DRAFT SUPPLEMENTAL GROUNDWATER INVESTIGATION WORK PLAN REMEDIAL INVESTIGATION/FEASIBILITY STUDY

OLD ERIE CANAL SITE
CLYDE, NEW YORK
SITE NO. 859015

Prepared For:

Parker Hannifin Corporation
Cleveland, Ohio

General Electric Company
Albany, New York

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1.0 INTRODUCTION

Conestoga-Rovers & Associates, Inc. (CRA) has prepared this Supplemental Work Plan on behalf of Parker-Hannifin Corporation (P-H) and the General Electric Company (GE) for the Old Erie Canal Site located in Clyde, New York (Site). The Site is listed in the Registry of Inactive Hazardous Waste Disposal Sites in New York State as Site No. 859015. The location of the Site is shown on Figure 1.1.

The Supplemental Work Plan has been prepared in response to comments of the New York State Department of Environmental Conservation (NYSDEC) dated March 1, 2006, regarding the "Feasibility Study, Old Erie Canal Site, Clyde, New York," dated November 2005.

1.1 OBJECTIVE

The primary objective of the Supplemental Work Plan is to describe the work to be conducted to gather additional data to further define the nature and extent of Site-related chemical presence in the groundwater beneath the Site to the extent necessary to complete the Feasibility Study (FS).

1.2 ORGANIZATION OF THE REPORT

This Supplemental Work Plan is organized as follows:

i) Section 1 - Introduction: A brief description of the background and objectives of the Supplemental Work Plan is presented in Section 1;

ii) Section 2 - Groundwater Quality: The supplemental work proposed to gather the data necessary to further define the quality of groundwater beneath the Site is described in Section 2;

iii) Section 3 - Definition of Top of Till: An update of the definition of the surface of the glacial till beneath the Site is presented in Section 3;

iv) Section 4 - Reporting: A description of the reporting to be conducted for the Supplemental Groundwater Investigation and FS is described in Section 5; and

v) Section 5 - Schedule: A tentative schedule for the completion of the supplemental investigation and associated reporting is presented in Section 6.

A site-specific Health and Safety Plan (HASP), a Sampling and Analysis Plan (SAP) including both the Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP), and a Citizen Participation Plan (CPP) were developed for use with the Remedial Investigation/Feasibility Study (RI/FS) Work Plan. The field tasks and laboratory analyses described in this Supplemental Work Plan will be conducted in accordance with the procedures presented in these support documents prepared for the RI/FS and approved previously by NYSDEC for use at the Site. For reference purposes, the "Remedial Investigation Sampling and Analysis Plan" is presented in Appendix A.

2.0 GROUNDWATER QUALITY

Additional monitoring wells will be installed and groundwater sampling and analyses conducted to further define the nature and extent of groundwater impact at the Site.

2.1 GROUNDWATER MONITORING WELL INSTALLATION

Overburden monitoring wells screened in the same intervals as the existing monitoring wells will be installed at the following three locations where chemical presence was observed in sample collected from direct push borings: GP-13; GP-25; and GP-34. The monitored intervals of these wells will be the same as the existing overburden wells; 5 feet extending from the top of till upward. Where till is not present above the bedrock surface, a 2-foot bentonite plug will be placed in the bottom of the boring prior to installing the monitoring well.

Shallow bedrock monitoring wells will be installed adjacent to existing monitoring wells MW-1, MW-5S, and MW-6S where chemical presence has been identified in the overburden. A shallow bedrock monitoring well will also be installed adjacent to overburden well MW-3S. The monitored intervals of the shallow bedrock monitoring wells will be the same as the existing shallow bedrock monitoring wells; 3 to 13 feet below the top of bedrock (BTOR).

A deeper bedrock monitoring well will be installed adjacent to existing shallow bedrock well MW-4B. The deeper bedrock monitoring well will be completed in the first 10-foot waterbearing interval below the existing well depth. For the purpose of this work, a waterbearing interval is defined as a 10-foot bedrock interval which yields at least 0.1 gallon per minute (gpm) of groundwater per 1-inch diameter of borehole during a short term pumping test.

Two temporary monitoring wells will be installed outside the east wall of the manufacturing building. These temporary wells will consist of borings advanced using a direct push well point system such as the Geoprobe™ mill-slotted well point systems. Data from existing borings shows that the overburden above the till is shallow in this area (see SSB-1 through SSB-11 in Table 3.1); therefore, the well point system will use a 2-foot screen advanced to the top of till. A pilot boring advanced with continuous soil sampling may be required at each location to identify the depth of the till prior to advancing the well screen. Groundwater samples will be collected from the screened interval as described in Section 2.2 and the screen will be removed upon completion of sampling. The open boring will be plugged using bentonite or cement/bentonite grout

and the upper 1-foot will be finished with materials consistent with the surrounding surface cover.

The locations of the existing and proposed additional groundwater monitoring wells are shown on Figure 2.1. A summary of the estimated installation depths of the additional monitoring wells is presented in Table 2.1. Actual well installation details will be dependent upon the conditions encountered.

2.1.1 WELL INSTALLATION PROCEDURES

Borehole drilling and monitoring well installation and development procedures will be the same as previously approved for work at the Site and presented in Appendix A.

Where chemical presence has been observed in the overburden or bedrock intervals above targeted intervals for the additional wells, intermediate casings will be installed. These casings will seal off the upper intervals preventing transport of contaminants downward. Procedures for casing installation will be the same as described in Section 2.4.2.2 of the SAP presented in Appendix A. For the shallow bedrock monitoring wells, the intermediate casing will extend 3 feet into the upper bedrock surface. For the deeper bedrock monitoring well, the intermediate casing will extend at least 2 feet below the bottom of the monitored interval of MW-4B, or to approximately 15 feet BTOR.

The completion depth of the deeper groundwater monitoring well (MW-4C) will be dependent upon the water producing characteristics of the bedrock. Upon completion of each 10-foot interval of bedrock coring, a short-term pumping and recovery test will be conducted. The procedure for the pumping and recovery test is presented in Appendix B. If an interval is found not to meet the minimum water producing criteria (0.1 gpm/inch diameter), the boring will be extended 10-feet and the testing repeated. The boring for well MW-4C will not be advanced more than 20 feet below the bottom of the intermediate casing, or approximately 35 feet BTOR.

2.2 GROUNDWATER SAMPLING AND ANALYSES

One round of groundwater sampling will be conducted following completion of the installation and development of the additional monitoring wells. Samples will be collected from all new and existing monitoring wells. Groundwater samples will also be collected from temporary wells installed in two borings advanced along the east side of

the manufacturing building. (Note that the eastern end of the manufacturing building is finished as office space. Drilling through the floor in this area cannot be accomplished without significant disruption in the area.) The analytical data from these temporary wells will aid in completing the definition of chemical presence in groundwater beneath the building.

All groundwater samples will be collected using low flow well purging techniques as described in the SAP presented in Appendix A. The samples will be analyzed for the Target Compound List (TCL) volatile organic compounds (VOCs), sodium, chloride, nitrate, dissolved organic carbon, sulfate, sulfide, alkalinity, ethane, ethene, and methane. Field determinations of iron II, oxidation-reduction potential (Redox), temperature, dissolved oxygen, pH, and turbidity will also be made.

As stated previously, the laboratory analyses of the supplemental groundwater samples will be conducted in accordance with the QAPP included in the SAP presented in Appendix A.

3.0 DEFINITION OF TOP OF TILL

NYSDEC has expressed concern that the existing Site stratigraphic information does not adequately define the top of the till unit beneath the Site. During the RI, 76 soil borings were advanced to depths sufficient to define the top of till beneath the Site. The logs of these borings were submitted to NYSDEC previously in the following reports:

i) "Volume II, Remedial Investigation Report," dated November 2003; and

ii) "Remedial Investigation Addendum No. 1 Report," dated May 2005.

A summary of the stratigraphic information from these borings is presented in Table 3.1. The top of till contour map (Figure 3.5 of the FS) has been updated to include the stratigraphic information from soil borings SSB-1 through SSB-11 located within the manufacturing building in the northern portion of the Site. The updated top of till contour map is presented on Figure 3.1.

Table 3.1 and Figure 3.1 will be updated once again utilizing the information gathered during the borehole drilling and monitoring well installation program described in Section 2 and presented in the revised FS.

4.0 REPORTING

Following the completion of the supplemental field activities and the receipt and quality assurance review of the analytical data, the FS will be revised and submitted to NYSDEC for review and approval. The revised FS will include an updated Site characterization consisting of the following:

i) a summary of the supplemental investigative activities completed;

ii) stratigraphic logs of all borings advanced during the supplemental investigation and not submitted previously;

iii) updated geologic cross-sections;

iv) updated top of till contour map;

v) updated top of bedrock contour maps; and

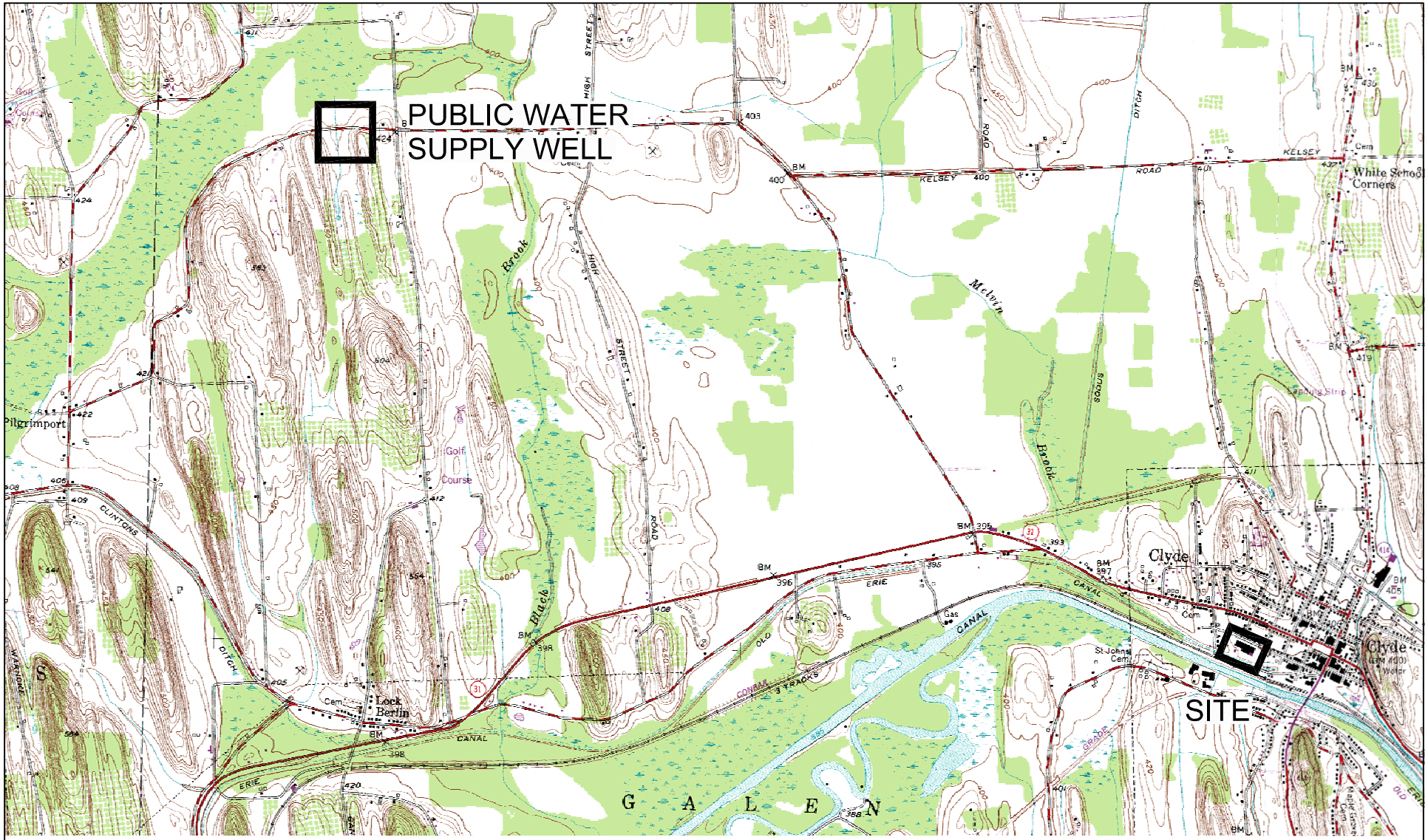
vi) tabulations of all analytical and testing data collected during the supplemental investigation.

5.0 SCHEDULE

The following is the tentative schedule for completion of the work described in this Work Plan. The actual schedule will be dependent upon NYSDEC review and approval of this work plan and upon contractor availability.

Item	*Activity*	*Estimated Completion Date*
1	Submission of Draft Work Plan	June 15, 2006
2	NYSDEC Review & Approval of Draft Work Plan (30 days following Item 1)	July 14, 2006
3	Completion of field activities & sample analyses (60 days following Item 2)	September 13, 2006
4	Submission of revised FS (45 days following Item 3)	October 27, 2006

NYSDEC will be notified of any changes to this schedule as the project proceeds.

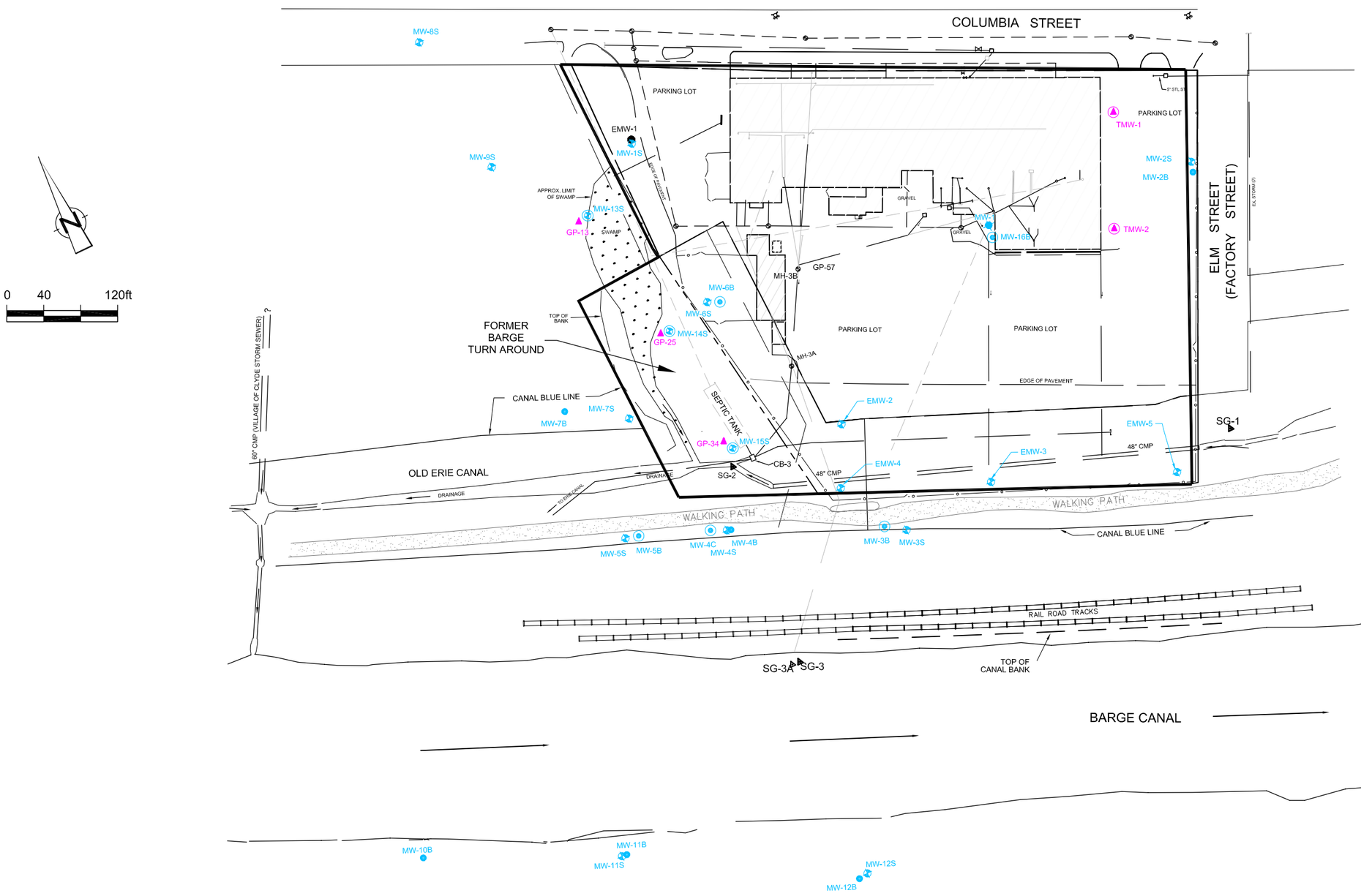


SOURCE:
USGS, USC&GS,TVA, NEW YORK
QUADRANGLE, DATED 1953

figure 1.1

SITE LOCATION MAP
OLD ERIE CANAL SITE
Clyde, New York

35048-01(003)GN-NF001 APR 03/2006



LEGEND

- PROPERTY BOUNDARY
- SITE BOUNDARY
- CANAL
- STORM SEWER
- 48-INCH CMP

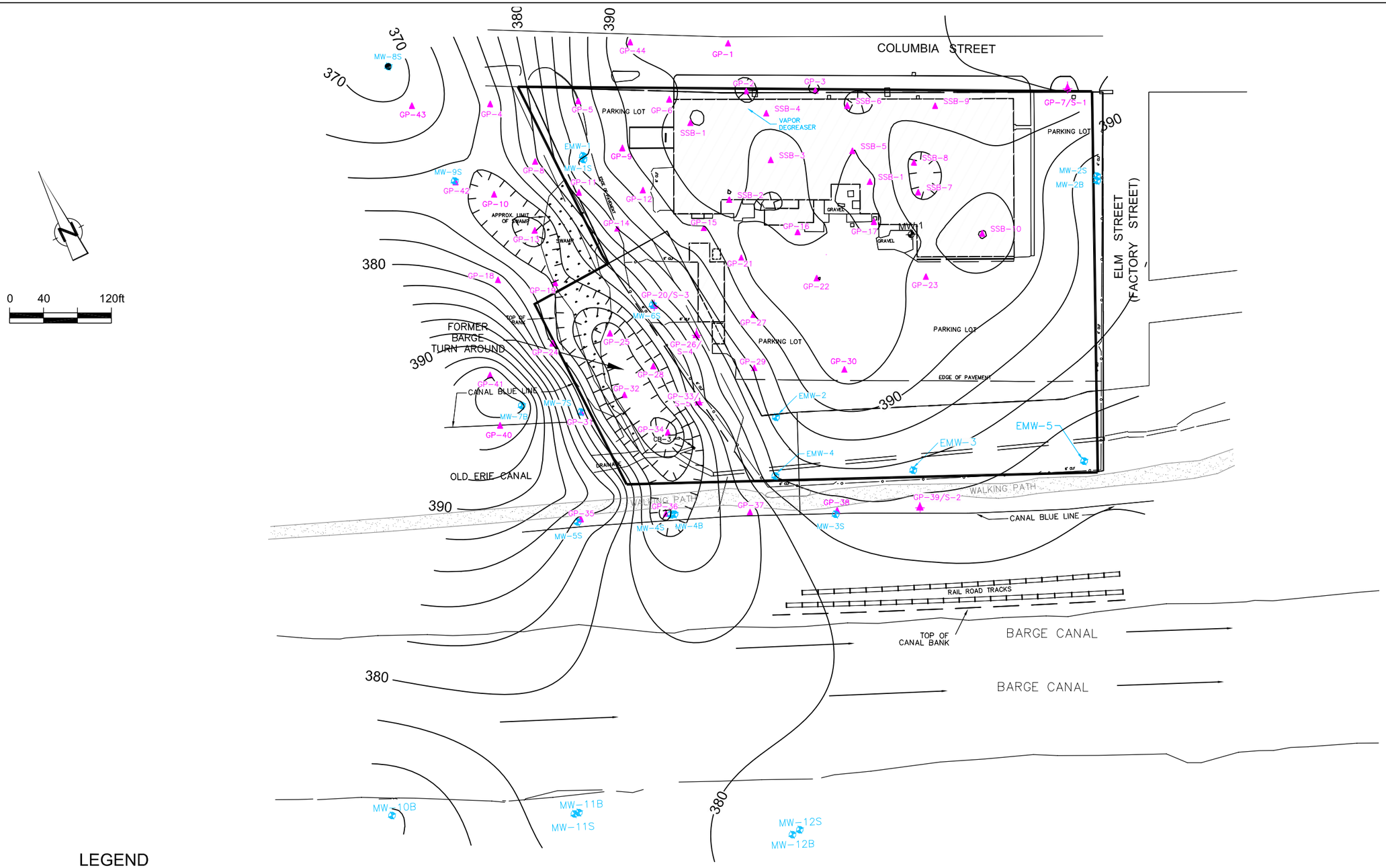
- MW-3S OVERBURDEN MONITORING WELL
- MW-3B BEDROCK MONITORING WELL
- GP-13 DIRECT PUSH SAMPLE LOCATION

- PROPOSED OVERBURDEN MONITORING WELL
- PROPOSED BEDROCK MONITORING WELL
- PROPOSED TEMPORARY MONITORING WELL

figure 2.1

PROPOSED LOCATIONS OF ADDITIONAL GROUNDWATER MONITORING WELLS OLD ERIE CANAL SITE

Clyde, New York



LEGEND

- PROPERTY BOUNDARY
- SITE BOUNDARY
- CANAL
- STORM SEWER
- 48-INCH CMP

MW-3S OVERBURDEN

MW-3B BEDROCK MONITORING WELL

GP-13 DIRECT PUSH SAMPLE LOCATION

380 TOP OF TILL CONTOUR

figure 3.1

TOP OF TILL CONTOUR MAP
OLD ERIE CANAL SITE
Clyde, New York

TABLE 2.1

ESTIMATED MONITORED INTERVALS OF PROPOSED WELLS
SUPPLEMENTAL GROUNDWATER INVESTIGATION
OLD ERIE CANAL SITE
CLYDE, NEW YORK

Proposed Well	*Location*	*Well Type*	*Estimated Screened Interval**
MW-3S	Adjacent to MW-3S	Bedrock	3 to 13 ft. BTOR
MW-4C	Adjacent to MW-4S/4B	Bedrock	15 to 25 ft. BTOR
MW-5B	Adjacent to MW-5S	Bedrock	3 to 13 ft. BTOR
MW-6B	Adjacent to MW-6S	Bedrock	3 to 13 ft. BTOR
MW-13S	Adjacent to GP-13	Overburden	15 to 20 ft. BGS
MW-14S	Adjacent to GP-25	Overburden	17 to 22 ft. BGS
MW-15S	Adjacent to GP-34	Overburden	24 to 29 ft. BGS
MW-16B	Adjacent to MW-1	Bedrock	3 to 13 ft. BTOR
TMW-1	Outside E. Wall of Bldg.	Overburden	4 to 6 ft. BGS
TMW-2	Outside E. Wall of Bldg.	Overburden	4 to 6 ft. BGS

Notes:

* Intervals are estimated based upon existing boring logs, actual screened intervals will be selected based on conditions encountered at the time of drilling.

ft. BGS Feet Below Ground Surface.

ft. BTOR Feet Below Top of Bedrock.

TABLE 3.1

SUMMARY OF TILL DEPTH AND THICKNESS
SUPPLEMENTAL GROUNDWATER INVESTIGATION
OLD ERIE CANAL SITE
CLYDE, NEW YORK

Boring No.	Date Completed	Ground Elevation	Total Depth of Boring	End of Boring Elevation	Depth To Glacial Till	Top of Glacial Till Elevation	Till Thickness	Depth To Bedrock	Top of Bedrock Elevation
GP-1	04/24/02	397.6	6.5	391.1	5.0	392.6	>1.5	----	----
GP-1A	08/02/04	NA	20.0		15.0		>5.0	----	----
GP-2	04/24/02	397.7	6.5	391.2	6.3	391.5	>0.2	----	----
GP-2A	08/02/04	NA	20.0		----		----	----	----
GP-3	04/24/02	397.7	4.0	393.7	3.5	394.2	>0.5	----	----
GP-3A	08/02/04	NA	12.0		----		----	----	----
GP-4	04/23/02	391.7	18.0	373.7	17.0	374.7	>1.0	----	----
GP-4A	08/02/04	NA	8.0		5.3		>2.7	----	----
GP-5	04/24/02	393.7	8.0	385.7	7.0	386.7	>1.0	----	----
GP-5A	08/02/04	NA	5.0		2.1		>2.9	----	----
GP-6	04/24/02	396.2	6.0	390.2	5.0	391.2	>1.0	----	----
GP-6A	08/02/04	NA	7.0		5.5		>1.5	----	----
GP-7	04/24/02	397.9	4.0	393.9	3.5	394.4	>0.5	----	----
GP-7A	08/02/04	NA	8.0		7.8		>0.2	----	----
GP-8	04/23/02	389.5	10.5	379.0	9.8	379.7	>0.7	----	----
GP-9	04/25/02	395.6	9.0	386.6	6.0	389.6	>3.0	----	----
GP-10	04/23/02	389.7	18.5	371.2	17.5	372.2	>1.0	----	----
GP-11	04/26/02	390.5	10.0	380.5	7.5	383.0	>2.5	----	----
GP-12	04/25/02	396.0	11.0	385.0	7.0	389.0	>4.0	----	----
GP-13	04/29/02	389.3	20.0	369.3	----	----	0.0	19.0	370.3
GP-14	04/29/02	394.6	13.5	381.1	10.5	384.1	>3.0	----	----
GP-15	04/24/02	396.8	11.0	385.8	7.0	389.8	>4.0	----	----
GP-16	04/24/02	398.2	12.0	386.2	7.8	390.4	>4.2	----	----
GP-17	04/24/02	398.0	4.0	394.0	3.5	394.5	>0.5	----	----
GP-18	04/23/02	391.1	13.0	378.1	12.0	379.1	>1.0	----	----
GP-19	04/29/02	389.3	20.0	369.3	15.5	373.8	3.5	19.0	370.3
GP-20/MW-6S	05/01/02	395.0	16.0	379.0	15.0	380.0	>1.0	----	----
GP-21	04/25/02	397.4	10.5	386.9	6.0	391.4	>4.5	----	----
GP-22	04/24/02	397.8	4.0	393.8	3.8	394.0	>0.2	----	----
GP-23	04/24/02	398.1	8.0	390.1	7.0	391.1	>1.0	----	----
GP-24	04/23/02	393.7	20.0	373.7	19.0	374.7	>1.0	----	----
GP-25	04/26/02	389.2	22.0	367.2	----	----	0.0	21.0	368.2
GP-26	04/26/02	395.4	16.0	379.4	13.0	382.4	>3.0	----	----
GP-27	04/25/02	396.6	10.0	386.6	6.5	390.1	>3.5	----	----
GP-28	04/30/02	394.2	24.0	370.2	22.5	371.7	>1.5	----	----
GP-29	04/25/02	395.8	12.0	383.8	9.5	386.3	>2.5	----	----
GP-30	04/25/02	396.9	8.0	388.9	3.7	393.2	>4.3	----	----
GP-31/MW-7S	04/23/02	394.9	17.0	377.9	16.5	378.4	>0.5	----	----
GP-32	04/23/02	389.4	22.0	367.4	21.5	367.9	>0.5	----	----
GP-33	04/30/02	394.4	16.0	378.4	15.0	379.4	>1.0	----	----
GP-34	05/01/02	395.2	29.2	366.0	----	----	0.0	29.2	366.0
GP-35/MW-5S	04/22/02	393.3	11.0	382.3	10.0	383.3	>1.0	----	----
GP-36/MW-4S	04/22/02	393.2	24.0	369.2	20.0	370.2	>1.0	----	----
GP-37	04/22/02	393.8	20.0	373.8	16.5	377.3	>3.5	----	----
GP-38/MW-3S	04/22/02	394.1	12.0	382.1	11.0	383.1	>1.0	----	----
GP-39	04/22/02	393.5	12.0	381.5	10.2	383.3	>1.8	----	----
GP-40	05/01/02	398.2	7.0	391.2	3.0	395.2	>4.0	----	----
GP-41	05/01/02	398.1	4.0	394.1	2.0	396.1	>2.0	----	----
GP-42	05/02/02	391.8	20.0	371.8	17.0	374.8	>3.0	----	----
GP-43	05/02/02	391.0	20.5	370.5	----	----	0.0	20.5	370.5
GP-44	05/02/02	395.4	8.0	387.4	3.0	392.4	>5.0	----	----

TABLE 3.1

SUMMARY OF TILL DEPTH AND THICKNESS
SUPPLEMENTAL GROUNDWATER INVESTIGATION
OLD ERIE CANAL SITE
CLYDE, NEW YORK

Boring No.	*Date Completed*	*Ground Elevation*	*Total Depth of Boring*	*End of Boring Elevation*	*Depth To Glacial Till*	*Top of Glacial Till Elevation*	*Till Thickness*	*Depth To Bedrock*	*Top of Bedrock Elevation*
GP-45	11/19/02	398.0	9.0	389.0	8.6	389.4	>0.4	----	----
GP-46	11/19/02	398.1	8.5	389.6	8.5	389.6	----	----	----
GP-47	11/19/02	398.5	5.0	393.5	4.6	393.9	>0.4	----	----
GP-48	11/20/02	396.2	10.2	386.0	6.5	389.7	>3.7	----	----
GP-49	11/19/02	397.9	10.5	387.4	5.0	392.9	>5.5	----	----
GP-50	11/19/02	398.3	6.0	392.3	6.0	392.3	----	----	----
GP-51	11/20/02	396.2	10.1	386.1	8.0	388.2	>2.1	----	----
GP-52	11/19/02	397.9	10.5	387.4	4.0	393.9	>6.5	----	----
GP-53	11/19/02	398.1	7.0	391.1	7.0	391.1	----	----	----
GP-54	11/19/02	398.0	6.0	392.0	6.0	392.0	----	----	----
GP-55	11/19/02	398.1	8.2	389.9	4.7	393.4	>3.5	----	----
GP-56	11/20/02	396.2	12.6	383.6	9.5	386.7	>3.1	----	----
GP-57	11/20/02	397.7	6.0	391.7	4.0	393.7	>2.0	----	----
GP-58	11/20/02	398.2	7.5	390.7	5.2	393.0	>2.3	----	----
GP-59	11/20/02	393.1	10.0	383.1	8.0	385.1	>2.0	----	----
GP-60	11/20/02	393.3	17.0	376.3	16.8	376.5	>0.2	----	----
GP-61	11/20/02	393.7	11.5	382.2	6.0	387.7	>5.5	----	----
MW-1S	05/30/02	394.6	8.0	386.6	7.0	387.6	>1.0	----	
MW-2S/2B	05/20/02	398.4	19.0	379.4	12.3	386.1	6.7	19.0	379.4
MW-7B	05/23/02	397.4	30.0	367.4	0.5	396.9	27.7	28.2	369.2
MW-10B	11/25/02	391.2	34.0	357.2	17.5	373.7	11.5	29.0	362.2
MW-11S/11B	11/25/02	389.8	33.7	356.1	11.0	378.8	19.8	30.8	359.0
MW-12B	11/22/02	391.4	34.0	357.4	10.0	381.4	21.0	31.0	360.4
SSB-1	01/14/05	NA	6.0		4.1		>1.9	----	----
SSB-2	01/14/05	NA	5.7		4.3		>1.4	----	----
SSB-3	01/14/05	NA	7.9		----			----	----
SSB-4	01/14/05	NA	5.8		5.8			----	----
SSB-5	01/14/05	NA	7.3		5.0		>2.3	----	----
SSB-6	01/13/05	NA	7.4		7.1		>0.3	----	----
SSB-7	01/12/05	NA	9.3		----			----	----
SSB-8	01/13/05	NA	9.3		8.7		>0.6	----	----
SSB-9	01/13/05	NA	6.2		5.0		>1.2	----	----
SSB-10	01/13/05	NA	6.8		4.2		>2.6	----	----
SSB-11	01/13/05	NA	5.8		4.2		>1.6	----	----

Notes:
1. All depths in feet below ground surface
2. All elevations in feet above mean sea level.
---- Not encountered.
NA Not Applicable.

APPENDIX A

REMEDIAL INVESTIGATION SAMPLING AND ANALYSIS PLAN

FINAL

REMEDIAL INVESTIGATION SAMPLING AND ANALYSIS PLAN

OLD ERIE CANAL SITE
Clyde, New York

Parker Hannifin Corporation
Cleveland, Ohio

General Electric Corporation
Albany, New York

December 16, 1999
Revised February 25, 2000

O'BRIEN & GERE
ENGINEERS, INC.

Final

Remedial Investigation Sampling and Analysis Plan

Old Erie Canal Site Clyde, New York

Parker Hannifin Corp.
Cleveland, Ohio

General Electric Co.
Albany, New York

James R. Heckathorne, P.E.
Vice Presendent

December 16, 1999
Revised February 25, 2000

19 Walker Way
Albany, New York 12205

4. Quality Assurance Project Plan

The following quality assurance (QA) topics are addressed in this plan:

- DQOs;
- Sampling procedures;
- Documentation and chain-of-custody;
- Calibration procedures;
- Sample preparation and analytical procedures;
- Data reduction, validation, and reporting;
- Quality Control checks;
- Preventative maintenance;
- Data assessment procedures;
- Corrective actions; and
- QA reports to management.

The remainder of this document provides details of these topics. Additional sampling procedures details are provided elsewhere in the FSP.

4.1. Data Quality Objectives

DQOs are quantitative and qualitative statements specifying the quality of the environmental data required to support the decision-making process. DQOs define the total acceptable uncertainty in the data for each specific activity conducted during the investigation. The uncertainty includes both sampling error and analytical error. Ideally, zero uncertainty is the intent. However, the variables associated with the process (field and laboratory) inherently

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1. Introduction

1.1. Purpose

This Sampling and Analysis Plan (SAP) has been developed by O'Brien & Gere Engineers, Inc. (O'Brien & Gere) on behalf of the Parker Hannifin Corporation (Parker Hannifin) and the General Electric Company (GE). The purpose of this SAP is to describe the procedures that will be implemented in order to fulfill the scope of work outlined in the Remedial Investigation/Feasibility Study (RI/FS) Work Plan (O'Brien & Gere, February 2000) for the Old Erie Canal Site (Site).

The two major components of this SAP are the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP). The FSP provides the detailed procedures for the collection of environmental samples including the following: equipment and personnel requirements; drilling and well installation techniques; sampling techniques; and equipment decontamination procedures.

The QAPP provides quality assurance/quality control (QA/QC) criteria for work efforts associated with sampling of environmental media at the Site. The QAPP indicates project organization and responsibilities and outlines the data quality objectives (DQOs) and analytical protocols to document that the data collected during the RI are of sufficient quality to support remedial decisions. This document has been prepared with the guidance of United States Environmental Protection Agency's (USEPA's) *Interim Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, October 1988) and New York State Department of Environmental Conservation's (NYSDEC's) Resource Conservation and Recovery Act (RCRA) *Quality Assurance Project Plan Guidance* (NYSDEC, March 1991).

1.2. Project Description

The Site is located on the southern and southwestern portions of property owned by Parker Hannifin (Property) at 124 Columbia Street in the Village of Clyde, Town of Galen, Wayne County, New York as shown on Figure 1-1. The study area, which includes portions of Parker Hannifin's property and the abandoned Erie Canal, is approximately 6.5 acres is size. The study area is bounded to the north by Columbia Street, to the east by the P&C Grocery Store property, and to the west by private residential property(ies). To the

Investigation of environmental conditions at the Site began in July 1989 when the NYSDEC collected surface water and surface soil/sediment samples from the bottom of the Old Erie Canal east and west of the filled portion of the Old Erie Canal. The following year, in 1990, the NYSDEC conducted a PSA which included file reviews and a Site visit. Based on the recommendations presented in the Preliminary PSA Report (URS, 1991), the NYSDEC conducted an expanded environmental investigation at the Site in 1994. This investigation included the collection of surface water, surface soil/sediment, subsurface soils, and ground water samples, as well as soil gas and geophysical surveys. In addition, the NYSDOH collected a basement sump water sample from an adjacent residence at an unknown location in March 1996.

The results of previous investigations performed at the Site indicate that the ground water, surface water, surface soil/sediment and soils present at the Site are contaminated with chlorinated solvents and other constituents. Based on this information, the Site was reclassified by NYSDEC and listed in the Registry of Inactive Hazardous Waste Disposal Sites (Site No. 859015) as a Class 2 Site.

An Order on Consent is to be executed between the NYSDEC, Parker Hannifin and GE to implement an RI/FS for the Site. The RI/FS is to be conducted in accordance with the provisions of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) as amended, the National Contingency Plan (NCP), and the USEPA's *Interim Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, October 1988). The tasks are discussed in the RI/FS Work Plan. The following items are considered the primary components of the RI activities:

- Public water connection verification program;
- Electromagnetic field survey;
- Abandonment of monitoring well EMW-1;
- Preliminary screening program;
- Ground water investigation;
- Surface water and surface soil/sediment sampling; and
- Storm water sampling.

2. Field Sampling Plan

The following sections augment the RI/FS Work Plan in describing the specific procedures and requirements of the RI activities. Certain information such as the proposed number of samples, sample locations, sample types, required analyses, and monitoring well locations are provided in the work plan but are also discussed herein. Whenever possible, any deviations from this FSP will receive prior approval from the NYSDEC.

2.1. Electromagnetic Field Survey

2.1.1. General

As shown on Figure 2-1, the Village of Clyde maintains a 16.5 foot wide right-of-way along the western boundary of the Site. Based on available information and historical facility drawings, the village's sanitary sewer system discharged to a septic tank which was located at the confluence of the former barge turnaround and the Old Erie Canal. The purpose of the electromagnetic survey is to determine if the septic tank is still present, so that it's location can be avoided during the subsequent direct push soil boring program.

O'Brien & Gere proposes to use variable frequency electromagnetics (VFEM) for the field survey. The location targeted for this investigation is the southern portion of the former barge turnaround.

2.1.2. Procedures

Geophysical survey lines will be generally oriented in a east-west direction along transects located five feet apart. Along a survey line, the data rate will range between about one data point per 2.5 feet to about one data point per 5 feet. The data collection rate is variable based on how fast the portable unit is carried along the survey line and the nature of the survey line (i.e., roughness of the terrain, obstructions such as trees, etc). The geophysical survey will subdivided into several smaller survey areas labeled as Area-A, Area B, etc. in order to work around the surface structures (i.e., fences, building, etc.).

Once the data is collected on the GEM-300, the geophysical data will be downloaded to a portable field computer for subsequent processing. The

data is reviewed for completeness and quality and then the results from each of the survey areas will be merged to form one complete data set which will then be contoured using a personal computer (PC) based data contouring program. The resultant output is a spatial representation of the variations of the electrical conductive properties of underlying objects.

2.2. Monitoring Well EMW-1 Abandonment

2.2.1. General

As a result of the reported high concentration of volatile organic compounds (VOCs) present in monitoring well EMW-1 and the reported well drilling and construction details for this well, the collapsed portion of the borehole and existing monitoring well EMW-1 will be properly decommissioned to reduce the potential that the collapsed portion of the borehole is allowing short circuiting between the shallow unconsolidated unit and the bedrock.

2.2.2. Well Abandonment Procedure

Consistent with the NYSDEC's well decommissioning guidance, developed by Malcolm Pirnie, Inc. for the NYSDEC dated April 1993, and American Society for Testing and Materials (ASTM) D-5299-92 (Standard Guide for Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, Boreholes and Other Devices for Environmental Activities), the collapsed portion of the borehole and existing monitoring well EMW-1 will be properly decommissioned by overdrilling the existing monitoring well and advancing the augers to the borehole's original total depth of 32 feet below grade.

Well decommissioning will proceed by removing the flush mounted protective casing and then overdrilling the existing monitoring well utilizing 4-1/4-inch hollow stem augers (HSA). The borehole will be further advanced to a depth of 32 feet below grade. Following the completion of drilling, the borehole will be backfilled with a standard grout mixture consisting of one bag of Type 1 Portland cement, approximately 3.9 pounds of powdered bentonite and 7.8 gallons of water.

The grout will be placed in the borehole starting from the bottom, forcing other fluids upward. This is accomplished by using a tremie pipe of not less than ½-inch diameter. Grout will then be pumped into the borehole until the grout appears at the ground surface. At this time the rate of settling will be observed. When the grout level stabilizes, additional grout will be added to keep the level close to the ground surface. This process is repeated as the augers are withdrawn from the borehole until the grout level is maintained and settling is minimal. Upon completion of grouting, the final grout level shall be approximately 3 feet below grade. A ferrous metal marker will be

embedded in the top of the grout to indicate the location of the former monitoring well.

Following completion of the well grouting, the uppermost 3 feet of the borehole will be backfilled with clean fill material (e.g., clean top soil and/or sand). The surface of the borehole will be restored to the condition of the area surrounding the borehole. All waste materials generated during the decommissioning process will be disposed of in accordance with Section 3.0.

2.3. Preliminary Screening Program

2.3.1. General

The purpose of the screening program is to characterize shallow unconsolidated unit conditions, particularly with respect to the nature and distribution of fill materials at the Site, and to further evaluate the extent of the dissolved phase plume in the shallow unconsolidated unit along the southern and western portions of the Site.

As shown on Figure 2-1, 32 test borings are proposed along the western and southwestern portions of the Site. Eight test borings are proposed in the area near monitoring well EMW-1, six test borings are proposed in the area near monitoring well EMW-2 and the pole barn building, 12 soil borings are proposed in the area near the former barge turnaround and five test borings are proposed along the access road located south of the abandoned Old Erie Canal. In addition, one location is proposed for the northeastern portion of the Property in order to confirm that this location is suitable for the installation of a background/upgradient monitoring well. It is assumed herein that access to the property just west of the Site will be granted.

It should be noted that the final locations of the soil borings may need to be modified based on the results of the VFEM survey and/or field conditions encountered during drilling activities (i.e., occurance of surface and/or subsurface obstructions). If a boring encounters an obstruction prior to reaching the glacial till unit, up to three additional attempts will be made to advance the boring by stepping out within a 5-foot radius of the original borehole location.

Supervision of the test boring activities will be provided by a qualified geologist and/or hydrogeologist who will be in attendance at all times during the test boring activities to:

- Perform air monitoring;
- Inspect soil;

- Prepare geologic field logs based on soil observations;
- Obtain ground water samples for laboratory analysis; and
- Complete daily drilling records.

2.3.2. Drilling Procedures

Soil samples will be obtained for geotechnical evaluation continuously down to the top of the glacial till unit using direct push soil sampling methods and/or geotechnical drilling techniques (drive casing). The top of the glacial till unit is expected to range between 8 and 10 feet below grade.

All soil samples will be logged on-site and retained for geotechnical analysis, if necessary. Test boring logs describing subsurface materials encountered in each of these borings will be prepared by the on-site geologist or hydrogeologist. Descriptions of soil sample texture, composition, color, consistency, moisture content and recovery will also be recorded. Soil samples from these borings will also be screened for the presence of VOCs using a portable photoionization detector (PID).

In the event the results of the PID screening indicate that the soil boring location may be a "hot spot", then up to a total of three unsaturated soil samples will be obtained and submitted to the laboratory for target compound list (TCL) VOC analysis. For the purposes of this sampling activity, "hot spots" are defined as being locations at which unsaturated soil samples obtained during drilling visually exhibit gross contamination (i.e., oils and/or sheens) or elevated concentrations of VOCs are indicated by field screening observations [(i.e., PID measurements greater than 50 parts per million (ppm)].

2.3.3. Shallow Ground Water Sampling Procedure

Following the completion of each soil boring, a ground water sample will be obtained from the shallow unconsolidated unit. Ground water samples will be collected using a temporary device, such as a HydroPunch® sampler, or a similar device. Alternatively, the sample may be collected using a peristaltic pump and Tygon® tubing or by using high density polyethylene (HDPE) tubing equipped with a foot valve. Ground water samples collected from the direct push locations will be sent to an approved laboratory for quick turnaround analysis (i.e., 24 to 72 hours) using a modified USEPA SW-846 Method 8021B.

New nitrile gloves will be donned prior to collection of each ground water sample. Field QC samples will be collected in accordance with the QAPP.

Based on the results of the ground water sample analyses, additional direct push soil borings may be necessary to define the extent of the dissolved phase VOC contamination in the vicinity of the Site.

2.3.4. Decontamination Procedures

The drilling program will also include decontamination procedures to ensure that potential contaminants are not introduced into the borehole or transferred across the Site. A temporary decontamination pad will be constructed at the Site at a location approved by Parker Hannifin. Prior to drilling the first boring, the equipment used in drilling will be cleaned to remove possible contaminants which may have been encountered during mobilization of drilling equipment to the Site. All equipment which will come into contact with the soil, as well as drill tools, drive casing, drill rod, hoses and the back of the drill rig will undergo the initial cleaning process. While working at the Site, the drilling equipment that comes into contact with the soil will be decontaminated between monitoring well locations to prevent cross-contamination. Drilling equipment will again undergo the cleaning process prior to leaving the Site at the conclusion of drilling activities.

The cleaning process will involve the use of a high-pressure steam cleaner. Potable water will be used for all decontamination and drilling procedures. Smaller pieces of drilling equipment and/or sampling tools may be hand washed in small buckets using an Alconox and tap water wash and a tap water rinse. Decontamination water will be collected and stored for subsequent characterization and off-site disposal in accordance with Section 3.0.

2.4. Ground Water Investigation

2.4.1. General

In order to further evaluate the hydrogeologic setting at the Site, a monitoring well installation program is proposed. Seven new shallow unconsolidated unit monitoring wells and three new shallow bedrock monitoring wells are proposed for locations near the perimeter of the Site. The proposed well locations are shown on Figure 2-1. However, the final well locations may be modified based on the results of the direct push screening program.

As shown on Figure 2-1, a new shallow unconsolidated unit monitoring well, designated MW-1S, is proposed to be installed adjacent to the location of monitoring well EMW-1. As discussed in Section 2.3, monitoring well EMW-1 is proposed to be abandoned. Therefore, new monitoring well

MW-1S will be installed as a replacement well for well EMW-1. New monitoring well MW-2S is proposed to be installed in the northeast portion of the property as a background well.

Three new monitoring wells, designated MW-3S, MW-4S and MW-5S, are proposed south of the property between the abandoned Old Erie Canal and the railroad tracks. These well locations will provide an indication if Site-related constituents are migrating south of the Old Erie Canal. In addition, one new monitoring well, designated MW-6S, is proposed for the area just west of the pole barn building. Another new well, designated MW-7S, is proposed to be installed on the adjacent property west of the Site, provided access can be obtained.

Three new shallow bedrock wells, designated MW-2B, MW-3B and MW-7B, are proposed to be installed adjacent to the associated shallow unconsolidated unit monitoring well discussed above. Paired monitoring wells at locations MW-2, MW-3 and MW-7 (assuming access is granted by the adjacent property owner) will allow for the calculation of vertical hydraulic gradients across the glacial till aquitard and an evaluation of horizontal flow directions within the shallow bedrock at the Site. The proposed locations of the shallow bedrock wells were chosen because they are locations in which the shallow unconsolidated unit is not expected to exhibit significantly elevated concentrations of Site-related constituents. This will help to minimize the potential for short circuiting between the shallow unconsolidated unit and the bedrock.

Supervision of the drilling and monitoring well installation activities will be provided by a qualified geologist and/or hydrogeologist who will be in attendance at all times during the drilling and well installation activities to:

- Perform air monitoring;
- Inspect split-barrel samples;
- Prepare geologic field logs based on soil observations;
- Properly label, package and handle soil samples;
- Supervise monitoring well installation; and
- Complete daily drilling records.

2.4.2. Drilling and Well Installation Program

2.4.2.1 Shallow Unconsolidated Unit Drilling Procedures

Soil borings will be advanced through the unconsolidated deposits to the top of the glacial till unit utilizing 4¼-inch hollow-stem auger drilling techniques. Split-barrel samples will be obtained continuously down to the top of the glacial till at each location according to ASTM Method D-1586 in advance of the hollow-stem augers. All soil samples will be logged on-site and retained for geotechnical analysis, if necessary. Test boring logs describing subsurface materials encountered in each of these borings will be prepared by the on-site geologist or hydrogeologist. Descriptions of soil sample texture, composition, color, consistency, moisture content and recovery will also be recorded. Soil samples from these borings will also be screened with a portable PID for health and safety purposes.

2.4.2.2 Shallow Bedrock Unit Drilling Procedures

For the shallow bedrock well installation, soil borings will be advanced to the unconsolidated unit-bedrock interface utilizing 6¼-inch ID hollow-stem augers. The borehole will be further advanced into the top of the bedrock unit a minimum of one foot by advancing the augers into the top of the weathered zone or by utilizing rotary drilling techniques. The top of bedrock will be determined by split-barrel sampler refusal and/or prolonged grinding of the augers.

Split-barrel samples will be obtained continuously down to the top of bedrock in one boring at each location according to ASTM Method D-1586 in advance of the hollow-stem augers. Test boring logs describing subsurface materials encountered in each of these borings will be prepared by the on-site geologist or hydrogeologist. Descriptions of soil sample texture, composition, color, consistency, moisture content and recovery will also be recorded. Soil samples from these borings will also be screened with a portable PID for health and safety purposes.

Shallow bedrock wells will be constructed using 5-inch diameter steel or polyvinyl chloride (PVC) casing grouted into a rock socket prior to rock drilling and coring. The 5-inch ID casing will be lowered into the borehole and tapped into place with a mallet or light weight to seat the casing. A cement-bentonite grout will be tremied into the annulus between the casing and the borehole. As the grout is pumped into the annulus, the tremie pipe will be kept within the grout as it is placed so that a continuous seal is achieved. The cement grout will be allowed to set overnight before further bedrock drilling is initiated. Any remaining grout inside the casing will be drilled out using a 4⅞-inch roller bit. The shallow bedrock wells will be drilled to final depth using a 4-inch OD (HX) diamond core bit.

2.4.2.3 Well Installation

All newly installed monitoring wells will be constructed of 2-inch ID, flush joint, schedule 40 PVC riser pipe with either 5 or 10 feet of 0.010-inch slot PVC well screen. Each shallow unconsolidated unit monitoring well will be constructed such that the base of the well screen is set just above the top of the glacial till unit. Each shallow bedrock monitoring well will have 10 feet of well screen set from approximately 3 to 13 feet below the top of bedrock. The base of each well will be equipped with threaded bottom plugs and the top of each well will be equipped with a vented, non-threaded cap. In addition, a designated measuring point will be notched in to the top of the PVC riser pipe to provide a permanent reference point for subsequent total depth and depth to water measurements.

After setting the well, sand will be introduced gradually inside the augers, and will fill the annular space between the screen and the borehole adjacent to the screen. The sand pack will extend from the bottom of the boring to approximately one foot above the top of the screen. The sand pack will consist of a clean, graded, silica sand with grain size distribution matched to the slot size of the screen. A Morie Grade 0 or equivalent sand is deemed appropriate.

A bentonite pellet seal will be placed above the sand pack to form a seal at least 2 feet thick. A thick cement-bentonite grout will extend from the top of the bentonite pellet seal to the ground surface. The grout material will consist of Type I Portland cement mixed with either a powdered or granular bentonite. The grout mixture will be prepared in accordance with ASTM D 5092-90, such that approximately 3 to 5 pounds of bentonite is mixed with 6½ to 7 gallons of water per 94-pound sack of cement. The grout will be introduced via a tremie pipe lowered to just above the top of the bentonite pellet seal. As the grout is pumped into the borehole, the tremie pipe will be removed in sections so that the grout is pumped into the borehole at a level below the top of the grout seal as it is emplaced.

Each shallow unconsolidated unit monitoring well will have a steel casing equipped with a locking cap placed over the monitoring well. The protective casing will extend at least two feet below ground surface and be cemented in place. The shallow bedrock monitoring wells will have a lockable cap installed on top of the 5-inch casing grouted into place initially. In some areas, it may be necessary to provide flush mounted casings.

2.4.3. Decontamination Procedures

The drilling program will also include decontamination procedures to ensure that potential contaminants are not introduced into the borehole or transferred across the Site. A temporary decontamination pad will be constructed at the Site at a location approved by Parker Hannifin. Prior to drilling the first boring, the equipment used in drilling and well installation will be cleaned to remove possible contaminants which may have been encountered during mobilization of drilling equipment to the Site. All equipment which will come into contact with the soil, as well as drill tools, augers, drill rod, hoses and the back of the drill rig will undergo the initial cleaning process. While working at the Site, the drilling equipment that comes into contact with the soil will be decontaminated between monitoring well locations to prevent cross-contamination. Drilling equipment will again undergo the cleaning process prior to leaving the Site at the conclusion of drilling activities.

All well construction materials will be transported to the Site factory sealed in plastic. In the event the well construction materials are not sealed, then they will be decontaminated and sealed in plastic before beginning drilling at the first location.

The cleaning process will involve the use of a high-pressure steam cleaner. Potable water will be used for all decontamination and drilling procedures. Decontamination water will be collected and stored for subsequent characterization and off-site disposal in accordance with Section 3.0.

2.4.4. Development

Following the completion of the monitoring well installation program, each monitoring well will be developed prior to ground water sampling.

Each newly-constructed monitoring well will be developed to:

- Remove fine-grained materials from the sand pack and formation;
- Reduce the turbidity of ground water samples; and
- Increase the yield of the well to reduce the potential of the well yielding an insufficient volume of water during ground water sampling.

The monitoring wells will be developed as soon as possible, but not less than 24 hours after installation. All ground water and surface soil/sediments resulting from the well development will be managed as described in Section 3.3.2. The wells will be developed using one of the following procedures:

- Bailing;

- Inertial pumping (i.e., WaTerra pump); and/or
- Centrifugal pumping in conjunction with manual inertial pumping.

The well development equipment (i.e., bailers, tubing, etc.) will be new, pre-cleaned and/or dedicated to each monitoring well. Care will be taken not to introduce contaminants on the equipment during installation.

Well development will proceed by repeated removal of ground water from the well. The goals for development will be to obtain ground water in which the pH, temperature and specific conductivity have stabilized and exhibits a turbidity of less than or equal to 50 Nephelometric Turbidity Units (NTUs). However, a minimum of five well volumes will be removed regardless of whether these goals have been achieved earlier during development. Also, due to the required management of removed ground water, if the goals discussed above can not be obtained, well development will continue until an amount of ground water equivalent to 10 well volumes has been removed.

In addition, each of the existing monitoring wells will be inspected and total depths obtained. If significant silting has occurred in these wells (i.e., greater than 50% of the well screen is blocked), then the existing monitoring wells will be redeveloped prior to ground water sampling activities.

Well development water will be handled in accordance with the procedures outlined in Section 3.0.

2.4.5. Water-Level Measurements

Three rounds of monthly water-level measurements are desired from the new and existing monitoring wells during the RI. Additionally, surface water elevation measurements will be obtained from the Old Erie Canal. These measurements will be coordinated with the water-level measurements from the monitoring wells and will be obtained from a staff gauge which will be installed downgradient of catch basin CB-3.

All water-level measurements will be obtained with an electronic water-level indicator. The electronic water-level measurement method involves lowering a probe into a well which, upon contact with the water, completes an electric circuit. At the instant the circuit is closed, the water-level indicator provides an audible and/or visual alarm which indicates that the water has been contacted. The cable of the probe(s) utilized will be graduated in 0.01 feet increments.

All water-level measurements will be obtained in accordance with the procedures below. Nitrile gloves will be worn during all water-level measurement activities.

1. Unlock the well cover and carefully remove to avoid having any foreign material enter the well. The riser pipe will be monitored with a PID for the presence of VOCs, as required by the HASP.

2. Clean the water-level probe and lower portion of cable, and the test water-level meter to ensure that the batteries are charged.

3. Lower the probe slowly into the monitoring well until the audible and/or visual alarm indicates the top of the water column.

4. Read the depth, to the nearest 0.01 feet, from the graduated cable using the notched measuring point on the monitoring wells riser pipe. Record the depth to water in the field notebook. If the well is dry or frozen, record that condition in the field notebook.

5. Remove the probe from the monitoring well slowly. Clean the probe and lower portion of cable using clean paper towels saturated with distilled or deionized water.

6. Replace the monitoring well's cap and lock the protective casing's cap in place.

2.4.6. Ground Water Sampling

Subsequent to well development activities, one round of ground water samples will be obtained from each newly installed and existing monitoring wells for laboratory analysis. Ground water samples will be collected by either conventional (i.e., dedicated bailers or centrifugal pump with dedicated HDPE tubing) and/or low flow sampling techniques. Low flow sampling techniques will be used when sampling for natural attenuation parameters (see Section 2.6.4. of the RI/FS Work Plan).

All persons involved with the sampling program will be technically competent and familiar with the sampling procedures described herein. All persons will also be familiar with the site-specific field Health and Safety Plan (HASP) (O'Brien & Gere, February 2000 or as amended) and will also have completed Occupational Safety and Health Administration (OSHA) 40-hour training, including 8-hour annual refreshers, as appropriate.

Prior to any sampling event, the following steps must be taken by personnel responsible for sampling:

1. Notify the NYSDEC of the sampling round at least one week prior to the proposed dates of sample collection. Also notify Parker Hannifin personnel at the facility of the sampling schedule.

2. Review the sampling procedures and the HASP.

3. Assemble all equipment and materials necessary for sample collection.

A complete round of ground water elevations will be measured in each Site well prior to commencing ground water sampling activities. Care will be taken to disturb only the upper portion of the well water column to avoid re-suspending settled solids in the wells. Water level measurements will be performed as described in Section 2.4.5.

2.4.6.1. Conventional Sampling Techniques

Table 2-1. Field Equipment

Sampling Equipment
- Personal safety equipment (e.g., steel-toed work boots, nitrile gloves, safety glasses).
- Insulated sample coolers containing prepared sampling containers, preservatives, and wet ice.
- Water level indicators.
- Plastic sheeting.
- Plastic wrap for decontaminated bailers, if required.
- Tool box.
- Duct tape and clear tape.
- Distilled water.
- Paper towels.
- Suction-lift pump and ½-inch polyethylene tubing for well purging, if required.
- Dedicated Teflon® or PVC bailers with Teflon®-coated stainless-steel wire or disposable nylon line, if required.
- Dedicated one-way foot valves, if required.
- Peristaltic pump and Tygon® tubing
- Phosphate-free detergent.
- 5-gallon pails.

Documentation Equipment
- Prepared sample labels.
- Waterproof pens not containing organic solvents.
- Chain-of-custody forms.
- Custody seals.
- Field notebook.

Miscellaneous Equipment
- Sampling and Analysis Plan.
- Health & Safety Plan.
- Well keys.
- Calculator.

Inspect the equipment to ensure that it is in working order and decontaminate sampling equipment, as appropriate.

Note and replace any equipment or materials that are in short supply or are showing indication of wear.

Upon receipt of the sampling containers from the laboratory, inventory the containers to make sure appropriate containers were delivered, check if preservatives have been added, if necessary, and assess the general condition of containers.

Monitoring Well Purging

To collect representative ground water samples using conventional sampling techniques, ground water monitoring wells must be adequately purged prior to conventional sampling. Purging refers to the process of removing standing water from within the casing of a monitoring well. In rapidly recharging wells, a thorough purging will be accomplished by removal of a minimum of three well volumes of water to ensure that representative ground water is brought into the well for sampling. In slowly recharging wells, the well should be purged to dryness for a minimum of one well volume. Samples should be collected within three hours of completing well purging activities.

The procedure to be followed in purging the monitoring wells is as follows:

1. Prior to opening the well, water level and known total depth of each well will be reviewed to calculate the volume of water to be purged from the well. Using the water level and known total depth, the length of the water column in the well is calculated. This is accomplished by subtracting the depth to water from the measured total depth, both measured from the top of the casing, followed by multiplication by a conversion factor of 0.163 for 2-inch diameter wells to determine the number of gallons of water equaling one well volume. That value is multiplied by three to determine the volume of water required to purge the well of three well volumes.

2. The well cover will be unlocked and carefully removed to avoid having any foreign material enter the well.

3. If a dedicated Teflon®, polyethylene, or PVC bailer with either Teflon®-coated stainless-steel wire or new nylon line is used for evacuation, a sampling team member will remove the bailer from the protective bag and lower it down the well until it comes in contact with the water. The sampling team member will continue to lower the bailer allowing it to submerge. When the bailer has filled, it will be removed from the monitoring well and the water discharged into a 5-gallon pail. Care will be

taken to prevent the bailer from touching the 5-gallon pail, which could lead to cross-contamination of the bailer. These steps will be repeated until three well volumes have been removed or until the monitoring well is essentially dry. Sufficient time will be allowed for slowly recovering wells to recharge prior to sampling.

4. Some of the monitoring wells in the network may be purged using a suction pump and dedicated ½-inch diameter HDPE tubing with a dedicated "Delrin" acetal thermoplastic foot valve. After securely attaching the foot valve to the HDPE tubing, the HDPE tubing will be carefully lowered just below the water level and lowered as the water level lowers while pumping the monitoring well. The HDPE tubing will be connected to the suction pump and a discharge hose will be attached to the pump and run into a 5-gallon pail. After the purging has been completed, the suction pump will be disconnected from the HDPE tubing.

5. All purge water will be initially collected in 5-gallon pails. The purge water from on-site wells will subsequently be discharged to the ground surface in the immediate vicinity of the monitoring well from which it was purged. Care will be taken such that the discharged purge water does not flow into any nearby surface water.

Ground Water Sample Collection

Ground water samples will, if at all possible, be collected within three hours of purging of the well to be sampled by conventional techniques. If recharge is sufficient, then samples will be collected immediately following well purging as described in Section 2.6.1. For slowly recharging wells, every effort will be made to collect samples as soon as possible and within three hours of well purging. Samples will be collected using (a) dedicated ⅛-inch polyethylene tubing placed inside the dedicated ½-inch HDPE tubing or (b) dedicated, pre-cleaned, bottom-filling Teflon®, polyethylene, or PVC bailers and either dedicated Teflon®-coated, stainless-steel bailing line or disposable nylon rope. Sample containers will be filled directly from the bailer or tubing according to a prioritized order and using the specific sampling procedures listed below.

1. Well sampling should be performed on the same date as purging, at a time immediately after the well has recovered sufficiently to sample, or within three hours after purging, if the well recharges slowly. After well purging is completed and the well has sufficiently recharged, prepare the appropriate sample containers for sample collection.

2. Don new nitrile gloves.

3. If a bailer is utilized, lower the bailer slowly down the well taking care to minimize agitation of the water column which could result in the loss of VOCs. After the bailer is submersed to within the screened section of the well, slowly remove the bailer from the well and fill individual sample containers directly from the bailer. During sampling, take care to prevent the bailer and wire from coming in contact with any objects other than the riser of the well, ground plastic and nitrile gloves worn by the sampler(s). Special attention should be taken when filling vials for volatile organic analysis. The vials will be filled in a controlled manner focused at reducing ground water contact with the air and ensuring that no headspace remains after capping.

4. For wells purged using the suction pump and dedicated HDPE tubing, sampling will be performed using small diameter (i.e., ⅛-inch) dedicated polyethylene tubing inserted inside the ½-inch HDPE tubing used for purging. The ½-inch HDPE tubing will then be hand pumped, creating a uniform, laminar flow through the small diameter tubing. Samples will then be collected through the small diameter tubing.

   Afterwards, the small diameter tubing will be removed, rinsed thoroughly with distilled water and placed in a clean plastic bag labeled with the well designation. The rinsate will be collected along with the purge water and subsequently treated in the on-site air stripper. The dedicated ½-inch HDPE tubing and foot valve will remain in the well between sampling events.

5. Fill the individual sample containers directly from the bailer or tubing in the prioritized order set forth below:

Priority	Parameter
1	Volatile Organics
2	Semi-Volatile Organics
3	Pesticides/PCBs
4	Metals
5	Dissolved Organic Carbon
6	Cyanide
7	Nitrate and pH
8	Sulfate, Sulfide, Chloride, Alkalinity, Specific Conductivity and Turbidity

6. After collecting the sample, record the date and time of sampling onto the sampling containers and in the field notebook.

7. Place sample containers in a cooler containing wet ice for transportation to the laboratory.

8. Close and lock the monitoring well. The bailer should be rinsed thoroughly with deionized water and placed in a labeled clean, plastic storage bag to be ready for the next sampling event. The rinsate will be collected along with the purge water and subsequently treated in the portable purge water treatment system. Remove all waste materials from the area before moving to the next sampling location.

Specific information regarding sample bottle and preservation requirements are provided in the QAPP presented in Section 4.

2.4.6.2. Low Flow Sampling Techniques

The low-flow sampling method relies on direct in-line water quality indicator readings to establish equilibration or time criteria for collecting a representative ground water sample.

The following equipment should be available and ready for use prior to initiating the field sampling efforts.

- An adjustable rate, electric submersible pump, and a peristaltic pump.
- Tubing - Polyethylene, polypropylene, PVC, or Tygon® tubing may be used for sample collection.
- Water level measuring device, 0.01 foot accuracy (electronic preferred for tracking water level drawdown during all pumping operations).
- Flow measurement supplies (for example, graduated cylinder and stop watch).
- Power source (generator or battery).
- In-line indicator parameter monitoring instrument consisting of a clear flow-through cell housing the pH, specific conductance, temperature, dissolved oxygen, and oxidation-reduction potential probes. The volume of the flow-through cell will be minimized to expedite change over of ground water in the cell. Turbidity samples will be collected from an in-line tap prior to the flow-through cell.
- Decontamination supplies.

- Logbook(s).
- Interface probe, if needed.
- Sample bottles.
- Sample preservation supplies (as required by the analytical methods).
- Sample tags or labels.
- Well construction data, location map, field data from last sampling event.
- FSP.

Low Flow Ground Water Sample Collection

Prior to commencing daily sampling activities, the ground water quality monitoring probes/meters including pH, conductivity, ORP, dissolved oxygen, and turbidity will be calibrated. Dissolved oxygen calibration will be corrected for local barometric pressure and elevation. Calibration results will be recorded in the field log notebook.

The depth of wells and well screen intervals will be acquired from site-specific drilling logs or existing monitoring well specification tables. This data (and source of data) will be pre-recorded on the Ground Water Field Sampling Log.

1. Prepare the pumping system for operation. Connect the tubing to the in-line water quality indicator parameter meter.

2. When using the submersible pump, slowly and carefully lower the sampling pump and associated equipment into the well. When using the peristaltic pump, slowly lower the tubing into the well. The objectives are to minimize mixing of the stagnant water above the screened interval with the water within the interval, and to avoid re-suspending fines within the well. Position the pump intake near the center of the screened interval.

3. Commence well purging by low flow pumping from the well. The flow rate shall not exceed 0.5 liters/min. Efforts should be made to minimize the generation of air bubbles in the sample tubing by either increasing the flow rate as appropriate, or restricting the flow by clamping the tubing. Record purge rate on the Low Flow Ground Water Sampling Log.

4. During purging, monitor and record pH, specific conductivity, temperature, oxidation-reduction potential (redox), dissolved oxygen, and turbidity at time intervals sufficient to evacuate the volume of the flow-through cell.

5. Well sampling can commence after equilibration of water quality parameters. Well drawdown of 0.3 ft is desirable, but not mandatory. Equilibrated trends are generally obvious and usually follow either an exponential decay or asymptotic trend during purging. The equilibration guidelines are as follows:

temperature	± 10%
pH	± 0.5 pH units
specific conductance	± 10%
redox	± 10 mV
DO	± 10%
turbidity	± 10%

If the indicator field parameters have not equilibrated within the above specified limits after 2 hours of purging, then one of the following options may be taken: 1) continue purging until stabilization is achieved; 2) discontinue purging and do not collect samples (document attempts to achieve stabilization); or 3) discontinue purging and collect samples (document attempts to achieve stabilization). Record total volume of water purged and purging time on the Low Flow Ground Water Sampling Log for future reference.

6. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to avoid pumping the well dry and/or allow stabilization of indicator parameters. If the recharge rate of the well is very low and the well is purged dry, then sampling should commence as soon as the well has recharged to a sufficient level to collect the appropriate volume of samples. Sample collection using bailing techniques may be used in this situation. However, turbidity levels shall be maintained as low as possible.

7. Remove the sampling bottles from their transport containers, and prepare the bottles for receiving samples. Inspect all labels to insure proper sample identification. Sample bottles should be kept cool with their caps on until they are ready to receive samples. Arrange the sampling containers to allow for convenient filling.

8. Sample bottles for VOC analyses, containing hydrochloric acid for preservation, will be filled completely so that there is no headspace or bubbles. The VOC sample vials will be examined for proper filling by inverting the vials immediately after filling.

9. After the last sample has been collected, record the date and time.

10. Begin preparing the Chain-of-Custody documentation.

2.4.6.3. Sample Identification and Labeling

All samples collected will be assigned a unique sample identification code based on the sampling location. Generally, the sample identification code will be the well designation for the sampling location (e.g., MW-1, EMW-2, etc.) A sample may be further labeled matrix spike (MS) or matrix spike duplicate (MSD) if the sample is to be used by the laboratory as a MS or MSD. Blind field duplicate samples will be labeled X-1, X-2, etc. Trip blank samples obtained from the laboratory will be dated and identified as a trip blank. The trip blank sample will accompany those samples collected on that particular date and submitted to the laboratory for VOC analysis. The field notebook will identify the blind field duplicate samples as well as where they were obtained.

In addition to the sample identification, each sample container will be labeled with the following information:

- site name;
- Date and time of sample collection;
- Analysis requested;
- Preservative(s); and
- Client name.

All information should also be entered in the field book in waterproof ink. Sample container labels should be completed with ink containing no organic solvents. Specific details on chain-of-custody protocols and shipping requirements are provided in the QAPP.

3.4.6.4. Decontamination of Sampling Equipment

Following the sampling round, the dedicated bailers and small diameter polyethylene tubing will be cleaned with distilled or deionized water. After rinsing, each bailer and small diameter polyethylene tubing will be placed in a labeled plastic bag and sealed to ensure that no outside contaminants are introduced prior to use during subsequent sampling activities. This procedure will also be utilized to clean any new dedicated equipment to be used at the facility and to clean any dedicated equipment which may become contaminated in the field.

Prior to initial assembly of the low flow sampling apparatus decontaminate the non-dedicated miscellaneous parts, which come in contact with the sample, with an Alconox and tap water wash, tap water rinse, isopropyl alcohol rinse, and a distilled water rinse. After rinsing, dry the various parts with clean paper towels and place in a plastic bag, sealing to ensure that no outside contaminants are introduced prior to use during subsequent sampling activities. Dedicated HDPE tubing will remain in the monitoring well; therefore, decontamination is not required.

2.4.6.5. Sample Analysis

Ground water samples collected from the permanent monitoring wells will be analyzed for target compound list (TCL) VOCs by Method 8260B, TCL SVOCs by Method 8270C, TCL PCBs by Method 8082, TCL pesticides by Method 8081A, total cyanide by Method 9010B/9012A or 9014, Target Analyte List (TAL) total metals by Methods 6010B and 7470A, and pH by Method 9045C.

In addition, ground water samples from each of the permanent wells will also be analyzed for the following natural attenuation parameters:

Natural Attenuation	
Parameter	**USEPA SW-846[1] Analytical Method**
methane	modified 8015/Kampbell *et al.*, 1989
ethane	modified 8015/Kampbell *et al.*, 1989
ethene	modified 8015/Kampbell *et al.*, 1989
DOC	9060
alkalinity	MCAWW 310[2]
chloride	9212, 9250, 9251, 9253 or 9056
nitrate	9210 or 9056
sulfate	9038, 9036, 9035 or 9056
sulfide	9215
iron II (Fe^{+2})	field
redox potential	field
specific conductivity	9050A or field
temperature	field
turbidity	MCAWW 180.1[2] or field
dissolved O_2	field
pH	9045C or field

DOC: dissolved organic carbon
O_2: Oxygen

[1] SW-846: USEPA's *Test Methods for Evaluating Solid Waste, 3rd Edition*, December 1996, with all current revisions.
[2] MCAWW: *Methods for Chemical Analysis of Water and Wastes*, USEPA, 1983.

Specific details on sample analysis, laboratory methodologies and QA/QC procedures are described in the QAPP provided in Section 4. The laboratory reporting requirements and the data validation criteria are also provided in the QAPP.

2.4.6.6. Field Notes

All field notes will be entered into the designated field notebook. Sufficient information will be contained in the notebook to allow anyone to reconstruct the sample collection and handling procedures at a later date. The field notebook should include the following: site map; monitoring well construction spreadsheet, daily field report forms; and individual monitoring well purging and sampling forms which include the information listed in Table 2-2 of this document.

Table 2-2. *Field Notes*

General

- Name and location of site.
- Date.
- Purpose of visit (i.e., water level measurements, sampling, etc.).
- Weather conditions.
- Other persons present on site.
- Names of field personnel.
- Any other field conditions/observations (e.g., damage to the well).

Water Level and Total Depth Measurements

- Well identification.
- Physical condition of well.
- Date and time.
- Depth to water.
- Total depth of the well (installed and measured).
- Measuring point identification.
- Measuring point elevation.

Purging (conventional techniques only)

- Well identification.
- Date and time (start/stop).
- Recharge time(s).
- Type of purging equipment used.
- Total depth of the well (installed and measured).
- Depth to water.
- Well diameter.
- Volume of water to be purged (three well volumes).
- Procedures for collecting, measuring and disposing of purge water.
- Appearance of purge water and change, if any.
- Odor of purge water, if any.
- Quantity of water purged.

Conventional Sampling

- Date and time of sampling.
- Well identification number.
- Sample identification.
- Method of sample collection.
- Appearance of sample, odors present, etc.
- Type of container(s).
- Type of preservative, if any.
- Analytical method(s) requested.

2.4.7. Hydraulic Conductivity Testing

In-situ hydraulic conductivity tests will be performed on each new and existing monitoring well to determine the hydraulic conductivity of the screened interval. These tests involve observing the recovery of water levels toward an equilibrium level after an initial perturbation. The perturbation may be either a sudden rise or fall in water level. During a slug test, either a 5-foot inert rod or a volume of deionized water will be quickly introduced into the well to cause a water level rise. During a bail test, a 5-foot inert rod or a clean sampling bailer will be rapidly removed from the well to cause a water-level drop. Procedures and equipment requirements may vary depending on the rate of the water-level recovery. Each well will be tested in accordance with the following procedures:

- Determine the type of test to be performed based on the following:
  - If the screened interval of the well straddles the water table, only use a rising head test;
  - If the screened interval of the well is submerged within water, either method may be used, preferably both;
- Record appropriate initial data in field notebook, including date of test, well identification, well construction details (i.e., screen length, screen diameter, riser diameter, depth to top of screen, sand pack length, sand pack diameter, and depth to top of sand pack), type of test and names of field personnel;
- Clean the downhole equipment (e.g., pressure transducer, associated cable and, if used, the bailer or slug and associated line) following standard decontamination procedures before initiating test(s) at each well;
- Measure and record the static water level in the well (only wells which have fully recovered to static level conditions after drilling and development should be tested);
- Connect the pressure transducer to the data logger and lower the transducer into the well 5 to 10 feet below the water surface. Secure the position of the transducer by clamping the transducer cable to the well casing using a rubber-covered clamp. If the edges of the well casing are sharp, cover them with cloth or duct tape to protect the transducer cable;

- Quickly create the water level perturbation by slugging or bailing the well. While there is no fixed requirement for the magnitude of the change in water level, it is suggested that a minimum of 20% instantaneous hydraulic head differential be created to allow collection of a suitable data base; and

- If another test is to be performed, replace the bailer or solid object and allow the well to re-equilibrate prior to performing the next test. Repeat the procedures, changing settings as appropriate.

Interpretation of water level versus time data from the hydraulic conductivity tests will be performed using the Bower & Rice method. Other appropriate methods may be utilized, and if deemed necessary.

2.5. Surface Water and Surface Soil/Sediment Sampling

2.5.1. General

The purpose of the surface water and surface soil/sediment sampling program is to confirm prior analytical results and to help delineate the extent of the constituents from the Site. As shown on Figure 2-2, surface water and surface soil/sediment samples will be collected from a total of nine locations.

2.5.2. Sample Collection and Analysis

Surface water samples will be collected as grab samples directly into the appropriate sample containers or using a laboratory-supplied polyethylene container as a dipper bottle and then transferring the sample into the appropriate sample containers. New nitrile gloves will be donned prior to the collection of each surface water sample.

The sample containers will be labeled with the sample locations, date, time, project identification, and required analyses. The same information will be recorded on the field sheets. The sample containers will be immediately placed in an insulated cooler containing wet ice. New nitrile gloves will be donned prior to collecting the surface water sample at each location.

The surface soil/sediment samples collected will be collected with a stainless-steel bucket auger and transferred directly into the appropriate sample containers. The sample containers will be labeled with the sample locations, date, time, project identification, and required analyses. The same information will be recorded on the field sheets. The sample containers will be immediately placed in an insulated cooler containing wet ice. New nitrile gloves will donned prior to collecting the surface soil/sediment sample a each

location. Between each sample location, the stainless-steel bucket auger will be decontaminated with liquinox and water, followed by a distilled water rinse.

Surface water and surface soil/sediment samples collected from locations in the Old Erie Canal and barge turnaround area will be analyzed for:

- VOCs by USEPA SW-846 Method 8260B;
- SVOCs by USEPA SW-846 Method 8270C;
- PCBs by USEPA SW-846 Method 8082;
- Pesticides by USEPA SW-846 Method 8081A;
- Total cyanide by USEPA SW-486 Method 9010B/9012A or 9014;
- TAL total metals by USEPA SW-846 Methods 6010B and 7470A/7471A; and
- pH by USEPA SW-846 Method 9045C.

2.6. Storm Sewer Evaluation

2.6.1. General

Based on a review of available underground utility maps, and the information reported in the Final PSA Report (URS, 1995), several storm sewer lines run through the impacted portions of the Site and discharge into the catch basin located within the unfilled portion of the Old Erie Canal. As discussed in the Final PSA Report, surface water and surface soil/sediment samples were collected near and/or within this catch basin for laboratory analysis. Analysis of these samples indicate that Site-related VOCs are potentially present in the storm sewer system.

Ground water level information presented in the Final PSA Report (URS, 1995) indicate that the depth to ground water at monitoring well location EMW-2 was only about 1.5 feet below the measuring point. As shown on Figure 2-2, the locations of the storm sewers at the Site are relatively close to the location of monitoring well EMW-2. Based on the relative location of the storm sewers at the Site, the anticipated depth of the storm sewer lines and the shallow ground water conditions, the storm sewer lines may act as local discharge zones for the shallow fill unit ground water during some portions of

the year. Therefore, in order to evaluate the relationship between the storm sewer lines and potentially contaminated shallow fill unit ground water, a storm sewer evaluation is proposed.

2.6.2. Inspection of Storm Sewers, Manholes and Catch Basins

The initial step in the storm water evaluation is to perform a detailed review of available underground utility maps to locate existing and historical storm sewer system components in the study area. To the extent practicable, discrepancies between maps and drawings of different vintage will be reconciled for the purpose of establishing an accurate, comprehensive field map.

Following the completion of the map review, an inspection of on-site sewers, manholes and catch basins will be conducted to assess the condition of these storm sewer system components and the potential for the sewers to serve as conduits for ground water migration. Many of the existing catch basins and manhole locations were surveyed during a November 1999 survey. However, any additional storm sewer system components identified during the field verification task will be identified on the field map and subsequently surveyed to define their location and surface elevation.

Manholes and catch basins associated with the storm sewer system in the study area will be opened and inspected during the inspection. The inspection process will involve an assessment of the construction and condition of the interior of each storm sewer access point. The number, size, and elevation of inlet and outlet piping as well as the type and condition of construction materials will also be determined. Evidence of ground water infiltration, indications of plugged or abandoned sewer lines will be noted.

In order to maximize the visibility of manhole components during the inspection, it may be necessary to remove accumulated surface soil/sediment. Based on a preliminary inspection of the storm sewers at the Site, removal of surface soil/sediment and/or debris from catch basin CB-3 may be required. If required, the accumulated surface soil/sediments and/or debris will be removed from the catch basin, placed in drums and characterized for subsequent off-site disposal in accordance with applicable regulations.

2.6.3. Storm Water Sampling

In order to evaluate the extent of potential VOCs in the Site storm sewers, storm water samples will be collected during a period of relatively high ground water level conditions for laboratory analysis. As discussed previously, the purpose of the storm water evaluation is to determine if shallow ground water

is discharging into the storm sewers at the Site; therefore, it is important to the evaluation that the storm water sampling activities be performed during periods of relatively high ground water level conditions. As shown on Figure 2-2, storm water samples are proposed to be collected from each of the two influent lines to catch basin CB-3 located in the Old Erie Canal, the effluent line from catch basin CB-3, the two upgradient manholes located in the parking lot near the pole barn, and, if accessible, the influent to the 12-inch storm sewer line which originates near the P&C Grocery Store.

Since the primary ground water constituents detected during the PSA were VOCs and the intent of this task is to evaluate the potential for the storm sewers to serve as conduits for ground water migration, only VOCs have been identified as the target compounds for this sampling effort. Storm water samples collected from the catch basins and/or manholes at the Site will be analyzed for VOCs by USEPA SW-846 Method 8260B.

Storm water samples will be collected as grab samples directly into the appropriate sample containers using either a peristaltic pump equipped with dedicated Tygon® tubing or directly into 40-mL glass vials. New nitrile gloves will be donned prior to the collection of each storm water sample. Additional field QC samples will be collected in accordance with the QAPP. In addition to the water quality sampling, the depth of the flow in the catch basin and/or storm sewer will be obtained at the time of the sampling effort. The sample containers will be labeled with the sample locations, date, time, project identification, and required analyses. The same information will be recorded on the field sheets. The sample containers will be immediately placed in an insulated cooler containing wet ice. New nitrile gloves will be donned prior to collecting the storm water sample at each location.

2.7. Surveying

Each of the newly-installed monitoring wells, soil borings, surface water sample locations, surface soil/sediment sample locations and staff gauges will be surveyed for horizontal and vertical control and will be incorporated into the existing Site base map. Monitoring wells will be surveyed to the nearest 0.01 feet at the top of the wells riser pipe (measuring point) and top of protective steel casing. Ground surface at each location will be surveyed to the nearest 0.1 feet.

3. Handling of Investigation-Derived Materials (Waste Management Plan)

3.1. General

The RI activities will produce investigation-derived materials (IDM) which will require appropriate management. IDM includes the following:

- Drill cuttings;
- Ground water resulting from development of new monitoring wells;
- Ground water resulting from the sampling of the monitoring wells;
- Decontamination fluids and surface soil/sediments which may settle out of such fluids;
- Surface soil/sediments which settle out of ground water produced during the above; and
- Personnel protective equipment (PPE) and associated debris resulting from the execution of field activities.

The management of these materials is discussed below.

3.1.1. Drill Cuttings

Drill cuttings derived from each soil and bedrock boring will be placed in 55-gallon drums and transported to a central location designated by Parker Hannifin at the facility. All cuttings will be labeled with the borehole identification and the date which the cuttings were initially containerized. These drums will be stored at or near the hazardous waste storage building. The final disposition of the cuttings will be determined after the various analytical results from the investigation are available. Depending on the results of the investigation, and any other characterization deemed appropriate, it is assumed that various drill cuttings can be disposed on-site. Alternatively, if the results of the investigation, or any additional characterization which may be performed, indicates that the cuttings are contaminated, then the drill cuttings will be transported off-site for disposal at a permitted facility.

3.1.2. Ground Water

Ground water produced during development and sampling activities at the shallow unconsolidated unit monitoring wells will be discharged to the ground surface immediately adjacent to the monitoring well from which the development and/or purge water came from. Care will be taken to avoid allowing the waters to flow into surface water locations.

Ground water produced during development and sampling activities at the shallow bedrock monitoring wells will be containerized in 55-gallon drums and transported to a central location designated by Parker Hannifin at the facility. All drums will be labeled with the monitoring well identification and the date which the ground water were initially containerized. These drums will be stored at or near the hazardous waste storage building. The final disposition of the ground water will be determined after the various analytical results from the investigation are available. Depending on the results of the investigation, and any other characterization deemed appropriate, it is assumed that the ground water can be disposed on-site. Alternatively, if the results of the investigation, or any additional characterization which may be performed, indicates that the ground water is contaminated, then the ground water will be treated on-site using activated carbon and/or after receiving the necessary approvals, will be transported off-site for treatment and/or disposal at a permitted facility.

3.1.3. Decontamination Fluids

Decontamination fluids containing non-indigenous materials associated with drilling, and sampling activities will be containerized in plastic 55-gallon drums and temporarily stored in or next to the hazardous waste storage building. At the conclusion of field activities, these materials will be appropriately characterized and, after receiving the necessary approvals, will be transported off-site for treatment and/or disposal at a permitted facility.

3.1.4. Surface Soil/Sediment, PPE and Associated Debris

Used PPE and other associated debris (e.g., ground plastic, tubing, etc.) will be containerized in 55-gallon drums and temporarily stored in or next to the hazardous waste storage building. At the conclusion of field activities, these materials will be appropriately characterized and, after receiving the necessary approvals, will be transported off-site for treatment and/or disposal at a permitted facility. Solids which settle out of the decontamination fluids will be containerized separately, but managed similarly.

4. Quality Assurance Project Plan

The following quality assurance (QA) topics are addressed in this plan:

- DQOs;
- Sampling procedures;
- Documentation and chain-of-custody;
- Calibration procedures;
- Sample preparation and analytical procedures;
- Data reduction, validation, and reporting;
- Quality Control checks;
- Preventative maintenance;
- Data assessment procedures;
- Corrective actions; and
- QA reports to management.

The remainder of this document provides details of these topics. Additional sampling procedures details are provided elsewhere in the FSP.

4.1. Data Quality Objectives

DQOs are quantitative and qualitative statements specifying the quality of the environmental data required to support the decision-making process. DQOs define the total acceptable uncertainty in the data for each specific activity conducted during the investigation. The uncertainty includes both sampling error and analytical error. Ideally, zero uncertainty is the intent. However, the variables associated with the process (field and laboratory) inherently

contribute to some uncertainty in the data. It is the overall objective to keep the total uncertainty within an acceptable range that will not hinder the intended use of the data. QA/QC requirements have been established such that there will be a high degree of confidence in the measurements.

The principal DQOs of this investigation are to generate data of sufficient quality to support both qualitative and quantitative conclusions concerning potential nature and extent of chemical constituents at the facility, to support engineering evaluations of potential remedial response activities, and to support the baseline risk assessment. In order to achieve these DQOs, the process of data generation was designed to develop a body of analytical data of sufficient quality to be used to support conclusions made as a result of this investigation. Specific data quality requirements such as criteria for precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS) are specified in this document.

Laboratory analyses and analytical levels will adhere to the guidelines described in USEPA's *Data Quality Objectives for Remedial Response Activities* (USEPA, March 1987). Analytical levels are defined in the guidance document as follows:

- Level I implies field screening or analysis using portable instruments. Results are often not compound specific and not quantitative but results are available on a real-time basis.

- Level II implies field analyses using more sophisticated portable analytical instruments. In some cases, the instruments may be set up in a mobile laboratory on-site. There is a wide range of the quality of data that can be generated for Level II analyses. In general, data quality depends on the use of suitable calibration standards, reference materials, sample preparation equipment, and training of the instrument operator(s). Results are available on a real-time basis or within several hours.

- Level III implies that all analyses be performed in an off-site laboratory. Level III analyses may or may not use USEPA Contract Laboratory Program (CLP) procedures. The laboratory may or may not be a CLP laboratory. Level III analyses will provide data of the same quality as Level IV, but USEPA's methods such as *Test Methods for Evaluating Solid Waste* (USEPA SW-846, July 1992 with all current revisions) are utilized instead of CLP methods.

- Level IV implies CLP routine analytical services (RAS). Analyses are performed in an off-site CLP analytical laboratory following CLP protocols. Level IV is characterized by rigorous QA/QC protocols and documentation.

- Level V implies analyses by non-standard methods. Analyses are performed in an off-site analytical laboratory which may or may not be a CLP laboratory. Method development or method modification may be required for specific constituents or detection limits. CLP special analytical services (SAS) are Level V.

Table 4-1 contains sampling efforts, objectives, analyses, data uses, and analytical levels. The remainder of this QAPP describes the specific approaches that will be taken to achieve the required DQOs.

In order to assess adherence to DQOs, O'Brien & Gere has developed the QA/QC program described in this QAPP. The USEPA's CLP states that the purpose of a QA/QC program "is the definition of procedures for the evaluation and documentation of sampling and analytical methodologies and the reduction and reporting of data. The objective is to provide a uniform basis for sample collection and handling, instrument and methods maintenance, performance evaluation, and analytical data gathering and reporting." The NYSDEC, in its guidance document for QAPPs, states that "quality assurance is a management system for ensuring that all information, data, and decisions resulting from an investigation are technically sound, and properly documented." QC is defined as the "functional mechanism through which QA achieves its goals."

Table 4-1. *Sampling Efforts, Objectives, Analyses, Data Uses, and Analytical Level*

Sampling efforts	Objectives	Types of analyses	Data uses	Analytical levels
Ground water screening	Quantify constituents, if any	VOCs	Site Characterization, Baseline Risk Assessment, Evaluation of Remedial Alternatives, and Engineering Design	III
Ground water sampling	Quantify constituents, if any	VOCs SVOCs PCBs pesticides total cyanide total metals pH	Site Characterization, Baseline Risk Assessment, Evaluation of Remedial Alternatives, and Engineering Design	III
Ground water sampling	Quantify constituents, if any	methane ethene ethane DOC alkalinity chloride nitrate sulfate sulfide turbidity specific conductivity redox potential temperature dissolved oxygen iron II (Fe^{+2}) pH	Natural Attenuation Evaluation, Evaluation of Remedial Alternatives, and Engineering Design	III III III III III III III III III II or III II or III II II II II II
Surface water sampling	Quantify constituents, if any	VOCs SVOCs PCBs pesticides total cyanide total metals pH	Site Characterization, Baseline Risk Assessment, Evaluation of Remedial Alternatives, and Engineering Design	III
Surface soil/sediment sampling	Quantify constituents, if any	VOCs SVOCs PCBs pesticides total cyanide total metals pH	Site Characterization, Baseline Risk Assessment, Evaluation of Remedial Alternatives, and Engineering Design	III
Storm water sampling	Quantify constituents, if any	VOCs	Storm Water System Evaluation, Evaluation of Remedial Alternatives, and Engineering Design	III

VOCs: volatile organic compounds
SVOCs: semi-volatile organic compounds
PCBs: polychlorinated biphenyls
DOC: dissolved organic carbon

The following is a brief description of data quality parameters addressed in the QAPP. Goals for completeness, accuracy, and precision are also specified. It should be pointed out that these goals may not always be achievable due to matrix interferences and minor problems caused by analyte or instrument instability. In those cases where these goals are not met, the impact of not meeting the goals will be discussed in the data usability report contained in the data validation report.

Precision describes the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements, that have been made in an identical manner, compared to their average value. Precision can be expressed in a variety of manners, including absolute methods such as deviation from the mean or median values, standard deviation and variance, or relative methods, such as relative deviation from the mean or median. The overall precision may be established through the analysis of field duplicate and laboratory duplicate samples. For this project, a DQO goal for precision has been established that 100% of the analytes in the precision measurement must meet the control limits specified in this QAPP. If this goal is met, the data will have acceptable precision and will be considered usable. If this goal is not met, appropriate corrective action will be taken.

Accuracy is defined as the degree of difference between measured or calculated values and the true value. The closer the numerical value of the measurement comes to the true value, or actual concentration, the more accurate the measurement is. Accuracy is expressed in terms of absolute or relative error. Accuracy will be determined through analysis of spiked samples and the analysis of standards with known concentrations. The percent recovery of surrogate spikes for organic analyses will also provide an evaluation of the accuracy of the measurements. An overall project DQO goal for accuracy has been established that 100% of the analytes within the accuracy measurements must meet the control limits specified in this QAPP. If this goal is met, the data will have acceptable accuracy and will be considered usable. If this goal is not met, appropriate corrective actions will be taken.

Representativeness refers to the degree to which a sample taken from a site accurately reflects the matrix at the site. It is a qualitative parameter which is most closely associated with the design of the sampling program. Factors that should be considered in the determination of representativeness include appropriateness of sampling and analytical methodologies, representativeness of the selected media, and representativeness of the selected analytical procedures. Representativeness will be achieved by the use of procedures for

the collection and preservation of samples as described in USEPA's *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, 3rd Edition, July 1992 with all current revisions, the associated FSP, and this QAPP.

Comparability refers to the use of consistent procedures, second source reference standards, reporting units, and standardized data format with document control. Adherence to standard procedures and the analysis of external source standard materials maximizes the probability that data generated from a particular method at a given laboratory can be validly compared to the data of another. This QAPP has been written to provide data which will be comparable to other data collected, as standard methods will be utilized.

Completeness refers to the process of obtaining the required data as outlined in the associated FSP and RI/FS Work Plan. Completeness is also defined as the percentage of measurements judged to be usable. Samples for which the critical data points fail completeness objectives will require reanalysis of samples (within the specified holding times) until the DQOs are met. The completeness goal has been specified at 100% for this investigation.

Sensitivity refers to a measurable concentration of an analyte which has an acceptable level of confidence. Method detection limits (MDLs) are the lowest concentration of an analyte that can be measured with 99% confidence that the analyte concentration is greater than zero. For inorganics, the instrument detection limit (IDL) is determined by multiplying the Students t-Test value the standard deviation obtained for the analysis of a standard solution at a concentration of 3 to 5 times the estimated IDL on three days with a minimum of seven measurements. The practical quantitation limit (PQL) is the lowest concentration that can be reliably quantified within specified limits of precision and accuracy during routine laboratory operations. The contract required quantitation limit (CRQL) is the minimum level of quantitation acceptable for this project. CRQLs originated from the USEPA CLP scopes of work (SOWs) for the analysis of organic TCL and inorganic TAL. The analytical methods associated with this project can achieve the MDLs, PQLs, and CRQLs low enough to adequately meet the project's DQOs.

4.1.1. Field Sampling

The objective of field sampling procedures is to obtain samples that represent the environmental matrix being investigated. This will be accomplished through the use of proper sampling techniques and equipment. Appropriate sampling protocols are presented in the associated FSP.

4.1.2. Laboratory Analyses

To obtain data of a quality sufficient to meet the project DQOs, the following analytical laboratory techniques will be utilized:

- VOC screening using gas chromatography (GC);
- TCL VOC analysis using gas chromatography/mass spectrometry (GC/MS);
- Select VOC (i.e., ethene, ethane, and methane) analysis using a modified GC headspace technique;
- TCL SVOC analysis using GC/MS;
- TCL PCB analysis using GC;
- TCL Pesticide analysis using GC;
- Total cyanide analysis using spectrophotometry;
- TAL total metals analysis using inductively coupled plasma (ICP) and cold vapor techniques;
- pH analysis using an electrode;
- Dissolved organic carbon (DOC) analysis using UV persulfate oxidation; and
- Miscellaneous inorganic analyses using various wet chemistry techniques based on the selected laboratory.

The analytical QA/QC and data reporting will adhere to the specific analytical methods, or equivalents and/or updates, listed in Table 4-2 along with requirements of Exhibit E of the NYSDEC Analytical Service Protocol (ASP) October 1995 revision.

Table 4-2. *Analytical Methods*

Sampling Program	Matrix	Parameter	USEPA SW-846[1] Analytical Method
Preliminary Screening Program	Water	VOCs	8021B
Shallow Unconsolidated Unit Investigation	Water	TCL VOCs	8260B
		TCL SVOCs	8270C
		TCL PCBs	8082
		TCL pesticides	8081A
		total cyanide	9010B/9012A or 9014
		TAL total metals	6010B & 7470A
		pH	9045C
Shallow Unconsolidated Unit Natural Attenuation Evaluation	Water	methane, ethene, ethane	modified 8015/Kampbell *et al.*
		DOC	9060
		alkalinity	MCAWW 310[2]
		chloride	9212, 9250, 9251, 9253 or 9056
		nitrate	9210 or 9056
		sulfate	9038, 9036, 9035 or 9056
		sulfide	9215
		redox potential	field
		specific cond.	9050A or field
		temperature	field
		iron II (Fe^{+2})	field
		turbidity	MCAWW 180.1[2] or field
		dissolved O_2	field
		pH	9045C or field
Surface Water Investigation	Water	TCL VOCs	8260B
		TCL SVOCs	8270C
		TCL PCBs	8082
		TCL pesticides	8081A
		total cyanide	9010B/ 9012A or 9014
		TAL total metals	6010B & 7470A
		pH	9045C
Surface Soil/ Sediment Investigation	Soil/Sed	TCL VOCs	8260B
		TCL SVOCs	8270C
		TCL PCBs	8082
		TCL pesticides	8081A
		total cyanide	9010B/9012A or 9014
		TAL total metals	6010B & 7471A
		pH	9045C
Storm Water Investigation	Water	TCL VOCs	8260B

VOCs: volatile organic compounds
SVOCs: semi-volatile organic compounds
PCBs: polychlorinated biphenyls
DOC: dissolved organic carbon
TCL: target compound list
TAL: target analyte list
O_2: Oxygen

[1] SW-846: USEPA's *Test Methods for Evaluating Solid Waste, 3rd Edition*, December 1996, with all current revisions.
[2] MCAWW: *Methods for Chemical Analysis of Water and Wastes*, USEPA, 1983.

4.2. Sampling Procedures

A detailed description of the sampling procedures that will be used during the RI/FS at the Site in are presented in the associated FSP.

4.2.1. Sampling Locations

Sampling locations for each RI/FS task are presented in the associated work plan and FSP.

4.2.2. Field QA/QC Samples

In order to evaluate data quality, QA/QC samples will be collected during the field investigation. The following field QA/QC samples will be collected for samples submitted for Level III laboratory analyses.

4.2.2.1. Field Duplicate Samples

Collection of field duplicate samples provides for the evaluation of the laboratory's performance by comparing analytical results of two samples from the same location. Field duplicate samples are also collected to evaluate field sample collection procedures. Field duplicate samples are duplicate samples collected from one location and sent to the laboratory blind (with two different sample identifications). Field duplicate samples will be collected at a rate of one per 20 environmental samples per matrix per parameter.

4.2.2.2. Matrix Spikes and Matrix Spike Duplicates

Matrix spike/matrix spike duplicate (MS/MSD) samples are duplicate samples that have a known concentration of spiking solution added to evaluate potential matrix interferences. The percent recovery of the spiked amount indicates the accuracy of the analysis extraction or sample preparation, as well as interferences caused by the matrix, if any. Relative percent differences (RPDs) between spike sample recoveries will indicate the precision of the data. One set of MS/MSD samples will be collected at a rate of one per 20 environmental samples per matrix per parameter, if applicable (i.e., MS/MSD samples are not applicable for pH, alkalinity, specific conductivity, and turbidity analyses).

4.2.2.3. Field/Equipment Blanks

Field/equipment blanks will consist of analyte-free deionized water that has been passed through and/or over decontaminated sampling equipment. One field/equipment blank will be collected per type of sampling equipment per sampling event. Field/equipment blanks will not be required if dedicated sampling equipment is utilized. The field/equipment blanks will be subject to the same analyses as the environmental samples.

4.2.2.4. Trip Blanks

Trip blanks will consist of samples of VOC-free deionized water that have undergone shipment from the laboratory to the Site and back to the laboratory in coolers containing aqueous samples to be analyzed for VOCs. Trip blanks will be analyzed for VOCs to determine if contamination has taken place during sample shipment and/or laboratory storage. A trip blank will accompany each shipment that contains aqueous samples for VOC analyses. Trip blanks will not be required for surface soil/sediment samples submitted for VOC analyses. However, trip blanks will be required to accompany equipment blanks collected from surface soil/sediment equipment and submitted for VOC analysis.

4.2.3. Sampling Preparation and Preservation

Immediately after collection, samples will be transferred to labeled sample containers and properly preserved. Table 4-3 lists the appropriate sample containers, volume requirements, and preservation techniques. Samples requiring refrigeration for preservation will be promptly transferred to coolers packed with ice. Samples will be shipped or transported within 24 hours of being collected and will arrive at the laboratory no later than 48 hours after sample collection. Proper chain-of-custody documentation will be maintained as discussed in Section 6 of this QAPP. Samples will be extracted and/or analyzed within the holding times specified in Table 4-3. Holding times begin from the laboratory verified time of sample receipt (VTSR).

Table 4-3. *Field Sampling Summary*

Parameter	Matrix	Sample containers and volumes	Preservation	Holding times*
TCL VOCs	water	3 x 40 mL glass vial with Teflon®-lined septum	4°C, HCl	14 days
Chlorinated VOCs	water	3 x 40 mL glass vial with Teflon®-lined septum	4°C, HCl	14 days
methane, ethane, ethene	water	3 x 40 mL glass vial with Teflon®-lined septum	4°C, HCl	14 days
TCL SVOCs	water	1 x one liter amber glass container with Teflon®-lined cap	4°C	7/40 days
TCL PCBs	water	1 x one liter amber glass container with Teflon®-lined cap	4°C	7/40 days
TCL Pesticides	water	1 x one liter amber glass container with Teflon®-lined cap	4°C	7/40 days
Total Cyanide	water	1 x 250 mL plastic bottle	4°C, NaOH	14 days
TAL Total Metals	water	1 x 500 mL plastic bottle	4°C, HNO_3	6 months
TAL Total Mercury	water	1 x 500 mL plastic bottle	4°C, HNO_3	28 days
pH	water	1 x 125 mL plastic bottle	4°C	immediately upon receipt
Alkalinity	water	1 x 100 mL plastic bottle	4°C	14 days
Chloride	Water	1 x 50 mL plastic bottle	4°C	28 days
Nitrate	water	1 x 100 mL plastic bottle	4°C	48 hours
Specific Conductivity	water	1 x 500 mL plastic bottle	4°C	28 days
Sulfate	water	1 x 500 mL plastic bottle	4°C	28 days
Sulfide	water	1 x 250 mL plastic bottle	4°C, zinc acetate	7 day
Turbidity	water	1 x 250 mL plastic bottle	4°C	48 hours
TCL VOCs	soil/sed	1 x 125-mL widemouth glass container with Teflon®-lined cap	4°C	14 days
TCL SVOCs	soil/sed	1 x 250-mL widemouth glass container with Teflon®-lined cap	4°C	14/40 days
TCL PCBs	soil/sed	1 x 250-mL widemouth glass container with Teflon®-lined cap	4°C	14/40 days
TCL Pesticides	soil/sed	1 x 250-mL widemouth glass container with Teflon®-lined cap	4°C	14/40 days
Total Cyanide	soil/sed	1 x 4 oz widemouth glass container with Teflon®-lined cap	4°C	14 days
TAL Total Metals	soil/sed	1 x 4 oz widemouth glass container with Teflon®-lined cap	4°C	6 months
TAL Total Mercury	soil/sed	1 x 4 oz widemouth glass container with Teflon®-lined cap	4°C	28 days
pH	soil/sed	1 x 4 oz widemouth glass container with Teflon®-lined cap	4°C	immediately upon receipt

Notes:
* from VTSR; TCL: target compound list; TAL: target analyte list; VOCs: volatile organic compounds; SVOCs: semi-volatile organic compounds; PCBs: polychlorinated biphenyls; 7/40: 7 days to extraction/40 days to analysis; NaOH: sodium hydroxide; HCl: hydrochloric acid; HNO_3: nitric acid; soil/sed: surface soil/sediment; oz: ounces ; 14/40: 14 days to extraction/40 days to analysis.

4.2.4. Decontamination of Sampling Equipment

Protocols for the decontamination activities, if required, are described in the associated FSP.

4.3. Sample Custody

Chain-of-custody procedures will be instituted and followed throughout the RI/FS at the Site in Clyde, New York. These procedures include field custody, laboratory custody, and evidence files. Samples are physical evidence and will be handled according to strict chain-of-custody protocols. The QA Coordinator must be prepared to produce documentation that traces the samples from the field to the laboratory and through analyses. The USEPA has defined custody of evidence as follows:

- In actual possession;
- In view after being in physical possession;
- In a locked laboratory; or
- In a secure, restricted area.

Chain-of-custody records will be initiated in the field when sample collection has begun. The field sampler will indicate the sample identification number, date, time, sample matrix, sample type (i.e., grab or composite), number of containers and the analyses requested on the appropriate chain-of-custody form.

Chain-of-custody forms must be signed by both individuals upon transfer of sample coolers, unless shipped by an overnight courier. In this case, a copy of the overnight courier's signed shipping label will document the complete transfer. The chain-of-custody form will be signed and placed in a sealed bag and sealed in the shipping container. An example chain-of-custody form is attached as Figure 6-1. The shipping container will be closed, and two paper seals will be affixed to the latch and lid. The seal must be broken to open the cooler and will indicate possible tampering if the seal is broken before receipt at the laboratory.

The cooler will be shipped via an overnight delivery service or hand delivered to the laboratory. When the samples arrive at the laboratory, the sample custodian will sign the vendor's air bill or bill-of-lading (unless hand-delivered). The sample custodian's duties and responsibilities upon sample receipt will be to:

- Document receipt of samples by signing the chain-of-custody and internal laboratory log book;
- Inspect sample shipping containers for the presence or absence of custody seals and for container integrity;
- Sign the appropriate forms or documents, verify and record the agreement or disagreement of information on sample documents and, if there are discrepancies, record the problem and notify the Laboratory QA Officer and QA Coordinator;
- Label samples with laboratory sample numbers; and
- Place samples in secure, limited-access storage.

At the laboratory, the analysts will be required to log samples and extracts in and out of storage as the analysis proceeds. Samples and extracts will be returned to secure storage at the close of business. Written records will be kept of each time the sample or extract changes hands. Care must be exercised to properly complete, date, and sign items needed to generate data. Copies of the following will be stored for incorporation into the sample file:

- Documentation of the preparation and analysis of samples, including copies of the analyst's notebooks;
- Bench sheets, graphs, computer printouts, chromatograms, and mass spectra;
- Copies of QA/QC data;
- Instrument logs showing the date, time, and identity of the analyst; and
- Analytical tracking forms that record the date, time, and identity of the analyst for each step of the sample preparation, extraction, and analysis.

Upon completion of the analyses, the Laboratory QA Officer, or his/her designee, will begin assimilating the field and laboratory notes. In this way, the file for the samples will be generated. The final file for the sample will consist of:

- Laboratory data packages (including summary, instrument print outs, and raw data from the analysis of environmental and QC samples, chromatograms, mass spectra, calibration data, quantitation forms, work sheets, sample preparation logs); and

- Chain-of-custody records.

4.4. Calibration and Frequency

4.4.1. Laboratory Equipment Calibration

Proper calibration of laboratory analytical instrumentation is essential for the generation of reliable data which meets the project's DQOs. Analytical instrument calibration is monitored through the use of control limits which are established for individual analytical methods. Calibration procedures to be followed are specified, in detail, in the analytical methods and in NYSDEC ASP October 1995 revisions, Exhibit E (hereafter "ASP Exhibit E"). These procedures specify the type of calibration, calibration materials to be used, range of calibration, frequency of calibration, and calibration QC criteria.

The laboratory will be responsible for proper calibration and maintenance of laboratory analytical equipment. The following subsections detail some of the calibration procedures outlined in the analytical methods and ASP Exhibit E.

4.4.1.1. Gas Chromatography/Mass Spectrometer

Before the GC/MS is calibrated for volatile and semi-volatile analysis, the mass calibration and resolutions of the instruments are verified by a 50 nanogram (ng) injection of 4-bromofluorobenzene (BFB) for VOCs or by a 50 ng injection of decafluorotriphenylphosphine (DFTPP) for SVOCs. The tune must meet the ion abundance criteria specified in ASP Exhibit E. The system must be verified every 12 hours of analysis and when the instrument performance check solution fails to meet ASP Exhibit E criteria. After re-tuning, the performance check solution is reanalyzed. Samples are not analyzed until ASP Exhibit E tuning criteria are met.

For volatile and semi-volatile analysis, an initial five-point calibration is performed for the target compounds prior to start-up and whenever system specifications change or if the continuing calibration acceptance criteria have not been met. The lowest calibration standard must be at the concentration of the PQL and/or CRQL. The relative response factors (RRFs) and percent relative standard deviation (%RSD) of specific compounds must meet established criteria as specified in ASP Exhibit E. If these parameters fail to meet criteria, corrective actions must be implemented and the initial calibration must be repeated. A midpoint continuing calibration standard containing the target compounds is analyzed at the beginning of every 12 hour period following the compliant GC/MS tune. This standard must meet specific QC limits listed in ASP Exhibit E to verify that the initial five-point calibration is still valid.

4.4.1.2. Gas Chromatography

After determination of acceptable chromatograph resolution, detector sensitivity and chromatographic performance, calibration curves are generated from the analysis of standards at known concentrations covering the dynamic range of each analysis group for the primary and confirmation columns. The lowest concentration calibration standard establishes the quantitation limit based on the final volume of the samples. Recalibration of initial standard curves are completed when criteria are not compliant with the control limits established in this QAPP (i.e., tables presented in Section 10).

At the beginning of each new 12 hour analysis sequence and after every 10 sample analyses, a mid-point standard must be analyzed to verify a compliant continued calibration. For analysis to continue, the response for the analytes of interest must not vary by more than 15% of the response obtained during the initial calibration. In the event that calibration criteria are not met, a new calibration curve must be prepared for each compound out of compliance.

The laboratory will calculate retention time (RT) windows for the standards on the GC columns and whenever a new GC column is installed. The establishment of daily RT windows is accomplished by using ASP Exhibit E criteria. If any of the calibration verification standards fall outside the daily RT window, the system is out of control. The cause of the problem must be identified and corrected before sample analysis may resume.

4.4.1.3. Metals and Inorganics

Instrument calibration for metal and inorganic analyses is performed daily. A two point calibration for ICP analyses is performed. Five point calibrations are performed for spectrophotometers and other applicable wet chemistry techniques. The calibration curves must have correlation coefficients greater than or equal to 0.995. Calibration verification is monitored by analyzing a calibration verification standard and a calibration blank following the initial calibration, every ten samples, and at the end of the analytical sequence. The calibration verification standard recovery must be within the criteria specified in this QAPP (i.e., Table 4-6) or the instrument must be resloped, if applicable, and if necessary, recalibrated. The calibration blank must not contain target compounds at concentrations greater than the PQL or CRQL, whichever is applicable, or corrective actions are implemented.

To verify interelement and background corrective factors for ICAP analysis, interference check samples (ICSA and ICSAB) must be analyzed at the beginning and end of the analysis sequence or a minimum of twice per eight hours. The percent recoveries for solutions must be within ASP Exhibit E criteria. In addition, for ICAP analyses, a serial dilution analysis must be performed per sample matrix. If the analyte concentration is greater than fifty times the MDL in the original sample, a serial dilution (five fold dilution) must agree within ten percent of the original determination. Detection limits,

interelement corrective factors, and linear ranges must be established at the frequency specified in the method.

4.4.2. Standards and Solutions

The use of standard materials of a known purity and quality is necessary for the generation of reproducible data. Standards and standard solutions are obtained from the USEPA or USEPA-certified commercial vendors. Standard reference materials and performance evaluation materials are obtained from the National Institute of Science and Technology (NIST) or USEPA-certified commercial vendors.

Standards and standard solutions are verified prior to use. This verification may be in the form of a certification from the supplier. Standards may also be verified by comparison to a standard curve or another standard from a separate source. Standards are routinely checked for signs of deterioration including unusual volume changes (solvent loss), discoloration, formation of precipitates, changes in analyte response, or age. Standards will not be used after expiration date.

Solvent materials are also verified prior to use. Each new lot of solvent is analyzed to verify the absence of interfering constituents. Reagent and method blanks are routinely analyzed to evaluate laboratory-based contamination of samples.

4.4.3. Standards Records

A records book will be kept for standards and will include the following information:

- Material name;
- Control or lot number;
- Purity and/or concentration;
- Supplier/manufacturer;
- Receipt/preparation date;
- Recipient/preparer's name; and
- Expiration date.

These records will be checked periodically as part of the laboratory's internal controls review.

4.4.4. Calibration Records

A bound notebook will be kept with each instrument that requires calibration. The notebook will contain a record of activities associated with QA monitoring and instrument repairs. These records will be checked during periodic equipment review and internal QA/QC audits.

4.5. Analytical Procedures

4.5.1. Laboratory Analytical Procedures

The accuracy and precision of the analytical data generated by the laboratory will be determined through the analysis of duplicate samples, spiked samples, reference standard samples, laboratory control samples (LCS), and field and/or laboratory blank samples analyzed along with each set of environmental samples.

Interferences will be identified and documented. When matrix interferences are noted during sample analysis, actions will be taken by the laboratory to achieve the specified quantitation limits. Samples may be diluted only if analytes of concern generate responses in excess of the linear range of the instrument. The selection of analytical cleanup methodologies will follow SW-846 method requirements. In such cases, the Laboratory QA Officer will document that the laboratory demonstrates good analytical practices and that such practices are documented in order to achieve the specified quantitation limits.

The accuracy of the method will be determined by spiking the sample matrix with analytes and surrogates. Standards and reference materials will also be analyzed to determine analyte concentrations for comparison with expected concentrations to provide a measure of accuracy of the methods. Percent recoveries of the spikes will be calculated and compared with control limits. A measure of precision will be obtained through the RPD between MSs and MSDs. Sampling precision will be evaluated based on the RPD of duplicate field samples. RPDs will be compared to established control limits.

The generated data will be entered into the laboratory database management system. Records described in Section 6 will be incorporated into the final file for the samples. Complete descriptions of analytical procedures to be used in the laboratory are described by the NYSDEC ASP October 1995 Revision, USEPA Methods for Chemical Analysis of Water and Wastes, (March 1983), USEPA SW-846 methodologies and/or in the laboratory's QA Manual and standard operating procedures (SOPs).

4.5.2. Method Detection Limits and Quantitation Limits

The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix

containing the analyte. For inorganics, the instrument detection limit (IDL) is determined by multiplying the Students t-Test value the standard deviation obtained for the analysis of a standard solution at a concentration of 3 to 5 times the estimated IDL on three days with a minimum of seven measurements. The PQL is the lowest concentration that can be reliably quantified within specified limits of precision and accuracy during routine laboratory operations. The contract required quantitation limit (CRQL) is the minimum level of quantitation acceptable for each method. CRQLs originated from the USEPA CLP scopes of work (SOW) for the analysis of organic TCL and inorganic TAL. Tables 4-4, 4-5, 4-6, and 4-7, 4-8, and 4-9 list CRQLs to be used for this project. The laboratory should report estimated concentrations (i.e., flagged with "J") for compounds detected between the IDL and the CRQL or PQL. The PQLs for the inorganic wet chemistry parameters (i.e., natural attenuation parameters) are laboratory dependent and will be evaluated and approved on a laboratory by laboratory basis.

Table 4-4. *Laboratory Practical Quantitation Limits for Volatile Organics (Method 8021B)*

Parameter	Water PQL (ug/L)
Benzene	1
Bromobenzene	1
Bromochloromethane	1
Bromodichloromethane	1
Bromoform	1
Bromomethane	1
Carbon tetrachloride	1
Chlorobenzene	1
Chlorodibromomethane	1
Chloroethane	1
Chloroform	1
Chloromethane	1
2-Chlorotoluene	1
4-Chlorotoluene	1
1,2-Dibromo-3-chloropropane	1
1,2-Dibromoethane	1
Dibromomethane	1
1,2-Dichlorobenzene	1
1,3-Dichlorobenzene	1
1,4-Dichlorobenzene	1
Dichlorodifluoromethane	1
1,1-Dichloroethane	1
1,2-Dichloroethane	1
1,1-Dichloroethene	1
cis-1,2-Dichloroethene	1
trans-1,2-Dichloroethene	1
1,2-Dichloropropane	1
1,3-Dichloropropane	1
2,2-Dichloropropane	1
1,1-Dichloropropene	1
cis-1,3-dichloropropene	1
trans-1,3-dichloropropene	1
1,2,4-trimethylbenzene	1
1,3,5-trimethylbenzene	1
p-Cymene	1
Ethylbenzene	1
Hexachlorobutadiene	1
Isopropyl benzene	1
n-propylbenzene	1
n-butylbenzene	1
t-butylbenzene	1
sec-butylbenzene	1
Methylene chloride	1
Naphthalene	1
Styrene	1
1,1,1,2-Tetrachloroethane	1
1,1,2,2-Tetrachloroethane	1
Tetrachloroethene	1
Toluene	1
1,2,3-Trichlorobenzene	1
1,2,4-Trichlorobenzene	1

Table 4-4 (continued). *Laboratory Practical Quantitation Limits for Volatile Organics (Method 8021B)*

Parameter	Water PQL (ug/L)
1,1,1-Trichloroethane	1
1,1,2-Trichloroethane	1
Trichloroethene	1
Trichlorofluoromethane	1
1,2,3-Trichloropropane	1
Vinyl Chloride	1
o-Xylene	1
m-Xylene	1
p-Xylene	1

Notes:

ug/L indicates micrograms per liter or parts per billion.

Table 4-5. *Laboratory Contract Required Quantitation Limits for Target Compound List Volatile Organics (Method 8260B).*

Parameter	Water CRQL (ug/L)	Soil CRQL (ug/kg), wet weight
Chloromethane	1	10
Vinyl chloride	1	10
Bromomethane	1	10
Chloroethane	1	10
Acetone	5	10
1,1-Dichloroethene	1	10
Methylene chloride	2	10
Carbon disulfide	1	10
trans-1,2-Dichloroethene	1	10
1,1-Dichloroethane	1	10
2-Butanone	5	10
cis-1,2-Dichloroethene	1	10
Chloroform	1	10
1,1,1-Trichloroethane	1	10
Carbon tetrachloride	1	10
1,2-Dichloroethane	1	10
Benzene	1	10
Trichloroethene	1	10
1,2-Dichloropropane	1	10
Bromodichloromethane	1	10
4-Methyl-2-Pentanone	5	10
cis-1,3-Dichloropropene	1	10
Toluene	1	10
trans-1,3-Dichloropropene	1	10
1,1,2-Trichloroethane	1	10
Dibromochloromethane	1	10
2-Hexanone	5	10
Tetrachloroethene	1	10
Chlorobenzene	1	10
Ethylbenzene	1	10
Xylene (total)	1	10
Styrene	1	10
Bromoform	1	10
1,1,2,2-Tetrachloroethane	1	10

Notes:

CRQL indicates contract required quantitation limit.
ug/L indicates micrograms per liter or parts per billion.
ug/kg indicates micrograms per kilogram or parts per billion.
* Soil results should be reported with the CRQL adjusted for the dry weight.

Table 4-6. *Laboratory Contract Required Quantitation Limits for Target Compound List Semi-Volatile Organics (Method 8270C).*

Parameter	Water CRQL (ug/L)	Soil CRQL (ug/kg), wet weight
Phenol	10	330
Bis(2-chloroethyl)ether	10	330
2-Chlorophenol	10	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
1,2-Dichlorobenzene	10	330
2-Methylphenol	10	330
Bis(2-chloroisopropyl)ether	10	330
4-Methylphenol	10	330
N-Nitroso-di-n-propylamine	10	330
Hexachloroethane	10	330
Nitrobenzene	10	330
Isophorone	10	330
2-Nitrophenol	10	330
2,4-Dimethyl phenol	10	330
Carbazole	10	330
Bis(2-chloroethoxy)methane	10	330
2,4-Dichlorophenol	10	330
1,2,4-Trichlorobenzene	10	330
Naphthalene	10	330
4-Chloroaniline	10	330
Hexachlorobutadiene	10	330
4-Chloro-3-methylphenol	10	330
2-Methylnaphthalene	10	330
Hexachlorocyclopentadiene	10	330
2,4,6-Trichlorophenol	10	330
2,4,5-Trichlorophenol	10	330
2-Chloronaphthalene	10	330
2-Nitroaniline	25	800
Dimethyl phthalate	10	330

Table 4-6 (continued). *Laboratory Contract Required Quantitation Limits for Target Compound List Semi-Volatile Organics (Methods 8270C).*

Parameter	Water CRQL (ug/L)	Soil CRQL (ug/kg), wet weight
Acenaphthylene	10	330
2,6-Dinitrotoluene	10	330
3-Nitroaniline	25	800
Acenaphthene	10	330
2,4-Dinitrophenol	25	800
4-Nitrophenol	25	800
Dibenzofuran	10	330
2,4-Dinitrotoluene	10	330
Diethylphthalate	10	330
4-Chlorophenyl-phenyl ether	10	330
Fluorene	10	330
4-Nitroaniline	25	800
4,6-Dinitro-2-methylphenol	25	800
N-Nitrosodiphenylamine	10	330
4-Bromophenyl-phenyl ether	10	330
Hexachlorobenzene	10	330
Pentachlorophenol	25	800
Phenanthrene	10	330
Anthracene	10	330
Di-n-butyl phthalate	10	330
Fluoranthene	10	330
Pyrene	10	330
Butylbenzylphthalate	10	330
3,3-Dichlorobenzidine	20	660
Benzo(a)anthracene	10	330
Chrysene	10	330
Bis(2-ethylhexyl)phthalate	10	330
Di-n-octylphthalate	10	330
Benzo(b)fluoranthene	10	330
Benzo(k)fluoranthene	10	330

Table 4-6 (continued). *Laboratory Contract Required Quantitation Limits for Target Compound List Semi-Volatile Organics (Method 8270C).*

Parameter	Water CRQL (ug/L)	Soil CRQL (ug/kg), wet weight
Benzo(a)pyrene	10	330
Indeno(1,2,3-cd)pyrene	10	330
Dibenzo(a,h)anthracene	10	330
Benzo(g,h,i)perylene	10	330

Notes:

CRQL indicates contract required quantitation limit.
ug/L indicates micrograms per liter or parts per billion.
ug/kg indicates micrograms per kilogram or parts per billion.
* Soil results should be reported with the CRQL adjusted for the dry weight.

Table 4-7. ***Laboratory Contract Required Quantitation Limits for Target Compound List Polychlorinated Biphenyls(Method 8082).***

Parameter	Water CRQL (ug/L)	Soil CRQL (ug/kg), wet weight
Aroclor 1016	0.5	80
Aroclor 1221	0.5	80
Aroclor 1232	0.5	80
Aroclor 1242	0.5	80
Aroclor 1248	0.5	80
Aroclor 1254	1.0	160
Aroclor 1260	1.0	160

Notes:

CRQL indicates contract required quantitation limit.
ug/L indicates micrograms per liter or parts per billion.
ug/kg indicates micrograms per kilogram or parts per billion.
* Soil results should be reported with the CRQL adjusted for the dry weight.

Table 4-8. *Laboratory Contract Required Quantitation Limits for Target Compound List Pesticides (Method 8081A).*

Parameter	Water CRQL (ug/L)	Soil CRQL (ug/kg), wet weight
Aldrin	0.05	8.0
alpha-BHC	0.05	8.0
beta-BHC	0.05	8.0
delta-BHC	0.05	8.0
gamma-BHC (Lindane)	0.05	8.0
Chlordane (Total)	0.5	80
4,4'-DDD	0.10	16
4,4'-DDE	0.10	16
4,4'-DDT	0.10	16
Dieldrin	0.10	16
Endosulfan I	0.10	16
Endosulfan II	0.10	16
Endosulfan sulfate	0.10	16
Endrin	0.10	16
Endrin aldehyde	0.20	32
Heptachlor	0.05	8.0
Heptachlor epoxide	0.05	8.0
Methoxychlor	0.05	80
Toxaphene	1.0	160
Endrine ketone	0.20	32

Notes:

CRQL indicates contract required quantitation limit.
ug/L indicates micrograms per liter or parts per billion.
ug/kg indicates micrograms per kilogram or parts per billion.
* Soil results should be reported with the CRQL adjusted for the dry weight.

Table 4-9. *Laboratory Contract Required Quantitation Limits for Target Analyte List Metals (Method 6010B), Mercury (Method 7470A/7471A) and Cyanide (Method 9010B/9012A or 9014)*

Parameter	Water CRQL (ug/L)	Soil CRQL (mg/kg), wet weight
Aluminum	200	20
Antimony	60	6
Arsenic	10	1
Barium	200	20
Beryllium	5	0.5
Cadmium	5	0.5
Calcium	5000	500
Chromium	10	1
Cobalt	50	5
Copper	25	2.5
Iron	100	10
Lead	3	0.3
Magnesium	5000	500
Manganese	15	1.5
Mercury	0.2	0.02
Nickel	40	4
Potassium	5000	500
Selenium	5	0.5
Silver	10	1
Sodium	5000	500
Thallium	10	1
Vanadium	50	5
Zinc	20	2
Cyanide	10	1

Notes:

CRQL indicates contract required quantitation limit.
ug/L indicates micrograms per liter or parts per billion.
mg/kg indicates milligrams per kilogram.
The assumption made in the soil calculation is that 1 gram of sample aliquot is prepared in a final volume of 100 mL..

4.6. Data Reduction, Validation, and Reporting

The laboratory will be conducting analyses on samples in accordance with referenced USEPA method protocols, NYSDEC ASP (October 1995 revision) and the laboratory's QA Manual. Laboratory validation will be incorporated into their in-house effort for the appropriate parameters.

4.6.1. Data Production, Handling, and Reporting

Specific laboratory procedures and instrumentation can be found in the QA Manual and/or SOPs from the laboratory. The data production and reporting procedures described below will be employed at the laboratory.

Analytical data packages, which are fully validatable and document sample preparation, extraction, and analysis, will be provided for the analyses. Data report forms will be securely bound and the pages will be sequentially numbered. The analytical reports for sample matrices will conform to the list of deliverable requirements included in Appendix A to this QAPP.

The analyst has the primary responsibility and accountability for the correctness and completeness of the analytical data. Each laboratory analyst has responsibility for QA/QC functions at their level and within their assigned tasks. Initial review by the analyst and supervisor is completed in relation to compliance with methodology and acceptability of precision and accuracy results. Review at the QA Officer level includes these elements as well as a review of data acceptability based upon internal and project specific QC criteria. Tertiary review occurs with the laboratory management where pertinent information pertaining to each specific analysis is compiled. The data generated from the various laboratory sections is transferred to laboratory's QA Officer. Analytical data forms are then processed and data validation is accomplished.

4.6.2. Data Validation

The laboratory data validation process begins with the appropriate laboratory personnel who will review the raw and reduced data for possible calculation and transcription errors. Additionally, these personnel will check unusually high or low parameter values. The Laboratory QA Officer will perform a final laboratory validation of the data which will include a review of QC sample analyses and data completeness. The laboratory report will then be reviewed and approved by the manager of analytical services prior to its release to O'Brien & Gere. O'Brien & Gere chemists will perform an independent data validation upon receipt of the analytical data packages.

Data validation is a systematic process of evaluating analytical data quality by comparing the data generation process (sample collection through sample analysis) to QC criteria established prior to the initiation of the field investigation. Data quality criteria are established based on the project DQOs which are, in turn, established based on the intended use of the data. A data validation report establishes data usability by determining the degree of

adherence to QC criteria of the analytical data. As a result, sample data are determined to be usable as is, approximate, or unusable for the particular use established by the project DQOs. The analytical data will be validated in accordance with the criteria set forth in the following:

- Specific referenced USEPA method;
- NYSDEC ASP October 1995 Revision requirements;
- USEPA, Region II. January 1992. *CLP Organics Data Review and Preliminary Review*, SOP No. HW-6, Revision 8; and
- USEPA, Region II. January 1992. *Evaluation of Metals Data for the CLP*, SOP No. HW-2, Revision 11.

Data validation reports will be generated and incorporated into the RI Report.

The requirements to be checked for the validation of organics analyses (USEPA SW-846 Methods 8260B, 8270C, 8082 and 8081A) include the following:

- Holding times;
- Sample preservation;
- Instrument performance check;
- Initial and continuing calibration;
- Blank analyses;
- Surrogate spike evaluation;
- LCS evaluation;
- MS/MSD analysis;
- matrix spike blank (MSB) analysis;
- Field duplicate analysis;
- Laboratory duplicate analysis;
- Internal standard evaluation;
- RT evaluation;
- Reference standard analysis;
- Target compound identification;

- Analyte quantitation and reported detection limits;
- Document completeness;
- Data usability; and/or
- Overall data assessment.

The requirements to be checked for the validation of inorganics analyses include the following:

- Holding times;
- Sample preservation;
- Initial and continuing calibration;
- Blank analyses;
- Laboratory duplicate analyses;
- LCS evaluation;
- MS/MSD analysis;
- MSB analysis;
- Field duplicate analysis;
- Element quantitation and reported PQLs;
- Document completeness;
- Data usability; and/or
- Overall data assessment.

4.7. QC Checks

4.7.1. Laboratory QA/QC Checks

Tables 4-10 through 4-15 contain information regarding audits, frequency, acceptance criteria, and corrective actions. Upon the completion of a sample analysis, the results of QA/QC data will be reviewed to verify compliance with the criteria listed. When results are reported to the Laboratory QA Officer, QA/QC data will be included in the package for review. MSs, reference standards, and LCSs will be used to monitor the accuracy of the methodologies by comparing recoveries to the established QA/QC criteria. MSDs and duplicate samples will be incorporated as an indicator of the precision of the

sample results. The RPD calculations will also be compared to the established QA/QC criteria. Laboratory QA/QC procedures will be evaluated during data validation and will be discussed in the data validation report.

4.7.2. Field Sampling QA/QC

Field sampling crews will be under direct supervision of a field sampling leader. Bound log books and appropriate data sheets will be used to document the collection of samples and data so that any individual sample or data set can be traced back to its point of origin, sampler, and type of sampling equipment. Sampling will be performed according to the methods provided in the RI/FS Work Plan, FSP and in this QAPP. Blind field duplicate samples will be collected by the sampling team. These samples will be sent to the laboratory for analysis in conjunction with the environmental samples. Field sampling precision will be evaluated through the RPD of the duplicate sample analyses results. Control limits for field duplicate precision have been established at ±100% RPD for soil samples and ±50% RPD for water samples for this project. Decontamination of sampling equipment will be verified through the analysis of equipment blanks, if required. Proper chain-of-custody protocols, as presented in Section 6 of this QAPP, will be followed.

Table 4-10
Volatiles (GC) Screening Quality Control Requirements and Corrective Actions
Method 8021B with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
Holding times	Samples must be extracted and analyzed within holding time.	VOCs: Analyze within 14 days from VTSR.	If holding times are exceeded for initial or any reanalyses required due to QC excursions, notify Quality Assurance Officer (QAO) immediately since resampling may be required.
Initial Calibration	Prior to sample analysis and when continuing calibration criteria are not met.	1. Five concentrations bracketing expected concentration range for all compounds of interest. 2. Criteria <20% RPD or r ≥0.990.	1. Identify and correct problem. 2. If criteria are still not met, recalibrate. 3. Document corrective action - samples cannot be analyzed until calibration control limit criteria are met.
Continuing Calibration	Every 12 hours.	Mid-level concentration, <15%D and RT must fall within daily RT window.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate. 3. Document corrective action - samples cannot be analyzed until calibration control limit criteria are met.
Preparation Blank Analysis	Every 12 hours, following continuing calibration	< PQL	1. Reanalyze blank. 2. If limits are still exceeded, clean instrument, recalibrate analytical system, and reanalyze all samples if detected for same compounds as in blank. 3. Document corrective action - samples cannot be analyzed until blank criteria have been met.
Trip Blank	1 per cooler containing VOC samples.	<PQL	1. Investigate problem, contact QAO. 2. Write an explanation.
Surrogate Spike	All samples and blanks (including MS/MSD)	Recoveries within laboratory control limits.	1. Reanalyze any environmental or QC sample with surrogates that exceed control limits. 2. Qualify the data. 3. Document corrective action.
MS/MSD Analysis	1 per 20 samples.	Recovery and RPD within laboratory control limits.	1. Reanalyze.

Table 4-10 (continued)
Volatiles (GC) Screening Quality Control Requirements and Corrective Actions
Method 8021B with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
Field Dup. Analysis	1 per matrix and analytical batch and every 20 samples of similar matrix	50% RPD for waters.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be estimated on a case by case basis during the validation process.
Quantitation	Second column confirmation column is not required. Report "J" values. Identified compounds must be within established daily RT window criteria.		

Table 4-11
Volatiles (GC/MS) Quality Control Requirements and Corrective Actions
Method 8260 B with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
Holding times	Samples must be extracted and analyzed within holding time.	VOCs: Analyze within 14 days from VTSR.	If holding times are exceeded for initial or any reanalyses required due to QC excursions, notify QAO immediately since resampling may be required.
MS Tuning	Once every 12 hours.	BFB key ions and abundance criteria listed in NYSDEC ASP 10/95 Exhibit E must be met for all mass ions.	1. Tune the mass spectrometer. 2. Document corrective action - samples cannot be analyzed until control limit criteria have been met.
Initial Calibration	Prior to sample analysis, when continuing calibration criteria are not met, and when changes are made to the instrument (column replacement, ion source cleaning, etc.)	1. Five concentrations bracketing expected concentration range for all compounds of interest. 2. Criteria as listed in NYSDEC ASP 10/95 Exhibit E.	1. Identify and correct problem. 2. If criteria are still not met, recalibrate. 3. Document corrective action - samples cannot be analyzed until calibration control limit criteria are met.
Continuing Calibration	Every 12 hours, following BFB.	Within criteria as listed in NYSDEC ASP 10/95 Exhibit E.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate. 3. Document corrective action - samples cannot be analyzed until calibration control limit criteria are met.
Preparation Blank Analysis	Every 12 hours, following continuing calibration	Common laboratory contaminants less than 5 x PQL; all remaining compounds less than CRQL.	1. Reanalyze blank. 2. If limits are still exceeded, clean instrument, recalibrate analytical system, and reanalyze all samples if detected for same compounds as in blank. 3. Document corrective action - samples cannot be analyzed until blank criteria have been met.
LCS Analysis	Each analytical batch (every 12 hours), following continuing calibration. Prepared independently from calibration standards. LCS must contain all target analytes.	Recovery within laboratory control limits.	1. If recovery failures are above control limits and these compounds are not detected in the associated samples, contact QAO. 2. Reanalyze LCS and examine results of other QC analyses. 3. If recovery is still outside limits, and other QC criteria are met, contact QAO. 4. If other QC criteria have not been met, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. 5. Document corrective action.

Table 4-11 (continued)
Volatiles (GC/MS) Quality Control Requirements and Corrective Actions
Method 8260B with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
Internal Standards	All samples and blanks (including MS/MSD)	1. Response -50% - +100% of internal standards from the current 12-hr continuing calibration standard. 2. RT must be ± 30 sec. from current 12-hr continuing calibration standard.	1. Reanalyze. 2. If still outside of the limits, qualify data. 3. Document corrective action.
Surrogate Spike	Add NYSDEC ASP 10/95 Exhibit E required surrogates to all samples and blanks (including MS/MSD).	Recovery within NYSDEC ASP 10/95 Exhibit E control limits.	1. Reanalyze any environmental or QC sample with surrogates that exceed control limits. 2. Qualify the data. 3. Document corrective action.
MS/MSD Analysis	1 per 20 samples per matrix.	Recovery and RPD within NYSDEC ASP 10/95 Exhibit E limits or within laboratory limits, whichever is more stringent.	1. Reanalyze if <10%. 2. If >10% and LCS criteria are met, document in case narrative; no additional corrective action required. 3. If LCS criteria are exceeded also, examine other QC data for source of problem; *i.e.*, surrogate recoveries for extraction efficiency and calibration data for instrument performance issues. 4. Take corrective action as required, re-extract or reanalyze samples and associated MS/MSD and LCSs as required.
Field Dup. Analysis	1 per 20 samples of similar matrix	50% RPD for waters and 100% RPD for soil.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case by case basis during the validation process.
Tentatively Identified Compounds.	Not Required		

Table 4-12
Semi-volatile (GC/MS) Quality Control Requirements and Corrective Actions
Method 8270C with NYSDEC ASP Exhibit E requirements

Audit	Frequency	Control Limits	Corrective Action
Holding Times	Samples must be extracted and analyzed within holding time.	SVOCs: Extract within seven days from VTSR. Analyze extracts within 40 days from extraction.	If holding times are exceeded for initial or any reanalyses required due to QC excursions, notify the QAO immediately since resampling may be required.
MS Tuning	Once every 12 hours.	DFTPP key ions and abundance criteria listed in NYSDEC ASP 10/95 Exhibit E must be met for all 13 ions.	1. Tune the mass spectrometer. 2. Document corrective action - samples cannot be analyzed until control limit criteria have been met.
Initial Calibration	Prior to sample analysis, when continuing calibration criteria are not met, and when changes are made to the instrument (column replacement, ion source cleaning, etc.).	1. Five concentrations bracketing expected concentration range for all compounds of interest. 2. Criteria as listed in NYSDEC ASP 10/95 Exhibit E.	1. Identify and correct problem. 2. If criteria are still not met, recalibrate. 3. Document corrective action - samples cannot be analyzed until calibration control limit criteria are met.
Continuing Calibration	Every 12 hours, following DFTPP.	Criteria as listed in NYSDEC ASP 10/95 Exhibit E.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate. 3. Document corrective action - samples cannot be analyzed until calibration control limit criteria are met.
Preparation Blank Analysis	With each extraction batch, of no more than 20 analytical samples.	Common laboratory contaminants less than 5 x PQL; all remaining compounds less than CRQL.	1. Reanalyze blank. 2. If limits are still exceeded, clean instrument, recalibrate analytical system and re-extract and reanalyze all samples if detected for same compounds as in blank. 3. Document corrective action - samples cannot be analyzed until blank criteria have been met.
LCS Analysis	With each extraction batch, of no more than 20 analytical samples. Prepared independently from calibration standards. LCS must contain all target compounds.	Recovery within laboratory control limits.	1. If recovery failures are above control limits and these compounds are not detected in the associated samples, contact QAO. 2. Reanalyze LCS and examine results of other QC analyses. 3. If recovery is still outside limits, and other QC criteria are met, contact QAO. 4. If other QC criteria have not been met, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. 5. Document corrective action.

Table 4-12 (continued)
Semi-volatile (GC/MS) Quality Control Requirements and Corrective Actions
Method 8270C with NYSDEC ASP Exhibit E requirements

Audit	Frequency	Control Limits	Corrective Action
Internal Standards	All samples and blanks (including MS/MSD).	1. Response -50% - +100% of the internal standards from the current 12-hr continuing calibration standard. 2. RT must be ±30 sec. from current 12-hr continuing calibration standard.	1. Reanalyze. 2. If recovery is still outside criteria, qualify data. 3. Document corrective action.
Surrogate Spike	Add NYSDEC ASP 10/95 Exhibit E required surrogates to all samples and blanks (including MS/MSD).	Recovery within NYSDEC ASP 10/95 Exhibit E control limits.	1. If more than 1 AE or 1 BN fails, or if any one surrogate %R is < 10%, reanalyze. 2. If recovery is still outside control limits, qualify the data; if < 10% re-extract if still in holding time. 3. Document corrective action.
MS/MSD Analysis	1 per 20 samples per matrix.	Recovery within NYSDEC ASP 10/95 Exhibit E control limits or within laboratory control limits, whichever is more stringent.	1. Reanalyze if <10%. 2. If > 10% and LCS criteria are met, document in case narrative no additional corrective action required. 3. If LCS criteria are exceeded also, examine other QC data for source of problem; i.e., surrogate recoveries for extraction efficiency and calibration data for instrument performance issues. 4. Take corrective action as required, re-extract or reanalyze samples and associated MS/MSD and LCSs as required.
Field Dup. Analysis	1 per 20 samples of similar matrix.	50% RPD for waters and 100% RPD for soil.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case by case basis during the validation process.
Tentatively Identified Compounds	Not Required.		

Table 4-13
Polychlorinated Biphenyls Quality Control Requirements and Corrective Actions
Method 8082 with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Laboratory Corrective Action
Holding Times	Samples must be extracted and analyzed within holding time.	Extract within seven days from VTSR. Analyze extracts within 40 days from extraction.	If holding times are exceeded for initial or any reanalyses required due to QC excursions, notify the QAO immediately since resampling may be required.
Initial Calibration	Prior to start up and when criteria are exceeded for continuing calibration.	1. Five concentrations bracketing expected concentration range for all compounds as described in SW-846 8082 for Aroclors, specifically Aroclor 1254 and 1260 based on previous detections at the Site. 2. <20%RSD	1. Identify and correct problem. 2. Recalibrate instrument; samples must not be analyzed until initial calibration criteria are met.
Continuing Calibration	Minimally, analyze continuing calibration standards at beginning of every 12 hours. Continuing calibration standards should also be analyzed after every 10 samples.	Mid-level concentrations, <15%D and standard RT must fall within daily RT window.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate; reanalyze samples back to last compliant calibration standard. Samples must be bracketed by compliant calibration standards.
RT Windows	RT windows must be established in accordance with NYSDEC ASP criteria.	1. Compounds must be within NYSDEC ASP criteria. 2. RT shift for surrogate in samples and standards must not exceed 0.3%.	1. Reanalyze non-compliant standards and samples. 2. If criteria are still not met, identify and correct problem, recalibrate; reanalyze samples back to last compliant calibration standard.
Method Blank Analysis	With each extraction batch, of no more than 20 analytical samples, or each 7 calendar day period in which samples are received, whichever is more frequent.	1. Compound concentrations must be <CRQL. 2. Surrogate RTs must be within RT windows.	1. Source of contamination must be investigated and corrected. 2. Clean instrument, recalibrate analytical system and re-extract and reanalyze all associated samples. 3. Document corrective action - samples cannot be analyzed until blank criteria have been met.

Table 4-13 (continued)
Polychlorinated Biphenyls Quality Control Requirements and Corrective Actions
Method 8082 with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Laboratory Corrective Action
Analytical Sequence	For PCB, in accordance with NYSDEC ASP criteria.	Must meet NYSDEC ASP criteria.	1. Reanalyze with correct sequence.
LCS Analysis	1 per 20 samples of similar matrix extracted at the same time. LCSs must be spiked with Aroclors 1254 and 1260, prepared independently from calibration standard. These were previously detected at the Site.	Percent recoveries must be within laboratory control limits, as per SW-846 method.	1. Only if recovery failures are above control limits and these compounds are not detected in the associated samples, is corrective action not required; document in case narrative. 2. Reanalyze LCS and examine results of other QC analyses. 3. If recovery is still outside limits, and other QC criteria are met, contact QAO. 4. If other QC criteria have not been met, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. 5. Document corrective action.
MS/MSD Analysis	1 per 20 samples of similar matrix. MS/MSDs must be spiked with Aroclors suspected to be present at the Site, Aroclor 1254 and 1260, at concentrations specified in the method.	Recovery and RPD within laboratory control limits, as per SW-846 method.	1. Reanalyze if <10%. 2. If LCS criteria are exceeded also, examine other QC data for source of problem; *i.e.*, surrogate recoveries for extraction efficiency and calibration data for instrument performance issues. 3. Take corrective action if other QC data criteria are exceeded; re-extract or reanalyze samples and associated MS/MSD and LCSs as required.

Table 4-13 (continued)
Polychlorinated Biphenyls Quality Control Requirements and Corrective Actions
Method 8082 with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Laboratory Corrective Action
MSB	1 per MS/MSD. MSB must be spiked with Aroclors suspected to be present at the Site, Aroclor 1254 and 1260, at concentrations specified in the method.	Recovery within laboratory control limits, as per SW-846 method.	1. Reprepare, re-extract, and reanalyze MSB, MS and MSD. 2. If recovery is still outside limits, and other QC criteria are met, contact QAO. 3. If other QC criteria have not been met, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory MSB. 4. Document corrective action.
Sulfur Blank	In addition to a method blank, when samples require sulfur cleanup, even if only part of a set.	Compound concentrations must be ≤CRQL.	Re-extract and reanalyze blank and associated samples.
Instrument Blank	For PCBs, the first analysis in the 12 hour analytical sequence.	As per NYSDEC ASP 10/95 Exhibit E, compound concentration must be ≤0.5 times the CRQL. Surrogates must be within RT windows.	1. Stop analysis and correct. 2. Reanalyze. 3. All samples must be associated with acceptable instrument blank.
Surrogate Spike	Samples, blanks, MS/MSD/MSB, and LCSs must be spiked with method specified surrogate compound (decachlorobiphenyl) .	1. Recovery within NYSDEC ASP criteria or lab control limits, whichever is more stringent.	1. Reanalyze. 2. If recovery is still outside control limits but >10%, document in case narrative report. 3. If recovery is <10% with reanalysis, re-extract and reanalyze the sample if the holding time has not elapsed. If holding time has elapsed, notify the QAO immediately prior to proceeding since resampling may be required.
Identification	Samples, blanks, and QC data.	1. A minimum of five peaks must be used to define each Aroclor pattern. 2. RTs must be within established RT windows or must meet relative RT criteria.	1. Investigate problem; reanalyze calibration standards to check for RT shift.

Table 4-13 (continued)
Polychlorinated Biphenyls Quality Control Requirements and Corrective Actions
Method 8082 with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Laboratory Corrective Action
Quantitation	Samples, blanks, and QC data.	1. External standard method. 2. Verify concentration is within linear calibration range. 3. Peak areas from five peaks unique to the target Aroclor will be used to quantitate the Aroclor concentration. 4. Soil samples concentrations must be corrected to dry weight.	1. If concentration is above linear calibration range, dilute sample and reanalyze. Dilution should result in concentration in the mid to upper calibration range of the instrument. 2. Perform appropriate cleanup procedures as necessary to minimize sample matrix effects.
Field Duplicate Analysis	1 per 20 samples of similar matrix.	50% RPD for waters and 100% RPD for soil.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case by case basis during the validation process.
Dilutions	1. When target analyte concentration exceed upper limit of calibration curve. 2. Prior to diluting, samples will be cleaned up during sample preparation/extraction procedure using appropriate methods when matrix interference is present. 3. Do not dilute for MS/MSD samples.	Not applicable	Not applicable
Confirmation Analysis	Quantitation confirmation will be performed at a 10% per matrix frequency; qualitative confirmation will be performed for sample results, if matrix interference is present, or if overlapping Aroclors are present.	Not Applicable	Not Applicable

Table 4-14
Pesticides Quality Control Requirements and Corrective Actions
Method 8081A with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Laboratory Corrective Action
Holding Times	Samples must be extracted and analyzed within holding time.	Extract within seven days from VTSR. Analyze extracts within 40 days from extraction.	If holding times are exceeded for initial or any reanalyses required due to QC excursions, notify the QAO immediately since resampling may be required.
Initial Calibration	Prior to start up and when criteria are exceeded for continuing calibration.	1. As listed in NYSDEC ASP criteria.	1. Identify and correct problem. 2. Recalibrate instrument; samples must not be analyzed until initial calibration criteria are met.
Calibration Verification	Minimally, analyze calibration standards every 12 hours. Calibration verification standards should be analyzed every 20 samples.	1. As listed in NYSDEC ASP criteria.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate; reanalyze samples back to last compliant calibration standard. Samples must be bracketed by compliant calibration standards.
RT Windows	RT windows must be established in accordance with NYSDEC ASP criteria.	1. Compounds must be within NYSDEC ASP criteria. 2. RT shift for surrogate in samples and standards must not exceed 0.3%.	1. Reanalyze non-compliant standards and samples. 2. If criteria are still not met, identify and correct problem, recalibrate; reanalyze samples back to last compliant calibration standard.
Method Blank Analysis	With each extraction batch, of no more than 20 analytical samples, or each 7 calendar day period in which samples are received, whichever is more frequent.	1. Compound concentrations must be <RL 2. Surrogate RTs must be within RT windows.	1. Source of contamination must be investigated and corrected. 2. Clean instrument, recalibrate analytical system and re-extract and reanalyze all associated samples. 3. Document corrective action - samples cannot be analyzed until blank criteria have been met.
Analytical Sequence	In accordance with NYSDEC ASP criteria.	Must meet NYSDEC ASP criteria.	1. Reanalyze with correct sequence. 2. Document corrective action.

Table 4-14 (continued)
Pesticides Quality Control Requirements and Corrective Actions
Method 8081A with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Laboratory Corrective Action
LCS Analysis	1 per 20 samples of similar matrix extracted at the same time.	Percent recoveries must be within laboratory control limits.	1. Only if recovery failures are above control limits and these compounds are not detected in the associated samples, is corrective action not required; document in case narrative. 2. Reanalyze LCS and examine results of other QC analyses. 3. If recovery is still outside limits, and other QC criteria are met, contact QAO. 4. If other QC criteria have not been met, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. 5. Document corrective action.
MS/MSD Analysis	1 per 20 samples of similar matrix.	Recovery and RPD within NYSDEC ASP criteria.	1. Reanalyze if <10%. 2. If LCS criteria are exceeded also, examine other QC data for source of problem; *i.e.*, surrogate recoveries for extraction efficiency and calibration data for instrument performance issues. 3. Take corrective action if other QC data criteria are exceeded; re-extract or reanalyze samples and associated MS/MSD and LCSs as required.
MSB	1 per MS/MSD.	Recovery within NYSDEC ASP criteria.	1. Reprepare, re-extract, and reanalyze MSB, MS and MSD. 2. If recovery is still outside limits, and other QC criteria are met, contact QAO. 3. If other QC criteria have not been met, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory MSB. 4. Document corrective action.

Table 4-14 (continued)
Pesticides Quality Control Requirements and Corrective Actions
Method 8081A with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Laboratory Corrective Action
Instrument Blank	The first analysis in the 12 hour analytical sequence.	Compound concentration must be ≤0.5 times the RL. Surrogates must be within RT windows.	1. Stop analysis and correct. 2. Reanalyze. 3. All samples must be associated with acceptable instrument blank.
Surrogate Spike	Samples, blanks, MS/MSD/MSB, and LCSs must be spiked with method specified surrogate compounds.	1. Recovery within NYSDEC ASP criteria. 2. Corrective action is not required if one of the two required surrogates has recovery outside of control limits if the recovery is >10%.	1. Reanalyze. 2. If recovery is still outside control limits but >10%, document in case narrative report. 3. If recovery is <10% with reanalysis, re-extract and reanalyze the sample if the holding time has not elapsed. If holding time has elapsed, notify the QAO immediately prior to proceeding since resampling may be required.
Identification	Samples, blanks, and QC data.	1. RTs must be within established RT windows or must meet relative RT criteria.	1. Investigate problem; reanalyze calibration standards to check for RT shift.
Quantitation	Samples, blanks, and QC data.	1. Internal or external standard method. 2. Verify concentration is within linear calibration range. 3. Soil samples concentrations must be corrected to dry weight.	1. If concentration is above linear calibration range, dilute sample and reanalyze. Dilution should result in concentration in the upper calibration range of the instrument. 2. Perform appropriate cleanup procedures as necessary to minimize sample matrix effects.
Field Duplicate Analysis	1 per 20 samples of similar matrix.	50% RPD for waters and 100% RPD for soil.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case by case basis during the validation process.

Table 4-14 (continued)
Pesticides Quality Control Requirements and Corrective Actions
Method 8081A with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Laboratory Corrective Action
Dilutions	1. When target analyte concentration exceed upper limit of Calibration Curve. 2. Prior to diluting, samples will be cleaned up during sample preparation/extraction procedure using appropriate methods when matrix interference is present. 3. Do not dilute for MS/MSD samples.	Not applicable	Not applicable
Confirmation Analysis	Quantitation confirmation will be performed at a 10% per matrix frequency; qualitative confirmation will be performed for sample results, if matrix interference is present.	Not Applicable	Not Applicable

Table 4-15
Metals and Cyanide Quality Control Requirements and Corrective Actions
Methods 6010B, 7470A/7471A, and 9010B/9012A or 9014 with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
Holding Times	Samples must be digested and analyzed within holding time.	Metals - Analyze 180 days from VTSR. Mercury - 28 days from date of VTSR. Cyanide - 14 days from date of VTSR.	If holding times are exceeded for initial or any reanalyses required due to QC excursions, notify the QAO immediately since resampling may be required.
Calibration Verification (ICV, CCV)	Calibrate daily according to method and each time instrument is set up; verify at more frequent of 10% or each 2 hours. Also verify at the end of each run. Standard at 1-2 times the PQL should be analyzed after initial cal for ICP and mercury.	90% to 110% of expected value for ICP and AA. 80% to 120% of expected value for mercury. 85% to 115% of expected value for cyanide and remaining applicable wet chemistry parameters. NYSDEC ASP Exhibit E requirements.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate. 3. Document corrective action - samples cannot be analyzed until calibration control limit criteria have been met.
Calibration Blank	At beginning and end of run and at a rate of 10% during run.	NYSDEC ASP Exhibit E requirements.	1. Identify and correct problem. 2. If criteria are still not met, recalibrate. 3. Document corrective action - samples cannot be analyzed until blank control limit criteria have been met.
Preparation Blank Analysis	1 per batch of samples digested, or 1 in 20, whichever is greater.	NYSDEC ASP Exhibit E requirements.	1. Reanalyze blank. 2. If limits are still exceeded, clean instrument and recalibrate analytical system and reprep and reanalyze affected samples if detected. 3. Document corrective action - samples cannot be analyzed until blank criteria are met.
Initial Calibration	Calibrate daily according to method and each time instrument is set up.	ICP: 2-point ICAL Misc. Inorganic - 5-point ICAL $\geq$ 0.995	

Table 4-15 (continued)
Metal and Cyanide Quality Control Requirements and Corrective Actions
Method 6010B and Method 9010B/9014 with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
LCS Analysis	Every 20 samples or each digestion batch. Prepared independently from calibration standards.	Recovery within laboratory control limits.	1. Reanalyze LCS and examine results of other QC analyses. 2. If recovery is still outside limits, and other QC criteria are met, contact QAO. 3. If other QC criteria have not been met, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. 4. Document corrective action.
Serial Dilution Analysis	Only required when analyte concentration is >50 times the IDL after dilution for metals.	NYSDEC ASP Exhibit E requirements.	1. Qualify data. 2. Document corrective action.
Interference Check Sample Analysis	Beginning and end of each analytical run or twice during every 8 hours, whichever is more frequent for metals.	NYSDEC ASP Exhibit E requirements.	1. Reanalyze. 2. If limits are still exceeded, adjust instrument. 3. Restart analytical run and reanalyze samples analyzed since last satisfactory ICS. 4. Document corrective action.
MS Analysis	1 per group of similar concentration and matrix, 1 per case of samples, or 1 in 20, whichever is greater.	Recovery within NYSDEC ASP Exhibit E limits if available, otherwise within laboratory control limits.	1. Analyze post spike. 2. Document corrective action.

Table 4-15 (continued)
Metal and Cyanide Quality Control Requirements and Corrective Actions
Method 6010B and Method 9010B/9014 with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
Laboratory Duplicate Analysis	1 per group of similar concentration and matrix, 1 per case of samples, or 1 in 20, whichever is greater.	NYSDEC ASP Exhibit E requirements	1. Investigate problem and reanalyze. 2. Document corrective action.
Field Dup. Analysis	1 per matrix and analytical batch and every 20 samples of similar matrix	50% RPD for waters and 100% RPD for soil.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case by case basis during the validation process.

4.8. Preventive Maintenance

Preventive maintenance procedures will be carried out on field equipment in accordance with the procedures outlined by the manufacturers' equipment manuals. Calibration activities involving field equipment will be recorded in a field log book.

The laboratory's maintenance activities are documented and maintained in permanent files and logbooks. The laboratory's internal preventive maintenance service should involve cleaning, adjusting, inspecting, and performing testing procedures designed to reduce product failure and extend useful product life.

4.9. Data Assessment Procedures

The procedures employed by the laboratory to assess the quality of data generated in the laboratory include, but are not limited to, the following:

- Determination of analytical precision per method;
- Determination of analytical accuracy per method;
- Determination of analytical completeness; and
- Determination of MDLs and PQLs.

Data quality reviews by analysts, supervisors, managers, laboratory directors, and QA personnel contribute to the total process. Analytical project managers interface with clients to evaluate whether the clients' needs are met and that the information provided fulfills their requirements.

Precision and accuracy will be assessed utilizing control charts. Control charts will consist of line graphs which provide a continuous graphic representation of the state of each analytical procedure. The standard deviation of the mean of the QC measurements is calculated and the upper and lower warning limits are set at plus or minus two standard deviation units. The upper and lower control limits are set at plus or minus three standard deviation units. Acceptable data are realized when results fall between the lower and upper warning limits. If the QC value falls between the control limit and the warning limit, the analysis should be scrutinized as possibly out of control.

In general, the accuracy of the methods will be determined by spiking the sample matrix with the analyte and by analyzing reference materials with known concentrations. The spiking levels will be selected to reflect the concentration range of interest. Percent recoveries of the spikes and reference materials will be calculated and compared to the established limits. The precision of the methods will be determined by the analysis of MS and laboratory and field duplicate samples. The precision will be evaluated by calculating the RPD between the duplicates. RPD calculations will be compared to the established limits.

The definitions and equations used for the assessment of data quality are:

Accuracy - is a measure of the nearness of an analytical result, or a set of results, to the true value. It is usually expressed in terms of error, bias, or percent recovery (%R).

Normally, the term accuracy is used synonymously with percent recovery. It describes either the recovery of a synthetic standard of known value, or the recovery of known amount of analyte (spike) added to a sample of known value. The %R or accuracy can be calculated by using:

standards: %R = (observed value/true value) x 100

spikes: %R = (conc. spike + sample conc.) - sample conc. x 100)/conc. spike

Precision - refers to the agreement or reproducibility of a set of replicate results among themselves without assumption of any prior information as to the true result. It is usually expressed in terms of the percent difference (%D) or RPD. The %D is calculated by using:

%D = (larger SR - smaller SR x 100)/ smaller SR

where SR is the sample result. RPD is calculated by using:

RPD = (|OSR - DSR| x 100)/ ((OSR + DSR)/2)

where OSR is the original sample result and DSR is the duplicate sample result.

Average - The average or arithmetic mean (X) of a set of n values (Xi) is calculated by summing the individual values and dividing by n:

$$X = (\sum Xi_{\,I=1 \text{ to } n})/n$$

Range - The range (R_i) is the difference between the highest and lowest value in a group. For n sets of duplicate values (X_2, X_1) the range (R) of the duplicates and the average range (R) of the n sets are calculated by the following:

$$R_i = X_2 - X_1$$

and

$$R = \sum Ri_{i=1 \text{ to } n}/n$$

Standard Deviation and Variation - The standard deviation (S) of a sample of n results is the most widely used measure to describe the variability of a data set. It is calculated by using the following equation:

$$S = \sqrt{\frac{\sum(Xi - X)^2_{i-1 \text{ to } n}}{n}}$$

where X is the average of the n results and Xi is the value of result I. Normally, X ± S will include 68% and X ± 2S about 95% of the data for normally distributed data.

The variance is equal to S^2. The percent%RSD or coefficient of variation (CV) is the standard deviation divided by the mean and multiplied by 100 as follows.

$$CV = 100S/X$$

The Laboratory QA Officer, with individual laboratory group leaders, will identify any data that should be rated as "unacceptable," based on the assessment of the QA/QC criteria. Data assessment will be evaluated during data validation and discussed in the data validation report.

4.10. Corrective Action

Corrective action procedures will be implemented based on unacceptable audit results or upon detection of data unacceptability during validation. Two types of audits may be performed during this investigation. The data generation process will be audited by assessing adherence to laboratory control limits. The field program will be audited by assessing adherence to the procedures outlined in the Work Plan and in this document by the analysis of field QC samples. If required, corrective action procedures will be developed on a case-by-case basis. The enacted corrective actions will be documented in the appropriate notebook, log, or case file.

The following corrective actions should be taken by the laboratory. When calibration, instrument performance, and blank criteria are not met, the cause of the problem will be located and corrected. The analytical system will then be recalibrated. Sample analysis will not begin until calibration, instrument performance, and blank criteria are met. When MS, reference standard, or duplicate analyses are out of control, samples analysis will cease. The problem will be investigated. Depending on the results of overall QC program for the sample set, the data may be accepted, accepted with qualification, or determined unusable. If the laboratory determines data to be unusable, those samples will be reprepared and reanalyzed. If matrix interferences are suspected, samples will be subjected to one or more of the clean-up techniques specified in the analytical methods. If QC criteria are met upon reanalysis, only the new results are reported. If QC criteria are still not met upon reanalysis, both sets of sample results will be reported.

The laboratory will make every reasonable effort to correct QC excursions and to document the presence of matrix interferences. In this way, unnecessary resampling of difficult matrices may be avoided. However, if matrix interferences are not documented resampling may be required.

Corrective actions for the field investigation program, if required, will generally involve altering the incorrect field procedure to match the guidelines set forth in the RI/FS Work Plan, FSP and in this QAPP. If problems arise with procedures or guidelines set forth therein, the client, the QA Coordinator,

Project Officer/Manager, and the RI Manager will formulate an appropriate corrective action.

4.11. QA Reports to Management

The deliverables associated with the investigation will contain separate QA sections in which data quality information collected during the investigation is summarized. These data validation reports will be prepared under the direction of the Project Manager and will include the QA Coordinator's report on the accuracy, precision, and completeness of the data.

References

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NYSDEC, March 1991. *RCRA Quality Assurance Project Plan Guidance.*

NYSDEC, October 1995. Analytical Service Protocol.

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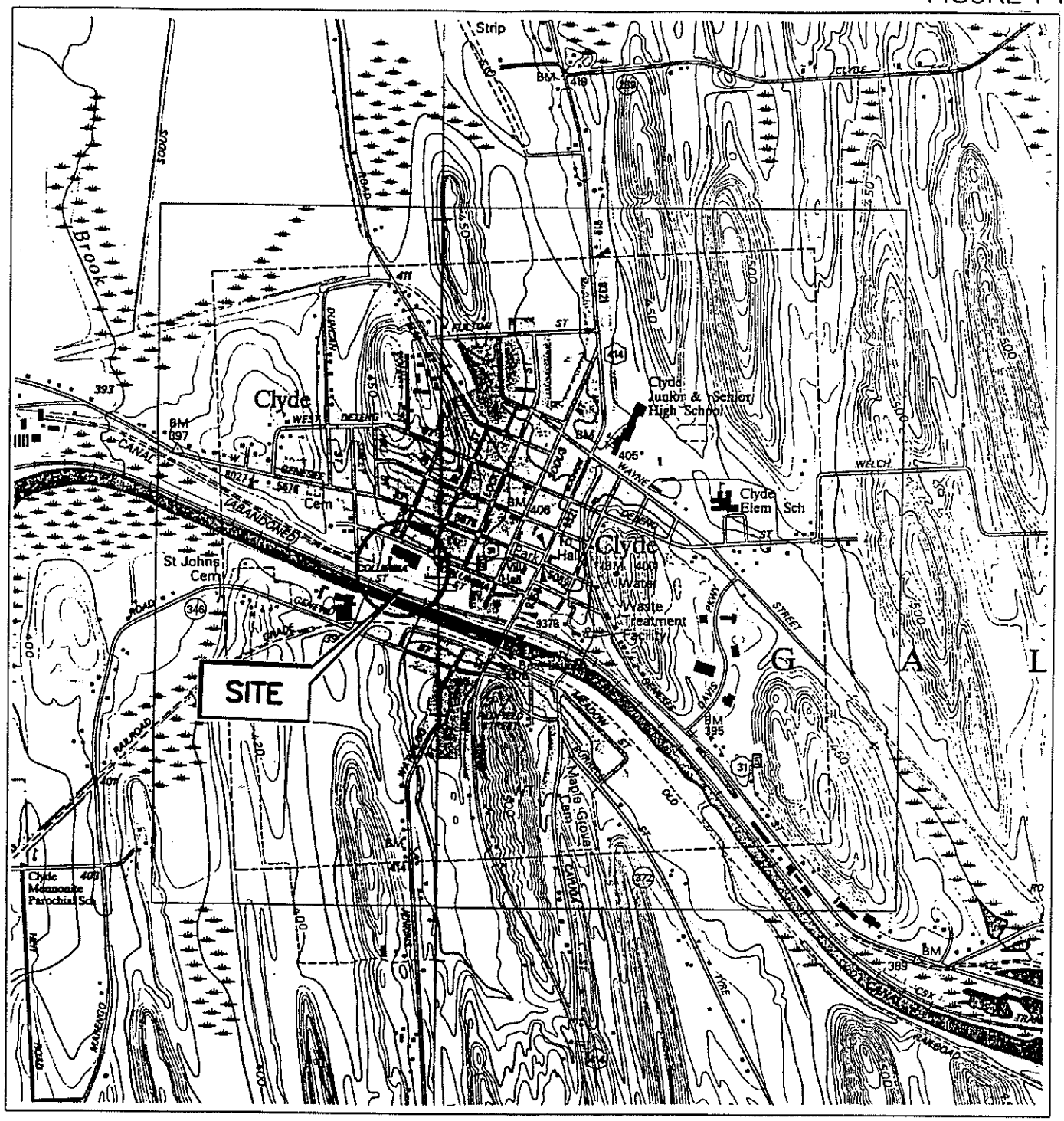
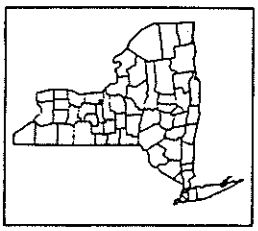
USEPA, July 1992. *Test Methods for Evaluating Solid Waste, Physical/ Chemical Methods*, SW-846 34d Edition.

USEPA, December 1996. *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), 3rd Edition*, Final Update III.

FIGURE 1-1



USGS 7.5 MIN quad., LYONS AND SAVANNAH, NEW YORK



STATE LOCATION MAP
43° 5'00",76° 52'30"

OLD ERIE CANAL SITE
CLYDE, NEW YORK

SITE LOCATION MAP

2000 0 2000

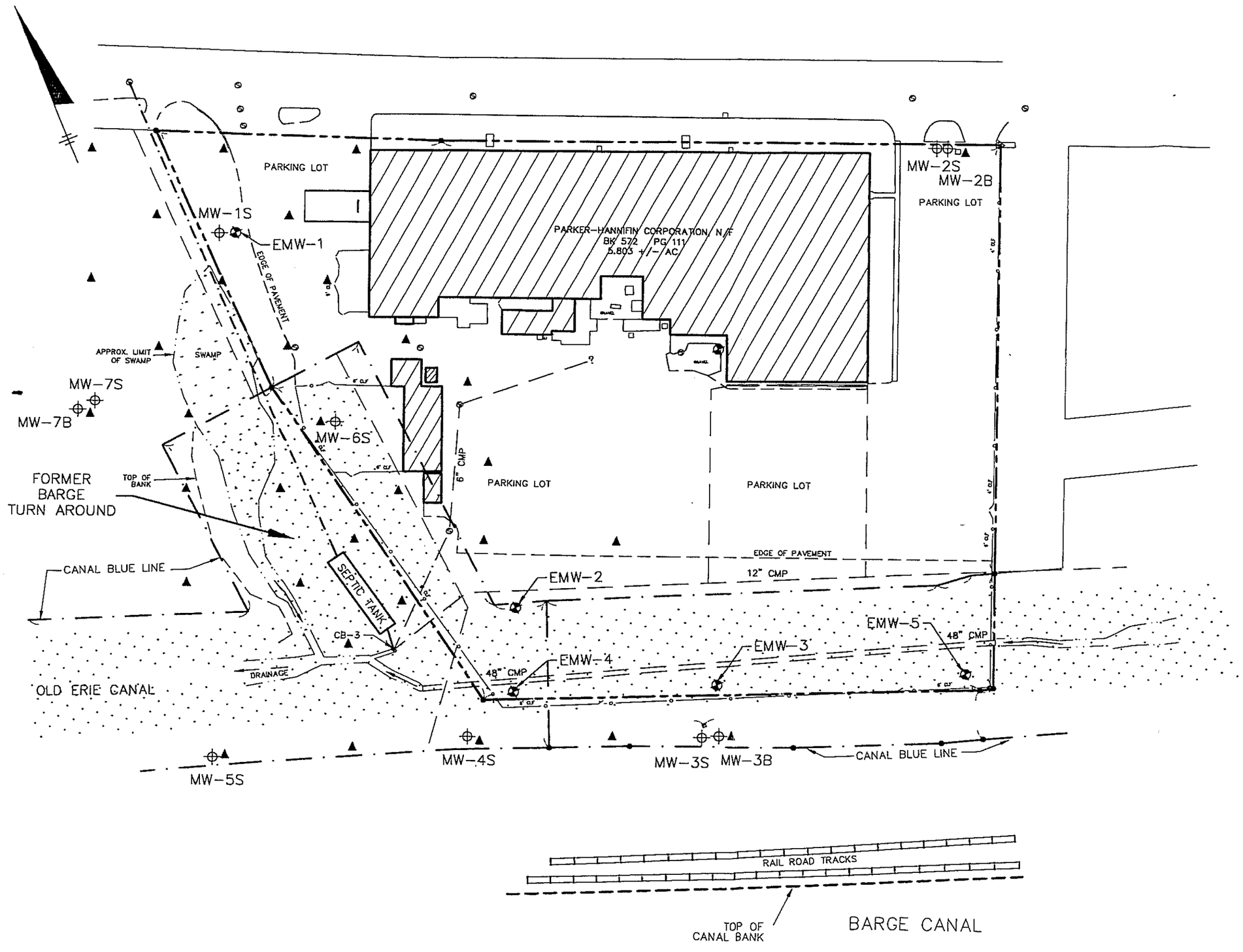
1"=2000'

24738

O'BRIEN & GERE ENGINEERS INC.

ALBANY\P:\24936\DWG\RIWP_2-1.DWG SF:1

FIGURE 2-1



LEGEND

- PROPERTY BOUNDARY
- CANAL BLUE LINE
- ▲ PROPOSED DIRECT PUSH SAMPLE LOCATION
- STORM SEWER
- 48-INCH CMP
- MW-3S ⊕ PROPOSED OVERBURDEN MONITORING WELL
- MW-3B ⊕ PROPOSED BEDROCK MONITORING WELL
- EMW-2 ⊕ EXISTING MONITORING WELL

OLD ERIE CANAL SITE
CLYDE, NEW YORK

PROPOSED SOIL BORINGS & MONITORING WELLS

80 0 80
SCALE IN FEET

FEBRUARY 2000
24936

O'BRIEN & GERE ENGINEERS INC.

2-16-2000

ALBANY\I:\24936\DWG\RIWP_2-1.DWG SF:1

FIGURE 2-2

PARKING LOT

EMW-1

PARKER-HANNIFIN CORPORATION, N/F
BK 572 PG 111
5.803 +/- AC.

PARKING LOT

EDGE OF PAVEMENT

APPROX. LIMIT OF SWAMP

SWAMP

FORMER BARGE TURN AROUND

PROPOSED STM

6" CMP

TOP OF BANK

PARKING LOT

PARKING LOT

PROPOSED STM

PROPOSED STM

PROPOSED SW/SED

CANAL BLUE LINE

SEPTIC TANK

EDGE OF PAVEMENT

12" CMP

EMW-2

CB-3

EMW-5

48" CMP

EMW-3

48" CMP

EMW-4

OLD ERIE CANAL

DRAINAGE

PROPOSED SW/SED

CANAL BLUE LINE

3 PROPOSED STM SAMPLES AT CATCH BASIN CB-3
(2 INFLUENT & 1 EFFLUENT)

RAIL ROAD TRACKS

TOP OF CANAL BANK

BARGE CANAL

LEGEND

- PROPERTY BOUNDARY
- CANAL BLUE LINE
- STORM SEWER
- 48-INCH CMP
- EXISTING MONITORING WELL
- PROPOSED SEDIMENT SAMPLE LOCATION
- PROPOSED SURFACE WATER SAMPLE LOCATION
- PROPOSED STORM WATER SAMPLE LOCATION

OLD ERIE CANAL SITE
CLYDE, NEW YORK

PROPOSED SURFACE WATER & SURFACE SOIL/ SEDIMENT SAMPLES

80 0 80
SCALE IN FEET

FEBRUARY 2000
24936

O'BRIEN & GERE
ENGINEERS INC.

2-16-2000

FIGURE 4-1

O'BRIEN & GERE ENGINEERS, INC.

EXAMPLE CHAIN-OF-CUSTODY

Office: _____ Sheet ____ of ____

Address: _____ Job No. _____

Phone: _____ Laboratory: _____

CLIENT: LOCATION:			COLLECTED BY: (Signature)			
SAMPLE DESCRIPTION	Date	Time	Sample Matrix[1]	Sample Type[2]	No. of Containers	ANALYSIS REQUESTED

[1] Matrix = water, wastewater, air, sludge, sediment, etc.
[2] Type = grab, composite

Relinquished by: _____ of: _____	Date	Time	Received by: _____ of: _____	Date	Time
Relinquished by: _____ of: _____	Date	Time	Received by: _____ of: _____	Date	Time
Relinquished by: _____ of: _____	Date	Time	Received by: _____ of: _____	Date	Time
Use this space if shipped via courier (e.g., Fed Ex) Relinquished by: _____ of: _____	Date	Time	Courier Name: _____ *Attach delivery/courier receipt to Chain of Custody	Date	Time

Appendix A
Analytical Deliverable Requirements

1. Table of Contents

The deliverable data package should contain a table of contents. This table of contents should contain sufficient information to be a useful tool in locating sample result forms, quality control (QC) summary tables, and raw data for a specific analysis.

2. Case Narrative

The case narrative should contain the following:

- A cross reference list which includes the field sample identification name, the laboratory identification number, sampling dates for each sample in the sample delivery group (SDG) included in the data package;
- Detailed documentation of QC, sample, shipment, analytical problems encountered in processing the samples for the data package; and
- Documentation of reanalyses, internal QC processes used, corrective actions taken, and the resolution of the corrective actions taken.

3. Laboratory Sample Information Sheets

A copy of the Laboratory Information Management System (LIMS) sheets for the samples in the SDG should be included in the data package. These LIMS sheets should include the information contained in the cross reference list (described above), as well as a list of the analyses required for each sample in the SDG.

4. Chain-of-Custody Forms

The data package should contain copies of both external and internal chain-of-custody forms for the samples in the SDG. Original chain-of-custody forms should be included in the data package for subcontracted analyses. Internal chain-of-custody forms must document times when samples are signed out and back in, or if the entire sample was used in analysis.

5. Sample Result Summary Forms

The sample results should be summarized on sample result summary forms (i.e., Form I or equivalent) and included twice in the data package. One copy should be included in the beginning of the document after the chain-of-custody forms and the other copy should be included sample data section of the data package. The sample result forms in the sample data section of the data package should reflect the results only for the raw data presented in that section of the sample data. Sample result summary forms should include information in the format required by the United States Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP).

6. QC Summary Forms

6.1. GC QC Summary Forms

Gas chromotagraphy (GC) QC summary section should include the following:

- Surrogate summary forms (i.e., Form II or equivalent) which include method reference, sample identifications, surrogate recoveries, surrogate compound identification, surrogate recovery QC limits, and number of surrogate recoveries outside the QC limits;
- Matrix spike/matrix spike duplicate (MS/MSD) and matrix spike blank (MSB) summary forms (i.e., Form III or equivalent) which include concentration of original sample and spiked sample, amount spiked, percent recovery of the spike, relative percent difference between the MS and MSD, and control limits;
- QC check standard [e.g., laboratory control sample (LCS)] summary (i.e., Form III or equivalent) includes the amount spiked, percent recovery, a means of establishing standards traceability, and control limits;

- Method blank summary (i.e., Form IV or equivalent) includes method blank identification, date and time of analysis, instrument and column(s) utilized, and a list of the associated samples;

- For pesticides analyses, a summary form of the percent breakdown for endrin and 4,4'-DDT; and

- Instrument detection limits (IDLs), MDLs and/or PQLs (where appropriate).

6.2. GC/MS QC Summary Forms

Gas chromatograph/mass spectrometer (GC/MS) QC summary section should include the following:

- Surrogate summary forms (i.e., Form II or equivalent) which include method reference, sample IDs, surrogate recoveries, surrogate compound identification, surrogate recovery QC limits, and number of surrogate recoveries outside the QC limits;

- Internal standards summary form (i.e., Form VIII or equivalent) including internal standard identification, amount spiked into sample, internal standard areas, retention time of samples and 12-hour standards, and control limits;

- MS/MSD summary forms (i.e., Form III or equivalent) which includes concentration of original sample and spiked sample, amount spiked, percent recovery of the spike, relative percent difference between the MS and MSD, and control limits;

- QC check standard (e.g., LCS) summary (i.e., Form III or equivalent) including the amount spiked, percent recovery, a means of establishing standards traceability, and control limits; and

- Method blank summary (i.e., Form IV or equivalent) includes method blank identification, date and time of analysis, instrument and column(s) utilized, and a list of the associated samples.

6.3. Metals QC Summary Forms

Metals QC summary section should include the following:

- Blank summary (i.e., Form III or equivalent) including the calibration blank and method/preparation blank results;

- For inductively coupled plasma (ICP) analyses, ICP interference check sample summary for A and AB solution (i.e., Form IV or equivalent) for all elements of interest, not only aluminum, magnesium, iron, and calcium, including amount spiked, amount found, and % recovery;

- For ICP analyses, ICP serial dilution summary (i.e., Form IX or equivalent);

- QC check standard (e.g., LCS) summary (i.e., Form VII or equivalent) including the amount spiked, percent recovery, a means of establishing standards traceability, and control limits;

- MS/MSD summary (i.e., Form V or equivalent) including concentration of original sample and spiked sample, amount spiked, percent recovery of the spike, relative percent difference between the MS and MSD, and control limits;

- Instrument detection limits (quarterly) summary (i.e., Form X);

- ICP interelement correction factors (annually) summary (i.e., Form XI); and

- ICP liner ranges (quarterly) summary (i.e., form XII).

6.4. Wet Chemistry QC Summary Forms

Wet chemistry QC summary section should include the following:

- Blank summary;

- QC check standard (e.g., LCS) recovery including the amount spiked, percent recovery, a means of establishing standards traceability, and control limits; and

- MS/MSD summary including concentration of original sample and spiked sample, amount spiked, percent recovery of the spike, relative percent difference between the MS and MSD, and control limits.

7. Calibration Data

7.1. GC Calibration Data

GC calibration data should include the following:

- Initial calibration summary (i.e., Form VI or equivalent);
- Continuing calibration summary (i.e., Form VII or equivalent);
- Daily retention time windows summary form for all target compound (i.e., Form VIIH or equivalent);
- An initial calibration packet for each instrument and each column used to analyze samples in the SDG containing a summary of the results and chromatography and quantitation reports for each of the initial calibration concentrations; and
- A continuing calibration packet for each instrument and each column used to analyze samples in the SDG containing a summary of the results and chromatography and quantitation reports for each of the continuing calibration analyses.

7.2. GC/MS Calibration Data

GC/MS calibration data should include the following:

- Instrument performance check summary (i.e., Form V or equivalent);
- Initial calibration summary (i.e., Form VI or equivalent);
- Continuing calibration summary (i.e., Form VII or equivalent);
- An initial calibration packet for each instrument used to analyze samples in the SDG containing a summary of the results and chromatography and quantitation reports for each of the initial calibration concentrations; and
- A continuing calibration packet for each instrument used containing a summary of the results and chromatography and quantitation reports for each of the continuing calibration analyses.

7.3. Metals Calibration Data

Metals calibration data should include the following:

- Calibration summary (including amount spiked, percent recovery, and correlation coefficients, where appropriate); and
- Initial and continuing calibration verification summary (i.e., Form II - Part 1 or equivalent) including the continuing calibration verification (CCV) result, amount spiked, and percent recovery.

7.4. Wet Chemistry Calibration Data

Wet chemistry calibration data should include the following:

- Calibration summary including amount spiked, percent recovery, and correlation coefficients, where appropriate; and
- Calibration verification summary including the CCV result, amount spiked, and percent recovery.

8. Sample Data

8.1. GC Sample Data

GC sample data should include the following:

- Sample result forms (as described in Section 5);
- Sample result forms for the diluted and undiluted samples (as described in Section 5) should also be included for samples that have been diluted;
- Extraction logs (where applicable);
- Analysis run logs with dates and times of injection, injection volume, dilution factor, method, instrument identification, column identification, volume and concentration of surrogates injected and volume and concentration of calibration, QC, and matrix spike standards;

- Retention time windows identification of detected compounds (i.e., Form XC);

- Example calculations;
- Chromatography for the samples with a header that includes the date and time of injection, volume of injection, column identification, and instrument identification (for diluted samples, the chromatography should be included for the diluted and undiluted samples); and

- An integration report or data system printout and calibration plot for 4,4'-DDT, 4,4'-DDD, and 4,4'-DDE or toxaphene (where appropriate).

8.2. GC/MS Sample Data

GC/MS sample data should include the following:

- Sample result forms (as described in Section 5);

- Sample result forms for the diluted and undiluted samples (as described in Section 5) should also be included for samples that have been diluted;

- Extraction logs (where applicable);

- Example calculations;

- Analysis run logs;

- Mass spectra for the detected compounds in the samples;

- Chromatography for the samples with a header that includes the date and time of analysis, sample identification, instrument identification, and laboratory file identification (for diluted samples, the chromatography should be included for the diluted and undiluted samples); and

- Tentatively identified compounds (TICs) included on a form similar to the sample result form.

8.3. Metals Sample Data

Metals sample data should include the following:

- Sample result forms (as described in Section 5);
- Analysis run logs (i.e., Form XIV or equivalent);
- Example calculations;
- Real-time instrument printouts;
- Digestion logs (i.e., Form XIII or equivalent) which include the date, sample weights and volumes, associated QC samples, sample pH, and comments describing any significant sample changes or reactions which occur during sample preparation;
- For furnace analyses, a summary form of instances when method of standard additions (MSA) (i.e., Form VIII or equivalent) has been performed;
- For furnace analyses, relative standard deviation between duplicate injections of samples should be summarized either on the run logs or on a separate summary form (i.e., Form VI or equivalent), where duplicate sample injection is required by the method; and
- For furnace analyses, post-digestion spike percent recoveries should be summarized either on the logsheets or on a separate form (i.e., Form V - Part 2 or equivalent), where required by the method.

8.4. Wet Chemistry Sample Data

Wet chemistry sample data should be arranged in packets which include the following:

- Sample result forms (as described in Section 5);
- Analysis run logs;
- Example calculations;
- Real-time instrument printouts; and
- Digestion logs (where applicable).

APPENDIX B

PROCEDURE FOR SHORT-TERM PUMPING TESTS

PROCEDURE FOR BEDROCK PUMPING TESTS

Purpose:

The purpose of the short-term pumping tests conducted in bedrock coreholes is to determine the water-producing characteristics of the open bedrock interval and select the appropriate interval for completion of the monitoring well.

Equipment:

Water level indicator
Submersible pump and control box
Container(s) for purged water

Procedure:

The procedure for pumping tests is as follows:

i) measure the static water level within the boring;

ii) install the pump near, but not at, the bottom of boring;

iii) determine maximum allowable drawdown to prevent damage to the pump (i.e., some pumps require a minimum depth of water above the pump intake to prevent pump damage);

iv) measure water level immediately prior to commencing pumping;

v) start pumping slowly and increase the pumping rate until either the maximum pumping rate of the equipment has been achieved or drawdown of the water level within the boring has been achieved, whichever is the less;

vi) once the pumping rate has stabilized, continue pumping for a minimum of 1/2 hour, measuring and recording water level and pumping rate data at 5-minute intervals;

vii) if discharge of water from the pump ceases or becomes sporadic, turn off the pump and allow the water level within the boring to recover with water level monitoring. Once recovered, restart the pump to verify that it is working properly;

viii) perform a recovery test with water level monitoring immediately following the completion of pumping in all borings before removing the pump; and

ix) after the pumping/recovery test is complete, collect groundwater samples, as specified in the Work Plan, using the appropriate sample collection equipment.

If the tested interval is found not to produce a minimum of 0.1 gallon per minute (gpm) of water per 1-inch of corehole diameter (e.g., 0.3 gpm in a 3-inch corehole), the boring may need to be extended.