuals of any species and higher levels in species higher on the food chain. Data are available mainly on species consumed by humans or those classified as endangered or threatened.

Data on mercury in NJ fish are available through research conducted from the late 1970's to the present. Most of the fish research has been conducted in the state's freshwater rivers, streams, lakes and reservoirs.

Prior to 1994 there was no systematic effort to collect data on mercury levels in NJ freshwater fish that could provide a useful statewide picture. Data that had been collected are limited in coverage and do not necessarily focus on fish from higher trophic levels or fish likely to be consumed by humans. Data from the 1970's and early 1980's (Jacangelo 1977; Ellis et al. 1980), which focused on industrialized areas found evidence of significant elevation of mercury concentrations (> 0.1 ppm). Fish from less industrialized areas, of the state had variable levels of mercury (NYDEC 1981; USFWS 1983, 1990), which tended to be moderately elevated for higher trophic level species while remaining low in fish at lower trophic levels.

NJDEP and the Academy of Natural Sciences of Philadelphia study (ANSP 1994, 1999) reported on results of surveys of mercury contamination in freshwater fish for 1992-94 and 1996-97, respectively, from selected waterways throughout NJ (see Table 2.18). These studies were designed to identify the range of mercury levels for selected fish species. The project design targeted gamefish species from waterbodies via a stratified geographic approach. Sampling locations were selected based on mercury point source inputs, importance of angling at the water body, limnological factors favorable for bioaccumulation (e.g., low pH), recently developed impoundments and reservoirs, and availability of targeted fish species. In the 1992-94 survey, a total of 313 fish from 55 waterbodies were collected. The primary fish species analyzed were Largemouth Bass (n=146) and Chain Pickerel (n=62). Other species sampled in lesser quantities were Smallmouth Bass, White Catfish, Channel Catfish, Yellow Bullhead, Brown Bullhead, Lake Trout, Black Crappie, Hybrid Striped Bass, Rainbow Trout and miscellaneous specimens of Northern Pike, Muskellunge and Walleye.

The study focused on medium or large sized individuals of each species, and all samples were composed of a single edible fillet from an individual specimen. In general, the mercury concentrations varied greatly among lakes, fish species, and with the size of the fish.

Table 2.18. Distribution of Mercury Concentrations in Largemouth Bass and Chain Pickerel in New Jersey Waterbodies Sampled in 1992-94 & 1996-97 (ANSP 1994a, 1999).

	Percent of Sampled Waterbodies			
	Largemouth Bass		Chain Pickerel	
Average Mercury Concentration for each Species	**1992-94***	**1996-97***	**1992-94***	**1996-97***
<0.07 ppm	0 %	0 %	0 %	0 %
0.08 - 0.18 ppm	16.0 %	20.0 %	6.0 %	25.0 %
0.19 - 0.54 ppm	56.0 %	45.5 %	53.0 %	31.5 %
>0.54 ppm	28.0 %	34.5 %	41.0 %	43.7 %

*1992-94 Data (55 Waterbodies Sampled), 1996-97 (30 Waterbodies Sampled)

Tables 2.18 and 2.19 present a summary of these data for the fish species with the highest mercury concentrations. Among the significant findings from this study are the following:

Mercury concentrations greater than 0.5 ppm and 1.0 ppm (FDA Action Level) were seen in fish from a variety of NJ water bodies. Mercury concentrations generally increased with fish size for most species tested and levels > 0.5 ppm were identified primarily in the larger specimens of Largemouth Bass and Chain Pickerel from several lakes and reservoirs. The highest mercury concentrations (3.0 - 8.9 ppm) were found in specimens of Largemouth Bass collected from the Upper Atlantic City Reservoir. High concentrations were also noted in Largemouth Bass from the Manasquan Reservoir (up to 3.9 ppm) and Union Lake (up to 2.0 ppm). Of the 55 waterbodies sampled, 19 (35%) had at least one Largemouth Bass with > 0.5 ppm mercury and 8 (15%) had at least one bass with > 1.0 ppm mercury.

Table 2.19. Percent of Fish Exceeding 0.5 ppm and 1.0 ppm.

	% Exceeding 0.5 ppm	% Exceeding 1 ppm
Largemouth Bass n=146	43% (n=63)	17% (n=25)
Chain Pickerel n=62	56% (n=35)	35% (n=22)
Yellow Bullhead N=9	44% (n=4)	33% (n=3)

The variation of mercury concentration in fish by geographic location probably reflects a number of parameters, including lake morphology, size, and type, as well as variations in pH, and local inputs from industrial activities and wastewater sources. Higher than predicted mercury concentrations in fish were found in recently filled reservoirs and sites from the industrialized northeastern part of the state. Lower than predicted mercury concentrations were observed in small run-of-river impoundments, tidal rivers and small (mainly coastal plain) lakes. Mercury concentrations tended to be higher at sites with lower pH. High

mercury concentrations were measured most frequently in Chain Pickerel from low pH (pH 4-5) lakes and streams in the Pine Barrens region and less acidic lakes (pH 5-6) at the edges of the Pine Barrens. All specimens collected from the Pine Barrens sites had mercury concentrations greater than 0.5 ppm, and 70% had mercury concentrations greater than 1.0 ppm, with a maximum of 2.1 ppm noted.

ANSP (1994b) also conducted a separate study of mercury concentrations in fish collected from rivers and lakes in Camden County, NJ in conjunction with Camden County. A total of five river and seven impoundment sites were sampled. Overall, the mercury levels identified were similar to those previously reported in the 1992-3 statewide ANSP study. The highest mercury concentrations were in samples of Largemouth Bass (1.36 ppm) from Marlton Lake and Chain Pickerel (1.30 ppm) from New Brooklyn Lake, where three of the five Chain Pickerel sampled exceeded 0.50 ppm. Levels in catfish and Black Crappie were low to moderate (generally <0.5ppm).

ANSP (1994c) reported on mercury concentrations in fish collected from three northern NJ reservoirs of the Hackensack Water Supply Company. In this study, samples of Largemouth Bass, Smallmouth Bass, Yellow Bullhead and Common Carp were analyzed. Overall, the concentrations of mercury in fish were low to moderate for all species sampled. However, three Largemouth Bass exceeded 0.50 ppm, with the two highest mercury concentrations, 0.82 ppm and 0.78 ppm, identified from Lake Deforest. Samples of Smallmouth Bass from Lake Tappan averaged 0.07 ppm, while Yellow Bullhead and Common Carp had low to moderate levels (average=0.09 ppm and 0.12 ppm).

NJDEP (1995) reported on results of a pilot project that examined a multi-media profile of three NJ rural, freshwater lakes. The lake profile included collections of surface water, sediments, soil, aquatic vegetation and fish at each lake. The three lakes were located in northern (Mountain Lake, Warren County), central (Assunpink Lake, Monmouth County) and southern (Parvin Lake, Salem County) areas of the state. A total of 15 Largemouth Bass samples (individual edible fillet) and 10 samples of Banded Killifish (individual whole body) were analyzed for total mercury concentrations. Levels of mercury in the Largemouth Bass ranged from 0.14 - 0.40 ppm for the three lakes. The average mercury concentrations in Largemouth Bass from Mountain Lake were 0.23 ppm, Assunpink Lake, 0.31 ppm and Parvin Lake, 0.30 ppm. Forage fish species such as Banded Killifish had mercury concentrations ranging from 0.01 to 0.04 ppm for all three lakes. Interestingly, the mercury concentrations in fish and aquatic vegetation followed a similar pattern for each of the three lakes. Data covering additional fish species and water bodies is expected to be available by 2002.

The results of this study identified an increase in mercury concentrations (through bioaccumulation/biomagnification) across trophic levels in all three of the NJ lakes. The mercury concentrations identified in top trophic level fish (Largemouth Bass) were at least six times greater than the levels identified for forage fish (killifish) and at least ten times greater than for aquatic vegetation. The average mercury concentrations for the Largemouth Bass analyzed for this project were comparable to concentrations of mercury identified in other water bodies (ANSP 1994a, 1994b).

ANSP (1999) reported on mercury in freshwater fish collected from 30 additional waterbodies throughout the state in 1996-97. This project complements the 1992-3 screening project and was designed to fill data gaps in the earlier study, develop trophic transfer information, and to provide additional fish data for selected geographic areas. Samples from 258 fish were analyzed, including 58 Largemouth Bass, 58 Chain Pickerel, and 109 fish of other species. Also, 32 composite samples of several species of forage fish were analyzed.

The results of this study were consistent with those of the 1992-3 study. Mercury concentrations showed a general increase at higher trophic levels. Maximum mercury concentrations were generally highest in piscivorous fish such as Chain Pickerel (average=2.30 ppm) and Largemouth Bass (average=1.68 ppm). Among the lower trophic level species, no clear differences were observed between planktonivores (e.g., Golden Shiners) and invertebrate feeders (e.g., the sunfish). Mercury concentrations for bottom feeding species of bullhead and catfish varied greatly by sampling location and region.

The highest mercury concentrations were in fish from the northern portions of the Pine Barrens (Double Trouble Lake, Ocean County), and on the periphery of the Pine Barrens (Willow Grove Lake and Malaga Lake, Salem County and Success Lake, Ocean County). Dwarf Sunfish had elevated mercury levels compared to other species their size. This may partly explain the elevated levels found in Chain Pickerel in the same lakes. High levels were also seen in fish from the northeastern part of the state where several of the rivers have a history of impacts from industrial activities. Average mercury concentrations in Largemouth Bass, Smallmouth Bass and Yellow Bullhead collected from the Pompton River in Passaic County were 1.17 ppm, 0.96 ppm and 0.80 ppm, respectively. The lowest concentrations were seen in samples from the cold water streams and high pH lakes in the northern part of the state, the Delaware River and in rivers of the southwestern part of the state. In general, the mercury concentrations in most catfish (White and Channel) were less than 0.30 ppm, but some individuals had levels > 0.5 ppm. Mercury concentrations in Yellow Bullhead were much higher than in Brown Bullhead in most waters where both species were collected, with Pine Barrens lakes having the highest levels for both.

Three sunfish species (Bluegill, Redbreast, and Pumpkinseed) were low in mercury concentrations in most areas, except for samples collected from the industrial northeast sites. High levels were identified in individual samples of Redbreast Sunfish (up to 0.41 ppm), Pumpkinseed Sunfish (up to 0.78 ppm) and Rock Bass (up to 0.58 ppm) collected from the Pequannock and Pompton Rivers, in Passaic County.

ANSP (1999) also reported a 1995 analysis of mercury in fish for 15 water bodies for which specific health-based consumption advisories were issued on the basis of the 1992-3 mercury screening study. The project included collections of gamefish species from three trophic levels and a forage fish specie. As in the original ANSP (1994a) project, Largemouth Bass and Chain Pickerel were targeted as the top trophic level species, but other top trophic level species, lower trophic level fish, forage fish, and omnivorous bottom dwelling species were also sampled. Overall, the results paralleled the initial 1992-93 ANSP (1994a) findings, where typically, the largest specimen of gamefish sampled exhibited the highest mercury concentration.

a. Summary and Conclusions

Mercury is a widespread and persistent contaminant in freshwater fish collected throughout the state. Concentrations exceeding 1.0 ppm have been found in higher trophic level fish, particularly Largemouth Bass and Chain Pickerel, in about 40% of the tested waterbodies. Some lakes in industrialized areas of the state which are subject to local mercury pollution had fish with elevated mercury levels, but some lakes in unpolluted areas such as the Pine Barrens also had high levels. Mercury concentrations in lower trophic level fish are also elevated and are commonly in the range of 0.2 to 0.5 ppm. Thus many tested water bodies exceed the recent surface water criterion value of 0.3 ppm in fish tissue promulgated by US EPA (2001). Waters impacted by industrial or municipal discharge, poorly buffered waters

with low pH (e.g., many in the Pine Barrens), and newly created lakes, tend to have fish with elevated mercury levels.

2. *Saltwater Fish and Invertebrates*

Fishing is a major recreational and economic activity in the estuarine, coastal and offshore waters of NJ. There are an estimated 1.2 million anglers who take about 4.5 million saltwater fishing trips per year, at a value of $1.2 billion. Although the catch-and-release option allows fishermen to enjoy their sport, preserve their resource, and avoid contaminants, the majority of saltwater fishermen eats some or all of their catch or gives it to friends or family. Moreover, upon returning from a successful fishing trip, they may consume fresh fish in large amounts over a period of a few days.

Relatively few data exist on mercury levels in NJ saltwater fish, reflecting the lack of systematic sampling. Ellis et al. (1980) reported the results of a study of metals in aquatic organisms primarily from the estuarine waters along coastal NJ. The data are shown in Table 2.20. A total of 77 species of fish, shellfish and crustacean were collected between 1978 and 1980. Among finfish species, the highest mercury concentrations were identified in eight high trophic level and two lower trophic level species. Samples for this study consisted of a combination of individual (single) edible portions of consumer species and whole body composite samples for lower trophic level samples.

Table 2.20. Mercury Concentration in Selected Saltwater Aquatic Species Collected from
The Lower Hudson River Estuary* (after Ellis et al. 1980).

Sample Type	Species	Average Hg (ppm)
Whole Body	Silversides	2.50
Composite Sample	Soft Clam	2.00
	Blue Mussel	1.90
	Killifish	1.66
Individual Fillet Sample	American eel	2.10
	Striped Bass	1.65
	Bluefish	1.40
	White Perch	1.32
	Summer Flounder	1.16
Composite*	Blue Crab	1.02

** Composite sample of backfin and claw meat from individual specimen*

The USFWS (1990) reported results for a variety of metals, organochlorine pesticides and polychlorinated biphenyls (PCBs) in fish and crabs collected from Deepwater, NJ. Three Blue Crab samples from the Deepwater, NJ site had moderately elevated mercury concentrations. Two of the Blue Crab samples were a muscle/hepatopancreas mixture. These samples revealed concentrations of 0.14 ppm and 0.19 ppm. The other Blue Crab sample was divided into separate muscle (backfin & claw) of 0.19 ppm and hepatopancreas (green gland) tissues with a mercury concentration of 0.13 ppm.

NOAA (Reid et al 1982 and Zdanowicz &Gadboisl 1990) reported on a variety of heavy metal and organochlorine contaminants in four marine fish species (Bluefish, Fluke, Seabass, and Tautog) collected from popular recreational fishing areas along the coast of Monmouth

County and within eight miles of the beach. Samples for metal analyses were composites of fillets from three specimens. The data are shown in Table 2.21. Mercury concentrations for all samples were low and did not exceed 0.11 ppm, and none of the composite fish reached 1.0 ppm. In general, the relative ranking of mercury concentration by species was Tautog = Bluefish > Fluke = Sea Bass. No biological or behavioral features were offered to explain this relationship.

A study by NOAA (Drexel et al 1991) reported on a variety of inorganic and organic contaminants in tissues of American Lobster caught from the New York Bight Apex. A total of 508 lobsters were analyzed for

Table 2.21. Mean Mercury Concentrations of Composite Samples by Species in ppm, Wet Weight.

Species	Site A	Site B	Site C	Site D	Site E	Site F
Bluefish	0.10 (5)	0.11 (5)	0.10 (4)			
Tautog	0.09 (5)	0.08 (4)	0.08 (5)			
Sea Bass	0.06 (4)	0.05 (5)	0.05 (5)			
Fluke	0.04 (2)	0.04 (2)	0.04 (3)	0.04 (3)	0.04(2)	0.03(2)

(n)= Number of composite samples per station

this project. Samples were obtained from commercial lobster fishery operators across a wide area within the New York Bight Apex, including the vicinity of the Mud Dump Site, the Hudson-Raritan estuarine outflow pipe, the Christiansen Basin, and the Hudson Shelf Valley. Samples consisted of composite tissue from five similar size, same sex specimens. A total of 48 muscle (tail) tissue and 48 hepatopancreas tissue and four extruded egg mass tissue samples were analyzed in this project. The remaining lobsters were individually composited and analyzed. All samples were analyzed for organic compounds and ten metals including total mercury. Overall, mercury concentrations for this project did not exceed 0.50 ppm. The maximum composite concentrations of mercury in muscle tissue and composite hepatopancreas tissue samples of five crabs were 0.491 ppm and 0.247 ppm, respectively. Mercury concentrations were below detection limit (<0.004 ppm) in all four of the egg mass samples. Seasonal differences in metal concentrations were observed in hepatopancreas tissue samples. Mercury concentrations in both muscle and hepatopancreas tissues were lowest from specimens collected in the fall (October).

NYSDEC (1996) analyzed total mercury concentrations in edible portions of fish, bivalves, crustaceans and cephalopods taken from the New York - NJ Harbor Estuary including four NJ waters: Upper Bay; The Kills (Arthur Kill, Kill Van Kull and Newark Bay); Lower Bay; and the New York Bight Apex. The species of fish collected were American Eel, Atlantic Herring, Atlantic Tomcod, Bluefish, Butterfish, Cunner, Kingfish, Northern Sea Robin, Porgy, Rainbow Smelt, Red Hake, Sea Bass, Silver Hake, Spot, Spotted Hake, Striped Bass, Striped Sea Robin, Summer Flounder, Tautog, Weakfish, White Perch, Windowpane Flounder and Winter Flounder. The bivalves collected were Blue Mussel, Eastern Oyster, Hard Clam, Horse Mussel, Soft-Shell Clam and Surf Clam. The crustaceans were American Lobster and Blue Crab (both muscle and hepatopancreas tissue). The single cephalopod species was Longfin Squid.

Analyses for total mercury were conducted on 545 samples, and mercury was detected (above the minimum detection level of 0.05 ppm) in 422 samples (77.4%). Two individual Striped Bass samples exceeded 1.0 ppm (1.05 ppm and 1.25 ppm). Mean mercury

concentrations exceeded 0.5 ppm only in Striped Bass measuring 30 inches or more in total length (the largest size group tested). Individual samples of American Eel, Bluefish, Cunner, Striped Bass, Tautog, White Perch and Blue Crab (muscle meat) approached or exceeded 0.50 ppm. Only Striped Bass and Tautog had average mercury concentrations greater than 0.25 ppm. Non-detectable mercury concentrations (<0.05 ppm) were encountered most frequently in the six bivalve species, and in Butterfish, Winter Flounder, the hakes and American Eel. For most species, there were few differences in mercury concentration among the four locations in the harbor estuary.

a. Summary and Conclusions

Data on mercury levels in saltwater fish in NJ are limited and mainly reflect estuarine rather than marine species. Based on the currently available data, most species have moderate mercury concentrations, averaging less than 0.25 ppm. Striped Bass and Tautog, however, may have mercury concentrations in the range of 0.5-1.0 ppm.

Data from 1980 for the Hudson-Raritan Estuary identified relatively high mercury concentrations in both forage base species as well as top trophic level species, while more recent data revealed only a limited number of samples with elevated mercury concentrations. The reason for and the significance of the apparent decline are uncertain due to insufficient data. These waterways have a current and historical record of municipal and industrial discharge activities and the data indicate that these waterways are still impacted.

D. Impacts of Mercury on NJ Fish

1. Introduction

There are two basic approaches that can be taken to assess the impact of mercury in NJ waters on the fish in those waters. One approach can be referred to as a direct approach. This involves making observations of fish health, survival, and performance as a function of mercury exposure. These observations can be supplemented with studies of health, survival and performance under controlled laboratory conditions in which mercury exposure duplicates that experienced in the environment. The other approach can be referred to as an indirect approach. This involves comparing measured concentrations of mercury in water or in fish tissue to toxicity criteria for fish, which were derived specifically for those media. This comparison can provide a prediction of the expected level of impact to the fish exposed to the measured environmental mercury levels.

2. Direct Assessment of Risk to NJ Fish

a. Freshwater Fish

The influence of mercury on the general and reproductive health of wild fish populations has not been well studied in general, and few NJ-specific data are available. Among the measures regularly used to assess the health or condition of fish are the ratio of the liver weight to total body weight (liversomatic index or LSI) and the ratio of gonad to total body weight (gonadsomatic index or GSI). Various researchers have conducted laboratory studies indicating that mercury can produce reproductive impairments in fish. These studies have suggested that mercury exposure can decrease gonadotropin hormone levels and impair spermatogenesis, decrease GSI, and reduce growth in juvenile fish. However, one preliminary field investigation (Friedmann et al. 1996) indicates that such adverse effects on

reproductive health do not occur at levels of tissue mercury four times the United States national average.

In 1997, the NJDEP-DFGW conducted a study to determine overall status, body weight and length, serum androgen levels, GSI, LSI, kidney nuclear diameter, and serum cortisol levels in male Largemouth Bass (NJDEP 1997). The fish were collected from three bodies of water in NJ: Assunpink Lake (containing low levels of mercury), Manasquan Reservoir (containing moderate levels of mercury), and Atlantic City Reservoir (containing high levels of mercury). The mean total mercury content in fish was 0.30 ppm from Assunpink Lake, 1.23 ppm from Manasquan Reservoir and 5.42 ppm from Atlantic City Reservoir (the latter being one of the highest average values recorded for freshwater fish anywhere). Inter-lake and intra-lake analyses demonstrated statistically significant positive associations between mercury levels in fish tissue and 11-ketotestosterone in serum and a negative association between mercury and serum testosterone concentrations. These data are consistent with the hypothesis that mercury influences androgen levels in fish. Other indicators of fish 'health' such as body weight, length, condition factor, and GSI and LSI indices, as well as serum cortisol and cell nuclei diameter were similar for all three lakes. Additional research is required to help understand the implications of the hormone changes.

b. Estuarine/Marine Fish

Killifish were collected from Piles Creek, a mercury-contaminated tidal creek emptying into the Arthur Kill in an industrialized area of NJ, where sediment contained up to 200 mg/kg (average 11.2 mg/kg) of mercury (Khan and Weis 1993). These fish differed biologically from those collected in less polluted areas: Tuckerton, NJ and East Hampton, NY (Weis & Weis, 1989). Piles Creek Killifish had liver concentrations of mercury more than seven times higher, grew more slowly, reached sexual maturity earlier, and did not live as long as those from Tuckerton (Khan & Weis, 1993). Piles Creek Killifish had higher levels of mercury in brain and were slower and poorer in prey capture and predator avoidance than Tuckerton fish (Weis & Khan, 1991; Smith et al. 1995; Smith & Weis, 1997).

Killifish embryos experimentally exposed to 5 or 10 μg/L methylmercury subsequently resulted in slower prey-capture ability in Killifish larvae (Weis & Weis 1995a and 1995b). This effect was transitory and lasted about one week. However, fish exposed in the field would continue to be exposed and might not recover from such deleterious effects (Weis & Weis 1995a and 1995b).

When uncontaminated fish were exposed to conditions similar to those of the polluted creek, this led both to a reduction in their prey capture rate and an increase in brain mercury to levels similar to those of fish native to the creek (Smith & Weis 1997).

c. Summary and Conclusions

There are very few data on the direct effects of mercury on NJ fish. The results of the Weis and Weis research, reported in several papers, demonstrate significant effects on many aspects of biology, behavior and viability of Killifish. Killifish from mercury-contaminated water showed abnormal behavior and reduced viability. A study of androgen levels in largemouth bass also showed the potential for significant reproductive impairment. Much more information is needed to draw conclusions regarding the impact of mercury on fish health and reproductive capacity. Too few data are available to permit generalization of these observations to other NJ species and location, but it is reasonable to expect that analogous situations occur elsewhere and in other species. These findings raise concerns,

and point out the need for research to examine the impact of mercury on the overall viability of fish in impacted NJ estuarine and marine environments.

3. Indirect Assessment of Risk to NJ Fish

a. Freshwater, Estuarine, and Marine Fish

Given the very limited direct data on the impact of mercury contamination in NJ waters on NJ fish, two indirect approaches were used to estimate risk to NJ fish species. One involved a comparison of surface water concentrations in NJ to published laboratory toxicity data on mercury and water quality criteria. The second method compares tissue concentrations of mercury in NJ fish to published data on mercury effects and Tissue Screening Concentrations (TSCs). Both methods can be characterized as a screening assessment. Additional data and a more rigorous evaluation would be needed to estimate risk to specific fish populations within the State.

With reference to the first method, numerous laboratory studies have been conducted on the toxicity of mercury in water to fish.(Table 2.22) For acute exposures (one to four days), concentrations causing mortality (i.e., LC_{50} values, which are concentrations lethal to 50% of the exposed fish) ranged from 1.24 μg/L for Threespine Stickleback (1-day exposure) to 500 μg/L for Carp (4-day exposure). Other 4-day LC_{50} values for species found in NJ include 90 μg/L for Striped Bass, 110 μg/L for Banded Killifish, 140 μg/L for American Eel, 220 μg/L for White Perch, and 300 μg/L for Pumpkinseed (US EPA 1999a). Chronic exposure to mercury causes effects at much lower concentrations than those causing acute effects due in part to bioaccumulation. Chronic exposure to MeHg reduced growth in Rainbow Trout at 0.04 μg/L (US EPA 1980). Exposure of fish eggs to mercury resulted in high embryo-larval mortality and teratogenesis at concentrations as low as 0.12 μg/L (Birge et al. 1979).

Applicable NJ water quality criteria for mercury in freshwater are 2.1 μg/L (acute; as dissolved mercury) and 0.012 μg/L (chronic; as total recoverable mercury); and for saltwater the criteria are 1.8 μg/L (acute) and 0.025 μg/L (chronic).

Table 2.23 compares chronic toxicity data and water quality criteria to mercury concentrations in NJ surface waters. In 1995-1997, 232 water samples from 78 freshwater stations were collected by NJDEP and USGS. The method detection level was 0.1 μg/L, and 94% of the samples fell below this level (i.e., not detected). A project conducted by NJDEP/DSRT measured average surface water concentrations of 0.0015 to 0.0198 μg/L in three NJ lakes (Stevenson et al. 1995). The maximum value in the DSRT study exceeded NJ's chronic water quality criteria for freshwater (0.012 μg/L). However, only approximately 6% of the 1995-1997 surface water samples exceeded 0.1 μg/L (Table 2.23) and the DSRT study maximum value of 0.0198 μg/L was less than the lowest listed chronic toxicity value (0.04μg/L).

Based on these limited data, it appears that some fish are at potential risk from the toxic effects of mercury in some of NJ's fresh waters.
Lower detection limits will help assess the risk of mercury in aquatic systems. Improvements in analytical capabilities combined with clean laboratory techniques make lower detection limits possible.

There are limited data for marine/estuarine waters. Data for the NY/NJ harbor area probably represent the high end of mercury concentrations in marine waters of NJ. Average concentrations

were 0.0071 µg/L (Raritan Bay), 0.0695 µg/L (Newark Bay), 0.0862 µg/L (Hackensack River), and 0.2499 µg/L (Passaic River)(GLEC 1996).

Table 2.22. Mercury and Methylmercury Acute and Chronic Toxicity Values for Fish.

Species	Exposure Period	Water Concentration of mercury causing Acute Toxicity (LC_{50}) µg/L	Water concentration of mercury causing Chronic Toxicity µg/L	Effect/Reference
Inorganic Mercury				
Striped Bass	4-day	90	-	(US EPA 1999a)
Banded Killifish	4-day	110	-	(US EPA 1999a)
American Eel	4-day	140	-	(US EPA 1999a)
White Perch	4-day	220	-	(US EPA 1999a)
Mummichog	4-day	300	-	(US EPA 1999a)
Pumpkinseed	4-day	300	-	(US EPA 1999a)
Carp	4-day	500	-	(US EPA 1999a)
Egg Exposure	4-day post hatch	0.12-0.21		High embryo-larval mortality; teratogenesis (Birge et al. 1979)
Parental Exposure	400-day	-	0.70-0.79	High embryo-larval mortality; teratogenesis; no detectable adult pathology (Birge et al. 1979)
Methylmercury				
Threespine Stickleback	1-day	1.24	-	(US EPA 1999a)
Rainbow Trout	4-day	31	-	(US EPA 1999a)
Goldfish	1-day	80	-	(US EPA 1999a)
Mummichog	4-day	150	-	(US EPA 1999a)
Rainbow Trout	64-day	-	0.04	Growth reduction (US EPA 1980)
Brook Trout	17-day	-	0.88	Enzyme disruption (US EPA 1980)
Brook Trout	21-day	-	0.79	Organo-Hg; Growth inhibition (US EPA 1980)
Medaka	3-months	-	1.8	Impaired spermatogenesis (Wester 1991)

A comparison of these data to the marine/estuarine surface water chronic criteria of 0.025 µg/L indicates that waters in the more urban areas of the harbor exceeded water quality criteria. This indicates that fish in these waters are at potential risk from the toxic effects of mercury contamination.

Table 2.23. Comparison of NJ Surface Water Criteria with Average Surface Water Concentrations of Mercury.

NJ Surface Water Criteria	Location	Average Surface Water Concentrations	Date
Freshwater			
Acute 2.1 µg/L	78 Water-Quality Stations	0.053 µg/L* (94% of samples below detection limit of 0.1 µg/L)	1995-1997
Chronic 0.012 µg/L	41 Water-Quality Stations	<0.1 µg/L (all samples below detection limit of 0.1µg/L)	1998
	Three NJ Lakes	0.007 µg/L (0.0015 to 0.0198 µg/L*)	1992
Marine/Estuarine			
Acute 1.8 µg/L	Raritan Bay	0.0071 µg/L	1995
Chronic 0.025 µg/L	Newark Bay	0.0695 µg/L*	1995
	Hackensack River	0.0862 µg/L*	1995
	Passaic River	0.2499 µg/L*	1995

** Concentration exceeds the chronic criteria for freshwater or salt water*

The second method for estimating risk to NJ fish species compares tissue concentrations of mercury in NJ fish to published data on mercury effects and Tissue Screening Concentrations (TSCs). However, there is limited information on the relationship between fish tissue concentration and adverse effects. Table 2.24 lists tissue and effects data from several sources for fish in general, and for specific species (e.g., Rainbow Trout). Based on these data, adverse effects are evident at whole body concentrations as low as 1.3 ppm (growth) and at muscle concentrations of 0.232 ppm (behavior). Shephard (1998) recommended the use of tissue screening concentrations (TSCs) to assist in determining the risk of bioaccumulated contaminants. TSCs were defined as "whole body, wet weight tissue residues of chemicals, which if not exceeded, pose little chance of causing adverse toxicological or ecological harm to aquatic biota." These values were derived by applying bioconcentration factors to the ambient water quality criteria. The TSC for mercury is 0.06 µg/g for freshwater (Shephard, 1998). The hazard quotient (HQ) method was used to conduct a screening level risk assessment where:

$$HQ = \frac{\text{Estimated Environmental Concentration}}{\text{Benchmark Concentration}}$$

HQs (see Table 2.25) were generated by comparing NJ fish tissue concentrations of mercury separately to the mercury TSC value and to the lowest observed effect concentration from Table 2.22 (i.e., 0.232 µg/g for adult fish). Exposure was estimated by using the data from the fish collected at 55 locations in NJ (ANSP 1994).

As indicated by the range in HQs, at least some of the fish samples for all of the species exceeded the TSC or effects thresholds (i.e., HQ>1). This indicates that at least some species of fish in some NJ waters are at risk for the effects of mercury. Largemouth Bass and Chain Pickerel are probably at increased risk based on the large HQs for those species.

Table 2.24. Adverse Effects at Observed Fish Tissue Concentrations.

Species	Mercury Concentration (µg/g; wet weight)	Effects	Reference
Brook Trout	5-7 (whole body)	Mortality, decreased growth, sluggishness, deformities	McKim et al. 1976
Rainbow Trout	20-30 (whole body)	Reduced appetite; gill hyperplasia	Niimi and Lowe-Jinde 1984
	4-27 (whole body) 9-52 (muscle)	Appetite & activity loss followed by death	Niimi & Kissoon 1994
	12-23 (muscle)	Reduced growth	Wobeser 1975
Northern Pike	7-9 (muscle)	Emaciation	Lockhart et al. 1972
Walleye	1.7-3.1 (whole body)	Decreased weight, length, & gonadosomatic index	Friedmann et al. 1996
Fathead Minnow	1.3 (whole body)	Decreased weight & length	Snarski & Olson 1982
	4.5 (whole body)	No spawning	
Fish	0.232 (muscle)	Decreased swimming ability	Rompala et al. 1984
Fish	10-30 (whole body)	Toxicity	Spry and Wiener 1991
Juvenile or Adult Fish	9-20 (whole body)	Harmful effects	Wiener 1996
Fish Eggs or Embryo	0.07-0.10	Adverse effects	Wiener 1996

Table 2.25. Hazard Quotients (HQs) Calculated from the Tissue Concentrations (Range of Concentrations) by Species Divided by the Tissue Screening Concentrations (TSC) and Effect Concentration.

NJ Fish Species (no. of samples)	Hazard Quotient	
	Based on TSC	Based on Effects Concentration
Largemouth bass (146)	0.8-149	0.2-38
Chain pickerel (62)	1.5-47	0.4-12
Smallmouth bass (21)	1.3-8.5	0.3-2.2
Channel catfish (12)	1.2-12	0.3-3.1
Brown bullhead (15)	0.3-7.8	0.1-2.0

b. Summary and Conclusions

The limited data, which allow comparison of mercury concentration in NJ fish to published criteria and guidelines, indicate the potential for chronic effects to fish in some waters of the State due to mercury. This potential is reflected in the exceedence of water quality criteria for chronic effects for both freshwater and saltwater fish. In particular, the NY-NJ Harbor area has exhibited mercury water concentrations above water quality criteria. Monitoring using more sensitive (i.e., lower detection limit) methods is needed to assess the levels of mercury in surface waters. It is apparent from both direct and indirect methods that some fish in some NJ waters may be at risk of mercury toxicity.

E. Mercury in NJ Birds

1. Assessment of NJ Species Potentially at Risk

The trophic level and feeding habitats of a bird species will influence its exposure to mercury. Piscivorous bird species are at greatest risk to the effects of mercury due to the biomagnification of mercury through the aquatic food chain. State threatened and endangered species, such as the piscivorous Osprey, Bald Eagle, Black Skimmer, and Least Tern may be at increased risk due to their trophic level and the potential cumulative effects of other contaminants in addition to mercury on reproduction (e.g., DDT/DDE, PCBs). The Peregrine Falcon, another NJ endangered species, may also be at high risk since its diet includes piscivorous birds (such as terns). A variety of large birds including herons and egrets, gulls, terns, and skimmers which typify the NJ shore, may also be at increased risk due to greater mercury exposure from the fish they eat.

Smaller birds that feed at lower trophic levels in the aquatic food chain also may be exposed to increased amounts of mercury due to their high food consumption rate relative to larger birds (US EPA 1997f).

2. Wildlife Criterion Value (Surface Water Concentration)

US EPA (1997d) calculated a wildlife criterion value of 50 pg/L of MeHg in surface water for protection of piscivorous wildlife. Based on this value, they calculated the concentration in fish that would meet this criterion. For trophic level 3 fish (e.g., sunfish) this value is 0.077 μg/g , and for trophic level 4 fish (e.g., Largemouth Bass) this value is 0.346 μg/g. Therefore, concentrations of MeHg in fish would need to be at or below these values to be protective of piscivorous birds and mammals. For example, the MeHg concentration in piscivorous fish species (e.g., Pickerel, Largemouth Bass) would need to be less than or equal to 0.346 μg/g to protect species that feed on them. The MeHg concentration in omnivorous fish (e.g., sunfish) prey would need to be less than or equal to 0.077 μg/g to protect wildlife species including larger predatory fish.

Based on these values, a comparison for the 55 NJ waterbodies sampled in 1992-93, indicates that top trophic level fish exceed the criterion value of 0.346 μg/g for protection of piscivorous wildlife and also exceed the new EPA surface water criterion of 0.3 μg/g (in fish tissue). The data indicate that Largemouth Bass in 70% (23 of 33) and Chain Pickerel in 82% (18 of 22) of the waterbodies exceeded this concentration. Overall, 60% of the Largemouth Bass samples and 74% of the Chain Pickerel samples exceeded this value. This indicates that certain piscivorous wildlife species feeding on these species in these waters are at potential risk from the effects of mercury. Additional data collection and a more comprehensive analysis are recommended for trophic level 3 and 4 fish.

The EPA provided relative ranking of exposure for the species considered: Kingfisher > River Otter > Loon = Osprey = Mink = Bald Eagle. The Belted Kingfisher has a higher daily mercury intake than Osprey, and EPA estimates that 29% of its national range has high atmospheric mercury deposition (5 $\mu g/m^2$). For Osprey and Bald Eagle, 20% and 34% of their national range respectively receives high mercury deposition. Both species were severely impacted by chlorinated hydrocarbon pesticides in the 1950's and 1960's and have recovered through a combination of pesticide bans and aggressive management. Whether mercury currently impairs their survival or reproduction requires additional monitoring.

3. *Criteria for Mercury in Birds*

US EPA (1997d) concluded, based on a review of laboratory and field data, that adverse impacts on avian populations are possible at mercury concentrations exceeding the following values (fresh weight): feathers - 20 μg/g (Scheuhammer 1991); eggs - 2.0 μg/g (after conversion from dry weight) (Scheuhammer 1991), and liver - 5 μg/g (Zillioux et al. 1993). EPA indicated that these numbers should be used with caution, because the literature contains reported thresholds that are higher than and lower than these values. Some of the NJ data approach these thresholds. Evidence of lower thresholds (e.g., developmental abnormalities in Common Tern chicks [Gochfeld, 1980]) indicate that NJ species may be at potential risk.

Summarizing literature on reproductive and behavioral outcomes, Burger and Gochfeld (1997) identified a level of 0.5 ppm (wet weight) in eggs and 5.0 ppm in feathers as criteria above which adverse effects could be anticipated. Feather levels in the 40-60 ppm range were associated with sterility and total chick mortality, while levels in the 5-40 ppm range were associated with reduced hatchability and behavioral abnormalities (Burger and Gochfeld 1997; Eisler 1987).

4. *Mercury Levels in Birds of NJ and the New York Harbor and Bight*

Birds have been monitored for mercury since the 1960's and data from NJ, and the New York Bight comprise a significant portion of the contaminants' data compiled in the national database by the US Fish and Wildlife Service (B. Rattner, Personal Comm).

a. *Common Loon*

The Common Loon (*Gavia immer*), icon of the northwoods, is a species at risk, declining over much of its breeding range. This piscivorous waterfowl breeds on fresh water of Canada and the northern United States. It visits NJ only on migration and as a winter resident between September and April on both fresh and saltwater. Its population has declined, due primarily to acid deposition, but loons have high mercury levels, and Barr (1986) found adverse reproductive effects in loons exposed to 0.3 μg/g of mercury in trophic level 3 fish.

b. *Colonial Waterbirds*

Species such as gulls and terns, herons and egrets nest in large groups, referred to as "colonies"on islands or other protected habitats mainly along the coast. Chicks are fed by the parents, who fish in the waters within a few kilometers of the colonies. The adults thus "collect" fish from a relatively small area over a period of weeks, thereby integrating exposure over time and space. Several studies of mercury in such species have been conducted in estuarine systems of the New York Bight from Fire Island, NY to Barnegat Bay, NJ.

In a summary of studies of mercury in eggs of nine coastal waterbird species from the New York Bight, Burger and Gochfeld (1997) found that mean mercury levels exceeded 0.5 ppm for Snowy Egrets from Lavalette, NJ; Black Skimmers and Common Terns from NY and NJ; and Forster's Tern and Herring Gulls from Barnegat Bay. Forster's Terns had the highest values. Only Laughing Gulls from Barnegat Bay had a mean less than 0.5 ppm. The same study of feather mercury, however, revealed that most of these colonial species had mean mercury below 5 ppm. Only Snowy Egrets from the Barnegat Light colony and Great Egrets from Lavallette, exceeded an average of 5 ppm. The Great Egret eats relatively large fish,

and Jurczck (1993) concluded that in south Florida this species was exposed to excessive amounts of mercury, thus placing the population at risk. Currently this species has an apparently stable population in NJ that breeds and partly winters in the state.

The insectivorous Cattle Egret also had moderately high levels of mercury, even though it is lower on the food chain. Mercury levels in its feathers averaged 0.60 ppm in the Arthur Kill colonies and 1.6 ppm in the Pea Patch, Salem County colony. These are substantially lower than the 3.5 ppm average at Aswan, Egypt (Burger et al. 1992), but are nonetheless elevated.

In NJ, Herring Gull eggs contained 0.26 μg/g (geometric mean wet weight) of mercury at Shooter's Island, 0.47μg/g at Lavallette, and 0.33 μg/g at Log Creek (Gochfeld 1997). Surprisingly, mercury levels in these two Barnegat Bay colonies were significantly higher than in eggs from the Arthur Kill (geometric mean=0.26 μg/g) and Jamaica Bay (geometric mean=0.29 μg/g) (Gochfeld 1997). The Barnegat Bay levels were comparable to the median for German colonies (about 0.40 μg/g; Lewis et al. 1993) and close to those for highly contaminated Great Lakes colonies (mean=0.51μg/g; Gilman et al. 1977). The source of this elevated mercury has not been identified.

Clearly, with these mean values, some of the birds at the high end would have been at risk of adverse effects. Burger (1997b) compared Herring Gull feather mercury levels in four Long Island, three NJ and one Virginia colony. The highest values (geometric means) were 2.66 μg/g in western Long Island Sound, and 2.45 μg/g in Barnegat Bay. These compare with median values from central Europe of about 5.0 μg/g (Lewis et al. 1993).

Laughing Gulls, mostly from breeding colonies in NJ, were killed at J.F. Kennedy Airport as part of a federal control program to avert aircraft collisions. The carcasses were collected and the tissue analyzed for mecury. Mercury levels averaged 0.55 μg/g in liver, 0.48 μg/g in kidney and 3.5 μg/g in feathers (Gochfeld et al. 1996).

The Roseate Tern (*Sterna dougallii*) is a federal endangered species, which formerly nested at least rarely in NJ. Samples from a Long Island colony revealed a slight decline in mercury in eggs (geometric mean, wet weight) from 1.49 μg/g (1989) to about 1.07 μg/g (1994). Between 1971 and 1982 the geometric mean mercury level in Common Tern eggs (Long Island, NY) declined from 0.61 to 0.25 μg/g (Burger and Gochfeld 1988). Herring Gull feathers from Captree, NY revealed no temporal trend between 1990 and 1993 (values of 0.2 μg/g to 0.4 μg/g in adults) (Burger 1995).

As evidence of biomagnification in Raritan Bay, mercury levels were higher in fish eating Common Terns than in omnivorous Herring Gulls and Greater Scaup or herbivorous Black Ducks (Burger et al. 1984). Some of the highest mercury levels in feathers were found in Black Skimmers from the New York Bight, with up to of 13.0 μg/g (Burger and Gochfeld 1992).

c. Waterfowl

Ducks and geese are prominent features of NJ wetlands, particularly in winter, and ducks have been used as indicators of contaminant levels. Greater Scaup, once the most abundant duck wintering in Raritan Bay, were monitored in 1980-81 (Burger et al. 1984) and again in 1996-97 (Cohen et al. 1999). The mean levels in liver were essentially unchanged (0.73 vs. 0.86 μg/g). Moreover, Cohen et al. (1999) found that mercury levels were higher in Scaup from Sandy Hook than from eastern Long Island or Long Island Sound, suggesting a local source of contamination rather than contamination on the breeding grounds in Canada.

Moreover, mercury levels increased from early winter (when the birds arrived from their Canadian breeding grounds) to early spring (before they departed northward), again indicative of local exposure to mercury in Raritan Bay.

Three species of ducks from Raritan Bay (1980-1981) were analyzed for mercury in liver. Mean levels were 0.53 μg/g (wet weight) in Black Duck, 0.73 μg/g in Scaup, and 0.32 μg/g in Mallards (Burger and Gochfeld 1985; Gochfeld and Burger 1987b). In 1983, Black Ducks, Greater Scaup and Herring Gulls all averaged less than 0.5μg/g of mercury in liver (wet weight) while Common Terns exhibited levels were at 0.7 μg/g.

d. Shorebirds

Many migratory shorebird species feed mainly on Horseshoe Crab eggs and small invertebrates. Average total mercury in Horseshoe Crab eggs from Delaware Bay were 27 ppb (1993), 93 ppb (1994), and 12 ppb (1995) (Burger 1997). Mercury levels were measured in feathers of three shorebird species from Delaware Bay in the early 1990s. Red Knot averaged 1.15 ppm, Sanderling 2.8 ppm, and Semi-palmated Sandpiper 0.021 ppm. These highly migratory species may be exposed in their tropical wintering grounds or their Arctic breeding grounds, as well as along Delaware Bay (Burger 1993).

e. Raptors

The falcons, hawks and eagles (collectively called raptors) are familiar birds to the public. The Osprey is a characteristic feature of the Jersey Shore; the falcon the emblem of the US Airforce, and the Bald Eagle is our national symbol. NJ has invested extensively in protecting raptorial birds. The populations of most species in the eastern United States have recovered. However, the populations of Ospreys, Peregrine Falcons and Bald Eagles has declined precipitously due to the bioaccumulation of chlorinated hydrocarbon pesticides, and the population of Northern Harrier (Marsh Hawk), has declined probably because of habitat loss. NJ has had an aggressive program to restore Eagles and Ospreys and to protect Northern Harrier habitat, as well as the crucial habitat in Cape May County required by migratory hawks. For migratory species such as the Peregrine, chlorinated hydrocarbon exposure in South America continues to be a threat.

Whether mercury has contributed to past declines or may impair future population, is not known. There are few data on mercury levels in NJ raptors (Bald Eagle, Osprey, Peregrine Falcon) but this sparse data show that raptors can accumulate high concentrations of mercury. Comparable data obtained systematically from NJ breeding populations would provide valuable information for a management program. As indicated earlier, piscivorous raptors, such as the Osprey and Bald Eagle, are at greater risk due to increased mercury exposure from their diet.

As of the mid-1990's, the population of Bald Eagles in the Delaware River basin had rebounded from one pair in the early 1970's to 13 pair. Blood mercury levels in 35 Bald Eagle chicks (1993-1996) showed a geometric mean of 140.6 μg/L and were generally below 300 μg/L. The five highest mercury concentrations between 756 and 1549 μg/L were found in 5 of 6 Union Lake nestlings (Clark 1999). These levels are quite high. Additional levels for mercury in NJ raptors are shown in Table 2.7 (Volume II, Chapter 6).

Osprey (*Pandion haliaetus)* and other avian populations have progressively recovered from the adverse effects of widespread pesticide usage. Recovery of several localized populations of Ospreys and Bald Eagles nesting along the Delaware Bay continue to be hampered by

organochlorine pesticides. Results from surveys in 1977 and 1987 contained some of the highest contaminant residues recorded in Bald Eagle eggs from the Delaware Bay region (Steidl et al. 1991).

5. Mercury and Developmental Defects

In the late 1960's and early 1970's, an epidemic of developmental defects was detected in several species of colonial birds in the New York Bight. These included craniofacial abnormalities (anencephaly, cyclopia, micrognathia, crossbill), limb abnormalities (phocomelia, excess limbs and toes), and feather defects. In the 1980's similar defects occurred in birds in the Great Lakes. Total mercury levels in chicks of Common Terns from western Long Island ranged from 165-750 μg/L in blood and 0.8 to 2.6 ppm in feathers, with abnormal chicks having higher levels than normal ones ($p < 0.05$). Developmental abnormalities in Common Tern chicks were associated with significantly higher mercury levels in liver of 2.2 vs. 1.1 μg/g and brain levels of 0.85 vs. 0.42 μg/g (Gochfeld 1980).

Common Terns with developmental defects associated with high levels of mercury also had elevated PCB concentrations (Hays & Riseborough 1971), and an additive or synergistic affect between these pollutants was proposed (Gochfeld 1975).

6. Summary and Conclusions: Mercury in NJ Birds

Mercury levels in tissues, feathers, and eggs of several populations of NJ and New York Bight birds are close to or above levels anticipated to impair behavior, reproduction, growth and survival. Mercury was associated with developmental defects in Common Terns in the 1970's and high mercury levels are considered one of the stressors causing the decline of Common Loons. Mercury in the fish diet of Bald Eagles and Osprey, appears to be elevated in the Delaware Bay region and may be a contributing factor to their relative lack of recovery in these regions.

F. Mercury in Other NJ Biota

Data on mercury levels in animals other than birds and fish are sparse in both the number of observations and the extent of taxonomic coverage.

1. Marine Invertebrates

Blue Mussels (Mytilus edulis) are widely used as an indicator of marine pollution. Mussels have been sampled by NOAA in the Hudson-Raritan estuary from 1986 to 1997 (NOAA 1998). Mercury levels ranged from 0.18 to 0.72 μg/g (dry weight), with the highest values in the Upper Bay and the lowest values in the Hudson River (below Peekskill). The highest value along the NJ portion of the estuary was 0.36 μg/g observed in the Shark River in 1991.

Horseshoe Crab (Limulus polyphemus): Delaware Bay has been the center of abundance of Atlantic Coast Horseshoe Crab, but this population has been jeopardized by over-harvesting, primarily for the conch and eel bait trade. Horseshoe Crab eggs are essential food for migrating shorebirds. Burger (1997) reported that Horseshoe Crab eggs collected in Delaware Bay in 1993, 1994, and 1995 averaged 0.027-0.093 μg/g, while adult Horsehoe Crab muscle averaged 0.053 μg/g (mean, wet weight). At these levels, it seems likely that mercury is not affecting this species.

2. *Mammals*

Mammals are relatively infrequently sampled for pollutants. Muskrats *(Ondatra zibethicus)* were collected from the Meadowlands and a reference area in NJ in 1975 (Galluzzi 1976). Thirty-six samples of eight species of mammals were collected in the Hackensack Meadowlands in 1978 (Galluzzi 1981). Average mercury concentrations for these mammals are listed in Table 2.26. Mercury concentrations in the Hackensack Meadowlands' Muskrats were generally higher than the Muskrats from the reference location in Morris County. Muskrat muscle, liver, and kidney mercury concentrations were generally higher in the Berry's Creek area as compared to the other two locations in the Meadowlands. The highest mercury concentrations were observed in Opossum *(Didelphis marsupialis)* tissues. The Opossum is an omnivore while several of the other mammal species are generally herbivores (e.g., Muskrat, Vole, and Rabbit). The Opossum's more diverse feeding habits may explain the higher mercury levels (i.e., greater exposure to mercury through food items).

3. *Reptiles*

Table 2.27 lists a few reptile species that were also collected in the Hackensack Meadowlands in 1978 (Galluzzi 1981). Mercury levels in the Diamondback Terrapin *(Malaclemys terrapin)* muscle and liver tissue were elevated compared to the other reptiles and mammals. This may be due to the Terrapin's diet of aquatic animals, leading to greater mercury exposure. The Garter Snake (*Thamnophis sirtalis*), which feeds on fish, amphibians and invertebrates had mercury levels one order of magnitude higher than the Milk Snake (*Lampropeltis doliata*), which feeds mainly on baby birds and mammals (Smith & Brodie, 1982). However, the sample sizes for all three species are very small and more data are needed before generalizations can be drawn.

The Pine Snake *(Pituophis melanoleucus)* is a threatened species that occupies the increasingly fragmented habitat of the Pine Barrens of southern NJ. Total mercury in body tissue (mainly muscle, bone, and connective tissue) of hatchlings ranged from 0.27 ppm in 1985 to 0.05 ppm in 1990. (Burger 1992)

Table 2.26. Concentrations of Mercury in Mammal Tissue in NJ.

Location	Average mercury Concentration (µg/g; wet weight)	Source
Muskrat *(Ondatra zibethicus)*		
Berry's Creek (West Riser ditch) (n=10)	Muscle=0.024 Liver=0.016 Kidney=0.279	Galluzzi 1976
Berry's Creek (n=10)	Muscle=0.027 Liver=0.036 Kidney=0.176	Galluzzi 1976
Anderson Creek (Secaucus) (n=10)	Muscle=0.006 Liver=0.020 Kidney=0.068	Galluzzi 1976
Sawmill Creek (n=10)	Muscle=0.006 Liver=0.012 Kidney=0.111	Galluzzi 1976
Montville (Morris County) (n=10)	Muscle=0.003 Liver=0.0005 Kidney=0.003	Galluzzi 1976

Hackensack Meadowlands (n=5)	Muscle=0.01 Liver=0.050 Kidney=0.030	Galluzzi 1981
Opossum *(Didelphis marsupialis)*		
Hackensack Meadowlands (n=3)	Muscle=0.17 Liver=1.25 Kidney=1.80	Galluzzi 1981
Norway Rat *(Rattus norvegicus)*		
Hackensack Meadowlands (n=4)	Muscle=0.05 Liver=0.11 Kidney=1.22	Galluzzi 1981
Cottontail Rabbit *(Sylvilagus sp)*		
Hackensack Meadowlands (n=3)	Muscle=ND Liver=0.15 Kidney=0.51	Galluzzi 1981
House Mouse *(Mus musculus)*		
Hackensack Meadowlands (n=11)	Muscle=0.01 Liver=0.06 Kidney=0.34	Galluzzi 1981
Vole *(Microtus sp)*		
Hackensack Meadowlands (n=7)	Muscle=ND Liver=ND Kidney=0.16	Galluzzi 1981
Raccoon *(Procyon lotor)*		
Oakland (Bergen County) (n=1)	Muscle=0.064 Liver=0.248 Kidney=0.227	Galluzzi 1981

4. Vegetation

Measuring mercury levels in terrestrial vegetation and biota may help determine major areas of deposition in the state and may serve as living indicators of mercury contamination through atmospheric deposition. However, there are currently few data on mercury in plants in NJ and no information on adverse impacts. Mercury levels in rye grass and sphagnum moss were measured near the Warren County Resource Recovery Facility (Carpi et. al. 1994). Total mercury in moss exposed at sites within 1.7 kilometers of the incinerator had significantly higher mercury levels (average 206 ng/g, or ppb) compared to samples exposed at greater distances from the facility (average 126 ng/g).

Mercury levels in aquatic vegetation have been measured in NJ. Pond lilies in Mountain Lake, Lake Assunpink, and Parvin Lake were reported to be 7 to 13 ng/g (Stevenson et al. 1995). More information on mercury levels in aquatic vegetation and non-fish biota are needed in order to characterize the extent of mercury pollution and provide baselines for detecting temporal trends.

Table 2.27. Concentrations of Mercury in Reptile Tissue in the Hackensack Meadowlands (Source: Galluzzi, 1981).

Species	Tissue	Average Mercury Concentration (μg/g; wet wt.)
Diamondback Terrapin *(Malaclemys terrapin)* (n=2)	Muscle	Muscle=0.76 Liver=5.6 Kidney=1.8
Garter Snake *(Thamnophis sirtalis)* (n=3)	Muscle	Muscle=0.28 Liver=1.40 Kidney=0.32
Milk Snake *(Lampropeltis doliata)* (n=1)	Muscle	Muscle=0.012 Liver=0.044 Kidney=0.027

5. Summary and Conclusions: Mercury in Other NJ Biota

Very limited data on mercury exposure in NJ plants and animals other than birds and fish are available. The data suggests that omniorous mammalian species have higher mercury levels than hebivorous species. Data on carnivorous species are lacking. For reptiles, elevated levels are associated with the consumption of aquatic biota (fish and invertebrates). Information for evaluating the ecological risk implications of these isolated observations is lacking, and more information on mercury in these animals and in various plant species is needed.

G. Recommendations

To understand the impacts of mercury on biota and ecosystems, it is necessary to systematically collect data on a group of representative species (bioindicators) from a wide variety of ecosystems, stratified by presumed exposure to mercury. A systematic assessment of mercury should be carried out in conjunction with other bioaccumulative pollutants and other heavy metals in NJ plants and animals.

Address critical information gaps concerning the quantities and chemical species of mercury emissions and releases, the fate and transport of mercury in the environment, and the exposure pathways. To accomplish this, NJ should:

- **Consider establishing the mercury-contaminated sites in the Berry's Creek area as an Environmental Research Park, patterned on the National Environmental Research Park system. This could serve as a resource for studies and monitoring of the complex processes governing the fate and transport of mercury in both the terrestrial and estuarine environment.**

(From Recommendation "M.5." in Volume 1).

The massive contamination of the Ventron/Velsicol and Berry's Creek area, provides a unique opportunity to understand the processes controlling the sequestration, availability, and ecological effects of mercury. Since some local residents consume wildlife from this ecosystem, human exposure can also be clarified. The opportunity exists to declare Berry's Creek Environmental Research Park, patterned on the National Environmental Research Park system (DOE 1994), and to fund research studies and monitoring to clarify the complex processes governing the fate and transport of mercury in both the terrestrial and estuarine environment.

Expand and institutionalize routine monitoring for mercury in fish from NJ waters through State-level programs (From Recommendation "G" in Volume 1).

Regular monitoring of freshwater fish, including selected species of recreational and ecological importance, should be conducted to identify temporal and spatial trends in mercury and other bioaccumulative contaminants, to allow the state to keep potential consumers informed of levels, to provide information for updating advisories, and to identify new or unsuspected sources of contaminants.

The scope of sampling should be expanded to additional water bodies to support fish advisories.

There should be regular and systematic monitoring of saltwater species in NJ waters for mercury and other contaminants, in order to provide appropriate consumption advisories. The recent (January 2001) fish consumption advisories issued by FDA and EPA are not NJ-specific.

Address critical information gaps concerning the quantities and chemical species of mercury emissions and releases, the fate and transport of mercury in the environment, and the exposure pathways. To accomplish this, NJ should:

- **Encourage federal agencies to expand existing national research on the ecological effects of mercury, particularly on piscivorous (fish-eating) fish, birds and mammals (particularly marine mammals).**

(From Recommendation "M.3." in Volume 1).

Reduce mercury levels in fish and other biota. Mercury concentrations in freshwater and estuarine fish in New Jersey should, at a minimum, be in compliance with the EPA's recent Surface Water Criterion of 0.3 μg/g methylmercury in tissue. This guidance value, aimed at protecting human health, may not be adequate to protect the health of the fish. Therefore mercury levels in surface water and fish tissue should achieve levels protective of aquatic life and of wildlife (the criterion for which is currently under development). Assessing this criterion requires the use of improved analytic methodologies that lower detection levels by at least an order of magnitude. (From Recommendation "Q" in Volume 1).

Additional research in the domain of aquatic toxicology is needed to understand how mercury effects fish health in terms, not only of survival, but behavior, condition, and reproduction, all of, which are inter-related. The dose-response relationship between mercury exposure measures (mercury in sediment, prey species, or tissue) and fish health need to be established.

Additional data collection and a more comprehensive analysis of fish tissue concentrations and their comparison to effect levels should be carried out especially for tropic levels 3 and 4 fish in NJ, as it appears that these fish are most at risk for adverse effects and are consumed by piscivorous species. Monitoring using more sensitive methods (i.e., lower detection limit) is needed to assess the levels of mercury in surface waters to more precisely estimate the potential for adverse effects on fish on a waterbody-by-waterbody basis.

Develop improved environmental indicators of the impact of mercury on NJ's environment. To accomplish this, NJ should:

- **Develop and apply indicators of trends of mercury in environmental media, including air deposition, mercury concentrations in surface water, mercury**

entry into aquatic food chains, mercury levels in fish tissue, mercury levels in human tissue in the NJ population, and mercury levels in feathers of piscivorous birds nesting in NJ.

(From Recommendation "O.2." in Volume 1).

Establish a monitoring program for mercury and other contaminants in NJ birds, including but not limited to, threatened and endangered species.