

June 19, 2018

Christopher Mannes
NYSDEC Division of Environmental Remediation, Region 7
615 Erie Boulevard West
Syracuse, New York 13204

**Re: Novak Farm Emerging Contaminants Sampling Work Plan
McDonough, New York
NYSDEC Site No. 07-09-005
Langan Project No.: 170528401**

Dear Mr. Mannes:

This Emerging Contaminants Sampling Work Plan (Work Plan) was prepared by Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, DPC (Langan) on behalf of Stauffer Management Company, LLC (SMC) for the Novak Farm (the "Site") in McDonough, New York (New York State Department of Environmental Conservation (NYSDEC) Inactive Hazardous Waste Disposal Site No. 7-09-005). A Site Location Map is included as Figure 1. This Work Plan was developed in response to NYSDEC's Request for Sampling of Emerging Contaminants, dated April 4, 2018. The scope of work presented herein was discussed with Mr. Mannes of the NYSDEC during the Thursday, May 3, 2018 teleconference. The objective of this sampling event is to assess the presence of emerging contaminants, including per- and polyfluoroalkyl substances (PFAS) and 1,4-dioxane, in groundwater as part of a statewide evaluation to better understand the potential presence of these compounds. It is understood that the sampling will be a singular event, and additional sampling will not be warranted so long as the site is not identified as a source of these contaminants. This Work Plan will be implemented during the next groundwater monitoring event, which, per our May 3, 2018 conference call, will be scheduled for November 2018.

Summary of Site History

Spent solvents and other chemical wastes were disposed of at the Site from the early 1960s through the 1970s. Investigations conducted by the New York State Department of Health (NYSDOH) and NYSDEC from 1979 through 1985 identified volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) in soil and groundwater as a result of the historical solvent disposal. After an initial remediation was performed between August 1987

and October 1988, a Consent Order was executed between the NYSDEC and SMC in December 1989 for the development and implementation of a Remedial Investigation and Feasibility Study (RI/FS). The RI was completed in May 1991 and the FS was submitted by SMC to NYSDEC in October 1993. This remedy was outlined in the March 1994 Record of Decision (ROD) prepared by the NYSDEC.

The remedial objectives outlined in the ROD were to reduce, control or eliminate contamination present within soil, groundwater and soil vapor at the site, minimize the potential for direct human or animal contact with contaminated soils at the site, minimize impacts to groundwater discharged to the adjacent Balsam Creek, and minimize long-term restrictions for future uses at the Site. The selected remedy included two-phase bio-cell and vapor extraction soil treatment system and ex-situ groundwater treatment implemented from 1987 through 2004. As documented in the August 2001 Final Remedial Engineering Report, the NYSDEC determined that the selected remedy was completed in accordance with the March 1994 ROD and the remedial objectives outlined in the ROD were achieved. On June 14, 2004, a deed restriction was recorded that provides for groundwater use restriction, soil management plan implementation, cover system protection, and fencing/access control. Currently, per the January 2000 Groundwater Monitoring Plan and NYSDEC-approved modifications, monitoring well MW-104 is sampled once every three years for VOCs in groundwater. The next sampling event is schedule for the fall of 2019. However, to satisfy the NYSDEC request for sampling emerging contaminants SMC will expedite the next scheduled sampling event to the fall of 2018.

Emerging Contaminants Groundwater Sampling Scope of Work

The field investigation will include collection of two groundwater samples, including a duplicate, from monitoring well MW-104. Sampling activities will comply with the safety guidelines outlined in the existing Health and Safety Plan (HASP). A Sample Location Plan is presented in Figure 2.

Groundwater sampling for PFAS and 1,4-dioxane will be performed in accordance with the NYSDEC March 1991 Sampling Guidelines and Protocol, the April 2018 NYSDEC guidance on Groundwater Sampling for Emerging Contaminants and the June 2016 NYSDEC guidance on Collection of Groundwater Samples for Perfluorooctanoic Acid (PFOA) and Perfluorinated Compounds (PFCs) from Monitoring Wells Sample Protocol (Attachment A). In accordance with the NYSDEC Emerging Contaminants guidance documents, MW-104 will be purged and sampled with sampling equipment made with stainless steel, high-density polyethylene (HDPE), or polypropylene. The groundwater sample will be collected into laboratory-supplied sample containers and submitted to a NYSDOH Environmental Laboratory Approval Program (ELAP)-certified laboratory and analyzed for NYSDEC's Target Analyte List of PFAS compounds

using EPA Test Modified Method 537 and 1,4-dioxane using EPA Method 8270 SIM. Laboratory analyses will be reported in accordance with the NYSDEC Analytical Services Protocol (ASP) Category B data deliverable format. Relevant quality assurance/quality control (QA/QC) procedures to be followed are described in the Quality Assurance Program Plan (QAPP) in Attachment B.

Reporting

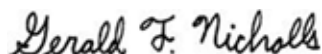
The results of the sampling will be submitted to NYSDEC as part of Stauffer's Tri-annual Monitoring Report. The report will be included as an appendix in the groundwater monitoring report, and will describe the completed scope of work and present the field and analytical results of the sampling. Analytical results will be presented in summary tables and the groundwater sample location will be shown on an attached Site plan. The Category B data deliverable will be validated and a Data Usability Summary Report (DUSR) will be provided as part of the report. There is no current groundwater standard for PFAS compounds and 1,4-dioxane so data will be compared to the current health advisory guidelines. If standards are promulgated prior to the date of the forthcoming report, relevant comparisons will be presented.

Closing

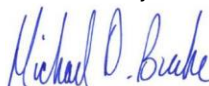
Should you have any questions regarding this work plan, please feel free to call us at 212-479-5400.

Sincerely,

**Langan Engineering, Environmental, Surveying,
Landscape Architecture and Geology, D.P.C.**



Gerald Nicholls, PE, CHMM
Senior Project Manager

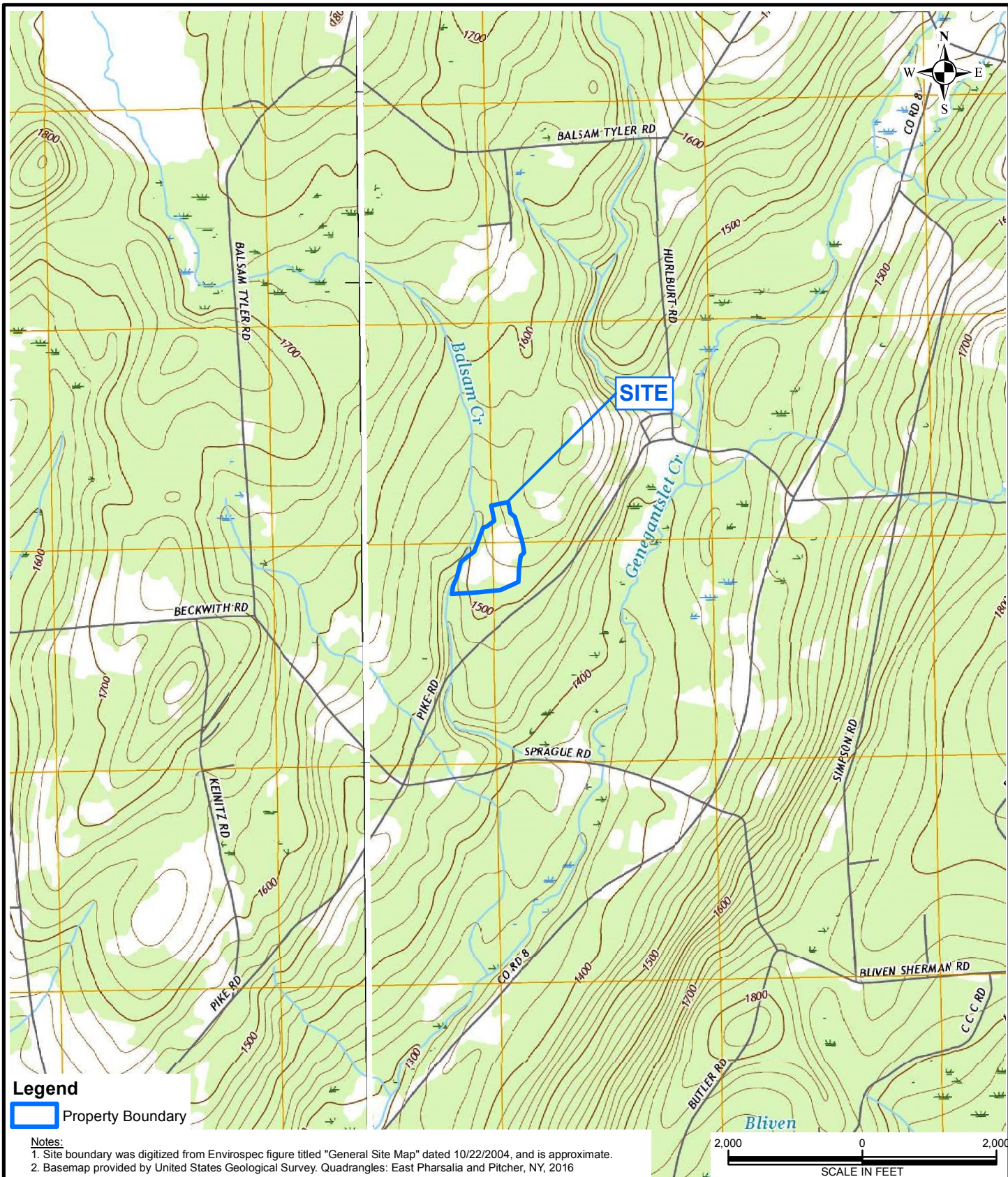


Michael Burke, PG, CHMM
Principal/Vice President

cc: John-Paul Rossi – Stauffer Management Company

Attachments: Figure 1 – Site Location Map
 Figure 2 – Sample Location Map
 Attachment A – NYSDEC Guidance for Emerging Contaminant Sampling
 Attachment B – Quality Assurance Project Plan

Figures



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Collectively known as Langan

Project

NOVAK FARM

MCDONOUGH

CHENANGO COUNTY NEW YORK

Drawing Title

**SITE LOCATION
MAP**

Project No.

170528401

Date

06/04/18

Scale

1"=2,000'

Drawn By

MMK

Submission Date

06/04/18

Figure

1

Sheet 1 of 2



LANGAN 21 Penn Plaza, 360 West 31st Street, 8th Floor New York, NY 10001-2727 T: 212.479.5400 F: 212.479.5444 www.langan.com Langan Engineering & Environmental Services, Inc. Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C. Langan International LLC Collectively known as Langan	Project NOVAK FARM MCDONOUGH CHENANGO COUNTY NEW YORK	Drawing Title SAMPLE LOCATION PLAN	Project No. 170528401	Figure 2 Sheet 2 of 2
			Date 05/22/18	
			Scale 1"=200'	
			Drawn By MMK Submission Date 05/22/18	

Attachment A
NYSDEC Guidance for Emerging Contaminant Sampling

5.0 SAMPLING PROCEDURES

5.1 INTRODUCTION

This section discusses practices and procedures for use by DEC Bureau of Spill Prevention and Response (DEC BSPR) personnel or contractor during field operations to ensure the collection of representative samples. All sampling activities conducted by DEC BSPR personnel or contractor are conducted with the expectation that they will be used for enforcement purposes, unless specifically stated to the contrary in advance of the field investigation. Therefore, the use of proper sampling procedures cannot be over emphasized. The collection of representative samples depends upon:

- ensuring that the sample taken is truly representative of the material or medium being sampled;
- using proper sampling, sample handling, preservation, and quality control techniques;
- properly identifying the collected samples and documenting their collection in permanent field records;
- maintaining sample chain-of-custody; and
- protecting the collected samples by properly packing and transporting (shipping) them to a laboratory for analysis.

The objectives of this section are to present:

- general considerations that must be incorporated in all sampling operations conducted by the DEC BSPR personnel or contractor;
- specific sampling site selection and collection procedures for individual media; and
- specific sampling quality assurance procedures as well as equipment calibration and maintenance requirements for sampling equipment.

5.2 GENERAL CONSIDERATIONS

The following factors and procedures shall be considered and implemented in planning and conducting all sampling operations with the specific objectives and scope of individual site investigation. Representative sampling sites are dependent on the type of investigation being undertaken and are discussed under the sample procedures for each medium later in this section. The type of sampling equipment to be used is also discussed in Section 3.0 and the sampling procedure in this section. Section 4.0 describes the equipment cleaning procedures.

5.2.1 Sampling Equipment Construction Material

The material that sampling equipment is constructed of can affect sample analytical results. Materials must not contaminate the sample being collected and must be readily cleaned so that samples are not cross-contaminated. The standard materials for sampling equipment used for trace organic compounds or metals analyses are, in order of decreasing desirability; Teflon, glass, stainless steel and steel.

5.2.2 Selection of Parameters to be Measured

Parameters to be measured are usually dictated by the purpose of an investigation and should be based on

required monitoring conditions (NPDES or RCRA permits for example) or on the field investigator's or requester's knowledge of the problem being investigated.

5.2.3 Dissolved and Particulate Sample Fractions

A water sample is generally composed of dissolved and particulate fraction. When it is necessary to analyze samples for each fraction, instead of the total sample, it may be necessary to filter the sample in the field. Field filtration should be conducted only for conventional analytical parameters or metals; samples that will be analyzed for organic compounds shall not be filtered in the field.

5.2.4 Required Sample Volumes

The volume of samples obtained should be sufficient to perform all required analyses with an additional amount collected to provide for quality control needs, split samples, or repeat examinations. Individual aliquots of a composite sample should be at least 100 milliliters in order to minimize sample solids bias when using a peristaltic pump.

Although the volume of sample required by contract laboratories depends on the analyses to be performed, the amount of sample required for a complete water or wastewater analysis can be up to two gallons (7.6 liters) for each laboratory receiving a sample. However, the laboratory receiving the sample should be consulted for any specific volume requirements.

The volumes of samples collected from waste sources at hazardous waste sites or samples from sources which are known to be toxic should be kept to an absolute minimum.

The sample volume required for each analysis is the volume of the standard container less ullage (empty space) required for sample mixing by laboratory personnel and safe shipment of samples to the laboratory. Sampling personnel shall allow a minimum of ten percent ullage in every sample container for this purpose. The only exceptions are samples collected for purgeable organic analysis (VOA) or dissolved gases such as sulfides for which sample containers must be completely filled.

5.2.5 Selection and Proper Preparation of Sample Containers

The type of sample container is dictated by the analyses required. Standard sample containers to be used by sampling personnel are presented in Appendix 5X.1. Special sample container preparation requirements are in Section 4.0.

5.2.6 Sample Preservation

Samples for some analyses must be preserved in order to maintain their integrity. Preservations required for routine analyses of samples are given in Appendix 5X.1. All samples should be preserved immediately upon collection in the field. The only samples that should not be immediately preserved in the field are:

- Samples collected within a hazardous waste site that are known or thought to be highly contaminated with toxic materials. Barrel, drum, closed container, spillage, or other source samples from hazardous waste sites are not to be preserved with any chemical. These samples may be preserved with ice, if necessary.
- Samples that have extremely low or high pH or samples that may generate potentially dangerous gases if they were preserved using the procedures given in Appendix 5X.1.
- Well or ground water samples that contain visible sediment, that are not filtered in the field, shall

not be preserved with nitric acid in the field. These samples shall be preserved with ice and taken to the laboratory for additional sample preparation.

- Samples for metals analysis which are to be shipped as soon as possible. They shall not be preserved with nitric acid in excess of the amount specified in Appendix 5X.3.
- Samples for purgeable organic compounds (VOA) analyses which are shipped by air shall not be preserved with hydrochloric acid in excess of the amount specified in Appendix 5X.3.

All samples preserved with chemicals shall be clearly identified by indicating on the sample tag that the sample is preserved. If the samples are not preserved, field records shall indicate why.

5.2.7 Sample Holding Times

The elapsed time between sample collection and initiation of laboratory analyses must be within a prescribed time frame for each individual analysis. Sample holding times for all routine samples are shown in Appendix 5X.1.

5.2.8 Sample Handling and Mixing

Once a sample has been collected, it may have to be split into separate containers for different analyses. The best way to split liquid samples is to continually stir the sample contents with a clean pipette or pre-cleaned Teflon rod and allow the contents to be alternately siphoned into respective sample containers using Teflon or PVC (Tygon type) tubing. Teflon must be used when analyses for organic compounds or trace metals are to be conducted. Any device used for stirring, or tubing used for siphoning, must be cleaned in the same manner as other equipment (Section 4.0).

A true split of soil, sediment, or sludge samples is almost impossible to accomplish under field conditions. The more moisture samples contain, the more difficult it is to split them. Procedures such as the one outlined in Section 5.7.4.5 should be used to obtain a homogenous sample. Even when such procedures are followed, the sample should be considered a duplicate and not a split sample.

After collection, all samples should be handled as few times as possible. Sample handling personnel should use extreme care to ensure that samples are not contaminated. If samples are placed in an ice chest, personnel should ensure that melted ice cannot cause sample containers to become submerged, as this may result in sample cross-contamination. Plastic bags, such as zip-lock bags, should be used to prevent cross-contamination when small sample containers (e.g., VOA's or bacterial samples) are placed in ice chests.

5.2.9 Special Precautions for Trace Contaminant Sampling

Some compounds can be detected in the parts per billion and/or parts per trillion range. Extreme care must be taken to prevent cross-contamination of these samples. The following precautions shall be taken when trace contaminants are of concern:

- A clean pair of new, disposable gloves will be worn each time a different point or location is sampled;
- Sample containers for source samples or samples suspected of containing high concentrations of contaminants shall be placed in separate plastic bags immediately after collecting, preserving, tagging, etc.;
- If possible, ambient samples and source samples should be collected by different field teams. If separate collection is not possible, all ambient samples shall be collected first and placed in separate

ice chests or shipping containers. Samples of waste or highly contaminated samples shall never be placed in the same ice chest as environmental samples. It is good practice to enclose waste or highly contaminated samples in a plastic bag before placing them in ice chests. Ice chests or shipping containers for source samples or samples suspected of containing high concentrations of contaminants shall be lined with new, clean, plastic bags.

- If possible, one member of the field team should take all the notes, fill out tags, etc., while the other member does all of the sampling.
- When sampling surface waters, the water sample should always be collected before the sediment sample is collected.
- Sample collection activities should proceed progressively from the least contaminated area to the most contaminated area (if this fact is known).
- Sampling personnel should use equipment constructed of Teflon, stainless steel, or glass that has been properly precleaned (Section 4.0) for collecting samples for trace metals or organic compounds analyses. Teflon or glass is preferred for collecting samples where trace metals are of concern. Equipment constructed of plastic or PVC shall not be used to collect samples for trace organic compounds analyses.

5.2.10 Sample Identification

All samples will be fully documented, as outlined in Appendix 5X.2, in the field records, on the field sample chain-of-custody record, and on the sample tags.

5.2.11 Procedures for Identifying Potentially Hazardous Samples

Any sample either known or thought to be hazardous should be so identified on both the sample tag and the field sample chain-of-custody sheet. Information explaining the hazard, i.e., corrosive, flammable, poison, etc., shall also be listed.

5.2.12 Collection of Auxiliary Data

All auxiliary data such as flow measurements, photographs of sampling sites, meteorological conditions, and other observations shall be entered into field records when the auxiliary data are collected. Auxiliary data relative to a particular sampling location should be collected as close to the sample collection time as possible. Specific types of auxiliary data to collect for each medium sampled are discussed later in this section.

5.2.13 Time Records

All records of time shall be kept using local time in the 2400 hour time format and shall be recorded to the nearest five minutes.

5.2.14 Transporting and Shipping of Samples

Samples may be hand delivered to the laboratory using government owned (or private) vehicles or they may be shipped by common carrier. All sample handling personnel must be aware that certain samples are hazardous materials and, as such, are regulated by the U.S. Department of Transportation under the Transportation Safety Act of 1974. These regulations are contained in Title 49, CFR, Parts 110-119. All DEC BSPR employees shall be aware of and meet the regulations that have been set up by the Transportation Safety Act of 1974 when shipping samples by common carrier.

5.2.15 Sample Chain-of-Custody

DEC BSPR employees or all sample handling personnel shall maintain chain-of-custody during all field investigations for all samples collected. The recommended sample chain-of-custody procedures used by DEC BSPR employees or contractor are given in Appendix 5X.2.

5.3 DEFINITIONS

5.3.1 Grab Sample

A grab sample is an individual sample collected over a period of time generally not exceeding 15 minutes. A grab sample is normally associated with water or polluted water sampling. However, soil, sediment, liquid hazardous samples, etc., may also be considered grab samples. No particular time limit would apply for the collection of such samples.

1. Grab samples are:
 - Used to characterize the medium at a particular instant in time; and
 - Always associated with instantaneous water or polluted water flow data (where appropriate).
2. Grab sampling is conducted when:
 - The water or polluted water stream is not continuous (e.g., batch-discharges or intermittent flow);
 - The characteristic of the water or polluted stream are known to be constant or nearly so;
 - The sample is to be analyzed for parameters whose characteristics are likely to change significantly with time, i.e., dissolved gases, bacteria, etc.;
 - The sample is to be collected for analysis of a parameter such as oil and grease where the compositing process could significantly affect the actual concentration; and
 - Data on maximum/minimum concentrations are desired for a continuous water or polluted water stream.
3. Analyses for which samples of water should always be collected by the DEC BSPR personnel or contractor using the grab sample method or for which measurements shall be made in-situ include:

pH	phenol
temperature	oil and grease
dissolved oxygen	bacteria
sulfide	volatile organic compounds
chlorine residual	specific conductance
other dissolved gases	dissolved constituents in field filtered samples (total-P, ortho-P, metals, etc.)

5.3.2 Composite Sample

5.3.2.1 Timed Composite - A sample containing some discrete samples in equal volume collected at equal time intervals over the compositing period. (A timed composite may be collected continuously). Timed composites may be collected where water or polluted water flows vary widely and are not dampened by polluted water treatment units.

5.3.2.2 Flow Proportional Composites - A sample containing some discrete samples collected proportionally to the flow rate over the compositing period. Flow proportional samples may be collected where water or polluted water flows vary widely and are not dampened by polluted water treatment units.

5.3.2.3 Timed and Flow Proportional Composite Samples - The following guidance is given concerning the collection of composite samples:

1. Composite samples are:
 - collected when average concentrations are of interest; and are
 - always associated with average flow data (where appropriate).
2. Composite sampling is used when:
 - the water or polluted water stream is continuous;
 - it is necessary to calculate mass/unit time loadings; or when
 - analytical capabilities are limited.
3. A timed composite shall be collected as follows:
 - continuously; or
 - with constant sample volume at a constant time interval between samples.
4. A flow proportional composite shall be collected as follows:
 - continuously, proportional to stream flow;
 - with constant sample volume and with the time between samples proportional to stream flow; or
 - at a constant time interval between samples and with the sample volume proportional to flow at time of sampling.

5.3.2.4 Areal Composite - A sample composited from individual grab samples collected on an areal or cross-sectional basis. Areal composites shall be made up of equal volumes of grab samples. Each grab sample shall be collected in an identical manner. Examples include sediment composites made up of quarter-point grab samples from a stream, soil samples from grid points on a grid system, water samples collected at various depths at the same point or from quarter points in a stream, etc.

5.3.3 Split Sample

A split sample is a sample which has been portioned into two or more containers from a single sample container. Portioning assumes adequate mixing to assure the "split samples" are, for all practical purposes, identical.

5.3.4 Duplicate Samples

Duplicate samples are samples collected simultaneously from the same source under identical conditions into separate containers.

5.3.5 Reference or Control Sample

A sample collected upstream or upgradient from a source or site to isolate the effects of the source or site

on the particular ambient medium being sampled.

5.3.6 Background Sample

A sample collected from an area, water body, or site similar to the one being studied, but located in an area known or thought to be free from pollutants of concern.

5.3.7 Sample Aliquot

A portion of a sample that is representative of the entire sample.

5.4 SPECIFIC SAMPLE COLLECTION QUALITY CONTROL PROCEDURES

5.4.1 General

This subsection provides guidelines for establishing quality control procedures for DEC BSPR sampling activities. Specific guidelines for sample site selection, selection of sampling equipment, types of samples to be collected, standard sample collection procedures, specific maintenance and calibration procedures for sampling equipment, and other considerations are presented for each medium later in this Section. Specific recommendations for all sampling activities are presented in Section 5.2. Adherence to the standard operating procedures outlined in this section form the basis for the DEC BSPR sampling quality assurance program.

5.4.2 Experience Requirements

There is no substitute for field experience. Therefore, all employees shall have field experience before they are permitted to select sampling sites. This field experience shall be gained by on-the-job training using the "buddy" system. Each new employee shall accompany an experienced employee on as many different types of field studies as possible. During this training period, the new employee will be permitted to perform all facets of field investigations, including sampling, under the direction and supervision of qualified technical staff.

5.4.3 Traceability Requirements

All sample collection activities shall be traceable through field records to the person collecting the sample and to the specific piece of sampling equipment (where appropriate) used to collect that sample. All maintenance and calibration records for sampling equipment (where appropriate) shall be kept so that they are similarly traceable.

5.4.4 Measurement of Relative Sampling Precision

The following duplicate sampling procedures shall be used during the collection of samples as a relative measure of the precision of the sample collection process. Duplicate grab and composite samples shall be collected during all major investigations and studies conducted by the DEC BSPR. No more than ten percent of all samples shall be collected in duplicate. These duplicates shall be collected at the same time, using the same procedures, the same equipment, and in the same types of containers as the required samples. They shall also be preserved in the same manner and submitted for the same analyses as the required samples. The collection of duplicate composite samples shall require the installation of duplicate automatic sampler setups if automatic samplers are used for sample collection. Duplicate sample data shall be reported to the quality assurance officer or his designee.

These data will be periodically examined to determine if any problems are evident with specific types of media samples or with the procedures used by specific sample handling personnel. The Quality Assurance Officer will advise the appropriate Section Chiefs of any problems encountered so that corrective action can be taken.

5.4.5 Measurement of Sample Handling Effectiveness

The effectiveness of sampling handling personnel's sample handling techniques will be monitored by utilizing preserved and unpreserved field blank samples. These blank samples will be prepared by DEC BSPR personnel or proper suppliers. These blank samples will be handled as follows:

- Water Sample Organic Trip Blank - Two sealed preserved (or unpreserved if appropriate) VOA vials and one sealed container each for other organic compounds will be transported to the field. These samples will be handled and treated by sampling personnel in the same manner as the other samples collected for organic compounds analysis on that particular study. These samples will be clearly identified on sample tags and Chain-of-Custody Records as trip blanks. These water sample trip

blanks will also be used to monitor the effectiveness of sample handling techniques where samples other than water, i.e., sludge, soil, sediment, etc. are collected. At least one set of trip blanks will be used on every study where samples for organic compounds analyses will be conducted.

- Metals and General Inorganic Preservation Blanks - Metals and general inorganic sample containers filled with blank water will be transported to the field and treated in the same manner as other like samples. These blank samples will be preserved and submitted for the same analyses as the other samples collected. These samples will be clearly identified as preservative blanks on sample tags and in the Chain-of-Custody Record(s). At least one preservative blank for each type of sample should be collected on non-routine field investigations. A minimum of one preservative blank should be prepared at the beginning and at the end of all major field investigations (20 samples or more). At least one preservative blank for each type of sample should be prepared once per quarter for routine inspections.
- Automatic Sampler Blanks - The procedure for collecting automatic sampler blanks is given separately at its own category of automatic sampling. In general, cleaning procedures outlined in Section 4.0 should be adequate to insure sample integrity. However, it is the standard practice of the DEC BSPR to submit automatic sampler blanks for analysis when automatic samplers are used to collect samples for organic compounds analyses. Automatic sampler blanks for other standard analyses shall be submitted at least once per quarter.

The DEC BSPR will advise the Quality Assurance Officer when trip blanks or preservative blanks are unacceptably contaminated. The Quality Assurance Officer will immediately initiate an investigation to determine the cause of the problem. The results of this investigation will be promptly reported to the appropriate Section Chiefs so that corrective action can be initiated.

5.4.6 Measurement of Sample Container, Sample Equipment, and Cleaning Procedure Integrity

Specific quality control procedures are outlined in Section 4.0.

5.4.7 Special Quality Control Procedures for Water Samples for Extractable, Pesticide, or Herbicide Organic Compounds Analyses

Sampling personnel shall submit duplicate water samples for extractable organic, pesticide, and/or herbicide organic compounds analyses from one sampling location per project. This sample should be collected from a location expected to be relatively free from contamination, since this sample will be used for laboratory quality control purposes. The duplicate sample should be clearly identified as "Duplicate Sample for Matrix Spike" on the sample tag, in the Chain-of-Custody Record, in the field logbook. This procedure shall be followed for all DEC BSPR projects where water samples are collected for the indicated organic compounds analyses, whether the samples are submitted to the contracted lab or other certified laboratory.

5.5 GROUNDWATER SAMPLING

5.5.1 General

Groundwater sampling may be required for a variety of reasons, such as examining potable or industrial water supplies, checking for and/or tracking contaminant plume movement in the vicinity of a land disposal or spill site, RCRA compliance monitoring, or examining a site where historical information is minimal or non-existent, but where it is thought groundwater contamination could have occurred.

Groundwater is usually sampled from a monitoring well, either temporarily or permanently installed. However, it can also be sampled anywhere groundwater is present, as in a pit or a dug or drilled hole.

Occasionally, a well will not be in the ideal location to obtain the sample needed. For example, a well may not be ideally located for tracking a contaminant plume. In that case, a well will have to be installed, and it may be either temporary or permanent. An experienced and knowledgeable person, preferably a hydrogeologist, will be needed to locate a place for the well and to supervise its installation so that the samples ultimately collected will be representative of the groundwater.

5.5.2 Site Selection

The relationship of the following factors to potential pollution sources shall be considered and evaluated when selecting groundwater sampling sites; the direction of groundwater flow; depth of groundwater; thickness of the aquifer (if applicable); type of stratigraphy; presence of perched water tables; types of soils; depth of bedrock; type of vegetation; surface drainage patterns; type of topography; and general land use. Surface features such as rock outcrops, seeps, springs, streams, rivers, and wet areas should also be considered (14). The area of interest should be located on an aerial photograph, a USGS 7.5 minute quadrangle map, a USDA soils map, and/or any other appropriate map that shows topography and general relationships between surface features. Aerial photographs can usually be obtained at the local Agricultural Stabilization Conservation Service Office or the local county tax office. USGS 7.5 minute quadrangle maps can be acquired from the State Department of Transportation or from the USGS, and soils maps from the USDA-SCS. A visual inspection of the area may be sufficient to evaluate and determine the surface conditions and their relationship to the subsurface conditions (14). In some cases, surface conditions and subsurface conditions cannot be correlated by site inspection or reconnaissance. When this occurs, a more detailed study, possibly involving test drilling, will have to be conducted.

It is extremely important to sample the unconfined or surficial aquifer downgradient of potential pollution sources or spills to determine if this aquifer has been affected. Generally the direction of groundwater flow can be estimated by two vectors - one in the direction of surface water flow (i.e., downstream) and another toward the surface water stream or river, if present. The relative magnitude of these vectors will vary according to site conditions and in some instances, both direction and magnitude may be changed by construction activities. If both shallow and deep aquifers are involved in the zone of interest, a screening study will reveal whether or not the deep aquifer needs to be sampled and/or if a more detailed study is required. To adequately assess subsurface conditions, a minimum of three wells are required, one in the upgradient portion of the area of interest, one in the middle portion, and one in the downgradient portion. In some cases, a more complex system of wells may be needed to define the subsurface conditions. Site conditions and the scope of the project will determine the total number of wells required. Existing wells should be used whenever possible. Where well installation is necessary, the wells should be installed according to the following procedures.

5.5.3 Monitoring Well Installation

Wells shall be dug, driven, drilled, or bored depending on the scope of work. Hand equipment such as augers, post hole diggers, picks, and shovels can be used to dig shallow wells in soft soils. Wells can be installed

by driving a piece of casing connected to a well point into the ground with an axe, sledge hammer, or mechanical or power device. Power equipment such as drilling rigs can be used to drill or auger wells in all types of soils and to any depth.

Where feasible the following procedures shall be used for well installation:

5.5.3.1 Temporary Monitoring Wells - For very shallow wells (15 feet) in soft material, hand augers or small portable power augers shall be used for boring. A temporary well casing with a well screen attached shall be installed as soon as the hole is augured.

For deeper temporary wells, larger well drilling equipment should be used with a hollow stem auger wherever possible. The use of a hollow stem auger prevents cave-in of the hole during drilling, allows for the collection of soil samples at various depths during the drilling operation, and may serve as a temporary casing for the well. In some cases the bottom of the auger will become plugged and not allow water to flow into the casing. When this happens, the auger should be pulled and the hole allowed to fill with water. A well casing can be installed if caving occurs.

When the water table is 25 to 30 feet deep, permanent well installation procedures should be considered.

5.5.3.2 Permanent Monitoring Well - Permanent monitoring wells shall be installed using hollow stem augers or continuous flight augers in soil and by standard rock coring procedures when drilling in rock. Where site conditions do not warrant the use of augers, alternate drilling methods such as straight rotary by using mud as a drilling fluid, or air rotary can be used. When muds are used in the drilling, a sample of the mud shall be collected for appropriate analyses. Casings with well screens shall be installed in unconsolidated and semi-consolidated soils to prevent soil and other foreign material from entering the well during pumping. Screens may or may not be required for wells in rock. The space surrounding the screen should be back filled with sand and filter pack and the remainder of the space surrounding the casing above the screen should be backfilled with natural clay, bentonite and/or cement bentonite grout, depending on the conditions at the site. Stainless steel well casings are preferred if samples are to be collected for organic compounds analyses. PVC casings are not acceptable where organic contaminants are a concern or under extremely corrosive conditions (18).

5.5.3.3 Monitoring Well Security - Wells should be capped and locked at the conclusion of installation or sampling for future use, or if the well will not be used in the future, it should be properly abandoned by backfilling with suitable permanent fill materials such as concrete, bentonite, compatible soil, or a combination of these materials (15).

5.5.4 Monitoring Well Development

All permanently installed wells shall be adequately developed prior to initial sampling efforts (14). Adequate development should eliminate all fine material from the area of the well screen and allow for the collection of a sample which is free of suspended materials. Wells installed by "wet drilling" where drilling muds are used shall be developed so that residual drilling muds will not settle around the well screens or in the surrounding soil and contaminate future sampling.

Various methods may be used to develop wells. These methods consist of suction lift pumping (pitcher, centrifugal, roller, piston, peristaltic pumps), pressure ejection pumping, submersible pumping, surge blocks, bailing, and air lift pumping (15, 16, 17).

5.5.5 Purging Equipment and Techniques

5.5.5.1 General - Wells shall be purged before taking samples in order to clear the well of stagnant water which has been standing in the well casing and may not be representative of aquifer conditions. One method of

purging is to pump the well until three to five times the volume of standing water in the well has been removed. A second method is to pump the well until the specific conductance, temperature and pH of the groundwater stabilizes. Normally, a combination of the two methods is employed (i.e., specific conductance, temperature, and pH are measured at intervals and a record of the volume purged is monitored). If a well is pumped dry, this constitutes an adequate purge and the well can be sampled following recovery (15, 17).

5.5.5.2 Equipment Available - Monitoring well purging is accomplished by using in-place plumbing/pumps or when in-place pumps are not available, by using a proper equipment, such as peristaltic, turbine, bladder, centrifugal, or other appropriate pump, depending on well depth. A Teflon, closed top bailer may be used for purging; however, bailing stirs up sediment in the well and tends to increase turbidity. Thus pumping is preferred.

Other monitoring equipment used during purging includes water level indicators, pH meters, thermometers, and conductivity bridges.

5.5.5.3 Purging Techniques (Wells Without Plumbing or in Place Pumps)

5.5.5.3.1 General - For permanently installed wells, the depth of water shall be determined (if possible) before purging. This can be accomplished by attaching a weight on the end of tape and lowering it into the well until it touches the water, or by use of a mechanical or electrical water level indicator. Operating personnel shall exercise extreme caution during this procedure to prevent contamination of the well. This is a critical concern when samples for trace organic compounds or metals analyses are collected.

5.5.5.3.2 Using Pumps to Purge - When suction lift or centrifugal pumps are used, only the intake line is placed into the water column. To minimize contamination, the line placed into the water is either standard cleaned Teflon (see Section 4.0), in the case of the suction lift pumps, or standard cleaned stainless steel pipe attached to a hose, when centrifugal pumps are used.

When submersible pumps (bladder, turbine, displacement, etc.) are used, the pump itself is lowered into the water column.

5.5.5.3.3 Using Bailers to Purge - Standard cleaned (Section 4.0) closed-top bailers with nylon rope are lowered into the top of the water column, allowed to fill and be removed, and the water is discarded.

Cleaning and decontamination materials are specifically mentioned as having to be collected and disposed of properly in Section 4.1.6. Purge water should be held in drums, labeled for each well, then disposed of properly in accordance with water quality laboratory results.

5.5.5.3.4 Field Care of Purging Equipment - Regardless of which method is used for purging, new aluminum foil or plastic sheeting shall be placed on the ground surface around the well casing. This is done to prevent contamination of the pumps, hoses, ropes, etc. in the event they need to be placed on the ground during the purging or accidentally come into contact with the ground surface.

It is preferable that hoses used in purging that come into contact with the groundwater be kept on a spool, both during transporting and during field use, to further minimize contamination from the transportation vehicle or ground surface.

5.5.5.3.5 Purging Entire Water Column - The pump/hose assembly or bailer used in purging should be lowered into the top of the standing water column and not deep into the column. This is done so that the purging will "pull" water from the formation into the screened area of the well and up through the casing so that the entire static volume can be removed. If the pump was placed deep into the water column, the water above the pump may not be removed, and the subsequent samples collected may not be representative of the groundwater.

To minimize cross contamination between wells, no more than three to five feet of hose should be lowered into the water column. If the recovery of the well is at least as fast as the pump rate, the pump may be left hanging at the initial level until an adequate volume has been purged. If the pump rate exceeds the recovery rate of the well, the pump will have to be lowered, as needed, to accommodate the draw-down.

After the pump is removed from the well, all wetted portions of the hose and the pump shall be cleaned as outlined in Section 4.0.

Careful consideration shall be given to using pumps to purge wells which are excessively contaminated with oily compounds, because it may be difficult to adequately decontaminate severely contaminated pumps under field conditions. When wells such as this are encountered, alternative purging methods, such as bailers, should be considered.

5.5.5.4 Purging Techniques - Wells With in-Place Plumbing

5.5.5.4.1 General - In-place plumbing is found at water treatment plants, industrial water supply wells, private residences, etc. The objective of purging is the same as with monitoring wells without in-place pumps -- to ultimately collect a sample representative of the groundwater.

The volume to be purged depends on several factors: whether the pumps are running continuously or intermittently, how close to the source the sample can be collected, and the presence of any storage/pressure tanks between the sampling point and the pump. If storage/pressure tanks are present, an adequate volume must be purged to totally exchange the volume of water in the tank.

5.5.5.4.2 Continuously Running Pumps - If the pump runs continuously, and the sample can be collected prior to a storage/pressure tank, no purge, other than opening a valve and allowing it to flush for a few minutes, is necessary.

If the pump runs continuously, and a storage/pressure tank is located ahead of the sample location, the purge must include the entire storage volume to be sure that a sample representative of the groundwater will be collected.

5.5.5.4.3 Intermittently Running Pumps - If the pump runs intermittently, it is necessary to determine the volume to be purged, including storage/pressure tanks that are located ahead of the sampling location.

The pump should then be run continuously until the required volume has been purged.

5.5.6 Sampling Equipment and Techniques

5.5.6.1 Equipment Available - Sampling equipment which can be used includes closed-top bailers and the peristaltic pump/vacuum jug assembly.

Other monitoring equipment used during sampling includes water level indicators, pH meters, thermometers, and conductivity bridges.

5.5.6.2 Sampling Techniques - Wells With in Place Plumbing - Following purging, samples should be collected from a valve or cold water tap as near to the well as possible. Samples should be collected directly into the appropriate containers (see recommended Sample Containers, Appendix 5X.1). Also, refer to the Potable Water Supply discussion in Section 5.6.

5.5.6.3 Sampling Techniques - Wells Without Plumbing - Following purging, samples should be collected using a peristaltic pump - vacuum jug procedure, if possible, or with a closed top bailer. The pump used for purging

generally should not be used for sampling. When the peristaltic pump is used, samples for purgeable organic compounds should be collected using a bailer or by allowing the Teflon tube to fill and then allowing the water to drain into the sample vials. All equipment shall be cleaned using the procedures described in Section 4.0. Also, refer to the Potable Water Supply discussion, Section 5.6, for additional information.

When bailing, new foil or plastic sheeting should be placed on the ground around each well to prevent contamination of sampling equipment in the event any equipment is dropped or otherwise comes in contact with the ground. Braided nylon cord may be used to haul the bailer if the nylon cord is used only one time and then discarded. Teflon coated wire, single strand stainless steel wire, or monofilament are acceptable for hauling bailers and may be decontaminated for reuse.

5.5.7 Special Sample Collection Procedures

5.5.7.1 Trace Organic Compounds and Metals - Special sample handling procedures shall be instituted when trace organic compounds and metals samples are being collected. All sampling equipment, including pumps, bailers, drilling equipment, water level measurement equipment, etc., which come into contact with the water in the well must be cleaned in accordance with the cleaning procedures described in Section 4.0. Synthetic drilling mud (i.e., Revert) should not be used when constructing wells which will be used for trace organic compounds and metals sampling. Pumps shall not be used for sampling, unless the interior and exterior portions of the pump and discharge hoses can be thoroughly cleaned. Blanks should be collected to determine the adequacy of cleaning prior to collection of any sample using a pump. Peristaltic pumps using Teflon tubing and a Teflon insert can be used to collect samples without the sample coming into contact with the pump. This is accomplished by placing the Teflon insert into the opening at a standard cleaned gallon glass container (Section 4.0). The Teflon tubing connects the container to the pump and sample source. The pump creates a vacuum in the container, thereby drawing the sample into the container without coming into contact with the pump tubing. Samples for purgeable organic compounds analyses shall be collected with well bailers or by allowing the Teflon tube to fill and then allowing the water to drain into sample collection vials. The procedures given in the General Considerations, Special Precautions for Trace Contaminant Sampling (Section 5.2) shall be followed.

5.5.7.2 Filtering - As a standard DEC BSPR policy, groundwater samples should not be filtered in the field. However, if required by RCRA regulations, then both filtered and non-filtered samples will be submitted for analyses. Proper well installation and development as well as proper well purging technique should minimize the turbidity of samples. Whenever extremely high concentrations of sediment are present in a well sample, the aliquot of the sample for metals analyses should not be preserved without first being filtered. Whenever samples for dissolved metals analyses are collected, an additional sample, unfiltered and acid preserved will also be collected for total metals analyses. Samples for analyses of organic compounds shall never be filtered. When samples are being filtered in the field, the filter apparatus must be cleaned (Section 4.0) and samples must be filtered properly.

5.5.7.3 Bacterial Sampling - Whenever wells (normally potable wells) are sampled for bacteriological parameters, care must be taken to ensure the sterility of all sampling equipment and all other equipment entering the well. Further information regarding bacteriological sampling is available in Sampling for Organic Chemicals and Microorganisms in the Subsurface (19) as well as References 4 and 5.

5.5.8 Specific Sampling Equipment Quality Assurance Techniques

All equipment used to collect groundwater samples shall be cleaned as outlined in Section 4.0 and repaired, if necessary, before being stored at the conclusion of field studies.

All equipment shall be tested before being issued for field studies.

Cleaning procedures conducted in the field (Section 4.0) or field repairs shall be thoroughly documented in field records.

5.5.9 Auxiliary Data Collection

Water table measurements from the top of the well casings (referenced to National Geodetic Vertical Datum) in permanent wells, and ground surface elevation in temporary wells should be made to determine the general direction of groundwater flow and gradient. Traced dyes and thermal detection methods can be used to determine direction and velocities of flow (14). Also, a study of the general topography and drainage patterns will generally indicate direction of groundwater flow.

Water table measurements shall not be taken until the water table has stabilized, preferably 24 hours after well installation for permanent wells (20). The ground surface elevation at the wells should be determined by standard engineering survey practices.

In addition to water level measurements, the pumping rate used to purge a well, the volume of water in wells, and drillers logs are examples of auxiliary data that should be collected during groundwater sampling activities. This information should be documented in field records. Methodology for obtaining these data are given in the following sections.

Temperature, specific conductance, and pH shall be measured each time a well is sampled. This information is generally obtained during the purging process to evaluate the adequacy of the purging procedure. In this situation, the final measurements for these parameters prior to sampling shall be considered the measurement of record for the well. If these parameters were not evaluated during purging, they shall be obtained prior to sampling.

5.5.9.1 Well Pumping Rate - Bucket/Stop Watch Method - The pumping rate of a pump can be determined by collecting the flow of water from the pump in a bucket of known volume and timing how long it takes to fill the bucket. The results should be flow rate in gallons per minute. This method shall be used only with pumps with a constant pump rate, such as gasoline powered or electric submersible pumps. It should not be used with battery powered pumps. As the batteries lose their charge, the pump rate decreases so that pumping time calculations using initial, high pump rates are erroneously short.

5.5.9.2 Volume of Water in Wells - In order to purge wells, the volume of water in the well should be known. To determine the volume, the following method should be used; measure the distance from the bottom of the well to the static water level, then measure the inside diameter of the well or casing. Obtain the volume of the well by the formula:

$$V = 0.041 d^2 h \quad \text{Where:} \quad \begin{array}{l} h = \text{depth of water in feet} \\ d = \text{diameter of well in inches} \\ V = \text{volume of water in gallons} \end{array}$$

If preferred, a quick reference nomograph or table may be used.

5.5.9.3 Driller's Log - It is imperative that drilling logs be concise, complete, and described in a manner that is easily understood to all who read them. The following items shall be included in the logging data:

- hole number and location;
- description of soils and subsurface conditions (if applicable);
- type of drilling equipment, driller, and drilling company (if applicable);
- method of drilling;
- type and size of casing;
- type and size of well screen;
- depth to well screen;
- type of pump and pumping rate;
- drilling and sampling times;

- depth to water table, and date and time measured;
- types of samples taken and depths at which the sample was taken;
- volume of water purged;
- type of well (permanent or temporary);
- type of sampling equipment and/or cleaning procedure; and
- depth of sampling and description (if applicable).

Additional groundwater related data can be obtained from most local, state, and federal agencies dealing with water resources. Some sites require well drillers to be licensed, and all work performed on wells must be reported to the state on prescribed forms. These forms are available to the public, so a study of wells installed in the area of interest will provide background information as to the subsurface conditions. State geological surveys, as well as the USGS, have various types of water related papers and reports on all phases of groundwater studies in each state. City and county governments usually have departments that deal with water related projects that may provide data for the local area. Federal agencies such as the U.S. Army Corps of Engineers, the Bureau of Reclamation, U.S. Forest Service, Science and Education Administration, and the U.S. Public Health Service have water programs and may provide data. Other sources include the Bureau of Mines, colleges, universities, and technical societies such as the American Association of Petroleum Geologists, American Institute of Mining and Metallurgical Engineers, National Water Well Association, Association of Engineering Geologists, and Geological Society of America (14,21).

5.6 SAMPLING OF POTABLE WATER SUPPLIES

5.6.1 General

When sampling potable water supplies, utmost care must be taken to insure that samples are representative of the water supply being sampled. This is important not only from a technical and public health perspective, but also from a public relations standpoint. Poor sampling techniques may result in incorrect results (either not detecting a compound which is present or by contaminating the sample and falsely indicating a compound which is not present). If incorrect results are disclosed to the public, it may be very difficult to change public opinion when correct results are reported.

5.6.2 Sampling Site Selection/Sampling Techniques

Even though the same care and techniques used in groundwater, etc., sampling (including thorough documentation of location, date, time, etc.) are used by sampling personnel in potable water supply sampling, there are certain additional special procedures which shall be used.

When water samples are collected from wells, either by mechanical or hand pumping, the wells must be purged before the sample is collected (see Section 5.5 for groundwater sampling methods). This procedure insures that water in the well field is sampled, not the standing water in the pump or holding tank. As a rule of thumb, at least one volume of water in the well casing and storage tank should be evacuated (see Section 5.5.5.4 for more details). This also insures that any contaminants that might have entered the area of the tap from external sources are flushed away (19).

Potable water samples shall be representative of the water quality within a given amount of the distribution network. Taps selected for sample collection should be supplied with water from a service pipe connected directly to a water main in the segment of interest and should not be separated from the segment of interest by a storage tank. The sampling tap must be protected from exterior contamination associated with being too close to the sink bottom or to the ground. Contaminated water or soil from the faucet exterior may enter the bottle during the collecting procedure since it is difficult to place a bottle under a low tap without grazing the neck interior against the outside faucet surface. Leaking taps that allow water to flow out from around the stem of the valve handle and down the outside of the faucet, or taps in which water tends to run up on the outside of the lip, are to be avoided as sampling locations. Aerator, strainer, and hose attachments on the tap must be removed before sampling. These devices can harbor a bacterial population if they are not cleaned routinely or replaced when worn or cracked. Whenever a steady stream of water cannot be obtained from taps, after such devices are removed, a more suitable tap shall be sought. Taps where the water flow is not steady should be avoided because temporary fluctuation in line pressure may cause sheets of microbial growth that are lodged in some pipe section or faucet connection to break loose and contaminate the sample. The cold water tap should be opened for two or three minutes or for sufficient time to permit clearing of the service line. A smooth-flowing water stream at moderate pressure without splashing should be obtained. Then, without changing the water flow which could dislodge some particles in the faucet, the samples can be collected (19).

Regardless of the type of sample bottle being used, the bottle cap should not be placed on the ground or in a pocket. Instead, hold the bottle in one hand and the cap in the other, keeping the bottle cap right side up (threads down) and using care not to touch the inside of the cap. Exercise care not to lose the Teflon liner in certain bottle caps. Avoid contaminating the sample bottle with fingers or permitting the faucet to touch the inside of the bottle. When sampling for bacterial content, the bottle should not be rinsed before use. This may not only contaminate the bottle, but also remove the thiosulfate dechlorinating agent (if used). When filling any container, care should be taken so splashed drops of water from the ground or sink do not enter into either the bottle or cap. In order to avoid dislodging particles in the pipe or valve, do not adjust the stream flow while sampling.

When sampling at a water treatment plant, samples should be collected both from the raw water supply and after chlorination.

Duplicate samples will always be collected for VOA and bacterial analyses. Single samples may be collected for extractable organic compounds, metals, phenol, cyanide, and conventional parameter analyses. The procedures given in Section 5.2.9 (Special Precautions for Trace Contamination Sampling) and in the Section 5.6.2.1 below (Purgeable Organic Compounds Sample Collection) shall always be followed when potable water supplies are sampled.

DEC BSPR or contractor shall always obtain the name(s) of the resident or water supply owner/operator and the resident's exact mailing address, as well as the resident's home and work telephone numbers. The information is required so that the residents or water supply owner/operators can be informed of the results of the sampling program.

5.6.2.1 Purgeable Organic Compounds Analyses (VOA) - Samples to be analyzed for purgeable organic compounds should be stored in 40 ml septum vials with screw caps that have a Teflon lined silicone disk in the cap to prevent contamination and loss of the sample through the cap. The disks should be placed in the caps (Teflon in contact with the sample) in the laboratory prior to the beginning of the sampling program.

When sampling for purgeable organic compounds, duplicate samples should always be collected from each location. The investigator should determine if the water to be sampled contains chlorine. If the water contains no chlorine, two 40-ml vials containing four drops of concentrated HCl should be filled with the sample and labeled PA (preserved acid). If the sample contains no chlorine and only if it will be analyzed within 24 hours, the HCl preservation is not necessary. If the water contains chlorine, the following sampling and preservation procedure should be followed:

- Fill a 4-ounce (120 ml) soil VOA sampling container containing 0.008 percent sodium thiosulfate with the water sample. Cap and mix thoroughly but gently by swirling to eliminate residual chlorine. Transfer the sample to two 40-ml VOA vials containing four drops of concentrated HCl*. Label 40-ml vials - PTA (preserved/sodium thiosulfate/acid).

* The sodium thiosulfate preservatives must be added in this order and in two separate steps because HCl reacts with sodium thiosulfate.

The purgeable organics vials (40-ml) should be completely filled to prevent volatilization, and extreme caution should be exercised when filling a vial to avoid any turbulence which could also produce volatilization. The sample should be carefully poured down the side of the vial to minimize turbulence. As a rule, it is best to gently pour the last few drops into the vial so that surface tension holds the water in a "convex meniscus". The cap is then applied and some overflow is lost, but air space in the bottle is eliminated. After capping, turn the bottle over and tap it to check for bubbles; if any are present, repeat the procedure.

Sampling and preservation containers should be pre-labeled (i.e., PA, PT, or PTA) prior to any field activities. This will reduce the chances of confusion during sampling activities by the investigation team.

5.6.3 Sampling Equipment/Specific Sampling Equipment Quality Assurance Techniques

Sampling equipment and specific equipment quality assurance techniques are contained in Section 5.5 (Groundwater Sampling).

5.7 SOIL SAMPLING

5.7.1 General

The objective of this section is to give general guidance for the collection of soil samples during field investigations. Guidance for preparing soil sampling protocols, including statistical sampling methodology are included in the EPA publication "Preparation of Soil Sampling Protocol, Techniques and Strategies" (22).

5.7.2 Sampling Location/Site Selection

Any site selected for soil sampling shall be strategically located in order to collect a representative fraction of the soils with the minimum number of samples and amount of effort. A surface inspection of the subject area shall be made to locate pertinent features (e.g., rock outcrops, drainage patterns, surface runoff, ponds, lakes, wet areas, seeps, springs, permanent structures, fill areas, erosional areas, depositional areas, etc.) and to evaluate the relationship between these features and potential sources of pollution. The location of sediment depositional areas are good indicators of surface runoff direction. If the direction of surface runoff or drainage is difficult to detect, observation of new depositions or sediment movement following a rain may prove helpful in establishing this direction. The spreading or fanning of the sediment body will indicate direction of flow.

In most instances, the first investigation of a site will be a reconnaissance type survey. Soil sampling in these instances will generally be confined to surface or near-surface soils and/or sediments with hand equipment. For screening purposes, sampling of this type should be conducted in depositional areas on the periphery of the study area, primarily at the downstream or downgradient portion(s) of the area of interest; however, an upgradient location should also be selected for obtaining background and/or control samples. Investigators should be aware that sampling in depositional areas tends to bias the sampling toward elevated concentrations, which is useful as a screening tool, but should not be construed as representative of the area conditions.

More in-depth investigations are usually conducted after a preliminary study or reconnaissance survey has been completed. Review of previous investigations will aid in selection of suitable sampling locations, and these studies should be examined when the study plan for the more detailed study is prepared. The number of samples and the number of test pits and/or borings and the specific depth that samples are collected will vary according to the site conditions and the scope of the investigation. A determination of soil sample number and location based on statistical concept is discussed in Section 6B.1.

5.7.3 Equipment Available

The following equipment is available for field use in soil sampling: stainless steel spoons; stainless steel hand augers; stainless steel shovels; Shelby tubes; portable power augers (Little Beaver); stainless steel scoops; glass pans; and drill rigs and associated equipment (i.e., split spoon samplers), which may, on occasion, be rented or borrowed for special projects.

5.7.4 Sampling Techniques

5.7.4.1 General - Sampling is often conducted in areas where a vegetative turf has been established. In these cases a clean stainless steel shovel should be used to carefully remove the turf so that it may be replaced at the conclusion of sampling. When the soil sample is obtained, it should be deposited into a glass pan for mixing (or compositing, if applicable) prior to filling in the sample containers. Mixing of the soil sample for non-volatile or non-semi volatile chemical analysis should be performed in accordance with the procedures outlined in Section 5.7.4.5. If an undisturbed sample is needed, the Shelby tube sampler may be used as described in Section 5.7.4.2.

If practical, and at the project leader's discretion, all trenches or holes that were excavated for sampling

should be filled in and the turf replaced.

5.7.4.2 Surface Soil Sampling - Prior to sampling, leaves, grass, and surface debris should be removed from the area to be sampled using a clean stainless steel spoon or shovel. Surface soil samples shall then be collected using a precleaned, stainless steel scoop or spoon.

5.7.4.3 Shallow Subsurface Soil Sampling - Shallow subsurface soil samples may be collected by digging a hole or trench with a stainless steel shovel, then removing all of the loose soil and collecting a sample at the desired depth using a stainless steel spoon, a stainless steel hand auger, or a Shelby tube.

The stainless steel hand auger consists of three basic parts: (1) the bucket, (2) extension, and (3) handle. At the bottom end of the bucket are two cutting edges. The extensions are three feet long. When sampling deeper subsurface soil (Section 5.7.4.4), a number of extensions may be joined end to end to increase the depth from which soil may be sampled.

The Shelby tube is a stainless steel tube approximately 12 inches long and 2 inches in diameter. One end of the tube has the edges beveled into a cutting edge. The other end can be mounted on an adapter which allows attachment to the end of the hand auger. The Shelby tube is pushed into the soil to be sampled and then removed. The tube can then be removed from the adapter and the soil pushed out using a decontaminated piece of equipment such as the handle of a stainless steel spoon. If an undisturbed sample is required, the Shelby tube with its sample intact may be shipped directly to the laboratory for analyses.

5.7.4.4 Deeper Subsurface Soil Sampling - For deeper sampling using hand equipment, a stainless steel auger (see Section 5.7.4.3) is used to bore a sampling hole until the desired depth is reached. Another clean auger bucket or a Shelby tube is then used to collect the sample which is placed in a glass pan as described in Section 5.7.4.1. Surface debris should be removed from the location of the sampling hole using a clean, stainless steel shovel or spoon before auguring operations are initiated.

Often the depth which can be reached using a hand auger is limited due to the soil having low cohesion which leads to the hole collapsing or to the soil being very tightly packed, which can make turning and removing the auger difficult. In cases such as these, a portable power auger Little Beaver may be used to reach the desired depth. The sample can then be collected as described in the previous paragraph. The portable power auger consists of a powered drive unit (hand-held) used by sampling personnel to drive crew-like auger flights. The auger flights should be cleaned using the same procedures as for the other soil sampling equipment (Section 4.0). For safety reasons, the Little Beaver portable power auger should never be used with less than two sampling personnel present.

The split spoon sampler may be used for sampling at greater depths. Because of its weight, the split spoon sampler is generally used with power equipment, i.e., drilling rig. A hollow stem auger is used to advance the hole to the desired depth. The split spoon is added to the correct length of drill rod and forced into the undisturbed soil by means of a 140-pound weight or hammer. The split spoon is retrieved from the hole and opened to reveal the sample. The top two or three inches of the sample normally will be disturbed and should be discarded. The undisturbed portion should be placed in a glass pan by means of a clean, stainless steel spoon or spatula. The procedure is repeated until the desired amount of sample is collected. The sample should then be thoroughly mixed.

5.7.4.5 Mixing - Regardless of the method of collection, soil samples collected for non-volatile chemical analyses should be thoroughly mixed before being placed in the appropriate sample containers. The soil should be removed from the sampling device (dredge, core tube, scoop, etc.) and placed in a glass or Teflon coated stainless steel pan. The soil in the pan should be scraped from the sides, corners, and bottom of the pan, rolled to the middle of the pan, and initially mixed. The sample should then be quartered and moved to the four corners of the container. Each quarter of the sample should be mixed individually. Each quarter is then rolled to the center of the container and the entire sample is mixed again.

This procedure should be continued to ensure that all parts of the sample are mixed and that the sample is as homogenous as possible before being placed in the sample containers.

5.7.5 Special Precautions for Trace Contaminant Soil Sampling

The procedures outlined in Section 5.2.11 shall be followed. All soil sampling equipment used for sampling of trace contaminants should be constructed of stainless steel whenever possible. In no case will chromium, cadmium, or galvanized plated or coated equipment be used for soil sampling operations. Similarly, no painted equipment shall be used. All paint and primer must be removed from soil sampling equipment by sandblasting or other means before such equipment can be used for collecting soil samples.

5.7.6 Soil Samples Collected for Purgeable Organic Compounds Analyses (VOA)

When soil samples collected for purgeable organic compounds analyses need to be mixed in field, they should be done properly and placed in containers as soon as possible after sampling. The sample should be placed in the sample container so that no head space is left in the container after the container is closed.

5.7.7 Specific Sampling Equipment Quality Assurance Techniques

Drilling rigs and other major equipment used to collect soil samples shall be identified so that they can be traced through field records. A log book shall be established for this equipment so that all cleaning, maintenance and repair procedures can be traced to the person performing these procedures and to the specific repairs made. Sampling spoons, hand augers, Shelby tubes, and other minor disposable type equipment are exempted from this equipment identification requirement.

All equipment used to collect soil samples shall be cleaned as outlined in Section 4.0 and repaired, if necessary, before being stored at the conclusion of field studies.

Any cleaning conducted in the field (Section 4.0) or field repairs should be thoroughly documented in field records.

5.7.8 Auxiliary Data Collection

In addition to information pertaining to an area of specific site/location that may be available in DEC BSPR files from previous investigations (i.e., site screenings, water quality, well monitoring studies, etc.) information and data may be obtained from various city, county, federal, and other state agencies.

A system of logging all pertinent data collected during drilling and sampling operations should be maintained. The test hole locations should be recorded and referenced to the site map and/or datum base so that each location can be permanently established. Samples should be accurately tagged and labeled with all pertinent site information at the time of sampling.

APPENDIX 5X.1
RECOMMENDED SAMPLE CONTAINERS, SAMPLE PRESERVATION, MAXIMUM SAMPLE HOLDING TIMES, AND
PERMISSIBLE SAMPLE TYPES

<u>Parameter</u>	<u>Container</u>	<u>Preservative</u>	<u>Maximum Holding Time</u>	<u>Permissible Sample Type</u>	<u>Reference</u>
<u>Concentrated Waste Samples</u>					
Organic Compounds	8-oz. widemouth glass with Teflon liner	None	7 days	G or C	A
Metals and Other Inorganic Compounds	8-oz. widemouth glass with Teflon liner	None	7 days	G or C	A
EP Toxicity	8-oz. widemouth glass with Teflon liner	None	7 days	G or C	B
Flash Point and/or Heat Content	8-oz. widemouth glass with Teflon liner	None	ASAP - NS	G	B
<u>Fish Samples</u>					
Organic Compounds	Wrap in aluminum foil	Freeze	ASAP	G or C	A
Metals and Other Inorganic Compounds	Place in plastic ziplock bag	Freeze	ASAP	G or C	A
<u>Liquid - Low to Medium Concentration Samples</u>					
Alkalinity	500-ml or 1-liter poly- ¹ ethylene with polyethylene or polyethylene lined closure	Cool, 4°C	12-14 days	G or C	C
Acidity	500-ml or 1-liter poly- ¹ ethylene with polyethylene or polyethylene lined closure	Cool, 4°C	12-14 days	G or C	C
Bacteriological Tests (coliform)	250-ml glass with glass closure or plastic capable of being autoclaved	Cool, 4°C	6 hrs.	G	C

<u>Parameter</u>	<u>Container</u>	<u>Preservative</u>	<u>Maximum Holding Time</u>	<u>Permissible Sample Type</u>	<u>Reference</u>
<u>Liquid - Low to Medium Concentration Samples (Continued)</u>					
Static Bioassay	1-gal. amber glass (not solvent rinsed)	Cool, 4° C	48 hrs.	G or C	D
Biochemical Oxygen Demand (BOD)	1/2-gal. polyethylene ¹ with polyethylene closure	Cool, 4° C	48 hrs.	G or C	C
Chloride	500-ml or 1-liter poly- ¹ ethylene with polyethylene or polyethylene lined closure	None	28 days	G or C	C
Chlorine Residual	In-situ, beaker or bucket	None	Analyze Immediately	G	C
Color	500-ml or 1-liter poly- ¹ ethylene with polyethylene or polyethylene lined closure	Cool, 4° C	48 hrs.	G or C	C
Conductivity	500-ml or 1-liter poly- ¹ ethylene with polyethylene or polyethylene lined closure	Cool, 4° C	28 days (determine on site if possible)	G or C	C
Chromium, Hexavalent	1-liter polyethylene with polyethylene closure	Cool, 4° C	24 hrs.	G	C
Cyanide	1-liter or 1/2-gallon polyethylene with polyethylene or polyethylene lined closure	Ascorbic Acid ^{2,3} Sodium Hydroxide, pH > 12, Cool, 4° C. None	14 days	G	C
Dissolved Oxygen (Probe)	In-situ, beaker or bucket	None	Determine On Site	G	C
Dissolved Oxygen (Winkler)	300-ml glass, BOD bottle	Fix on site, store in dark	8 hrs. (determine on site if possible)	G	C

Parameter Container

Liquid - Low to Medium Concentration Samples (Continued)

<u>Parameter</u>	<u>Container</u>	<u>Preservative</u>	<u>Maximum Holding Time</u>	<u>Permissible Sample Type</u>	<u>Reference</u>
EP Toxicity	1-gal. glass (amber) with Teflon liner	Cool, 4°C	7 days till extraction	G or C	B
Fluoride	1-liter polyethylene or 1/2-gal. polyethylene with polyethylene or polyethylene lined closure	None	28 days	G or C	C
Hardness	500-ml or 1-liter polyethylene with polyethylene or polyethylene lined closure	50% Nitric ² Acid, pH <2	6 months	G or C	C
LAS	500-ml or 1-liter poly- ¹ ethylene with polyethylene or polyethylene lined closure	Cool, 4°C	48 hrs.	G or C	C
Metals (Total)	1-liter polyethylene with polyethylene lined closure	50% Nitric ² Acid, pH <2	6 months (except Hg, Cr ⁺⁺⁶)	G or C	C
Metals, Dissolved	1-liter polyethylene with polyethylene lined closure	Filter-on-site ² 50% Nitric Acid, pH <2	6 months (except Hg, Cr ⁺⁺⁶)	G	C
Nutrients ⁴ (NH ₃ , COD, TOC, nitrate-nitrite, etc.)	1-liter polyethylene or 1/2-gal. polyethylene with polyethylene or polyethylene lined closure	50% Sulfuric ² Acid, pH <2 Cool, 4°C	28 days	G or C	C
Oil and grease	1-liter widemouth glass with Teflon liner	50% Sulfuric ² Acid, pH <2 Cool, 4°C	28 days	G	C

Parameter
Liquid - Low to Medium Concentration Samples (Continued)

Preservative

Maximum Holding Time

Permissible Sample Type

Reference

Organic Compounds --
Extractable and
Pesticide Scan

C

No Residual Chlorine
Present

1-gal. amber glass or 2 1/2-
gal. amber glass with Teflon
liner

5-7 days³

G or C

C

Residual Chlorine
Present

1-gal. amber glass or 2 1/2-
gal. amber glass with Teflon
liner

Add 3 ml 10%
sodium thiosulfate
per gallon Cool,
4°C

5-7 days³

G or C

C

Organic Compounds -
Purgeable (VOA)

No Residual Chlorine
Present

2 40-ml vials with Teflon
lined septum caps

4 drops conc.
hydrochloric acid,
Cool, 4°C

14 days

G

C

No Residual Chlorine
Present

2 40-ml vials with Teflon
lined septum caps

7 days

G

C

Residual Chlorine
Present

2 40-ml vials with Teflon
lined septum caps

Footnote 6

14 days

G

C

Organic Compounds -
Specified and Pesticides
(Non-Priority Pollutants
such as Herbicides)

1-gal. galss (amber) or 2
1/2-gal. glass (amber) with
Teflon lined closure

7 days⁷

G or C

C

Organic Halides -
Total (TOX)

250-ml amber glass with
Teflon lined septum closure

7 days

G

E

pH

In-situ, beaker or bucket

Analyze
Immediately

G

C

Phenols

1-liter amber glass with
Teflon lined closure

50% Sulfuric
Acid, pH <2
Cool, 4°C

28 days

G

C

<u>Parameter</u>	<u>Container</u>	<u>Preservative</u>	<u>Maximum Holding Time</u>	<u>Permissible Sample Type</u>	<u>Reference</u>
<u>Liquid - Low to Medium Concentration Samples (Continued)</u>					
Phosphate-Ortho	500-ml or 1-liter polyethylene with polyethylene or polyethylene lined closure	Filter-on-site Cool, 4°C	48 hrs.	G	C
Phosphorus, Total Dissolved	500-ml or 1-liter polyethylene with polyethylene or polyethylene lined closure	Filter-on-site 50% Sulfuric Acid, pH < 2, Cool, 4°C	28 days	G	C
Solids, Settleable	1/2-gal. polyethylene with polyethylene closure	Cool, 4°C	48 hrs.	G or C	C
Solids (Total and Suspended, etc.)	500-ml or 1-liter poly- ¹ ethylene with polyethylene or polyethylene lined closure	Cool, 4°C	7 days	G or C	C
Sulfates	500-ml or 1-liter poly- ¹ ethylene with polyethylene or polyethylene lined closure	Cool, 4°C	28 days	G or C	C
Sulfides	500-ml or 1-liter poly- ² ethylene with polyethylene or polyethylene lined closure	2 ml Zinc Acetate ² Conc. Sodium Hydroxide to pH > 9, Cool, 4°C	7 days	G	C
Temperature	In-situ, beaker or bucket	None	Determine On Site	C	C
Turbidity	500-ml or 1-liter poly- ¹ ethylene with polyethylene or polyethylene lined closure	Cool, 4°C	48 hrs.	G or C	C

<u>Parameter</u>	<u>Container</u>	<u>Preservative</u>	<u>Maximum Holding Time</u>	<u>Permissible Sample Type</u>	<u>Reference</u>
<u>Soil, Sediment or Sludge Samples - Low to Medium Concentration</u>					
E.P. Toxicity	8-oz. widemouth glass with Teflon lined closure	Cool, 4°C	7 days till extraction	G or C	B
Metals	8-oz. widemouth glass with Teflon lined closure	Cool, 4°C	6 months	G or C	A
Nutrients Including: Nitrogen, Phosphorus, Chemical Oxygen Demand	500-ml polyethylene with polyethylene closure or 8 oz. widemouth glass with Teflon lined closure	Cool, 4°C	ASAP	G or C	A
Organics - Extractable	8-oz. widemouth glass with Teflon liner	Cool, 4°C	ASAP	G or C	A
Organics - Purgeable (VOA)	4-oz. (120 ml) widemouth glass with Teflon liner	Cool, 4°C	7 days	G or C	A
Other Inorganic Compounds - Including Cyanide	500-ml polyethylene with polyethylene closure or 8-Oz. widemouth glass with Teflon lined closure	Cool, 4°C	7 days	G or C	A
<u>Radiological Tests</u>					
Alpha, beta, gamma	Polyethylene container with polyethylene closure	HNO ₃ to pH < 2	6 months	G or C	

Abbreviation: G = Grab
 C = Composite
 ASAP = As Soon As Possible
 NS = Not Specified

Footnotes:

1. Use indicated container for single parameter requests, 1/2-gallon polyethylene container for multiple parameter requests except those including BOD, or 1-gallon polyethylene container for multiple parameter request which include BOD.
2. Must be preserved in the field at time of collection. For dissolved metals, the sample must be filtered through a 0.45 membrane filter immediately after collection and prior to preservation in the field.
3. Use ascorbic acid only if the sample contains residual chlorine. Test a drop of sample with potassium iodide-starch test paper; a blue color indicates need for treatment. Add ascorbic acid, a few crystals at a time, until a drop of sample produces no color on the indicator paper. Then add an additional 0.6 g of ascorbic acid for each liter of sample volume.
4. May include nitrogen series (ammonia, total Kjeldahl nitrogen, nitrate-nitrite), total phosphorus, chemical oxygen demand and total organic carbon.
5. Samples must be extracted within seven days and extract must be analyzed within 40 days.
6. Collect the sample in a 4 oz. soil VOA container which has been pre-preserved with four drops of 10 percent sodium thiosulfate solution. Gently mix the sample and transfer to a 40 ml VOA vial that has been pre-preserved with four drops concentrated HCl, cool to 4°C.
7. See Organic Compounds - Extractable (the 4th page of this appendix). The Analytical Laboratory should be consulted for any special organic compound analyses in order to check on special preservation requirements and or extra sample volume.

References:

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- B. EPA Method 1310, Extraction Procedures, "SW 846," US-EPA, Office of Solid Wastes, Washington, DC, 1982.
- C. 40 CFR Part 136, Federal Register, Vol. 49, No. 209, October 26, 1984.
- D. US-EPA, Region IV, Environmental Services Division, "Ecological Support Branch, Standard Operating Procedures Manual," latest version.
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APPENDIX 5X.2 -- CHAIN-OF-CUSTODY, DOCUMENT CONTROL, AND STANDARD OPERATING PROCEDURES

The objectives of this section are to present the laboratory proper operating procedures for sample identification, sample control, chain-of-custody, maintenance of records, and document control.

The laboratory should not deviate from the procedures described herein without the written approval of the Bureau of Spill Prevention and Response, or without a DEC approved equivalent.

1. Sample Chain-of-Custody

A sample is physical evidence collected from a facility or from the environment. An essential part of hazardous chemical or material investigations is that samples and data may be used as evidence in NYSDEC enforcement proceedings. To satisfy enforcement uses of the data, the following chain-of-custody procedures have been established.

1.1 Sample Identification

To ensure traceability of samples while in possession of the laboratory, a method for sample identification shall be developed and documented in laboratory Standard Operating Procedures (SOPs) (see Section 3). Each sample or sample preparation container shall be labeled with a unique number identifier (or the NYSDEC Sample Number). This identifier shall be cross-referenced to the NYSDEC Sample Number. There shall be a written description of the method of assigning this identifier and attaching it to the sample container included in the laboratory SOPs.

Samples, other than those collected for in-situ field measurements or analyses, are identified by using a sample tag which is attached to the sample container. In some cases, particularly with biological samples, the sample tag may have to be included with or wrapped around the sample. The sample tags are sequentially numbered and are accountable documents after they are completed and attached to a sample or other physical evidence. The following information shall be included on the sample tag:

- DEC spill, project number and name;
- field identification or sample point number;
- date and time of sample collection;
- designation of the sample as a grab or composite;
- type of sample (groundwater, wastewater, leachate, soil, sediment, etc.) and a very brief description of the sampling location;
- the signature(s) of the sampler(s);
- whether the sample is preserved or unpreserved;
- the general types of analyses to be conducted (VOA, PAH, EPA 624, etc.)
- any relevant comments (such as readily detectable or identifiable odor, color, or known toxic properties).

1.2.1 A Sample is under custody if:

- It is in your actual possession,
- It is in your view after being in your physical possession,
- It was in your possession and then you locked or sealed it up to prevent tampering, or
- It is in a secure area.

1.2.2 - Upon receipt of the samples in custody, the laboratory shall inspect the shipping

**FIGURE 5X.2-1 (Example)
Sample Chain-of-Custody Record***

Must be completed for samples that might be used for enforcement proceedings or litigation.					
Sample ID (Lab Use Only)	Field Reference No.	Date/Time Collected	Sample Collection Point	Type/Number: Water, Air, Soil, Etc.	Remark
Specify Method of Preservation _____ NaOH _____ Cool, 4° C _____ Acidification (specify) _____ Other (specify)			Transporting Samples During transport of the sample from sampling site to laboratory, the chain-of-custody must be unbroken. Generally, this will require that the sample be delivered by the sample collector or a designated representative, who will sign for the receipt, integrity, and transfer of the sample during shipment. <u>If integrity of sample is questioned, describe problem on reverse side of this form.</u>		

		CUSTODY OF SAMPLES			
		Name	Affiliation	Date	
Time					
1.	Sample Container:				
	Prepared by:				
2.	Received by:				
3.	Received by:				
4.	Sample Collected by:				
5.	Sample Received by:				
6.	Sample Received by:				
7.	Sample Received by:				
8.	Sample Received by:				
9.	Sample Received by:				
10.	Sample Rec'd for Lab by:				
11.	Sample Accessed by:				

* This form was developed based on the chain-of-custody report used by Center for Laboratories and Research, New York State Department of Health.

FIGURE 5X2-2 (Example)

PROJECT NO.:		PROJECT NAME:		Name of Facility/Site:					
SAMPLERS (Signature)				Facility/Site Location:					
Split Samples Offered () Accepted () Declined									
STATION NO.	DATE	TIME	COMP	GRAB	SPLIT SAMPLES	TAG NUMBERS	SITE/STATION DESCRIPTION	NO. OF CONTAINERS	REMARKS
Transferred by: (Signature)					Received by: (Signature)		Telephone		
Date:		Time:		Date:		Time:			

container and sample bottles and shall document receiving information as specified in Section 3.2. The sample custodian or a designated representative shall sign and date appropriate receiving documents at the time of receipt (i.e. chain-of-custody forms (Figure 5X.2-1), Contract Lab Receipt of Samples Information Sheets (Figure 5X.2-2), airbills, etc.). The laboratory shall contact the Bureau of Spill Prevention and Response if documents are absent, if information on receiving documents does not agree, if custody seals are not intact, or if the sample is not in good condition. The laboratory shall document resolution of any discrepancies, and this documentation shall become a part of the permanent case file.

1.2.3 - Once samples have been accepted by the laboratory, checked, and logged in, they must be maintained in accordance with custody and security requirements specified in 3.3.

2. Document Control Procedures

The goal of the laboratory document control program is to ensure that all documents for a specified case will be accounted for when the project is completed. Accountable documents used by Contractor laboratories shall include, but not be limited to, logbooks, chain-of-custody records, sample work sheets, bench sheets, and other documents relating to the sample or sample analyses. The following document control procedures have been established to ensure that all laboratory records are assembled and stored for delivery to NYSDEC upon request from NYSDEC.

2.1 Pre-printed Data Sheet and Logbooks

Pre-printed data sheets shall contain the name of the laboratory and be dated and signed by the analyst or individual performing the work. All documents produced by the laboratory which are directly related to the preparation and analysis of NYSDEC samples shall become the property of the NYSDEC and shall be placed in the case file. For that reason, all observations and results recorded by the laboratory, but not on pre-printed data sheets, shall be entered into permanent laboratory logbooks. The person responsible for the work shall sign and date each entry and/or page in the logbook. When all data from a case is compiled, copies of all NYSDEC case-related logbook entries shall be included in the documentation package. Analysts' logbook entries must be in chronological order and shall include only one Case per page. Instrument run logs shall be maintained so as to enable a reconstruction of the run sequences of individual instruments.

Because the laboratory must provide copies of the instrument run logs to NYSDEC, the laboratory may exercise the option of using only laboratory or NYSDEC sample identification numbers in the logs for sample ID rather than government agency or commercial client names.

Using laboratory or NYSDEC Sample Number ID's only in the run sequences will assist the laboratory in preserving the confidentiality of commercial clients.

2.2 Error Correction Procedure

All documentation in logbooks and other documents shall be in ink. If an error is made, corrections shall be made by crossing a line through the error and entering the correct information. Changes shall be dated and initialed. No information shall be obliterated or rendered unreadable.

2.3 Consistency of Documentation

Before releasing analytical results, the laboratory shall assemble and cross-check the information on sample tags, custody records, lab bench sheets, personal and instrument logs, and other relevant data to ensure that data pertaining to each particular sample or case is consistent throughout the case file.

2.4 Document Numbering and Inventory Procedure

In order to provide document accountability of the completed analysis records, each item in a case

shall be inventoried and assigned a serialized number and identifier associating it to the case and region.

Case # - Region - Serialized Number (For Example: 75-2-0240)

The number of pages of each item must be accounted for if each page is not individually numbered. All documents relevant to each case, including logbook pages, bench sheets, mass spectra; chromatographs, custody records, library search results, etc., shall be inventoried. The laboratory shall be responsible for ensuring that all documents generated are placed in the file for inventory and are delivered to NYSDEC in the Case File Purge package. Figure 1 is an example of a document inventory.

FIGURE 1 (Example) DOCUMENT INVENTORY		
<u>Document Control #*</u>	<u>Document Type</u>	<u># Pages</u>
232-2-0001	Case File Document Inventory Sheet	1
232-2-0002	Chain-of-Custody Records	2
232-2-0003	Shipping Manifests	2
232-2-0004	Sample Tags	50
232-2-0005	Contract Lab Sample Information Sheets	10
232-2-0006	Inorganics Analysis Data Summary Sheets	10
232-2-0007	Analysts' Notebook Pages	14
232-2-0008	ICP and AA Instrument Logbook Pages	12
232-2-0009	GC/MS Spectra for Sample R-388-061-01	
232-2-0010	GC/MS Spectra for Sample R-388-0610-2	
etc.	etc.	etc.

* This number is to be recorded on each set of documents.

2.5 Shipping Data Packages and Case Files

The laboratory shall have written procedures to document shipment of deliverables packages to the recipients. These shipments require custody seals on the containers placed such that it cannot be opened without damaging or breaking the seal. The laboratory shall also document what was sent, to whom, the date, and the method (carrier) used.

3. Standard Operating Procedures

The laboratory must have written standard operating procedures (SOPs) for: (1) receipt of samples, (2) maintenance of custody, (3) sample storage, (4) tracking the analysis of samples, and (5) assembly of completed data.

An SOP is defined as a written narrative step-by-step description of laboratory operating procedures including examples of laboratory documentation. The SOPs must accurately describe the actual procedures used in the laboratory, and copies of the written SOPs shall be available to the appropriate laboratory personnel. These procedures are necessary to ensure that analytical data produced under this protocol are acceptable for use in NYSDEC enforcement case preparation and litigation. The laboratory's SOPs shall provide mechanisms and documentation to meet each of the following specifications and shall be used by NYSDEC as the basis for laboratory evidence audits.

3.1 The laboratory shall have a designated sample custodian responsible for receipt of samples

and have written SOPs describing his/her duties and responsibilities.

3.2 The laboratory shall have written SOPs for receiving and logging in of the samples. The procedures shall include but not be limited to, documenting the following information:

- Presence or absence of appropriate chain-of-custody forms
- Presence or absence of airbills
- Presence or absence of appropriate Contract Lab Receipt of Samples Information Sheet
- Presence or absence of custody seals on shipping and/or sample containers and their condition
- Presence or absence of sample tags
- Sample tag ID numbers if not recorded on the chain-of-custody record(s) or packing list(s)
- Condition of the shipping container
- Condition of the sample bottles
- Verification of agreement or non-agreement of information on receiving documents
- Resolution of problems or discrepancies with the Bureau of Spill Prevention and Response.

3.3 The laboratory shall have written SOPs for maintenance of the security of samples after log-in and shall demonstrate security of the sample storage and laboratory areas. The SOPs shall specifically include descriptions of all storage areas for NYSDEC samples in the laboratory, and steps taken to prevent sample contamination. The SOPs shall include a list of authorized personnel who have access or keys to secure storage areas.

3.4 The laboratory shall have written SOPs for tracking the work performed on any particular sample. The tracking SOP shall include the following:

3.4.1 A description of the documentation used to record sample receipt, sample storage, sample transfers, sample preparations, and sample analyses.

3.4.2 A description of the documentation used to record instrument calibration and other QA/QC activities.

3.4.3 Examples of the document formats and laboratory documentation used in the sample receipt, sample storage, sample transfer, and sample analyses.

3.5 The laboratory shall have written SOPs for organization and assembly of all documents relating to each NYSDEC Case, including technical and managerial review. Documents shall be filed on a Case-specific basis. The procedures must ensure that all documents including logbook pages, sample tracking records, chromatographic charts, computer printouts, raw data summaries, correspondence, and any other written documents having reference to the Case are compiled in one location for submission to NYSDEC. The system must include a document numbering and inventory procedures.

3.6 The laboratory shall have written SOPs for laboratory safety.

3.7 The laboratory shall have written SOPs for cleaning of glassware used in preparing and analyzing samples under this protocol.

3.8 The laboratory shall have SOPs for traceability of standards used in sample analysis QA/QC.

4. Handling of Confidential Information

Laboratory conducting work under this protocol may receive NYSDEC designated confidential information from the Agency. Confidential information must be handled separately from other documentation developed under this contract. To accomplish this, the following procedures for the handling of confidential information have been established.

4.1 All confidential documents shall be under the supervision of a designated Document Control Officer (DCO).

4.2 Confidential Information

Any samples or information received with a request of confidentiality shall be handled as "confidential". A separate locked file shall be maintained to store this information and shall be segregated from other non-confidential information. Data generated from confidential samples shall be treated as confidential. Upon receipt of confidential information, the DCO logs these documents into a Confidential Inventory Log. The information is then made available to authorized personnel but only after it has been signed out to that person by the DCO. The documents shall be returned to the locked file at the conclusion of each working day. Confidential information may not be reproduced except upon approval by the Bureau of Spill Prevention and Response. The DCO will enter all copies into the document control system. In addition, this information may not be disposed of except upon approval by the Bureau of Spill Prevention and Response. The DCO shall remove and retain the cover page of any confidential information disposed of for one year, and shall keep a record of the disposition in the Confidential Inventory Log.

APPENDIX 5X.3

**CHEMICALS LISTED IN THE HAZARDOUS MATERIALS TABLE (49 CFR 172.101)
USED FOR PRESERVING SAMPLES**

PRESERVATIVE	SAMPLE TYPE/ PARAMETER	pH RECOMMENDATION	QUANTITY OF PRESERVATIVE ADDED PER LITER	WT. % OF PRESERVATIVE
HCl	Volatile Organic Analysis	<2 - ≥1	4 drops conc. HCL/40 ml	0.22% (2)
HgCl ₂	Nitrogen Species	N.A.	40 mg.	0.004% (1)
HNO ₃	Metals, Hardness	<2 - ≥1	5 ml of conc. (70%)	0.35% (1)
H ₂ SO ₄	Nitrogen Species COD, Oil & Grease, P (hydrolyzable) Organic Carbon, Phenols	<2 - ≥1	2 ml of 36N	0.35% (1)
NaOH	Cyanides, Sulfides	>12 - ≤13	2 ml of 10N	0.080% (1)
Freezing* 0°C (Dry Ice)	Biological - Fish & Shellfish Tissue	N.A.	N.A.	N.A.

* - Dry ice is classified as a ORM-A hazard by DOT. There is no labeling requirement for samples preserved with dry ice, but each package must be plainly and durably marked on at least one side or edge with the designation "ORM-A". The package should also be marked "Dry Ice" or "Carbon Dioxide, Solid" and "Frozen Diagnostic Specimens". Samples must be packaged in accordance with the requirements of 49 CFR 173.615 and advance arrangements must be made between the shipper and each carrier.

N.A. - Not applicable.

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 24. Safety Manual for Hazardous Waste Site Investigations, U. S. Environmental Protection Agency, Draft, 1979.
 25. Characterization of Hazardous Waste Sites - A Methods Manual: Volume I - Site Investigations, US-EPA, EMSL, Las Vegas, EPA-600/4-84-075, April 1985.
 26. Characterization of Hazardous Waste Sites - A Methods Manual: Volume II - Available Sampling Methods, 2nd Edition, US-EPA, EMSL, Las Vegas, EPA-600/4-84-076, December 1984.
 27. Enforcement Considerations for Evaluation of Uncontrolled Hazardous Waste Disposal Sites by Contractors, US-EPA, NEIC, 1980.
 28. Test Methods for Evaluating Solid Waste - Physical/Chemical Methods (SW-846), US-EPA, Office of Solid Waste and Emergency Response, Washington, D.C., July 1982.

Collection of Groundwater Samples for Perfluorooctanoic Acid (PFOA) and Perfluorinated Compounds (PFCs) from Monitoring Wells Sample Protocol

Samples collected using this protocol are intended to be analyzed for perfluorooctanoic acid (PFOA) and other perfluorinated compounds by Modified (Low Level) Test Method 537.

The procedure used must be consistent with the NYSDEC March 1991 Sampling Guidelines and Protocols http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf with the following materials limitations.

At this time acceptable materials for sampling include: stainless steel, high density polyethylene (HDPE), PVC, silicone, acetate and polypropylene. Equipment blanks should be generated at least daily. Additional materials may be acceptable if pre-approved by NYSDEC. Requests to use alternate equipment should include clean equipment blanks. **NOTE: Grunfos pumps and bladder pumps are known to contain PFC materials (e.g. Teflon™ washers for Grunfos pumps and LDPE bladders for bladder pumps).** All sampling equipment components and sample containers should not come in contact with aluminum foil, low density polyethylene (LDPE), glass or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer. Standard two step decontamination using detergent and clean water rinse will be performed for equipment that does come in contact with PFC materials. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFC materials must be avoided. Many food and drink packaging materials and “plumbers thread seal tape” contain PFCs.

All clothing worn by sampling personnel must have been laundered multiple times. The sampler must wear nitrile gloves while filling and sealing the sample bottles.

Pre-cleaned sample bottles with closures, coolers, ice, sample labels and a chain of custody form will be provided by the laboratory.

1. Fill two pre-cleaned 500 mL HDPE or polypropylene bottle with the sample.
2. Cap the bottles with an acceptable cap and liner closure system.
3. Label the sample bottles.
4. Fill out the chain of custody.
5. Place in a cooler maintained at $4 \pm 2^{\circ}$ Celsius.

Collect one equipment blank for every sample batch, not to exceed 20 samples.

Collect one field duplicate for every sample batch, not to exceed 20 samples.

Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, not to exceed 20 samples.

Request appropriate data deliverable (Category A or B) and an electronic data deliverable.

Groundwater Sampling for Emerging Contaminants

April 2018

Issue: NYSDEC has committed to analyzing representative groundwater samples at remediation sites for emerging contaminants (1,4-dioxane and PFAS) as described in the below guidance.

Implementation

NYSDEC project managers will be contacting site owners to schedule sampling for these chemicals. Only groundwater sampling is required. The number of samples required will be similar to the number of samples where “full TAL/TCL sampling” would typically be required in a remedial investigation. If sampling is not feasible (e.g., the site no longer has any monitoring wells in place), sampling may be waived on a site-specific basis after first considering potential sources of these chemicals and whether there are water supplies nearby.

Upon a new site being brought into any program (i.e., SSF, BCP), PFAS and 1,4-dioxane will be incorporated into the investigation of groundwater as part of the standard “full TAL/TCL” sampling. Until an SCO is established for PFAS, soil samples do not need to be analyzed for PFAS unless groundwater contamination is detected. Separate guidance will be developed to address sites where emerging contaminants are found in the groundwater. The analysis currently performed for SVOCs in soil is adequate for evaluation of 1,4-dioxane, which already has an established SCO.

Analysis and Reporting

Labs should provide a full category B deliverable, and a DUSR should be prepared by a data validator, and the electronic data submission should meet the requirements provided at: <https://www.dec.ny.gov/chemical/62440.html> ,

The work plan should explicitly describe analysis and reporting requirements.

PFAS sample analysis: Currently, ELAP does not offer certification for PFAS compounds in matrices other than finished drinking water. However, laboratories analyzing environmental samples (ex. soil, sediments, and groundwater) are required, by DER, to hold ELAP certification for PFOA and PFOS in drinking water by EPA Method 537 or ISO 25101.

Modified EPA Method 537 is the preferred method to use for groundwater samples due to the ability to achieve 2 ng/L (ppt) detection limits. If contract labs or work plans submitted by responsible parties indicate that they are not able to achieve similar reporting limits, the project manager should discuss this with a DER chemist. Note: Reporting limits for PFOA and PFOS should not exceed 2 ng/L.

PFAS sample reporting: DER has developed a PFAS target analyte list (below) with the intent of achieving reporting consistency between labs for commonly reportable analytes. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. This list may be updated in the future as new information is learned and as labs develop new capabilities. If lab and/or matrix specific issues are encountered for any particular compounds, the NYSDEC project manager will make case-by-case decisions as to whether particular analytes may be temporarily or permanently discontinued from analysis for each site. Any technical lab issues should be brought to the attention of a NYSDEC chemist.

Some sampling using this full PFAS target analyte list is needed to understand the nature of contamination. It may also be critical to differentiate PFAS compounds associated with a site from other

sources of these chemicals. Like routine refinements to parameter lists based on investigative findings, the full PFAS target analyte list may not be needed for all sampling intended to define the extent of contamination. Project managers may approve a shorter analyte list (e.g., just the UCMR3 list) for some reporting on a case by case basis.

1,4-Dioxane Analysis and Reporting: The method detection limit (MDL) for 1,4-dioxane should be no higher than 0.28 µg/l (ppb). ELAP offers certification for both EPA Methods 8260 and 8270. In order to get the appropriate detection limits, the lab would need to run either of these methods in “selective ion monitoring” (SIM) mode. DER is advising the use of method 8270, since this method provides a more robust extraction procedure, uses a larger sample volume, and is less vulnerable to interference from chlorinated solvents (we acknowledge that 8260 has been shown to have a higher recovery in some studies).

Full PFAS Target Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonates	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanesulfonic acid	PFOS	1763-23-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluoroalkyl carboxylates	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	PFHpA	375-85-9
	Perfluorooctanoic acid	PFOA	335-67-1
	Perfluorononanoic acid	PFNA	375-95-1
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUA/PFUdA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTriA/PFTTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTA/PFTeDA	376-06-7
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
	8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4
Perfluorooctane-sulfonamides	Perfluorooctanesulfonamide	FOSA	754-91-6
Perfluorooctane-sulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

Bold entries depict the 6 original UCMR3 chemicals

Attachment B
Quality Assurance Project Plan

QUALITY ASSURANCE PROJECT PLAN

For

NOVAK FARM EMERGING CONTAMINANTS SAMPLING WORK PLAN MCDONOUGH, NEW YORK NYSDEC SITE NO. 7-09-005

Prepared For:

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June 2018

Langan Project No: 170528401

LANGAN

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1.0 PROJECT DESCRIPTION

1.1 INTRODUCTION

This Quality Assurance Project Plan (QAPP) was prepared on behalf of Stauffer Management Company, LLC (SMC) for the Novak Farm located in McDonough, New York (the site). This QAPP supports the Emerging Contaminants Supplemental Sampling Work Plan, which provides additional site information and data collected previously during site remediation and management.

This QAPP specifies the sampling procedures to be followed and the analytical methods to be used to ensure that data from the proposed investigation at the site are precise, accurate, representative, comparable, and complete.

1.2 PROJECT OBJECTIVES

The objective of this scope of work is to collect data to assist the NYSDEC in evaluating the risk posed by 1,4-dioxane and per- and poly- fluoroalkyl substance (PFAS), which have not previously been evaluated at remediation sites. These objectives were established in order to meet standards that will protect public health and the environment.

1.3 SCOPE OF WORK

The scope of work is described in detail in the Novak Farm Emerging Contaminants Sampling Work Plan. The scope consists of the collection and chemical analysis of one groundwater sample for PFAS and 1,4-dioxane. This work plan is meant to supplement the New York State Department of Environmental Conservation (NYSDEC)-approved Groundwater Monitoring Plan, dated August 27, 2004.

1.4 DATA QUALITY OBJECTIVES AND PROCESSES

Data Quality Objectives (DQOs) are qualitative and quantitative statements to help ensure that data of known and appropriate quality are obtained during the project. DQOs for sampling activities are determined by evaluating five factors:

- Data needs and uses: The types of data required and how the data will be used after it is obtained.
- Parameters of Interest: The types of chemical or physical parameters required for the intended use.

- **Level of Concern:** Levels of constituents, which may require remedial actions or further investigations.
- **Required Analytical Level:** The level of data quality, data precision, and QA/QC documentation required for chemical analysis.
- **Required Detection Limits:** The detection limits necessary based on the above information.

The quality assurance and quality control objectives for all measurement data include:

- **Precision** – an expression of the reproducibility of measurements of the same parameter under a given set of conditions. Field sampling precision will be determined by analyzing coded duplicate samples and analytical precision will be determined by analyzing internal QC duplicates and matrix spike duplicates.
- **Accuracy** – a measure of the degree of agreement of a measured value with the true or expected value of the quantity of concern. Sampling accuracy will be determined through the assessment of the analytical results of field blanks and trip blanks for each sample set. Analytical accuracy will be assessed by examining the percent recoveries of surrogate compounds that are added to each sample (organic analyses only), internal standards, laboratory method blanks, instrument calibration, and the percent recoveries of matrix spike compounds added to selected samples and laboratory blanks.
- **Representativeness** – expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is dependent upon the adequate design of the sampling program and will be satisfied by ensuring that the scope of work is followed and that specified sampling and analysis techniques are used. Representativeness in the laboratory is ensured by compliance to nationally-recognized analytical methods, meeting sample holding times, and maintaining sample integrity while the samples are in the laboratory's possession. This is accomplished by following all applicable methods, laboratory-issued standard operating procedures (SOPs), the laboratory's Quality Assurance Manual, and this QAPP. The laboratory is required to be properly certified and accredited.
- **Completeness** – the percentage of measurements made which are judged to be valid. Completeness will be assessed through data validation. The QC objective for

completeness is generation of valid data for at least 90 percent of the analyses requested.

- **Comparability** – expresses the degree of confidence with which one data set can be compared to another. The comparability of all data collected for this project will be ensured using several procedures, including standard methods for sampling and analysis, instrument calibrations, using standard reporting units and reporting formats, and data validation.
- **Sensitivity** – the ability of the instrument or method to detect target analytes at the levels of interest. The project manager will select, with input from the laboratory and QA personnel, sampling and analytical procedures that achieve the required levels of detection.

Each of the above objectives are discussed in detail in Section 3.

2.0 PROJECT ORGANIZATION

The Work Plan will be overseen by Langan on behalf of SMC. Langan will oversee the groundwater sampling of a pre-existing monitoring well. Langan will perform the sample collection as described in the Work Plan and analytical services.

The analytical services will be performed by Alpha Analytical of Mahwah, New Jersey, NYSDOH ELAP certification number 11148.

Key contacts for this project are as follows:

Stauffer Management Company, LLC (SMC):	Mr. John-Paul Rossi Telephone: (302) 886-6932
Qualified Environmental Professional (QEP):	Mr. Jason Hayes Telephone: (212) 479-5427 Fax: (212) 479-5444
Langan Project Director:	Mr. Michael Burke Telephone: (212) 479-5413 Fax: (212) 479-5444
Langan Project Manager:	Mr. Gerald Nicholls Telephone: (212) 479-5559 Fax: (212) 479-5444
Langan Quality Assurance Officer (QAO):	Ms. Kimberly Del Col Telephone: (212) 479-5438 Fax: (212) 479-5444
Program Quality Assurance Monitor:	Mr. William Bohrer Telephone: (212) 479-5533 Fax: (212) 479-5444
Data Validator:	Ms. Emily Strake, Langan Telephone: (215) 491-6526 Fax: None
Laboratory Representatives (Alpha Analytical):	Mr. Ben Rao Telephone: (201) 812-2633 Fax: (203) 357-0166

3.0 QUALITY ASSURANCE/QUALITY CONTROL OBJECTIVES FOR MEASUREMENT OF DATA

The quality assurance and quality control objectives for all measurement data include precision, accuracy, representativeness, completeness, comparability, and sensitivity. These objectives are defined in following subsections. Variances from the quality assurance objectives at any stage of the investigation will result in the implementation of appropriate corrective measures and an assessment of the impact of corrective measures on the usability of the data.

3.1 PRECISION

Precision is a measure of the degree to which two or more measurements are in agreement. Field precision is assessed through the collection and measurement of field duplicates. Laboratory precision and sample heterogeneity also contribute to the uncertainty of field duplicate measurements. This uncertainty is taken into account during the data assessment process. For field duplicates, results less than 2x the reporting limit (RL) meet the precision criteria if the absolute difference is less than $\pm 2x$ the RL. For results greater than 2x the RL, the acceptance criteria is a relative percent difference (RPD) of $<30\%$ (groundwater). RLs and method detection limits (MDL) are provided in Attachment B.

3.2 ACURACY

Accuracy is the measurement of the reproducibility of the sampling and analytical methodology. It should be noted that precise data may not be accurate data. For the purpose of this QAPP, bias is defined as the constant or systematic distortion of a measurement process, which manifests itself as a persistent positive or negative deviation from the known or true value. This may be due to (but not limited to) improper sample collection, sample matrix, poorly calibrated analytical or sampling equipment, or limitations or errors in analytical methods and techniques.

Accuracy in the field is assessed through the use of field blanks and through compliance to all sample handling, preservation, and holding time requirements. All field blanks should be non-detect when analyzed by the laboratory. Any contaminant detected in an associated field blank will be evaluated against laboratory blanks (preparation or method) and evaluated against field samples collected on the same day to determine potential for bias. Trip blanks are not required for non-aqueous matrices but are planned for non-aqueous matrices where high concentrations of VOCs are anticipated.

Laboratory accuracy is assessed by evaluating the percent recoveries of matrix spike/matrix spike duplicate (MS/MSD) samples, laboratory control samples (LCS), surrogate compound recoveries, and the results of method preparation blanks. MS/MSD, LCS, and surrogate percent recoveries will be compared to either method-specific control limits or laboratory-derived control limits. Sample volume permitting, samples displaying outliers should be reanalyzed. All associated method blanks should be non-detect when analyzed by the laboratory.

3.4 REPRESENTATIVENESS

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary. Representativeness is dependent upon the adequate design of the sampling program and will be satisfied by ensuring that the scope of work is followed and that specified sampling and analysis techniques are used. This is performed by following applicable standard operating procedures (SOPs) and this QAPP. All field technicians will be given copies of appropriate documents prior to sampling events and are required to read, understand, and follow each document as it pertains to the tasks at hand.

Representativeness in the laboratory is ensured by compliance to nationally-recognized analytical methods, meeting sample holding times, and maintaining sample integrity while the samples are in the laboratory's possession. This is performed by following all applicable analytical methods, laboratory-issued SOPs, the laboratory's Quality Assurance Manual, and this QAPP. The laboratory is required to be properly certified and accredited.

3.5 COMPLETENESS

Laboratory completeness is the ratio of total number of samples analyzed and verified as acceptable compared to the number of samples submitted to the fixed-base laboratory for analysis, expressed as a percent. Three measures of completeness are defined:

- Sampling completeness, defined as the number of valid samples collected relative to the number of samples planned for collection;
- Analytical completeness, defined as the number of valid sample measurements relative to the number of valid samples collected; and

- Overall completeness, defined as the number of valid sample measurements relative to the number of samples planned for collection.

Groundwater data will meet a 90% completeness criterion. If the criterion is not met, sample results will be evaluated for trends in rejected and unusable data. The effect of unusable data required for a determination of compliance will also be evaluated.

3.6 COMPARABILITY

Comparability expresses the degree of confidence with which one data set can be compared to another. The comparability of all data collected for this project will be ensured by:

- Using identified standard methods for both sampling and analysis phases of this project;
- Requiring traceability of all analytical standards and/or source materials to the U.S. Environmental Protection Agency (EPA) or National Institute of Standards and Technology (NIST);
- Requiring that all calibrations be verified with an independently prepared standard from a source other than that used for calibration (if applicable);
- Using standard reporting units and reporting formats including the reporting of QC data;
- Performing a complete data validation on a representative fraction of the analytical results, including the use of data qualifiers in all cases where appropriate; and
- Requiring that all validation qualifiers be used any time an analytical result is used for any purpose.

These steps will ensure all future users of either the data or the conclusions drawn from them will be able to judge the comparability of these data and conclusions.

3.7 SENSITIVITY

Sensitivity is the ability of the instrument or method to detect target analytes at the levels of interest. The project director will select, with input from the laboratory and QA personnel, sampling and analytical procedures that achieve the required levels of detection and QC acceptance limits that meet established performance criteria. Concurrently, the project director will select the level of data assessment to ensure that only data meeting the project DQOs are used in decision-making.

Field equipment will be used that can achieve the required levels of detection for analytical measurements in the field. In addition, the field sampling staff will collect and submit full volumes of samples as required by the laboratory for analysis, whenever possible. Full volume aliquots will help ensure achievement of the required limits of detection and allow for reanalysis if necessary. The concentration of the lowest level check standard in a multi-point calibration curve will represent the reporting limit.

Analytical methods and quality assurance parameters associated with the sampling program are presented in Attachment C. The frequency of associated field blanks and duplicate samples will be based on the recommendations listed in the Division of Environmental Remediation (DER)-10, and as described in Section 5.3.

Site-specific MS and MSD samples will be prepared and analyzed by the analytical laboratory by spiking an aliquot of submitted sample volume with analytes of interest. Additional sample volume is not required by the laboratory for this purpose. An MS/MSD analysis will be analyzed at a rate of 1 out of every 20 samples, or one per analytical batch. MS/MSD samples are only required for groundwater samples.

4.0 SAMPLING PROGRAM

4.1 INTRODUCTION

The Work Plan will consist of the following sampling:

- Monitoring Well Sampling
 - Collection of one groundwater sample from the existing monitoring well, MW-104, plus QA/QC sampling.
 - The groundwater sample collected will be analyzed for PFAS, and will be collected in accordance with the specialized protocol outlined in Section 4.3.1.
 - The groundwater sample will be collected for 1,4-dioxane with a detection limit no higher than 0.28 micrograms per liter, in accordance with the procedure outlined in Attachment B.

This section presents sample container preparation procedures, sample preservation procedures, sample holding times, and field QC sample requirements. Sample locations, and the number of environmental and QC samples will be determined per disposal facility requirements. The sampling will be conducted as described in the work Plan.

4.2 SAMPLE CONTAINER PREPARATION AND SAMPLE PRESERVATION

Sample containers will be properly washed and decontaminated prior to their use by either the analytical laboratory or the container vendor to the specifications required by the USEPA. Copies of the sample container QC analyses will be provided by the laboratory for each container lot used to obtain samples. The containers will be labeled and the appropriate preservatives will be added. The types of containers are shown in Attachment C.

Groundwater sampling for PFAS and 1,4-dioxane will be performed in accordance with the NYSDEC-approved Groundwater Monitoring Plan, dated August 27, 2004, which specifies purging three to five well volumes prior to sample collection. The pump will be decontaminated with Alconox and water. Field personnel will wear nitrile gloves while collecting and handing groundwater samples.

Groundwater sampling for PFAS will be conducted in accordance with EPA Method 537 Field Sampling Guidelines. PFAS samples will be collected first in High Density Polyethylene (HDPE)/polypropylene containers using sampling equipment either made with stainless steel, HDPE, or polypropylene. Food and beverages will be prohibited near the sampling equipment. Additionally, no cosmetics, moisturizers, hand cream,

sun screen or clothing materials containing Gore-Tex™ or Tyvek® will be worn during sampling.

Samples shall be preserved according to the preservation techniques given in Attachment C. Preservatives will be added to the sample bottles by the laboratory prior to their shipment in sufficient quantities to ensure that proper sample pH is met. Following sample collection, the sample bottles should be placed on ice in the shipping cooler, cooled to 4°C with ice or "blue ice", and delivered to the laboratory within 48 hours of collection. Blue ice will not be used to cool PFAS samples. Chain-of-custody procedures are described in Section 5.

4.3 SPECIAL CONSIDERATIONS FOR PFAS SAMPLE COLLECTION

The following special considerations apply to the collection of groundwater samples for PFAS analysis to prevent cross-contamination:

- Field equipment will not contain Teflon®
- All sampling material will be made from stainless steel, HDPE, acetate, silicon, or polypropylene
- No waterproof field books will be used
- No plastic clipboards, binders, or spiral hard cover notebooks will be used
- No adhesives will be used
- No sharpies or permanent markers will be used; ball point pens are acceptable
- Aluminum foil will not be used
- PFAS samples will be kept in a separate cooler from other sampling containers
- Coolers will be filled only with regular ice

PFAS compound sampling protocol is provided in Attachment D.

4.4 PFAS TARGET ANALYTE LIST

DER has developed a PFAS target analyte list. At minimum, the laboratory will report the following PFAS target compounds:

Group	Analyte Name	Abbreviation	CAS #
Perfluoroalkyl carboxylates	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	PFHpA	375-85-9
	Perfluorooctanoic acid	PFOA	335-67-1
	Perfluorononanoic acid	PFNA	375-95-1
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUA/PFUdA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTriA/PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTA/PFTeDA	376-06-7
Perfluoroalkyl sulfonates	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanesulfonic acid	PFOS	1763-23-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
	8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4
Perfluorooctane-sulfonamides	Perfluorooctanesulfonamide	FOSA	754-91-6
Perfluorooctane-sulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

4.5 SAMPLE HOLDING TIMES

The sample holding times for organic and inorganic parameters are given in Attachment C and must be in accordance with the NYSDEC Analytical Services Protocol (ASP) requirements. The NYSDEC ASP holding times must be strictly adhered to by the laboratory. Any holding time exceedances must be reported to Langan.

4.6 FIELD QC SAMPLES

To assess field sampling and decontamination performance, two types of "blanks" will be collected and submitted to the laboratory for analyses. In addition, the precision of field sampling procedures will be assessed by collecting coded field duplicates and matrix spike/matrix spike duplicates (MS/MSDs). The blanks will include:

- a. Trip Blanks - A trip blank will be prepared before the sample containers are sent by the laboratory. The trip blank will consist of a 40-ml VOA vial containing distilled, deionized water, which accompanies the other water sample bottles into the field and back to the laboratory. A trip blank will be included with each shipment of samples for Part 375 volatiles analysis to assess any contamination from sampling and transport, and internal laboratory procedures.
- b. Field Blanks - Field blanks will be taken at a minimum frequency of one per 20 field samples of groundwater. Field blanks are used to determine the effectiveness of the decontamination procedures for sampling equipment. The field blank will consist of a sample of PFAS-free, deionized, distilled water provided by the laboratory that has passed through a decontaminated bailer, tubing or other sampling apparatus. It is usually collected as a last step in the decontamination procedure, prior to taking an environmental sample. The field blank may be analyzed for all or some of the parameters of interest.
- c. Coded Field Duplicates - To determine the representativeness of the sampling methods, coded field duplicates will be collected at a minimum frequency of one per 20 field samples. The samples are termed "coded" because they will be labeled in such a manner that the laboratory will not be able to determine that they are a duplicate sample. This will eliminate any possible bias that could arise. The field duplicate precision criteria are provided in Section 3.1.
- d. Matrix Spike/Matrix Spike Duplicate (MS/MSD) - MS/MSD samples (MS/MSD for organics; MS and laboratory duplicate for inorganics) will be taken at a frequency of one pair per 20 field samples. These samples are used to assess the effect of the sample matrix on the recovery of target compounds or target analytes. The recovery limits and RPDs for each analyte are statistically derived at the laboratory on an ongoing basis.

5.0 SAMPLE TRACKING AND CUSTODY

5.1 INTRODUCTION

This section presents sample custody procedures for both the field and laboratory. Implementation of proper custody procedures for samples generated in the field is the responsibility of field personnel. Both laboratory and field personnel involved in the Chain-of-custody (COC) and transfer of samples will be trained as to the purpose and procedures prior to implementation.

Evidence of sample traceability and integrity is provided by COC procedures. These procedures document the sample traceability from the selection and preparation of the sample containers by the laboratory, to sample collection, to sample shipment, to laboratory receipt and analysis. The sample custody flowchart is shown in Figure 5.1. A sample is considered to be in a person's custody if the sample is:

- In a person's possession;
- Maintained in view after possession is accepted and documented;
- Locked and tagged with Custody Seals so that no one can tamper with it after having been in physical custody; or
- In a secured area which is restricted to authorized personnel.

5.2 FIELD SAMPLE CUSTODY

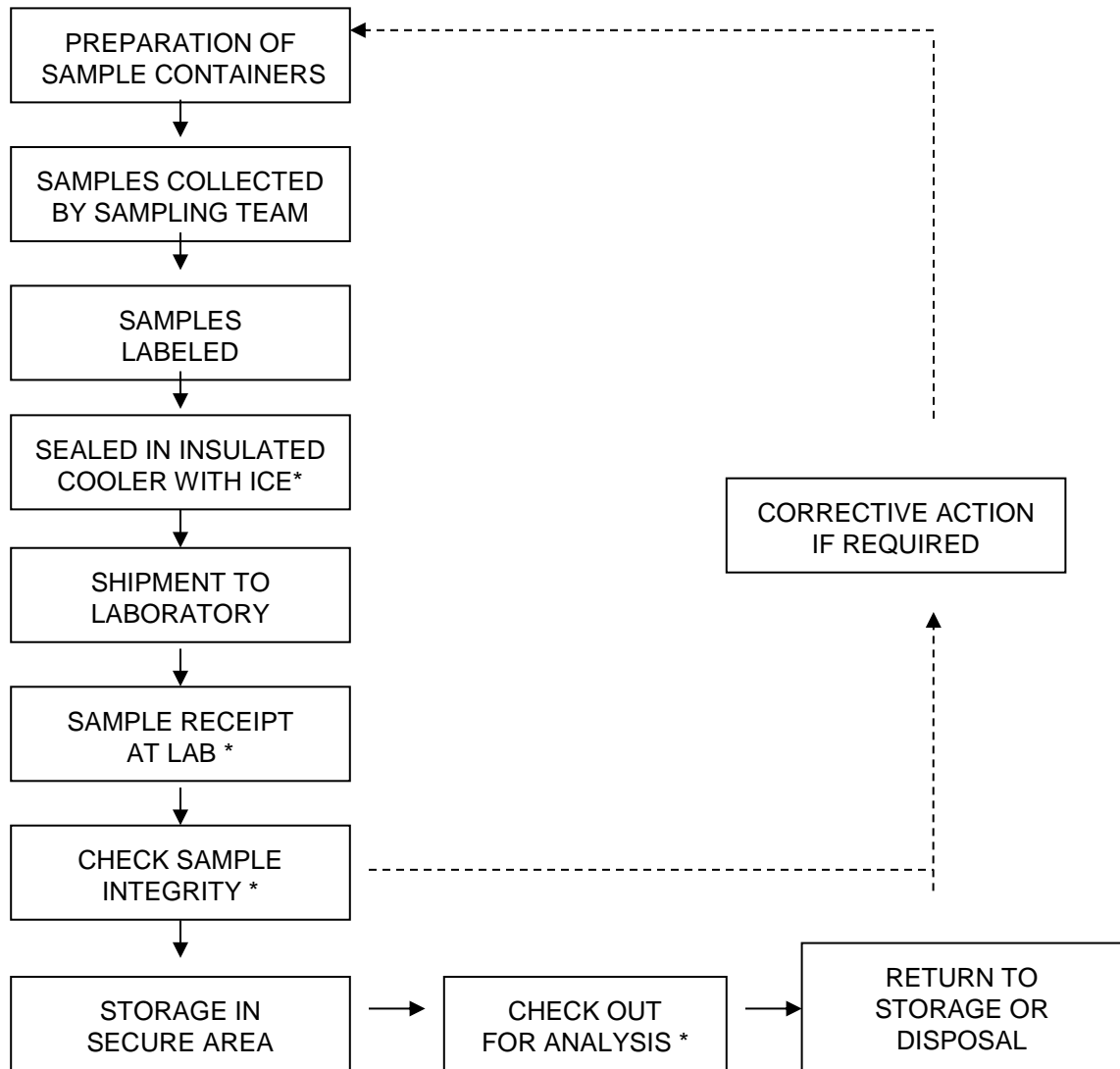
A COC record (Figure 5.2 or similar) accompanies the sample containers from selection and preparation at the laboratory, during shipment to the field for sample containment and preservation, and during return to the laboratory. Triplicate copies of the COC must be completed for each sample set collected.

The COC lists the field personnel responsible for taking samples, the project name and number, the name of the analytical laboratory to which the samples are sent, and the method of sample shipment. The COC also lists a unique description of every sample bottle in the set. If samples are split and sent to different laboratories, a copy of the COC record will be sent with each sample.

The REMARKS space on the COC is used to indicate if the sample is a matrix spike, matrix spike duplicate, or any other sample information for the laboratory. Since they are not specific to any one sample point, trip and field blanks are indicated on separate rows. Once all bottles are properly accounted for on the form, a sampler will write his or her signature and the date and time on the first RELINQUISHED BY space. The

sampler will also write the method of shipment, the shipping cooler identification number, and the shipper airbill number on the top of the COC.

Figure 5-1 Sample Custody



* REQUIRES SIGN-OFF ON CHAIN-OF-CUSTODY FORM

[illegible]

Mistakes will be crossed out with a single line in ink and initialed by the author.

One copy of the COC is retained by sampling personnel (notations identifying blind duplicate samples will be added to this copy of the COC but not the others that will go to the laboratory) and the other two copies are put into a sealable plastic bag and taped inside the lid of the shipping cooler. The cooler lid is closed, custody seals provided by the laboratory are affixed to the latch and across the back and front lids of the cooler, and the person relinquishing the samples signs their name across the seal. The seal is taped, and the cooler is wrapped tightly with clear packing tape. It is then relinquished by field personnel to personnel responsible for shipment, typically an overnight carrier. The COC seal must be broken to open the container. Breakage of the seals before receipt at the laboratory may indicate tampering. If tampering is apparent, the laboratory will contact the Project Manager, and the sample will not be analyzed.

5.3 LABORATORY SAMPLE CUSTODY

The Project Manager or Field Team Leader will notify the laboratory of upcoming field sampling activities, and the subsequent shipment of samples to the laboratory. This notification will include information concerning the number and type of samples to be shipped as well as the anticipated date of arrival.

The following laboratory sample custody procedures will be used:

- The laboratory will designate a sample custodian who will be responsible for maintaining custody of the samples, and for maintaining all associated records documenting that custody.
- Upon receipt of the samples, the custodian will check cooler temperature, and check the original COC documents and compare them with the labeled contents of each sample container for correctness and traceability. The sample custodian will sign the COC record and record the date and time received.
- Care will be exercised to annotate any labeling or descriptive errors. In the event of discrepant documentation, the laboratory will immediately contact the Project Manager or Field Team Leader as part of the corrective action process. A qualitative assessment of each sample container will be performed to note any anomalies, such as broken or leaking bottles. This assessment will be recorded as part of the incoming chain-of-custody procedure.
- The samples will be stored in a secured area at a temperature of approximately 4°C until analyses commence.
- A laboratory tracking record will accompany the sample or sample fraction through final analysis for control.

- A copy of the tracking record will accompany the laboratory report and will become a permanent part of the project records.

6.0 FIELD INSTRUMENT CALIBRATION AND MAINTENANCE

A photoionization detector (PID) will be used during the sampling activities to evaluate work zone action levels, and collect monitoring well headspace readings. Field calibration and/or field checking of the PID will be the responsibility of the field team leader and the site HSO, and will be accomplished by following the procedures outlined in the operating manual for the instrument. At a minimum, field calibration and/or field equipment checking will be performed once daily, prior to use. Field calibration will be documented in the field notebook. Entries made into the logbook regarding the status of field equipment will include the following information:

- Date and time of calibration
- Type of equipment serviced and identification number (such as serial number)
- Reference standard used for calibration
- Calibration and/or maintenance procedure used
- Other pertinent information

A water quality meter (YSI 6820 or similar) will be used during purging of groundwater to measure pH, specific conductance, temperature, dissolved oxygen, turbidity and oxidation-reduction-potential (ORP), every ten minutes. A portable turbidity meter (LaMotte or similar) may also be used to measure turbidity. Water-quality meters should be calibrated and the results documented before use each day using standardized field calibration procedures and calibration checks.

Equipment that fails calibration or becomes inoperable during use will be removed from service and segregated to prevent inadvertent utilization. The equipment will be properly tagged to indicate that it is out of calibration. Such equipment will be repaired and recalibrated to the manufacturer's specifications by qualified personnel. Equipment that cannot be repaired will be replaced.

Off-site calibration and maintenance of field instruments will be conducted as appropriate throughout the duration of project activities. All field instrumentation, sampling equipment and accessories will be maintained in accordance with the manufacturer's recommendations and specifications and established field equipment practice. Off-site calibration and maintenance will be performed by qualified personnel. A logbook will be kept to document that established calibration and maintenance procedures have been followed. Documentation will include both scheduled and unscheduled maintenance.

7.0 DATA REDUCTION, VALIDATION, AND REPORTING

7.1 INTRODUCTION

Data collected during the RI will be reduced and reviewed by the laboratory QA personnel, and a report on the findings will be tabulated in a standard format. The criteria used to identify and quantify the analytes will be those specified for the applicable methods in the USEPA SW-846 and subsequent updates. The data package provided by the laboratory will contain all items specified in the analytical methodology (Attachment C) appropriate for the analyses to be performed, and be reported in standard format.

The completed copies of the chain-of-custody records (both external and internal) accompanying each sample from time of initial bottle preparation to completion of analysis shall be attached to the analytical reports.

7.2 DATA REDUCTION

The ASP Category B data packages and an electronic data deliverable (EDD) will be provided by the laboratory after receipt of a complete sample delivery group. The Project Manager will immediately arrange for archiving the results and preparation of result tables. These tables will form the database for assessment of the site contamination condition.

Each EDD deliverable must be formatted using a Microsoft Windows operating system and the NYSDEC data deliverable format for EQulS. To avoid transcription errors, data will be loaded directly into the ASCII format from the laboratory information management system (LIMS). If this cannot be accomplished, the consultant should be notified via letter of transmittal indicating that manual entry of data is required for a particular method of analysis. All EDDs must also undergo a QC check by the laboratory before delivery. The original data, tabulations, and electronic media are stored in a secure and retrievable fashion.

The Project Manager or Task Manager will maintain close contact with the QA reviewer to ensure all non-conformance issues are acted upon prior to data manipulation and assessment routines. Once the QA review has been completed, the Project Manager may direct the Team Leaders or others to initiate and finalize the analytical data assessment.

7.3 DATA VALIDATION

Data validation will be performed in accordance with the EPA validation guidelines for organic and inorganic data review. Validation will include the following:

- Verification of the QC sample results,
- Verification of the identification of sample results (both positive hits and non-detects),
- Recalculation of 10% of all investigative sample results, and
- Preparation of Data Usability Summary Reports (DUSR).

A DUSR will be prepared and reviewed by the QAO before issuance. The DUSR will present the results of data validation, including a summary assessment of laboratory data packages, sample preservation and COC procedures, and a summary assessment of precision, accuracy, representativeness, comparability, and completeness for each analytical method. A detailed assessment of each SDG will follow. For each of the organic analytical methods, the following will be assessed:

- Holding times;
- Instrument tuning;
- Instrument calibrations;
- Blank results;
- System monitoring compounds or surrogate recovery compounds (as applicable);
- Internal standard recovery results;
- MS and MSD results;
- Target compound identification;
- Chromatogram quality;
- Pesticide cleanup (if applicable);
- Compound quantitation and reported detection limits;
- System performance; and
- Results verification.

For each of the inorganic compounds, the following will be assessed:

- Holding times;
- Calibrations;
- Blank results;
- Interference check sample;

- Laboratory check samples;
- Duplicates;
- Matrix Spike;
- Furnace atomic absorption analysis QC;
- ICP serial dilutions; and
- Results verification and reported detection limits.

Based on the results of data validation, the validated analytical results reported by the laboratory will be assigned one of the following usability flags:

- "U" - Not detected. The associated number indicates the approximate sample concentration necessary to be detected significantly greater than the level of the highest associated blank;
- "UJ" - Not detected. Quantitation limit may be inaccurate or imprecise;
- "J" - Analyte is present. Reported value may be associated with a higher level of uncertainty than is normally expected with the analytical method
- "N" – Tentative identification. Analyte is considered present in the sample;
- "R" – Unreliable result; data is rejected or unusable. Analyte may or may not be present in the sample; and
- No Flag - Result accepted without qualification.

7.4 REPORTING

Upon receipt of validated analytical results, NYSDEC format electronic data deliverables (EDDs), compatible with EQulS, will be prepared and submitted to the NYSDEC.

8.0 QUALITY ASSURANCE PERFORMANCE AND SYSTEMS AUDITS

8.1 INTRODUCTION

Quality assurance audits may be performed by the project quality assurance group under the direction and approval of the QAO. These audits will be implemented to evaluate the capability and performance of project and subcontractor personnel, items, activities, and documentation of the measurement system(s). Functioning as an independent body and reporting directly to corporate quality assurance management, the QAO may plan, schedule, and approve system and performance audits based upon procedures customized to the project requirements. At times, the QAO may request additional personnel with specific expertise from company and/or project groups to assist in conducting performance audits. However, these personnel will not have responsibility for the project work associated with the performance audit.

8.2 SYSTEM AUDITS

System audits may be performed by the QAO or designated auditors, and encompass a qualitative evaluation of measurement system components to ascertain their appropriate selection and application. In addition, field and laboratory quality control procedures and associated documentation may be system audited. These audits may be performed once during the performance of the project. However, if conditions adverse to quality are detected or if the Project Manager requests, additional audits may occur.

8.3 PERFORMANCE AUDITS

The laboratory may be required to conduct an analysis of Performance Evaluation samples or provide proof that Performance Evaluation samples submitted by USEPA or a state agency have been analyzed within the past twelve months.

8.4 FORMAL AUDITS

Formal audits refer to any system or performance audit that is documented and implemented by the QA group. These audits encompass documented activities performed by qualified lead auditors to a written procedure or checklists to objectively verify that quality assurance requirements have been developed, documented, and instituted in accordance with contractual and project criteria. Formal audits may be performed on project and subcontractor work at various locations.

Audit reports will be written by auditors who have performed the site audit after gathering and evaluating all data. Items, activities, and documents determined by lead auditors to be in noncompliance shall be identified at exit interviews conducted with the involved management. Non-compliances will be logged, and documented through audit findings, which are attached to and are a part of the integral audit report. These audit-finding forms are directed to management to satisfactorily resolve the noncompliance in a specified and timely manner.

The Project Manager has overall responsibility to ensure that all corrective actions necessary to resolve audit findings are acted upon promptly and satisfactorily. Audit reports must be submitted to the Project Manager within fifteen days of completion of the audit. Serious deficiencies will be reported to the Project Manager within 24 hours. All audit checklists, audit reports, audit findings, and acceptable resolutions are approved by the QAO prior to issue. Verification of acceptable resolutions may be determined by re-audit or documented surveillance of the item or activity. Upon verification acceptance, the QAO will close out the audit report and findings.

9.0 CORRECTIVE ACTION

9.1 INTRODUCTION

The following procedures have been established to ensure that conditions adverse to quality, such as malfunctions, deficiencies, deviations, and errors, are promptly investigated, documented, evaluated, and corrected.

9.2 PROCEDURE DESCRIPTION

When a significant condition adverse to quality is noted at site, laboratory, or subcontractor location, the cause of the condition will be determined and corrective action will be taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented and reported to the QAO, Project Manager, Field Team Leader and involved contractor management, at a minimum. Implementation of corrective action is verified by documented follow-up action.

All project personnel have the responsibility, as part of the normal work duties, to promptly identify, solicit approved correction, and report conditions adverse to quality. Corrective actions will be initiated as follows:

- When predetermined acceptance standards are not attained;
- When procedure or data compiled are determined to be deficient;
- When equipment or instrumentation is found to be faulty;
- When samples and analytical test results are not clearly traceable;
- When quality assurance requirements have been violated;
- When designated approvals have been circumvented;
- As a result of system and performance audits;
- As a result of a management assessment;
- As a result of laboratory/field comparison studies; and
- As required by USEPA SW-846, and subsequent updates, or by the NYSDEC ASP.

Project management and staff, such as field investigation teams, remedial response planning personnel, and laboratory groups, monitor on-going work performance in the normal course of daily responsibilities. Work may be audited at the sites, laboratories, or contractor locations. Activities, or documents ascertained to be noncompliant with quality assurance requirements will be documented. Corrective actions will be mandated through audit finding sheets attached to the audit report. Audit findings are logged, maintained, and controlled by the Task Manager.

Personnel assigned to quality assurance functions will have the responsibility to issue and control Corrective Action Request (CAR) Forms (Figure 12.1 or similar). The CAR identifies the out-of-compliance condition, reference document(s), and recommended corrective action(s) to be administered. The CAR is issued to the personnel responsible for the affected item or activity. A copy is also submitted to the Project Manager. The individual to whom the CAR is addressed returns the requested response promptly to the QA personnel, affixing his/her signature and date to the corrective action block, after stating the cause of the conditions and corrective action to be taken. The QA personnel maintain the log for status of CARs, confirms the adequacy of the intended corrective action, and verifies its implementation. CARs will be retained in the project file for the records.

Any project personnel may identify noncompliance issues; however, the designated QA personnel are responsible for documenting, numbering, logging, and verifying the close out action. The Project Manager will be responsible for ensuring that all recommended corrective actions are implemented, documented, and approved.

FIGURE 9.1

CORRECTIVE ACTION REQUEST					
Number: _____		Date: _____			
TO: _____ You are hereby requested to take corrective actions indicated below and as otherwise determined by you to (a) resolve the noted condition and (b) to prevent it from recurring. Your written response is to be returned to the project quality assurance manager by _____					
CONDITION:					
REFERENCE DOCUMENTS:					
RECOMMENDED CORRECTIVE ACTIONS:					
_____ Originator	_____ Date	_____ Approval	_____ Date	_____ Approval	_____ Date
RESPONSE					
CAUSE OF CONDITION					
CORRECTIVE ACTION (A) RESOLUTION (B) PREVENTION (C) AFFECTED DOCUMENTS					
C.A. FOLLOWUP: CORRECTIVE ACTION VERIFIED BY: _____ DATE: _____					

10.0 REFERENCES

- NYSDEC. Division of Environmental Remediation. DER-10/Technical Guidance for Site Investigation and Remediation, dated May 3, 2010.
- USEPA, 2015. Region II Standard Operating Procedure (SOP) #HW-34, "Trace Volatile Data Validation" (July 2015, Revision 0), USEPA Hazardous Waste Support Section. USEPA Region II
- USEPA, 2015. Region II SOP #HW-35A, "Semivolatile Data Validation" (June 2015, Revision 0), USEPA Hazardous Waste Support Section. USEPA Region II
- USEPA, 2015. Region II SOP #HW-36A, "Pesticide Data Validation" (June 2015, Revision 0), USEPA Hazardous Waste Support Section. USEPA Region II
- USEPA, 2015. Region II SOP #HW-37A, "PCB Aroclor Data Validation" (June 2015, Revision 0), USEPA Hazardous Waste Support Section. USEPA Region II
- USEPA, 2015. Region II SOP #HW-3a, "ICP-AES Data Validation" (July 2015, Revision 0), USEPA Hazardous Waste Support Section. USEPA Region II
- USEPA, 2014. Hazardous Waste Support Section. Analysis of Volatile Organic Compounds in Air Contained in Canisters by Method TO-15. SOP No. HW-31, Revision 6, dated June 2014.
- USEPA, 2017. National Functional Guidelines for Superfund Organic Methods Data Review, Office of Superfund Remediation and Technology Innovation, EPA-540-R-2017-002, January 2017.
- USEPA, 2017b. National Functional Guidelines for Superfund Inorganic Methods Data Review, Office of Superfund Remediation and Technology Innovation, EPA-540-R-2017-001, January 2017.

ATTACHMENT A

RESUMES

Jason J. Hayes, PE, LEED AP

**Principal
Environmental Engineering**



17 years in the industry

Mr. Hayes has experience in New York, New Jersey, Washington D.C., California, Washington, Oregon, Alaska, and Internationally. His experience includes Environmental Protection Agency (EPA), New York State (NYS) Brownfields applications, investigation, and remediation; New York City Department of Environmental Protection (NYCDEP) and New York City Office of Environmental Remediation (OER) E-designated site applications, investigations, and remediation. His expertise also includes Phase I and II Environmental Site Investigations and Assessments; contaminated building cleanup and demolition; Underground Storage Tank (UST) permitting, removal specifications, and closure reporting; soil vapor intrusion investigation and mitigation system design (depressurization systems, etc.); development of groundwater contaminant plume migration models; environmental analysis; and oversight, design and specification generation for remediation operations with contaminants of concern to include polychlorinated biphenyls (PCBs), solvents, mercury, arsenic, petroleum products, asbestos, mold and lead.

Selected Projects

- Confidential Location (Remediation for Mercury-Contaminated Site), New York, NY
- Confidential Location (Phase II ESI and Remedial Design for Mercury Impacted Site), Brooklyn, NY
- NYC School Construction Authority (PCB Remediation), Various Locations, New York, NY
- 28-29 High Line (Phase I ESA, Phase II ESI, and Environmental Remediation), New York, NY
- Georgetown Heating Plant (Phase II ESI and Remedial Design for Mercury Impacted Site), Washington D.C.
- 268 West Street (BCP Application, RI and RIWP), New York, NY
- Confidential Multiple Mixed-Use Tower Location (BCP Application, RI, Phase I ESA, and Phase II ESI), New York, NY
- Dock 72 at Brooklyn Navy Yard, (NYS Voluntary Cleanup Program), Brooklyn, NY
- 27-21 44th Drive (BCP Application, Remedial Investigation Phase I ESA, and Phase II ESI), Long Island City, NY
- Purves Street Development, BCP Application, RAWP, and Phase II ESI, Long Island City, NY
- 267-273 West 87th Street (BCP Application, Remedial Investigation, RIWP, RAWP), New York, NY
- New York Aquarium, Shark Tank and Animal Care Facility (Environmental Remediation), Coney Island, NY
- International Leadership Charter School (Environmental Remediation), Bronx, NY

Education

M.S., Environmental Engineering
Columbia University

B.S., Chemistry, Environmental
Toxicology
Humboldt State University

Business Administration (minor)
Humboldt State University

Professional Registration

Professional Engineer (PE) in NY

LEED Accredited Professional
(LEED AP)

Troxler Certification for Nuclear
Densometer Training

CPR and First Aid Certification

OSHA 40-Hour HAZWOPER

OSHA HAZWOPER Site Supervisor

Affiliations

US Green Building Council,
NYC Chapter (USGBC),
Communications Committee

Urban Land Institute (ULI), member

Commercial Real Estate Development
Association (NAIOP), member

NYC Brownfield Partnership, member

Jason Hayes, PE, LEED AP

- West & Watts (BCP Application), New York, NY
- Hudson Yards Redevelopment (Phase I ESA and Phase II ESI), New York, NY
- 627 Smith Street (RI and Report), Brooklyn, NY
- Gateway Center II Retail (Phase I ESA and Phase II ESI), Brooklyn, NY
- 261 Hudson Street (Phase I ESA, Phase II ESI, BCP, and RAWP), New York, NY
- Riverside Center, Building 2 (BCP, Phase I ESA and Phase II ESI), New York, NY
- New York Police Academy, (Sub-Slab Depressurization and Vapor Barrier System), College Point, NY
- Bronx Terminal Market (BCP, RIWP, RAWP, Phase I ESA and Phase II ESI), Bronx, NY
- Jacob Javits Convention Center (Phase I ESA and Phase II ESI), New York, NY
- Yankee Stadium Development Waterfront Park (NYSDEC Spill Sites), Bronx, NY
- Bushwick Inlet Park (Phase I ESA, Approvals for NYC E-Designation), Brooklyn, NY
- Silvercup West (BCP, RIWP, RIR, RAWP, and RAA), Long Island City, NY
- 29 Flatbush, Tall Residential Building (Groundwater Studies, RIR and RAWP), Brooklyn, NY
- Gowanus Village I (BCP, RIWP and RIR), Brooklyn, NY
- Sullivan Street Hotel (Site Characterization Study and Owner Representation), New York, NY
- Riker's Island Co-Generation Plant (Soil and Soil Vapor Quality Investigations), Bronx, NY
- The Shops at Atlas Park (Sub-Slab Depressurization and Vapor Barrier Design), Glendale, NY
- Memorial Sloan-Kettering Cancer Center (Subsurface and Soil Vapor Intrusion Investigations), New York, NY
- Element West 59th Street (Oversight and Monitoring of Sub-Slab Depressurization and Vapor Barrier Systems), New York, NY
- Teterboro Airport (Delineation and Remedial Oversight of Petroleum-Contaminated Soils), Teterboro, NJ
- Proposed New York JETS Stadium (Phase I ESA), New York, NY
- Former Con Edison Manufactured Gas Plant Sites (Research Reports), New York, NY
- 7 World Trade Center (Endpoint Sampling and Final Closure Report), New York, NY
- Peter Cooper Village, Environmental Subsurface Investigations, New York, NY

Selected Publications, Reports, and Presentations

NYC Mayor's Office of Environmental Remediation – Big Apple Brownfield Workshop – Presented on Soil Vapor Intrusion Remedies (e.g., SSD Systems, Vapor Barriers, Modified HVAC)

New York City Brownfield Partnership – Presented on environmental considerations and complications of the Hudson Yards Development

Waterfront Development Technical Course – Presented on Impacted Waterfront Planning Considerations

Michael D. Burke, PG, CHMM, LEED AP

Principal

Environmental Engineering and Remediation



19 years in the industry

Mr. Burke is a geologist/environmental scientist whose practice involves site investigation and remediation, transactional due diligence, environmental site assessments, in-situ remedial technology, and manufactured gas plant (MGP) site characterization and remediation. His additional services include multi-media compliance audits, sub-slab depressurization system design, non-hazardous and hazardous waste management, emergency response, community air monitoring programs, environmental and geotechnical site investigations, and health and safety monitoring. He has experience with projects in the New York State Department of Environmental Conservation (NYSDEC) and New York State Brownfield Cleanup (NYS BCP) Programs; Inactive Hazardous Waste, and Spill Programs, and New York City Office of Environmental Remediation (OER) e-designated and New York City Voluntary Cleanup Program (NYC VCP) sites.

Selected Projects

- 227-14 North Conduit Avenue, Industrial Wastewater Compliance, Jamaica, NY
- 420 Kent Avenue, NYS Brownfield Cleanup Program, Brooklyn, NY
- 572 Eleventh Avenue, NYC VCP, New York, NY
- Monian Site A, OER E-Designated Site, New York, NY
- 537 Sackett Street, Gowanus Canal Due Diligence/MGP Site, Brooklyn, NY
- ABC Blocks 25, 26 and 27, NYS Brownfield Cleanup Program Sites, Long Island City, NY
- 432 Rodney Street, NYS Brownfield Cleanup Program, Petroleum and Chlorinated Volatile Organic Compound Investigation and Remediation, Brooklyn, NY
- 787 Eleventh Avenue, NYS Brownfield Cleanup Program Site, New York, NY
- President Street at Gowanus Canal, NYS Brownfield Cleanup Program Site, Brooklyn, NY
- 22-36 Second Avenue at Gowanus Canal, NYS Brownfield Cleanup Program Site, Brooklyn, NY
- 563 Sacket Street, NYS Brownfield Cleanup Program Site, MGP Investigation, and Remediation, Brooklyn, NY
- 156-162 Perry Street, NYS Brownfield Cleanup Program Site, New York, NY
- Christopher and Weehawken Streets, NYS Brownfield Cleanup Program, New York, NY
- Phelps Dodge Block 2529 (Lots 40, 50, and 45), Inactive Hazardous Waste Disposal Site, Maspeth, NY

Education

M.S., Environmental Geology
Rutgers University

B.S., Geological Sciences
Rutgers University

B.S., Environmental Science
Rutgers University

Professional Registration

Professional Geologist (PG) in NY

Certified Hazardous Materials
Manager – CHMM No. 15998

LEED Accredited Professional
(LEED AP)

OSHA Certification for Hazardous
Waste Site Supervisor

OSHA 29 CFR 1910.120
Certification for Hazardous Waste
Operations and Emergency
Response

NJDEP Certification for Community
Noise Enforcement

Troxler Certification for Nuclear
Densometer Training

Michael D. Burke, CHMM, LEED AP

- 42-50 24th Street, NYS Brownfield Cleanup Program Site, Long Island City, NY
- Storage Deluxe (163 6th Street), OER E-Designation Site, New York, NY
- Prospect Park Redevelopment, Landfill Reclamation, Prospect Park, NJ
- 431 Carroll Street, Gowanus Canal Due Diligence, Brooklyn, NY
- 76 4th Street Property, Gowanus Due Diligence, Brooklyn, NY
- Foxgate/MREC, Due Diligence and Solid Waste Compliance, Central Islip, NY
- 175-225 3rd Street at Gowanus Canal, NYS Brownfield Cleanup Program, Brooklyn, NY
- New York University Tandon School of Engineering, Spill Investigation/ Remediation Dual Phase Recovery, and Laser Fluorescence Investigation, Brooklyn, NY
- 2420-2430 Amsterdam Avenue, NYS Brownfield Cleanup Program /Board of Standards and Appeals Variance, New York, NY
- 170 Amsterdam Avenue, NYC VCP, New York, NY
- 538-540 Hudson Street, NYS Brownfield Cleanup Program (Former Gas Station), New York, NY
- 234 Butler Street, Gowanus Canal Due Diligence, Brooklyn, NY
- 550 Clinton Street, NYS Brownfield Cleanup Program E-Designation, Brooklyn, NY
- 111 Leroy Street, OER E-Designation Site, New York, NY
- 335 Bond Street, NYS Brownfield Cleanup Program, New York, NY
- Gowanus Canal Northside, NYS BCP Former Fuel Oil Terminal, Brooklyn, NY
- Multiple Buildings, Major Oil Storage Facility, Gowanus Canal Location, Brooklyn, NY
- 197-205 Smith Street at Gowanus Canal, MGP Due Diligence, Brooklyn, NY
- 450 Union Street at Gowanus Canal, NYS Brownfield Cleanup Program, Brooklyn, NY
- 86 Fleet Place, NYC VCP E-Designation, Brooklyn, NY
- New York University College of Nursing at 433 1st Avenue, NYS BCP, Bronx, NY
- Retail Building at 225 3rd Street, Brooklyn, NY
- 29-37 41st Avenue, NYS Brownfield Cleanup Program, Long Island City, NY
- 43-01 22nd Street, NYS Brownfield Cleanup Program, Long Island City, NY
- Compliance Audit for NYU at Washington Square Park, New York, NY
- Former Watermark Locations, NYS Brownfield Cleanup Program, Chlorinated Volatile Organic Compound Investigation and Remediation; AS/SVE, Brooklyn, NY
- Former Gas Station (1525 Bedford Avenue), Brooklyn, NY
- NYS Brownfield Cleanup Program at 514 West 24th Street, New York, NY
- Gowanus Canal Due Diligence at 76 4th Street, Brooklyn, NY
- Urban Health Plan, Medical Building, NYS Brownfield Cleanup Program CVOC Investigation and Remediation, Bronx, NY
- 420 East 54th Street, NYS Spill Closure, New York, NY
- Equity Residential at 160 Riverside Boulevard, NYS Spill Closure, New York, NY
- 357-359 West Street and 156 Leroy Street, NYC VCP, New York, NY
- Emergency Spill Response at 322 West 57th Street, Investigation and Closure, New York, NY

Gerald F. Nicholls, PE, CHMM

Senior Project Manager

Environmental Engineering & Hazardous Materials Management



13 years in the industry

Mr. Nicholls is an environmental engineer and project manager with experience throughout New Jersey, New York City, and the five boroughs. His expertise includes management of remediation and site investigations, brownfield cleanups, remedial design, industrial hygiene, air monitoring and environmental health and safety projects including data collection, inspection and reporting. Mr. Nicholls has relevant work experience serving private, Department of Defense, state, commercial, industrial, and municipal clients.

Selected Projects

- 140 6th Avenue, Sub-Membrane Depressurization System Design, Spill Remediation, Subslab Remediation and Monitoring Well Piping Design, Remediation Oversight, and Construction Administration, New York, NY
- 23-01 42nd Road, Phase I, Phase II Remedial Investigation, Remedial Action Work Plan, Sub-Membrane Depressurization System Design, Underground Storage Tank Closure and Remediation, Brownfield Cleanup Program, Remediation Oversight, Construction Administration, Long Island City, NY
- 23-10 Queens Plaza South, Phase I, Phase II Remedial Investigation, Remedial Action Work Plan, Sub-Membrane Depressurization System Design, Underground Storage Tank Closure and Remediation, Brownfield Cleanup Program, Remediation Oversight, Construction Administration, Long Island City, NY
- 170 Amsterdam Avenue, Remedial Action Work Plan, Voluntary Cleanup Program, Remediation Oversight, Construction Administration, New York, NY
- Urban Health Plan, Medical Building, DNAPL Delineation, Remedial Action Work Plan, Hazardous Waste Management and Minimization, Brownfield Cleanup Program, Bronx, NY
- Whitehead Realty, Acme Sites, DNAPL Delineation, Site Characterization, Remedial Investigation and Reporting, Brooklyn, NY
- Second Avenue Subway, Air Monitoring and Ventilated Air Treatment Program, New York, NY
- West 17th Street Development, DNAPL Assessment, DNAPL Recovery, Remedial Design, Closure through Brownfield Cleanup Program, Remediation Oversight, Bid Documents, ISS and Containment Wall Design, Construction Administration, New York, NY
- New York University Spill Sites, 4 Washington Square Village, 7-13, Washington Square North, and 251 Mercer Street, Fuel Oil Spill Cleanup and Closure, New York, NY
- Dormitory Authority of New York (DASNY), City College of New York, Fuel Protection and Leak Detection System Repair and Upgrades, New York, NY
- Surfactant Remediation Project, In-Situ Chemical Oxidation Design and Implementation and Site Closure, Margate City, NJ

Education

M.S., Environmental Engineering
New Jersey Institute of Technology

B.S., Chemistry and
Environmental Studies (Double Major)
Ursinus College

Professional Registration

Professional Engineer (PE) in NY

Certified Hazardous Materials
Manager (CHMM)

Affiliations

City of Jersey City Environmental
Commission, Former Commission,
Vice Chair and Chair

Alliance of Hazardous Materials
Professionals (AHMP)

Academy of Hazardous Materials
Managers (ACHMM), NJ Chapter

American Chemical Society

Association of NJ Environmental
Commissions (ANJEC)

Gerald F. Nicholls, PE, CHMM

- NYU Langone Medical Center, New Science Building, Remediation Oversight and Construction Administration, Voluntary Cleanup Program, New York, NY
- 86 Warren Street, Waste Characterization and Construction Documents, New York, NY
- 459 Smith Street, Due Diligence and Cost Estimating, Brooklyn, NY
- 491 Wortman Ave, Air Sparge/Soil Vapor Extraction Design and Implementation, Brownfield Cleanup Program, Bid Documents, Construction Administration, Brooklyn, NY
- Gowanus Canal Northside, Demolition and Decommissioning of MOSF, Remediation Investigation, Brownfield Cleanup Program, Brooklyn, NY
- 163 6th Street, Phase I and Phase II Due Diligence, Spill Response, Remedial Action Work Plan, Brooklyn, NY
- 111 Leroy Street, New York, NY
- 45 Broad Street, Waste Characterization, Construction Documents, New York, NY
- 411 Broadway, Phase I, Remedial Investigation, Air/Noise Coordination for E-Designation, New York, NY
- Modera on the Hudson, Remediation Oversight, Remedial Action Work Plan, Submembrane Depressurization System Design, Yonkers, NY
- Honeywell Quanta, Remedial Design Peer Review, Edgewater, NJ
- New York University Tandon School of Engineering (Spill 1009933), Remediation, Laser-Induced Fluorescence Investigation, Remedial System Optimization, Product Recovery, Spill Cleanup, Brooklyn, NY
- 237-261 North 9th Street, Peer Review and Due Diligence, Brooklyn, NY

Selected Publications, Reports, and Presentations

"Biodegradation Pathways and End Products of Sodium Dioctyl Sulfosuccinate/Sodium Hexadecyl Diphenyl Oxide Disulfonate Surfactant Solution." Florida Remediation Conference, Orlando, Florida, November 2005.

William Bohrer

Project Geologist Geologist



39 years in the industry

Mr. Bohrer is an experienced geologist responsible for managing Langan's environmental standards and Health and Safety compliance for projects throughout New York City. His services include dissemination of environmental protocols, troubleshooting at project sites, in-house/field training, and maintenance of quality standards across the environmental discipline. Mr. Bohrer has a diverse and extensive background in geophysics, hydrogeology, mining and petroleum, and geotechnical engineering. He has developed conceptual site models for public, industrial and commercial facilities nationwide.

Selected Projects

- NYU Poly – 122 Johnson Street, Brooklyn, NY
- Con Edison of New York at Governor's Island, NY, NY
- 535 4th Avenue, Brooklyn, NY
- 27 Wooster Street, New York, NY
- 42 West Street, Brooklyn, NY
- 455 West 19th Street, New York, NY
- Kings Plaza Mall, Brooklyn, NY
- Hudson Yards "Terra Firma", New York, NY
- Hudson Yards, Platform Special Inspection, New York, NY
- PSAC II, Bronx, NY
- 595-647 Smith Street, Brooklyn, NY
- New York University, 7-13 Washington Square North Investigation, New York, NY
- NYU 4 Washington Square Village, New York, NY
- 125th Street and Lenox Avenue, New York, NY
- Sullivan Street Development, New York, NY
- Hudson Crossing II, New York, NY
- New York Aquarium, Shark Tank & Animal Care Facility, Brooklyn, NY
- 209-219 Sullivan Street, New York, NY
- 261 Hudson Street, New York, NY
- 460 Washington Street, New York, NY
- 552 West 24th Street, New York, NY
- Brooklyn Bridge Park Pier 1, New York, NY
- International Leadership Bronx Charter School, Bronx, NY
- 203 East 92nd Street, New York, NY
- HighLine 28-29, New York, NY
- 539 Smith Street Bulkhead, Brooklyn, NY
- Willets Point, Corona, NY

Education

Post Graduate Studies in Geophysics
Cornell University

B.S., Geology
Tufts University

Professional Registration

40 Hour OSHA HazWOPER

OSHA Construction Safety & Health

OSHA Supervisory Certification
Credential (TWIC)

Transportation Worker Identification

NYS DEC- Protecting New York's
Natural Resources with Better
Construction Site Management"

Affiliations

American Association of Petroleum
Geologists

National Groundwater Association

Geological Society of America

PA Council of Professional Geologists

Kimberly Del Col, PE, LEED GA

Senior Staff Engineer
Environmental Engineering



6 years in the industry

Ms. Del Col is a chemical engineer whose expertise includes groundwater hydrology, water resource planning and management, environmental oversight and remediation and sustainable engineering. She has been involved in various environmental projects in the New York Metro area and has performed environmental field work, site research, data management and report preparation. Ms. Del Col has also performed soil and groundwater sampling and is trained in EQuIS and Visual MODFlow groundwater and contouring programs. Her geotechnical services have included inspections and oversight for rock coring and bedrock wells..

Selected Projects

- 27-01 Jackson Avenue, (Phase I ESA, BCP Application, RIWP), Long Island City, NY
- 26-32 Jackson Avenue, (Phase I ESA, Phase II ESI, BCP Application), Long Island City, NY
- 266-270 West 96th Street, (Phase I ESA, Phase II ESI, BCP Application), New York, NY
- 1525 Bedford Avenue, (Noise IR, Quarterly Monitoring Report), Brooklyn, NY
- 805-825 Atlantic Avenue, (Phase I ESAs, Subsurface Investigations, BCP Application, RI, RIR, RAWP), Brooklyn, NY
- 181 Mercer Street, (RIR, RAWP, Environmental Remediation, Spill Closure), New York, NY
- Tottenham Hale, (Phase II ESI), London, UK
- Queens Plaza North, (NYS BCP, Environmental Remediation), Long Island City, NY
- 335 Bond Street, (BCP Application, Subsurface Investigations, Groundwater Remediation Design), Brooklyn, NY
- 540 West 21st Street, (NYC Voluntary Cleanup Program, RIR, RAWP), New York, NY
- 982-998 Fulton Street, (Phase I ESA), Brooklyn, NY
- 121 Christopher Street, (Phase I ESA), New York, NY
- 2415-2419 Jerome Avenue (Phase I ESA, Phase II ESI, Spill Closure), Bronx, NY
- 267 West 87th Street, (Remedial Investigation & Report), New York, NY
- 211-215 East 38th Street, (Phase I ESA, Phase II ESI), New York, NY
- 615 Tenth Avenue, (Reporting), New York, NY
- River Place I & II, (Groundwater Monitoring), New York, NY
- Riverside Parcel 5, (Construction Oversight, Endpoint Sampling, Closure Report), New York, NY
- Riverside Parcel 2, (Construction Oversight), New York, NY
- 170 Amsterdam Avenue, (Construction Oversight), New York, NY
- 17-29 West End Avenue, (Construction Oversight), New York, NY
- 539 Smith Street Bulkhead, , (Construction Oversight), Brooklyn, NY

Education

M.S., Sustainable Engineering –
Environmental Sustainability
Villanova University

B.S., Chemical Engineering
Villanova University

Professional Registration

Professional Engineer (PE) in NY

10-Hour OSHA

40-Hour OSHA (HAZWOPER)

LEED Green Associate (LEED GA)

Affiliations

Society of Women Engineers

Women in Construction

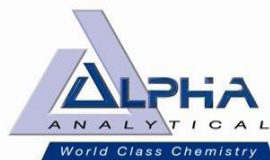
American Institute of Chemical
Engineers

Kimberly Del Col, PE, LEED GA

- Brooklyn Academy of Music North Tower, (Construction Oversight, FER), New York, NY
- Brooklyn Solvent Site (Whitehead Realty), (Construction Oversight), Brooklyn, NY
- Hudson Yards, Terra Firma, (Construction Oversight), New York, NY
- 616 First Avenue, (Construction Oversight), New York, NY
- 27 Wooster Street, (Closure Report), New York, NY
- Columbia University Manhattanville Development, Phase IA & Topdown Area, (Closure Report), New York, NY

ATTACHMENT B

LABORATORY REPORTING LIMITS AND METHOD DETECTION LIMITS



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Langan Engineering & Environmental

TCL Volatiles - EPA 8260C (WATER)

Holding Time: 14 days
Container/Sample Preservation: 3 - Vial HCl preserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Methylene chloride	75-09-2	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,1-Dichloroethane	75-34-3	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Chloroform	67-66-3	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Carbon tetrachloride	56-23-5	0.5	0.134	ug/l	63-132	20	63-132	20	20			
1,2-Dichloropropane	78-87-5	1	0.137	ug/l	70-130	20	70-130	20	20			
Dibromochloromethane	124-48-1	0.5	0.149	ug/l	63-130	20	63-130	20	20			
1,1,2-Trichloroethane	79-00-5	1.5	0.5	ug/l	70-130	20	70-130	20	20			
Tetrachloroethene	127-18-4	0.5	0.181	ug/l	70-130	20	70-130	20	20			
Chlorobenzene	108-90-7	2.5	0.7	ug/l	75-130	20	75-130	20	20			
Trichlorofluoromethane	75-69-4	2.5	0.7	ug/l	62-150	20	62-150	20	20			
1,2-Dichloroethane	107-06-2	0.5	0.132	ug/l	70-130	20	70-130	20	20			
1,1,1-Trichloroethane	71-55-6	2.5	0.7	ug/l	67-130	20	67-130	20	20			
Bromodichloromethane	75-27-4	0.5	0.192	ug/l	67-130	20	67-130	20	20			
trans-1,3-Dichloropropene	10061-02-6	0.5	0.164	ug/l	70-130	20	70-130	20	20			
cis-1,3-Dichloropropene	10061-01-5	0.5	0.144	ug/l	70-130	20	70-130	20	20			
1,3-Dichloropropene, Total	542-75-6	0.5	0.144	ug/l				20	20			
1,3-Dichloropropene, Total	542-75-6	0.5	0.144	ug/l				20	20			
1,1-Dichloropropene	563-58-6	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Bromoform	75-25-2	2	0.65	ug/l	54-136	20	54-136	20	20			
1,1,2,2-Tetrachloroethane	79-34-5	0.5	0.167	ug/l	67-130	20	67-130	20	20			
Benzene	71-43-2	0.5	0.159	ug/l	70-130	20	70-130	20	20			
Toluene	108-88-3	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Ethylbenzene	100-41-4	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Chloromethane	74-87-3	2.5	0.7	ug/l	64-130	20	64-130	20	20			
Bromomethane	74-83-9	2.5	0.7	ug/l	39-139	20	39-139	20	20			
Vinyl chloride	75-01-4	1	0.0714	ug/l	55-140	20	55-140	20	20			
Chloroethane	75-00-3	2.5	0.7	ug/l	55-138	20	55-138	20	20			
1,1-Dichloroethene	75-35-4	0.5	0.169	ug/l	61-145	20	61-145	20	20			
trans-1,2-Dichloroethene	156-60-5	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Trichloroethene	79-01-6	0.5	0.175	ug/l	70-130	20	70-130	20	20			
1,2-Dichlorobenzene	95-50-1	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,3-Dichlorobenzene	541-73-1	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,4-Dichlorobenzene	106-46-7	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Methyl tert butyl ether	1634-04-4	2.5	0.7	ug/l	63-130	20	63-130	20	20			
p/m-Xylene	179601-23-1	2.5	0.7	ug/l	70-130	20	70-130	20	20			
o-Xylene	95-47-6	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Xylene (Total)	1330-20-7	2.5	0.7	ug/l				20	20			
Xylene (Total)	1330-20-7	2.5	0.7	ug/l				20	20			
cis-1,2-Dichloroethene	156-59-2	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,2-Dichloroethene (total)	540-59-0	2.5	0.7	ug/l				20	20			
1,2-Dichloroethene (total)	540-59-0	2.5	0.7	ug/l				20	20			
Dibromomethane	74-95-3	5	1	ug/l	70-130	20	70-130	20	20			

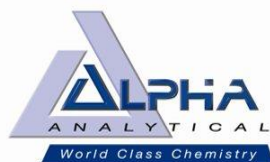
Please Note that the RL information provided in this table is calculated using a 100% Solids factor. (Soil/Solids only)
Please Note that the information provided in this table is subject to change at anytime at the discretion of Alpha Analytical, Inc.



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Langan Engineering & Environmental

TCL Volatiles - EPA 8260C (WATER)

Holding Time: 14 days
 Container/Sample Preservation: 3 - Vial HCl preserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
1,2,3-Trichloropropane	96-18-4	2.5	0.7	ug/l	64-130	20	64-130	20	20			
Acrylonitrile	107-13-1	5	1.5	ug/l	70-130	20	70-130	20	20			
Styrene	100-42-5	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Dichlorodifluoromethane	75-71-8	5	1	ug/l	36-147	20	36-147	20	20			
Acetone	67-64-1	5	1.46	ug/l	58-148	20	58-148	20	20			
Carbon disulfide	75-15-0	5	1	ug/l	51-130	20	51-130	20	20			
2-Butanone	78-93-3	5	1.94	ug/l	63-138	20	63-138	20	20			
Vinyl acetate	108-05-4	5	1	ug/l	70-130	20	70-130	20	20			
4-Methyl-2-pentanone	108-10-1	5	1	ug/l	59-130	20	59-130	20	20			
2-Hexanone	591-78-6	5	1	ug/l	57-130	20	57-130	20	20			
Bromochloromethane	74-97-5	2.5	0.7	ug/l	70-130	20	70-130	20	20			
2,2-Dichloropropane	594-20-7	2.5	0.7	ug/l	63-133	20	63-133	20	20			
1,2-Dibromoethane	106-93-4	2	0.65	ug/l	70-130	20	70-130	20	20			
1,3-Dichloropropane	142-28-9	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,1,1,2-Tetrachloroethane	630-20-6	2.5	0.7	ug/l	64-130	20	64-130	20	20			
Bromobenzene	108-86-1	2.5	0.7	ug/l	70-130	20	70-130	20	20			
n-Butylbenzene	104-51-8	2.5	0.7	ug/l	53-136	20	53-136	20	20			
sec-Butylbenzene	135-98-8	2.5	0.7	ug/l	70-130	20	70-130	20	20			
tert-Butylbenzene	98-06-6	2.5	0.7	ug/l	70-130	20	70-130	20	20			
o-Chlorotoluene	95-49-8	2.5	0.7	ug/l	70-130	20	70-130	20	20			
p-Chlorotoluene	106-43-4	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,2-Dibromo-3-chloropropane	96-12-8	2.5	0.7	ug/l	41-144	20	41-144	20	20			
Hexachlorobutadiene	87-68-3	2.5	0.7	ug/l	63-130	20	63-130	20	20			
Isopropylbenzene	98-82-8	2.5	0.7	ug/l	70-130	20	70-130	20	20			
p-Isopropyltoluene	99-87-6	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Naphthalene	91-20-3	2.5	0.7	ug/l	70-130	20	70-130	20	20			
n-Propylbenzene	103-65-1	2.5	0.7	ug/l	69-130	20	69-130	20	20			
1,2,3-Trichlorobenzene	87-61-6	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,2,4-Trichlorobenzene	120-82-1	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,3,5-Trimethylbenzene	108-67-8	2.5	0.7	ug/l	64-130	20	64-130	20	20			
1,2,4-Trimethylbenzene	95-63-6	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,4-Dioxane	123-91-1	250	60.8	ug/l	56-162	20	56-162	20	20			
1,4-Diethylbenzene	105-05-5	2	0.7	ug/l	70-130	20	70-130	20	20			
4-Ethyltoluene	622-96-8	2	0.7	ug/l	70-130	20	70-130	20	20			
1,2,4,5-Tetramethylbenzene	95-93-2	2	0.542	ug/l	70-130	20	70-130	20	20			
Ethyl ether	60-29-7	2.5	0.7	ug/l	59-134	20	59-134	20	20			
trans-1,4-Dichloro-2-butene	110-57-6	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,2-Dichloroethane-d4	17060-07-0										70-130	
Toluene-d8	2037-26-5										70-130	
4-Bromofluorobenzene	460-00-4										70-130	
Dibromofluoromethane	1868-53-7										70-130	

Please Note that the RL information provided in this table is calculated using a 100% Solids factor. (Soil/Solids only)
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ATTACHMENT C

ANALYTICAL METHODS/QUALITY ASSURANCE SUMMARY TABLE

ATTACHMENT C
ANALYTICAL METHODS/QUALITY ASSURANCE SUMMARY TABLE

Matrix Type	Field Parameters	Laboratory Parameters	Analytical Methods	Sample Preservation	Sample Container Volume and Type	Sample Hold Time	Field Duplicate Samples	Equipment Blank Samples	Trip Blank Samples	Ambient Air Samples	MS/MSD Samples	
Groundwater	Temperature, Turbidity, pH, ORP, Conductivity	Part 375 and TCL VOCs	EPA 8260C	Cool to 4°C; HCl to pH <2; no headspace	Three 40-mL VOC vials with Teflon® -lined cap	Analyze within 14 days of collection	1 per 20 samples (minimum 1)	1 per 20 samples (minimum 1)	1 per Shipment of VOC samples	NA	1 per 20 samples	
		Part 375 and TCL SVOCs	EPA 8270D and 8270D with SIM	Cool to 4°C	Two 1-Liter Amber Glass	7 days to extract; 40 days after extraction to analysis			NA			
		1,4-Dioxane as SVOC	EPA 8270D With SIM	Cool to 4°C	Two 1-Liter Amber Glass	7 days to extract; 40 days after extraction to analysis						
		Part 375 and TCL Pesticides	EPA 8081B	Cool to 4°C	Two 1-Liter Amber Glass	7 days to extract; 40 days after extraction to analysis						
		PCBs	EPA 8082A	Cool to 4°C		14 days to extract; 28 days after extraction to analysis						
		PFAS	EPA 537M	Cool to 4°C; Trizma	Three 25--mL HDPE or polypropylene container	14 days to extract; 28 days after extraction to analysis						
		Part 375 and TAL Metals	EPA 6010C, 6020A, 7470A	Cool to 4°C; HNO ₃ to pH <2	250 mL plastic	6 months, except Mercury 28 days						
		Hexavalent Chromium	EPA 7196A	Cool to 4°C	250 mL plastic	24 Hours						
		Cyanide	EPA 9012B/SM4500 C/E	NaOH plus 0.6g ascorbic acid	250 mL plastic	14 days to extract; 28 days after extraction to analysis						
Soil	Total VOCs via PID	Part 375 and TCL VOCs	EPA 8260C	Cool to 4°C	Two 40-mL VOC Vials with 5mL H ₂ O, one with MeOH or 3 Encore Samplers (separate container for % solids)	Analyze within 14 days of collection	1 per 20 samples (minimum 1)	1 per 20 samples (minimum 1)	1 per Shipment of VOC samples	NA	1 per 20 samples	
		Part 375 and TCL SVOCs	EPA 8270D and 8270D with SIM	Cool to 4°C	4 oz. jar*	14 days to extract; 40 days after extraction to analysis			NA			
		Part 375 and TCL Pesticides	EPA 8081B	Cool to 4°C	4 oz. jar*	14 days to extract; 40 days after extraction to analysis						
		PCBs	EPA 8082A	Cool to 4°C		14 days to extract; 40 days after extraction to analysis						
		Part 375 and TAL Metals	EPA 6010C, 7471B	Cool to 4°C	2 oz. jar*	6 months, except Mercury 28 days						
		Percent Solids	SM 2540G			NA						NA
		Soil Gas	Total VOCs via PID	TO-15 Listed VOCs	EPA TO-15	Ambient Temperature						6-Liter Summa Canister
Indoor Air	Total VOCs via PID	TO-15 Listed VOCs	EPA TO-15	Ambient Temperature	6-Liter Summa Canister	Analyze within 30 days of collection	1 per 20 samples (minimum 1)	1 per 20 samples (minimum 1)	NA	1 per 10 samples	NA	

Notes:
 ORP - Oxidation-Reduction Potential
 VOCs - Volatile Organic Compounds
 SVOCs - Semivolatile Organic Compounds
 PCBs - Polychlorinated Biphenyls
 PFAS - Perfluoro Alkylated Substances
 SIM - Selected Ion Monitoring
 HCl - Hydrochloric Acid
 HNO₃ - Nitric Acid
 MeOH - Methanol
 NaOH - Sodium Hydroxide
 *Can be combined in one or more 8 oz. jars

ATTACHMENT D

**PERFLUORINATED COMPOUND SAMPLING
PROTOCOL**

Groundwater Sampling for Emerging Contaminants

April 2018

Issue: NYSDEC has committed to analyzing representative groundwater samples at remediation sites for emerging contaminants (1,4-dioxane and PFAS) as described in the below guidance.

Implementation

NYSDEC project managers will be contacting site owners to schedule sampling for these chemicals. Only groundwater sampling is required. The number of samples required will be similar to the number of samples where “full TAL/TCL sampling” would typically be required in a remedial investigation. If sampling is not feasible (e.g., the site no longer has any monitoring wells in place), sampling may be waived on a site-specific basis after first considering potential sources of these chemicals and whether there are water supplies nearby.

Upon a new site being brought into any program (i.e., SSF, BCP), PFAS and 1,4-dioxane will be incorporated into the investigation of groundwater as part of the standard “full TAL/TCL” sampling. Until an SCO is established for PFAS, soil samples do not need to be analyzed for PFAS unless groundwater contamination is detected. Separate guidance will be developed to address sites where emerging contaminants are found in the groundwater. The analysis currently performed for SVOCs in soil is adequate for evaluation of 1,4-dioxane, which already has an established SCO.

Analysis and Reporting

Labs should provide a full category B deliverable, and a DUSR should be prepared by a data validator, and the electronic data submission should meet the requirements provided at: <https://www.dec.ny.gov/chemical/62440.html> ,

The work plan should explicitly describe analysis and reporting requirements.

PFAS sample analysis: Currently, ELAP does not offer certification for PFAS compounds in matrices other than finished drinking water. However, laboratories analyzing environmental samples (ex. soil, sediments, and groundwater) are required, by DER, to hold ELAP certification for PFOA and PFOS in drinking water by EPA Method 537 or ISO 25101.

Modified EPA Method 537 is the preferred method to use for groundwater samples due to the ability to achieve 2 ng/L (ppt) detection limits. If contract labs or work plans submitted by responsible parties indicate that they are not able to achieve similar reporting limits, the project manager should discuss this with a DER chemist. Note: Reporting limits for PFOA and PFOS should not exceed 2 ng/L.

PFAS sample reporting: DER has developed a PFAS target analyte list (below) with the intent of achieving reporting consistency between labs for commonly reportable analytes. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. This list may be updated in the future as new information is learned and as labs develop new capabilities. If lab and/or matrix specific issues are encountered for any particular compounds, the NYSDEC project manager will make case-by-case decisions as to whether particular analytes may be temporarily or permanently discontinued from analysis for each site. Any technical lab issues should be brought to the attention of a NYSDEC chemist.

Some sampling using this full PFAS target analyte list is needed to understand the nature of contamination. It may also be critical to differentiate PFAS compounds associated with a site from other

sources of these chemicals. Like routine refinements to parameter lists based on investigative findings, the full PFAS target analyte list may not be needed for all sampling intended to define the extent of contamination. Project managers may approve a shorter analyte list (e.g., just the UCMR3 list) for some reporting on a case by case basis.

1,4-Dioxane Analysis and Reporting: The method detection limit (MDL) for 1,4-dioxane should be no higher than 0.28 µg/l (ppb). ELAP offers certification for both EPA Methods 8260 and 8270. In order to get the appropriate detection limits, the lab would need to run either of these methods in “selective ion monitoring” (SIM) mode. DER is advising the use of method 8270, since this method provides a more robust extraction procedure, uses a larger sample volume, and is less vulnerable to interference from chlorinated solvents (we acknowledge that 8260 has been shown to have a higher recovery in some studies).

Full PFAS Target Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonates	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanessulfonic acid	PFOS	1763-23-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluoroalkyl carboxylates	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	PFHpA	375-85-9
	Perfluorooctanoic acid	PFOA	335-67-1
	Perfluorononanoic acid	PFNA	375-95-1
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUA/PFUdA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTriA/PFTTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTA/PFTeDA	376-06-7
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
	8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4
Perfluorooctane-sulfonamides	Perfluorooctanesulfonamide	FOSA	754-91-6
Perfluorooctane-sulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

Bold entries depict the 6 original UCMR3 chemicals

Collection of Groundwater Samples for Perfluorooctanoic Acid (PFOA) and Perfluorinated Compounds (PFCs) from Monitoring Wells Sample Protocol

Samples collected using this protocol are intended to be analyzed for perfluorooctanoic acid (PFOA) and other perfluorinated compounds by Modified (Low Level) Test Method 537.

The sampling procedure used must be consistent with the NYSDEC March 1991 SAMPLING GUIDELINES AND PROTOCOLS

<http://www.dec.ny.gov/regulations/2636.html> with the following materials limitations.

At this time acceptable materials for sampling include: stainless steel, high density polyethylene (HDPE) and polypropylene. Additional materials may be acceptable if proven not to contain PFCs. **NOTE: Grunfos pumps and bladder pumps are known to contain PFC materials (e.g. Teflon™ washers for Grunfos pumps and LDPE bladders for bladder pumps).** All sampling equipment components and sample containers should not come in contact with aluminum foil, low density polyethylene (LDPE), glass or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer. Standard two step decontamination using detergent and clean water rinse should be considered for equipment that does come in contact with PFC materials. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFC materials must be avoided. Many food and drink packaging materials and “plumbers thread seal tape” contain PFCs.

All clothing worn by sampling personnel must have been laundered multiple times. The sampler must wear nitrile gloves while filling and sealing the sample bottles.

Pre-cleaned sample bottles with closures, coolers, ice, sample labels and a chain of custody form will be provided by the laboratory.

1. Fill two pre-cleaned 500 mL HDPE or polypropylene bottle with the sample.
2. Cap the bottles with an acceptable cap and liner closure system.
3. Label the sample bottles.
4. Fill out the chain of custody.
5. Place in a cooler maintained at $4 \pm 2^{\circ}$ Celsius.

Collect one equipment blank for every sample batch, not to exceed 20 samples.

Collect one field duplicate for every sample batch, not to exceed 20 samples.

Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, not to exceed 20 samples.

Request appropriate data deliverable (Category A or B) and an electronic data deliverable.