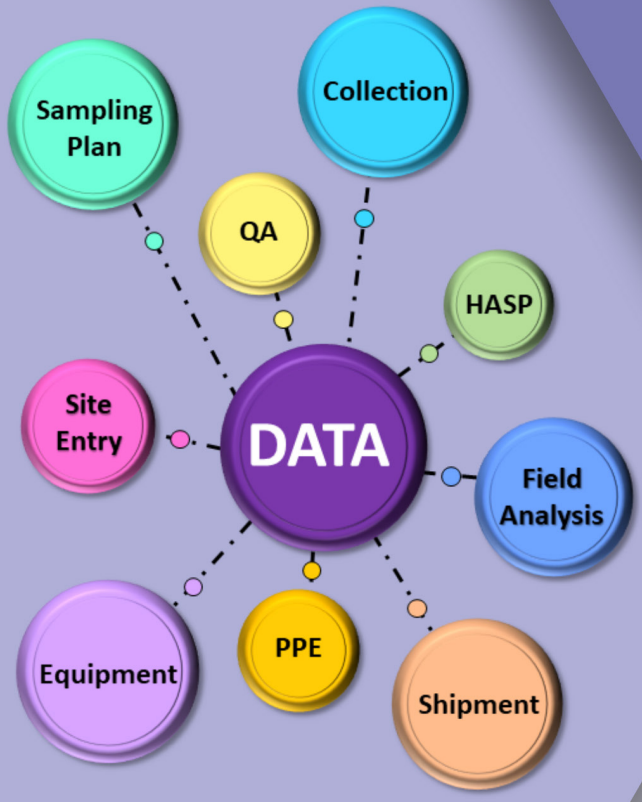
New Jersey Department of Environmental Protection

Field Sampling Procedures Manual



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Introduction

Intended Use of Guidance Document

This Field Sampling Procedures Manual (FSPM) is designed to help parties responsible for conducting environmental sampling as part of requirements established by the New Jersey Department of Environmental Protection (NJDEP). This guidance will be used by many different parties including, but not limited to, Licensed Site Remediation Professionals (LSRPs), environmental consultants, and other environmental professionals. Therefore, the generic term "investigator" will be used throughout this document to refer to any person using this technical guidance.

The procedures to vary from the Technical Requirements for Site Remediation (TRSR) are detailed at N.J.A.C. 7:26E-1.7. Variances from a technical requirement or deviation from guidance must be documented and adequately supported with data or other information. In applying technical guidance, the NJDEP recognizes that professional judgment may result in a range of interpretations on the application of the technical guidance to site conditions.

This document supersedes previous NJDEP guidance issued on this topic. Technical guidance may be used immediately upon issuance. However, the NJDEP recognizes the challenge of using newly issued technical guidance when a remediation affected by the guidance may have already been conducted or is currently in progress. To provide for the reasonable implementation of new technical guidance, the NJDEP will allow a six-month "phase-in" period between the date the technical guidance is issued final (or the revision date) and the time it should be used.

This guidance document was prepared with stakeholder input. The following people participated on the committee that prepared this technical guidance:

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Purpose

The primary intent of this manual is to promote accuracy and consistency when environmental samples are collected and prepared for chemical analysis by public and private entities. The validity of analytical data is directly dependent upon the integrity of the field procedures employed to obtain a sample. The methods and procedures described herein are intended for use by those State of New Jersey regulatory agencies that require chemical, physical, and certain biological analysis of samples for remedial evaluation and monitoring purposes.

Furnishing guidance for a broad range of field activities is meant to improve the planning, implementation, and documentation of most field-sampling activities. Said guidance may often suggest several ways to collect a sample, all of which may be scientifically correct under site or matrix specific circumstances. Hyperlinks that direct the reader to a variety of websites are intended to enhance specific information with the emphasis on "enhance," not necessarily "replace." Maintaining a balance between the evolving nature of environmental sampling and well-established regulatory oversight means that care should be taken when preparing documents based on the procedures outlined herein. All methodologies presented in this manual may not be applicable to specific site situations; a certain procedure, though included in the text of the manual or by hyperlink reference, may be disallowed at the discretion of NJDEP program personnel if determined inappropriate in a particular situation.

This manual has been prepared in an effort to represent the best available technology for field sampling activities associated with hazardous site investigations and remedial actions. It is also an appropriate reference for certain aspects of water data acquisition, water allocation, wastewater treatment operations, radiological assessment, geophysical investigations, and other regulated programs that require field sampling. Procedures outlined herein have been developed through internal peer review, extensive literature research, practical field application, and analysis of data from a quality assurance perspective.

Environmental sampling inherently may present extraneous variables, which may ultimately affect the outcome of analytical results. Since the nature of environmental media sampling warrants the analysis of a small aliquot relative to the bulk material, proper sampling techniques must be employed to obtain a sample that retains its scientific integrity and is legally defensible. To meet these conditions, a sample must be collected and handled so as to keep its original physical form and chemical composition to as great an extent as possible. For a sample to be "representative" of a larger body of material in question, it is imperative to ensure sample integrity and maintain quality assurance standards in the field. The sampling procedures put forth in the text of this manual, or by direct reference, are designed to minimize any possibility of altering the sample's integrity.

The achievement of consistency in sampling procedures and techniques helps to ensure the provision of data having acceptable quality, comparability, and usability. The importance of data quality has been recognized through stringent laboratory quality control programs. This manual is intended to compliment these processes by establishing appropriate quality control during sampling collection. Quality assurance measures, coupled with a comprehensive site-specific sampling plan, will improve the chance of collecting representative samples. This is important to ensure that public and private monetary resources are utilized in an effective manner.

NJDEP's *Field Sampling Procedures Manual (FSPM)* details the scope of field sampling protocol for site investigation and monitoring activities. From sampling plan preparation through chain of custody procedures, the

manual details the handling requirements and offers a variety of collection techniques for sample collection of various matrices. Related concerns such as personnel protection, geophysical investigation techniques, use of portable instrumentation, etc. are also included.

The reader is cautioned to be aware of the differences between materials presented in this manual as guidance, and specific requirements contained within control documents (e.g., promulgated regulations, permits, or Administrative Consent Orders). Control documents have legal precedence over this manual and may prescribe certain sampling activities or methods unique to a particular program, site, or matrix. In all cases, and when sampling within specific conditions set forth by any control documents, this manual should be utilized as a technical guidance document only.

The NJDEP will be updating this manual as needed to keep the most current and accepted sampling methods available to the public. Also, inquiries related to obtaining certification for certain analyze-immediately parameters related to environmental sampling should be made directly to the NJDEP Office of Quality Assurance. These include Laboratory Certification pursuant to N.J.A.C. 7:18, certification related to the Triad initiative, and certification associated with the Private Well Testing Act.

It is important to note that this technical guidance does not replace, supersede, or alleviate the responsible party's obligations to complete an investigation and remediation pursuant to the Administrative Requirements for the Remediation of Contaminated Sites (ARRCS) N.J.A.C. 7:26C, Remediation Standards N.J.A.C. 7:26D and the TRSR N.J.A.C. 7:26E. In all instances, the investigator and PRCR shall (N.J.S.A. 58:10C-16) ensure that the protection of public health and the environment is maintained.

Document Overview

This manual focuses on collecting and analyzing environmental samples. The document discusses, but is not limited to, analysis of the samples, health and safety, equipment used for different types of samples, procedures to properly sample and store for laboratory use, geophysical surveys, and personal protection. The manual also discusses different types of media that may be sampled. Other useful technical guidance documents may be accessed and downloaded from the NJDEP's SRP Guidance Library (http://www.nj.gov/dep/srp/guidance/).

Disclaimers

The use of any trade names, products, or materials in this manual does not constitute an endorsement by the State of New Jersey or the NJDEP.

The information in the NJDEP's *Field Sampling Procedures Manual (FSPM)* is provided free of charge to the public. The State of New Jersey, its agencies, and its employees assume no responsibility to any person or entity for the use of this information, and there are no representations or warranties, expressed or implied, of any kind regarding this information. Any use of this information is at the user's own risk.

Many of the web links and web addresses mentioned in the *FSPM* are to websites maintained by neither NJDEP, nor the State of New Jersey. Accordingly, the NJDEP makes no special endorsement for the content of these web links, web addresses, websites, or the views expressed by the websites' publishers.

Websites may change or remove their content at any time. Therefore, the NJDEP does not guarantee that the material on the referenced websites is the same as when the *FSPM* was developed, or that the web links are still available.

Chapter 1
The Sampling Plan

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Chapter 1
The Sampling Plan

1.1 Introduction

There are a wide variety of reasons for collecting samples, and various sampling strategies will be needed for different situations. It is important that the purpose of the sampling and its associated data quality objectives be identified before fieldwork begins. For example, samples may be collected to determine: 1) the existence and/or extent of contamination at a site; 2) waste characterization and classification for disposal or recovery; and 3) compliance with existing regulations. Once the objective of the sampling is known, decisions about analytical parameter selection, NJ certified laboratory selection, quality control samples, sample location and frequency, etc. can be made more confidently. In sampling to assess permit compliance, some of these selections may have been mandated by the NJDEP. Here, the permit applicant has the responsibility of ensuring that any proposed requirements will be achievable. Defining sampling and data quality objectives is important to ensure that the sampling plan is complete. Environmental sampling is often conducted to gather data that will be the basis for remedial or regulatory decisions. Because of the potential threat to health and the environment, and high costs usually associated with site remediation, strict adherence to quality assurance measures are strongly recommended. The objective of the sampling helps to dictate what should be prescribed in the sampling plan.

An integral part of any sampling program is planning. Before a plan can be written, site-specific information must be gathered to ensure that the plan is logical, will meet the required objectives, and the course of action is achievable.

The purpose of developing a sampling plan is to detail a "plan of action." The person writing the plan should be very familiar with the site-specific conditions, and those implementing the plan should be very familiar with the plan's contents. A properly prepared sampling plan that is correctly implemented will allow the sampling objectives to be met, help avoid confusion in the field, preserve health and safety, and ultimately save time and money.

The NJDEP maintains a library of guidance documents on its website at https://www.nj.gov/dep/srp/guidance/. It is recommended the reader access the website and review the guidance documents pertinent to the respective task. Examples of some of the relevant guidance documents pertaining to this chapter are:

Soil Investigation Technical Guidance: https://www.nj.gov/dep/srp/guidance/#si_ri_ra_soils;

Ground Water Technical Guidance: https://www.nj.gov/dep/srp/guidance/#pa_si_ri_gw;

Ecological Evaluation Technical Guidance: https://www.nj.gov/dep/srp/guidance/#eco_eval; and

Vapor Intrusion Technical Guidance: https://www.nj.gov/dep/srp/guidance/#vi.

The following documents are available at: https://www.nj.gov/dep/srp/guidance/#analytic_methods.

- Quality Assurance Project Plan Technical Guidance
- Data Quality Assessment and Data Usability Evaluation Technical Guidance
- Data of Known Quality Protocols Technical Guidance

Additional guidance may also be found at websites of Occupational Safety and Health Administration (OSHA), United States Environmental Protection Agency (USEPA), and the American Society for Testing and Materials (ASTM).

OSHA: https://www.osha.gov

USEPA: https://www.epa.gov/hw-sw846/sampling-guidance-documents-sw-846-compendium

USEPA Guidance Documents: https://www.epa.gov/guidance

ASTM: https://www.astm.org/

1.2 The Triad Approach

The New Jersey Department of Environmental Protection is committed to streamlining the site investigation and remediation process at contaminated sites without compromising data quality and reliability. This goal can sometimes be better achieved by implementing the Triad approach, a process that integrates systematic planning, dynamic work plans, and real-time measurements to achieve more reliable, timely and cost-effective site characterization and cleanup. The Triad approach seeks to recognize and manage the uncertainties involved in generating representative data from heterogeneous environmental matrices. The NJDEP supports and encourages the use of the Triad approach for sites undergoing investigation and remediation within the Site Remediation and Waste Management Program. The NJDEP has evaluated the Technical Requirements for Site Remediation, N.J.A.C. 7:26E, in the context of Triad approach, and has determined that the concepts embodied in Triad approach can be implemented within the framework of the rules. More information and details on the Triad approach may be found at https://triadcentral.clu-in.org/ and https://itrcweb.org/GuidanceDocuments/SCM-3.pdf.

1.3 Site History – Evaluating Existing Data/File Information

The first step in a site investigation should be the gathering of background information. The NJDEP has provided guidance on the collection and evaluation of site historical information in the Preliminary Assessment (PA) Technical Guidance, https://www.nj.gov/dep/srp/guidance/#pa_guide. Per the PA Guidance, the purpose is to provide the investigator with a list of resources and framework on how to use the resources to conduct a preliminary assessment. This assessment must meet the diligent inquiry requirements of the Technical Requirements for Site Remediation (Technical Regulations) at N.J.A.C. 7:26E-3.1 and 3.2 to determine if there may be any potentially contaminated areas of concern that require further investigation. A Preliminary Assessment Data Gathering Checklist is included in Appendix B of the Guidance to provide the investigator with a list of potential areas of concern to consider in the historical evaluation.

Data from the DEP's Geographic Information System (GIS) are a valuable resource that can provide additional background information to investigators, enabling the ability to analyze mapped datasets on computer. GIS datasets relevant to the history of activity at a site include statewide land use, soils, geology, and digital aerial orthophotography. Visit the NJDEP GIS website for more information and data downloads at http://www.state.nj.us/dep/gis and the New Jersey Spatial Data Clearinghouse at https://gisdata-njdep.opendata.arcgis.com/. The data can also be viewed online at https://www.state.nj.us/dep/gis/.

By revealing what materials were/are handled on site, a file search may provide guidance in choosing which parameters to include for analysis. A good source for this information are the hazardous waste manifests for the site. The hazardous waste codes will give clues as to what materials were handled at the site. An example would be F001 waste, which is classified as chlorinated solvents. Additionally, while caution must still be used, judgments regarding health and safety requirements can be made. When no information is available, field personnel should consider that worst case conditions may exist and take proper precautions to ensure safety.

Below is a list of potential sources of historical information. This list is not required or meant to be exhaustive.

U.S. Government

U.S. Department of Justice
U.S. Geological Survey
U.S. DOA - Soil Conservation Service
U.S. DOA - Forest Service
U.S. DOI - Fish and Wildlife Agencies
U.S. Army Corps of Engineers
U.S. Nuclear Regulatory Commission
Federal Emergency Management Agency
National Oceanic and Atmospheric Administration
U.S. Environmental Protection Agency

State of New Jersey

NJ State Library
NJ State Attorney General Office
NJ Geological and Water Survey
NJ Department of Transportation
NJ Department of Agriculture
NJ Department of Health
NJ Department of Environmental Protection
- Site Remediation and Waste Management Program GeoWeb application
- Site Remediation and Waste Management Program file reviews via the Open Public Records Act (OPRA)
- Watershed Restoration
- Division of Water Quality
- Regional Enforcement (Northern, Central and Southern)
- Bureau of Freshwater and Biological Monitoring (see 305b report, STORET)
- Bureau of Case Management
- Bureau of Site Management
- Division of Air Quality
- Bureau of Emergency Response
- Bureau of Environmental Evaluation and Risk Assessment
- Bureau of Environmental Measurements and Site Assessment
- Environmental Research Library Bureau of Geographic Information and Analysis
- (Digital aerial orthophotography and other GIS data sets) at http://www.state.nj.us/dep/gis and https://gisdata-njdep.opendata.arcgis.com/
- Coastal Management Program (Hard copy historical aerial photography)
- Radiation Protection Element
- Bureau of Pesticide Compliance
- Office of Community Relations
- Office of Brownfield Reuse

County Government

County Health Department
County Planning Board
County Library

Local Government

Local Health Department
Tax Assessors Office
Economic Development Officer
Environmental Commission
Local Planning Board
Town Engineer
Local Chamber of Commerce
Local Airport
Local Library
Local Well Drillers
Local Historical Society

Other Sources

Facility Records
Employee Records
Citizens residing nearby
Local and regional waste haulers and generators
New Jersey Environmental Digital Library (http://njedl.rutgers.edu)
Sanborn Fire Insurance Maps available at Princeton University Library
(https://library.princeton.edu/libraries/firestone/rbsc/aids/sanborn/sanborn-web.htm
Non-profit environmental organizations (e.g., nature conservancies, watershed associations etc.)

1.4 Defining the Physical Environment

Equal in importance to finding out what may have occurred on-site historically, and what may be taking place on-site currently, is determining where possible releases are most likely to be found (i.e., where did things actually take place). A pre-sampling site visit should be conducted to gather additional background information. The PA Guidance provides additional information on the site inspection. Labels and DOT numbers on drums and tanks may be useful. Files found on-site may include information about materials that were manufactured, stored, or disposed of on-site. Product names may be determined from shipping labels or manifests. Any and all information will be useful in sampling plan preparation, and in formulating a site-specific Health and Safety Plan (see Chapter 4, *Site Entry Activities*).

The fate of environmental contaminants is dictated by the source, the characteristics of the contaminant itself, (i.e., persistency and toxicity) and perhaps most importantly, by the physical environmental system into which it is released. Contaminants move at varying rates and to varying degrees when released into different kinds of matrices. It is extremely important to the success of achieving the sampling objectives to determine what kind of environmental system the site encompasses. An investigation into the local geology, hydrology (including flow rates of nearby surface waters, average depth to ground water and ground water flow direction, identification of areas of recharge, etc.), and climatology is necessary. The biological system should also be assessed. The flora and fauna of the area (including identification of sensitive environments and/or species, stressed vegetation, potential for bioaccumulation and biotransformation in the plant and animal life, especially agricultural) are definite factors to be taken into account. Stressed vegetation may serve as an indicator for contaminant migration to a particular area. A GIS system and GIS data can assist investigators in defining both the environmental and biological systems. Specific NJ based GIS data is available for download at http://www.state.nj.us/dep/gis and https://gisdata-njdep.opendata.arcgis.com/. These data elements include Coastal Area Facility Review Act (CAFRA) boundary, Pinelands boundary, soil

type, hydrography, land use, wetland delineation, surface contours and more. The data can also be viewed online at https://www.state.nj.us/dep/gis/. Defining the physical environment of the site will help in determining the fate of the contaminants. Migration pathways should also be identified, assuring that samples will be collected in the most appropriate area.

The factors addressed above offer an overview of considerations that should be evaluated for a sampling plan to be complete. The more information that is obtained, the more that will be known about the source, movement, and concentrations of contaminants in the media to be sampled. With this knowledge, it will be easier to develop a complete site-specific, sampling plan.

Along with the historical and physical information needed prior to sampling plan development, the following topical areas of basic information are necessary components for an inclusive sampling plan.

1.5 Sample Locations and Numbers

When choosing the location of sampling points, the objective of the sampling event is important. A field sampling approach should be based on information gathered about the site and/or areas of concern. Information may be gathered as part of the Preliminary Assessment and/or due diligence phase. The investigator should conduct data gathering in accordance with the Preliminary Assessment Technical Guidance; especially when applicable for a site (i.e., Industrial Site Recovery Act (ISRA)). Based on the information gathered about a site and/or area of concern, samples are then collected. Sample locations should be biased to characterize suspected or known areas of contamination. However, for sites where limited background information is available, and/or obvious contaminated areas do not exist, a random sampling scheme may be useful. Random sampling depends on the theory of random chance probabilities to choose the most representative sample. This process is utilized when there are numerous available sampling locations and there are no satisfactory reasons for choosing one location over another (i.e., bias). The investigator should develop a field sampling approach as noted in the Technical Guidance for Site Investigation of Soil, Remedial Investigation of Soil, and Remedial Action Verification Sampling for Soil. Subsequent investigations and sampling of groundwater should be biased based on any previous soil sampling results (i.e., biased toward areas of soil contamination), and follow the Ground Water Technical Guidance: Site Investigation, Remedial Investigation, Remedial Action Performance Monitoring. For guidance on sample locations and numbers for Ecological Evaluations refer to the NJDEP Ecological Evaluation Technical Guidance document available at https://www.nj.gov/dep/srp/guidance/#eco_eval.

Tables of random numbers are readily available from many sources and should be used to eliminate any possible bias generated by those collecting the sample, assuming a random approach is used.

Also, important when choosing sample locations is consideration of the site's physical environmental setting and how these factors can influence the concentration and movement of the material of concern. Sampling at hazardous waste sites is usually conducted in an attempt to discover contamination and to define its extent and variability. With such an objective, it is most logical to choose sample locations that will yield the most information about site conditions. Here, judgment (or biased) sampling should be employed. Biased samples are those collected at locations that were chosen based on historical information, knowledge about the location and behavior of the contaminant(s), and/or knowledge about the effects of the physical system on the contaminants' fate.

Both biased and random sampling techniques can be used together to thoroughly address an entire site or area of concern. Some samples may be biased to potentially contaminated areas (e.g., stained soil, former process or disposal areas) or potentially impacted areas (e.g., areas of stressed vegetation, sediment downstream from discharge pipe). In areas less likely to be contaminated or areas with little available background information, random samples may be used to allow adequate assessment of the entire site.

There are several factors that help determine the number of samples needed for site characterization:

- Exposure pathways
- Statistical performance objectives
- Data quality objectives
- Quality assurance objectives
- Background samples
- Sampling objectives
- Site specific conditions

Data quality and quality assurance objectives should be incorporated in a site-specific quality assurance project plan (QAPP) in accordance with 7:26E-2.2, Quality Assurance Project Plan Technical Guidance, and other applicable guidance. Additionally, data quality and sampling objectives should comply with the Data of Known Quality Protocol Technical Guidance.

Background sampling should be conducted in accordance with the appropriate guidance applicable per media. Sampling to evaluate naturally occurring background or upgradient/offsite source background should be implemented in accordance with the soil, groundwater, and/or ecological technical guidance documents, as applicable. Additional considerations for evaluation of background conditions may also include implementing investigations in accordance with Historic Fill and/or Historically Applied Pesticide Technical Guidance. Specific programs may have different requirements, please refer to the program guidance for details.

Considerations of the biased or random sampling should be evaluated on a site-by-site basis. If the objective of the event is to determine whether the site is contaminated, a limited number of samples, from properly chosen locations, will yield useful information. A greater number of samples may be needed however, if the site is known to be contaminated and delineation of the contamination is the objective. In many cases, statistical considerations can be helpful in determining sampling strategy. For sites suspected of being impacted by radioactive material, refer to Chapter 12, *Radiological Assessments*, for specific sampling considerations.

An additional consideration should be made if the sampling locations and results are to be analyzed or modeled in GIS with other spatial data. Accurate sampling locations (NJ State Plane Coordinates) must (per 7:26E-1.6(a)5) be determined in order to reference the data spatially. Depending on the accuracy requirements of the analysis, these locations could be determined through high accuracy surveys (including elevation), the use of Global Positioning System (GPS) receivers or from digital aerial orthophotography data on the GIS. General NJDEP GPS Standards, and GIS Mapping and Digital Data Standards, can be reviewed at http://www.state.nj.us/dep/gis. SRWMPs *Guidance for the Submission and Use of Data in GIS Compatible Formats Pursuant to Technical Requirements for Site Remediation* (TECHGIS2) can be reviewed at https://www.nj.gov/dep/srp/regs/techgis/techgis2.pdf. Sampling points inside a structure should be identified by physical and logical connections and relative locations with respect to other fixed structures and equipment.

1.6 Sample Methodology and Matrix

Once the appropriate number of samples and locations have been chosen, consideration should be given to what sample collection method will be used. An assessment of the proposed sampling method is needed to assure that representative samples of site conditions are obtained. To prevent the possible cross-contamination of samples, the sampling investigation should begin at the least contaminated or background areas of the site and proceed to the areas suspected of being the most highly contaminated. The selected sampling

methodology will be matrix dependent. In some instances, there may be several acceptable options available for collecting a sample. In other instances, site-specific conditions may dictate that only one approach will work, even though that method may not be the preferred method. In all cases, the construction material of the sampling device, its design, its decontamination, and proper use are critical factors and should be included in the proposed sampling plan.

Use of sampling equipment constructed of inappropriate or undesirable material may compromise sample quality by several processes: 1) Compounds related to the sampling equipment material may leach into the sample; 2) The sampling equipment used during sample collection may adsorb compounds from the sample itself; and 3) After repeated use and decontamination, compounds previously adsorbed onto the sampling device may now desorb from the sampling equipment into a cleaner sample. Sampling equipment design is also important. For example, a ground water sampling device that aerates the sample during collection may yield a sample that is not representative of actual aquifer conditions.

Even the most well designed, constructed, and cleaned sampling device may yield a non- representative sample if used improperly. All personnel involved in collection of the sample should receive training on the use, care, and limitations of the sampling equipment used.

Further, decontamination of the chosen device must be considered. The sampling device should be resistant to the decontamination solutions and should be constructed to allow ease of cleaning and assure thorough decontamination (see Chapter 5 *Sampling Equipment*, for decontamination procedures).

1.7 Laboratory Selection

Prior to selecting a laboratory, the certification status of the laboratory must be determined. Laboratories submitting analytical data to the State of New Jersey must hold current certification where applicable under the *Regulations Governing the Certification of Laboratories and Environmental Measurements* N.J.A.C. 7:18. Details on laboratory accreditation are provided in Chapter 2.

The Office of Quality Assurance offers certification in the following regulatory programs:

- Drinking Water Program
- Solid and Hazardous Waste
- Air
- Wastewater -Non Potable Water
- Radon
- The Contract Laboratory Program

The State of New Jersey Certification Program requires certification of the samplers collecting “Analyze Immediately” parameters for NJDEP programs. Certification for those parameters can be obtained from the Office of Quality Assurance. Additionally, immunoassay methods that are considered laboratory or field methods require certification under the Solid and Hazardous Waste Program. Regardless of whether a company or organization is or is not a laboratory, matrix, parameter, and method specific certification must be obtained. This includes but is not limited to responsible parties, contractors, and facilities.

More information on the two options available for laboratory certification offered by the Office of Quality Assurance (OQA) can be found at: https://www.nj.gov/dep/enforcement/oqa/labcert.html.

1.8 Electronic Submission of Data for Site Remediation and Waste Management

1.8.1 General Requirements

According to the Technical Requirements for Site Remediation (N.J.A.C. 7:26E) herein called the Tech Regs, the results of environmental sample analysis must be submitted to NJDEP Site Remediation and Waste Management Program (SRWMP) in an electronic format (per 7:26E-1.6(a)5). This requirement is applicable to the Site Investigation Report and applies to all subsequent phases of the remedial process. Furthermore, every sample point must be geographically referenced using approved accuracy standards (per 7:26E-1.6(a)5). NJDEPs GIS compatibility requirements can be reviewed at http://www.state.nj.us/dep/gis and the *Digital Data Standards* and *Guidance for the Submission and Use of Data in GIS Compatible Formats Pursuant to Technical Requirements for Site Remediation* (TECHGIS2) at https://www.nj.gov/dep/srp/regs/techgis/techgis2.pdf.

Prior to conducting sampling, it is important to consider the type and format of data that will be required when the results are submitted to SRWMP, as well as other information that must be gathered while in the field, such as geographic location of sampling points.

The current requirements call for the submission of three files. HZSAMPLE contains field sampling information; HZRESULT contains analytical results; DTST identifies the data submission. The complete requirements are outlined in detail at http://www.state.nj.us/dep/srp/hazsite. This site contains numerous guidance documents and related software to assist in the preparation of an electronic data submission. Both the *Getting Started Guide* and the *SRP Electronic Data Interchange Manual (SRP-EDI)* will assist in this effort. The SRP-EDI, in particular, specifies the three data tables that must be submitted, the fields in each of those tables, and the data requirements, such as field length and valid values, etc. Note that the SRP-EDI is updated periodically. The website should be accessed prior to preparing data to ensure that the latest requirements are met. Another important tool available at the website is the "Environmental Data Submittal Application Checking" (EDSA) program. Once samples have been collected and data prepared, the data should be run through EDSA to determine compliance with data requirements.

1.8.2 Consistency in Data Fields Among Data Tables

In DEP's system, three fields are used to link together the three data tables that comprise a complete submission. The fields are SRP ID, Sample Date, and Sample Number. Therefore, it is imperative that these fields are created per the SRP-EDI definitions, and are reproduced EXACTLY the same in each of the tables. Consistency among these fields is particularly important when one party, such as a consultant, is preparing the part of the submission related to sample collection, and a second party, such as a laboratory, is providing the analytical results information. Please review the definitions of the three fields SRP ID, Sample Number, and Sample Date that are in the most current version of the SRP-EDI prior to collecting samples, supplying samples to the laboratory for reference in the result table, and preparing a submission.

1.8.3 Securing Laboratory Services

Prior to securing the services of a laboratory, it is important to know what services they provide for meeting these electronic data requirements and are certified by the NJDEP OQA for the matrix and parameters being investigated. Several laboratories already have exports from their Information Management Systems that meet the required results format. Ensure that the laboratory has submitted results successfully in the past and that they will run the SRWMP data checker program, called EDSA, on the result file to ensure that it meets the required data format.

1.8.4 Geographically Referenced Points

All sample results must be submitted with a geographically referenced location associated with them (per 7:26E-1.6(a)5). Locations should be provided in State Plane Feet, using North American Datum 1983. Digital mapping shall conform to the "New Jersey Department of Environmental Protection Mapping the Present to Protect New Jersey's Future: Mapping and Digital Data Standards," in N.J.A.C. 7:1D, Appendix A. Additional accuracy standards are defined in the NJDEP, Mapping and Digital Data Standards at http://www.state.nj.us/dep/gis.

Detailed instructions outlining the specific map elements, support data and metadata requirements for GIS compatible digital map submissions for SRWMP are included in *Guidance for the Submission and Use of Data in GIS Compatible Formats* at https://www.nj.gov/dep/srp/gis/.

1.8.5 Permit Application and Compliance

Several permitting programs have provided for permit application data and/or sampling data required by permits to be submitted electronically. Since software development is an ongoing process, interested persons should contact the appropriate permitting bureaus for current capabilities and procedures.

1.9 Quality Assurance Considerations

Quality assurance measures must be associated with each sampling and analysis event as an additional measure of control to assure that the sample delivered to the lab for analysis is representative of site conditions. The field sampling plan should outline how the representative quality of the samples will be assured. This will include, but not be limited to: data quality objectives, laboratory SOPs, field SOPs, sample bottle preparation, equipment decontamination, trip blanks, field blanks, duplicates, split samples, sample preservation and handling, chain of custody, analysis request, analytical methods, parameters, and deliverables. See Chapter 2 for further quality assurance information.

1.10 Health and Safety Concerns

Prior to any work being performed at a hazardous waste site, as defined by 29 CFR 1910.120, the organization, or company, engaged for the work must develop a written Health and Safety Program for its employees. As part of the overall Health and Safety Program, a site-specific safety and health plan, which addresses the safety and health hazards at a particular site, must be developed and kept available at the site during the duration of all site work. Typically, a Health and Safety Program will address the following areas: organizational responsibilities, risk analysis, underground utility markouts, employee training, personnel personal protective equipment (PPE), respiratory protection, medical surveillance, air monitoring, site control, decontamination, site standard operating procedures, contingency planning, permit required confined space operations, hot work, spill containment, emergency response, emergency contacts, and hospital route. Depending on the types of contaminants, other hazards present, and the type of work that is anticipated, some of these concern areas may not be applicable to all aspects of a particular sampling episode. See Chapter 4 for more information on Site Entry Activities and training requirements.

Chapter 2
Quality Assurance

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Chapter 2
Quality Assurance

2.1 Introduction

This chapter provides the user with quality assurance (QA) requirements and procedures for conducting environmental measurements and sampling. In order to generate analytical data of known and defensible quality for its intended use, adherence to established quality assurance protocols is necessary. This document is designed to complement, not replace or supersede, program-specific technical guidance and regulatory requirements.

The foundation of an organization's quality program is typically documented in a Quality Management Plan (QMP). The QMP is viewed as the over-arching, 'umbrella' document which describes the quality policies, procedures, and applicable areas within the organization as well as the roles, responsibilities, and authorities of its members in planning, implementing, and assessing the degree to which the QMP is being followed. The QMP also includes the NJDEP QA management structure and contact information by relevant program for questions related to QA. Quality requirements for non- United States Environmental Protection Agency (USEPA) organizations that receive funds for work involving environmental data are specified in the Code of Federal Regulations for each type of extramural agreement. The USEPA issues documents to provide further information on satisfying the quality requirements. The current version of the USEPA QMP requirements is available at: https://www.epa.gov/quality/epa-qar-2-epa-requirements-quality-management-plans.

The New Jersey Department of Environmental Protection (NJDEP) prepares and maintains a QMP as required by the USEPA. The preparation and administration of the QMP is assigned to NJDEP's Office of Quality Assurance (OQA). The QMP is approved/signed by the NJDEP Commissioner, the NJDEP Quality Assurance Manager, all NJDEP Senior Staff, and the USEPA Region 2 Quality Assurance Manager. The QMP is valid for 5 years from the official date of publication. After this time period, USEPA requires the QMP be reissued or withdrawn from use by the NJDEP. The NJDEP's current QMP is available at: https://www.nj.gov/dep/enforcement/oqa/qap.html.

On a project level, Quality Assurance and Quality Control (QA/QC) measures applicable to sampling and analytical processes are documented in a Quality Assurance Project Plan (QAPP). Monitoring projects for the Clean Water Act Program, Safe Drinking Water Act Program, Resource Conservation Recovery Act (RCRA) Program, and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Program, and state programs are based on the approved QAPP. Elements and details contained within a project's QAPP are based on a graded approach. That is, the level of detail will vary depending on the nature of the work being performed and the intended use of the data generated. Plans are prepared by using a variety of standard and guidance references including, but not limited to, USEPA's Quality Assurance Project Plan Standard and its related Guidance document. The most current version of these documents are available at: https://www.epa.gov/quality/epa-qar-5-epa-requirements-quality-assurance-project-plans and https://www.epa.gov/quality/guidance-quality-assurance-project-plans-epa-qag-5, respectively. Additional guidance documents may be found at the USEPA website: https://www.epa.gov/quality/agency-wide-quality-program-documents. Quality assurance measures coupled with a prescribed sampling plan will improve sample collection while maintaining the integrity of the samples prior to analysis. It is important to include the analytical laboratory staff in the QAPP development process to ensure appropriate laboratory QA/QC measures are implemented during analysis and the deliverables produced are documented and appropriate for the decision being made.

For site remediation projects, selection and application of site-appropriate data quality levels should be discussed in the Quality Assurance Project Plan (QAPP). This document presents the organization, functional activities, and specific QA/QC activities needed to attain specific project goals and data quality objectives. A

QAPP is required per the Technical Requirements for Site Remediation (N.J.A.C. 7:26E-2.2) for all remedial activities for which data are generated. To formulate a QAPP for a remediation case, see the Quality Assurance Project Plan Technical Guidance at: https://www.state.nj.us/dep/srp/guidance/#analytic_methods.

For permit compliance sampling, a quality control program is often necessary to assure analytical accuracy and sensitivity to demonstrate compliance. Permits may require a permittee to achieve specific reporting limits when monitoring for pollutants. In 2014, USEPA amended the Clean Water Act (CWA) regulations to codify that under the National Pollutant Discharge Elimination System (NPDES) program, permit applicants and holders of permits must use sufficiently sensitive analytical test methods when completing an NPDES permit application and when submitting permit compliance monitoring data. The final rule clarified existing EPA regulations, codified existing EPA guidance on the use of sufficiently sensitive analytical methods with respect to measurement of mercury, and extends the approach outlined in that guidance to the NPDES program more generally. Specifically, USEPA modified existing NPDES application, compliance monitoring, and analytical methods regulations.

Standard Operating Procedures (SOPs) for sample collection, handling, and analysis are examples of elements that must be included in the QAPP. SOP requirements are established to maintain consistency in performance of sample collection and handling activities.[1]

Finally, this chapter highlights additional elements required in a QAPP, such as sample containers, decontamination procedures, quality control samples, preservation and holding time requirements. All aspects or scenarios are not discussed herein. The "site specific" nature of sampling makes it incumbent upon investigators to document in the QAPP any known unique feature that may contribute or impart a bias to data quality and what steps, if any, will be taken to address those specific conditions.

The NJDEP Site Remediation and Waste Management Program maintains a library of guidance manuals on its website at https://www.nj.gov/dep/srp/guidance/. It is recommended that the reader access the website and review the guidance documents pertinent to the respective task. Additional guidance may also be found at websites of the USEPA and the American Society for Testing and Materials (ASTM). Examples of some of the relevant guidance manuals and webpages pertaining to this chapter are:

Soil SI/RI/RA Technical Guidance: https://www.nj.gov/dep/srp/guidance/#si_ri_ra_soils;

Ground Water SI/RI/RA Technical Guidance: https://www.nj.gov/dep/srp/guidance/#pa_si_ri_gw;

Ecological Evaluation Technical Guidance: https://www.nj.gov/dep/srp/guidance/#eco_eval;

Vapor Intrusion Technical Guidance: https://www.nj.gov/dep/srp/guidance/#vi; and

Occupational Safety and Health Administration (OSHA): https://www.osha.gov/shpguidelines/index.html.

The following guidance documents are available at: https://www.nj.gov/dep/srp/guidance/#analytic_methods.

- Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance
- Quality Assurance Project Plan Technical Guidance
- Data of Known Quality Protocols Technical Guidance
- Data Quality Assessment and Data Usability Evaluation Technical Guidance

[1] National Pollutant Discharge Elimination System (NPDES): Use of Sufficiently Sensitive Test Methods for Permit Applications and Reporting (40 CFR Parts 122 and 136) publ. in Federal Register /Vol. 79, No. 160 /Tuesday, August 19, 2014 https://www.gpo.gov/fdsys/pkg/FR-2014-08-19/pdf/2014-19265.pdf

2.2 Certifications

For permit compliance sampling, a quality control program is often necessary to assure analytic accuracy to demonstrate compliance. Permits may require a permittee to achieve specific reporting limits or use specific analytical methods when monitoring for pollutants. Pollutants may need to be reduced or eliminated if they exceed specific concentrations. Those concentration levels may not be achievable unless proper quality control methods are implemented. The use of sufficiently sensitive test methods is required to comply with permit limits in accordance with the National Pollutant Discharge Elimination System (NPDES).

Pursuant to *Regulations Governing the Certification of Laboratories and Environmental Measurements* N.J.A.C. 7:18 (Laboratory Certification Rule), available at: https://www.nj.gov/dep/rules/rules/njac7_18.pdf, the OQA requires that field environmental measurements and environmental laboratories submitting analytical data to the NJDEP, regardless of quality level, must be certified. Environmental laboratory is defined as any laboratory, facility, consulting firm, local government or private agency, business entity or other person that the NJDEP has authorized to generate analytical data.

The certification status of the laboratory should be determined prior to submitting environmental samples to a laboratory for analysis. Laboratories submitting analytical data to the State of New Jersey must hold current certification where applicable under the Laboratory Certification Rule, N.J.A.C. 7:18. The certification status of laboratories is available at: https://www.nj.gov/dep/enforcement/oqa/certlabs.htm.

Two options for laboratory certification are offered by the OQA, including:

1. Certification through the state program, referred to as the Environmental Laboratory Certification Program (ELCP).
2. The National Environmental Laboratory Accreditation Program (NELAP) which offers certification based upon nationwide criteria that use a quality program approach to ensure the integrity of analytical data.

OQA offers certification in the following categories:

- Drinking Water Program
- Water Pollution Program
- Radon/Radon Progeny in Air
- Solid and Hazardous Waste Programs
- CERCLA- Contract Laboratory Program (CLP) Programs
- Air Methods
- Radiological Parameters other than Air

2.2.1 Field Environmental Measurements Certifications

For measurements collected in the field and submitted to the NJDEP to support regulatory compliance decision-making, the OQA requires certification for "Analyze Immediately" and other field parameters through the Laboratory Certification Rule, N.J.A.C. 7:18, unless a specific NJDEP regulation allows for measurement by a non-certified entity. Refer to: https://www.nj.gov/dep/enforcement/oqa/labcert.html.

This requirement applies to both measurements that occur in a conventional laboratory environment as well as measurements that take place in the field. Organizations that collect environmental samples by performing low flow purging and sampling are required to have the applicable certification to analyze for the field parameters that are required as part of this procedure. These water quality indicator parameters

measured in the field include pH, specific conductance, turbidity, temperature, dissolved oxygen, and ORP/Eh.

Certification for field measurement of water quality indicator parameters pursuant to N.J.A.C. 7:18 is obtained through a process that includes an application submitted to NJDEP Office of Quality Assurance, proficiency test samples, reviews of demonstration of capability data and on-site assessments conducted by NJDEP OQA. Field measurement instrument maintenance and calibration records must be maintained by the certified company. Only a company that has successfully completed the process and that has been granted certification can perform environmental field measurements of water quality indicator parameters and provide analytical data for these parameters for the purpose of establishing compliance with any NJDEP program. Additionally, when performing environmental field measurements, a company shall use only those analytical methods for which it has been granted certification by NJDEP OQA.

A company not having required certifications and attempting to provide analytical data in response to a NJDEP program will result in enforcement actions that can include suspensions, revocations, and fines. Regardless of whether the equipment in question is rented or privately owned the requirement for certification cannot be ignored. All certification documentation must accompany the instrument into the field and accompany all water quality indicator parameter data submitted to the NJDEP. Field instrument calibration and data reporting forms are found in the NJDEP Low Flow Purging and Sampling Guidance at:

https://www.nj.gov/dep/srp/guidance/lowflow/

https://www.nj.gov/dep/srp/guidance/lowflow/lfcalibrate.pdf

https://www.nj.gov/dep/srp/guidance/lowflow/lfdatasheet.pdf

NJDEP defines an environmental laboratory as any laboratory, facility, consulting firm, government or private agency, business entity or other person that the NJDEP has authorized, pursuant to N.J.A.C. 7:18, to perform analysis in accordance with the procedures of a given analytical method using a particular technique as set forth in a certain methods reference document and to report the results from the analysis of environmental samples in compliance with a NJDEP regulatory program.

Additionally, immunoassay field methods require certification pursuant to N.J.A.C. 7:18 under the Solid and Hazardous Waste Program category. Regardless of whether a company or organization is considered a true laboratory, certification is required when reporting data for compliance purposes. This includes but is not limited to responsible parties, contractors, and facilities. For additional information regarding laboratory, immunoassay, and field instrument certification requirements see the OQA website at: https://www.nj.gov/dep/enforcement/oqa.html.

2.3 Data Quality Objectives

Selection and application of site-appropriate Data Quality Objectives (DQO) should be discussed in the QAPP. Refer to *Guidance on Systematic Planning using the Data Quality Objectives (DQO) Process* available at: https://www.epa.gov/quality/agency-wide-quality-program-documents. To develop reliable site investigation data for NJDEP publicly-funded CERCLA (Superfund), or non-Superfund publicly-funded sites, the primary consultant/contractor has the responsibility to develop and implement the QAPP. This document must present the organization, functional activities, and specific QA/QC activities needed to attain specific project goals and data quality objectives. DQOs, developed by the investigator, are qualitative and quantitative statements derived from the DQO planning process that clarify the purpose of the study, define the most appropriate type of information to collect, determine the most appropriate conditions from which to collect that information, and specify tolerable levels of potential decision errors and uncertainty.

Any sampling conducted by remediation professionals and state contract vendors, including sampling associated with removal actions or operations and maintenance contracts, requires the development and implementation of a QAPP. The NJDEP will approve these plans prior to implementation by a state contractor. Requirements for these plans are generally specified in state contracts and NJDEP program technical guidance. Regardless of a document's title or "deliverable" name (e.g., QAPP), NJDEP requires these plans for all sampling events that are conducted in the state, pursuant to N.J.A.C. 7:26E. It is recommended that these plans be contained in a stand-alone document.

For permit compliance sampling, a quality assurance program is necessary to assure analytical accuracy sufficient to demonstrate compliance.

Sample analytical data that undergo data validation by the NJDEP or the remediation professional or data validator must be generated as a laboratory full data deliverable, pursuant to N.J.A.C. 7:26E-2. Other programs may also have specific data deliverable requirements and subsequent evaluation and validation of these data. For example, drinking water compliance monitoring data submitted to the NJDEP Bureau of Safe Drinking Water must be uploaded in a specific electronic data deliverable (EDD) format to the NJ E2 platform. These data must be generated by the analytical laboratory using published EPA drinking water methods and reported in accordance with the NJDEP BSDW guidelines contained in the E2 Quick Reference Guide (which is updated periodically).

2.3.1 Laboratory Analytical Methods

The procedures established to control the collection and handling of samples are an integral part of the Quality Assurance Program operating within NJDEP. The importance of a controlled environmental sample collection process and analytical data protocol is demonstrated through integration of this information into the decision-making process. All phases of this process rely on the provision of accurate, precise, comparable, and complete analytical data.

Current requirements for samples collected under the Safe Drinking Water Act and the Clean Water Act (chemical, physical, and biological components of wastewater and other environmental samples) are published annually in 40 CFR Parts 136, 141, and 143, and are available from the Government Printing Office at: https://ecfr.io/Title-40/cfrv25#0. Methods for marine and freshwater biological monitoring that are not in 40 CFR are listed herein, refer to Appendices 2.4 and 2.5.

Current guidelines for samples to be analyzed in accordance with the USEPA SW846 Methods are published in the latest final update of the USEPA SW846 *Test Methods for Evaluating Solid Waste – Physical and Chemical Methods*. They may be found on USEPA's website at https://www.epa.gov/hw-sw846.

The analytical methods promulgated under Clean Water Act section 304(h) are sometimes referred to as the "304(h)" or "Part 136" methods. The methods measure chemical and biological pollutants in media, such as wastewater, ambient water, sediment, and biosolids (sewage sludge). In addition to 40 CFR Part 136 methods, some approved industry-specific methods are published or incorporated by reference at 40 CFR Parts 401 through 503. Approved methods can be found at: https://www.epa.gov/cwa-methods/approved-cwa-chemical-test-methods.

Current requirements for samples to be analyzed in accordance with the USEPA Contract Laboratory Program are published in the latest version of the USEPA CLP Statements of Work (SOWs). These documents are found on the USEPA website at https://www.epa.gov/clp.

The following quality assurance requirements have been established to maintain sample integrity. Their primary objectives are to maintain the physical form and chemical composition of the sample and to prevent contamination from other sources or changes in contaminant concentration. To meet these objectives, there should be a measure of control over all sample-handling procedures beginning with

sample container cleaning procedures and ending with laboratory analysis.

2.3.2 Field Screening Methods

Field screening methods allow for the performance of rapid characterization via a dynamic sampling plan. They can provide qualitative data to meet the predetermined DQO, providing that supporting QA/QC procedures are in place.

For projects utilizing screening or semi-quantitative data during the field screening investigations, tools such as headspace gas chromatography (GC) can be simple and fast for the analysis of VOCs in soil and water samples during underground storage tank removal or well installation and monitoring. Enzyme kits can provide rapid detection for a variety of parameters, such as polychlorinated biphenyls (PCBs) or explosives during site characterization.

The field screening data should be of known quality, with respect to measurement precision or reproducibility, accuracy, sensitivity, and correlate with the standard laboratory methods. Several factors to be considered before mobilization include, but not limited to:

- Action levels for field decisions as part of the DQOs
- Screening and semi-quantitative data in addition to quantitative data to meet DQO
- Percentage of samples to be analyzed in the field as well as sent off-site for laboratory confirmation
- Methodology to compare field and laboratory data, such as duplicates, proficiency testing samples, and calibration measurements
- Analytical method, the measurement selectivity, sensitivity, precision, accuracy, representativeness, and action levels for the field instrument
- Potential matrix interference that might be associated with a particular field technology
- The field technician performing the analyses should be trained and demonstrate competence

2.4 Sample Containers and Sample Preservation Requirements

Prior to the collection of a sample, consideration should be given to the type of container that will be used to store and transport the sample. The entity requesting the analysis is responsible for requesting the proper sample containers or providing the laboratory with an accurate description of the matrix being sampled to enable the laboratory to provide the correct quantity and type of sample container. Selection is based on the sample matrix, potential contaminants to be encountered, analytical methods requested, and the laboratory's internal quality assurance requirements. Selection of appropriate sample containers should also be based upon review of the criteria listed below, as well as the information provided in the analytical methods, the tables at the end of this chapter, and the NJ Laboratory Certification Regulations Subchapter 9. See: https://www.nj.gov/dep/enforcement/oqa/labcert.html.

Sample collection, preservation and holding times for New Jersey certified parameters and methods are listed in the Laboratory Certification Rule, N.J.A.C. 7:18. However, for samples being analyzed to achieve compliance with the Safe Drinking Water Act and the Clean Water Act, refer to the latest Code of Federal Regulations, specifically 40 CFR Parts 141 and 136 respectively. Changes to the USEPA SW846 Methods are issued by the USEPA Office of Solid Waste (OSW) and are not final until adopted by Federal Regulations.

Additional information may be found in Appendices 2.1 to 2.6 of this chapter.

2.4.1 Reactivity of Container Material with Sample

Choosing the proper composition of sample containers will help to ensure that the chemical and physical integrity of the sample is maintained. For sampling potentially hazardous material, glass is the recommended container type because it is chemically inert to most substances. Plastic containers are not recommended for most hazardous wastes because contaminants may adsorb to the surface of the plastic, solvents may degrade the plastic, or plasticizers may leach into the sample.

In some instances, the sample characteristics or analytes of interest may dictate that plastic containers be used instead of glass because some metals species will adhere to the sides of glass containers in an aqueous matrix. However, the methodology being used for the sample analysis should always be reviewed first to determine the required bottle type. For example, USEPA Method 1631 *Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry* requires the use of either fluoropolymer bottles with fluoropolymer or fluoropolymer-lined caps, or borosilicate glass bottles. Polyethylene bottles are prohibited under this method.

In the case of a strong alkali waste or hydrofluoric solution, plastic containers may be more suitable because glass containers may be etched by these compounds creating adsorptive sites on the container surface. Only plastic containers should be used when the determinations of boron and silica are critical. Prior to ordering bottles from the laboratory, the method requirements should always be reviewed with the laboratory.

2.4.2 Sample Volume

The analytical method and the sample matrix and in the case of drinking water compliance samples, the federal regulations for the parameter being analyzed, will dictate the volume of sample to be collected. The sampler should supply sufficient volume of sample matrix for the laboratory to perform the required analysis and to meet project reporting limits. In most cases, the methodology dictates the volume of sample material (including sets of containers) required to conduct the analysis. Individual labs may provide larger volume containers for various analytes to ensure sufficient quantities for replicates or other quality control checks. However, if the expected concentrations in the sample are significant, such as in waste samples, the sample volume required by the laboratory may be less, to minimize the hazardous waste disposal problems. Reduced volume size may also be allowable based on new technologies that allow for a smaller sample size.

2.4.3 Color of Container

The analytical method can dictate the color of the sample container. Whenever possible, amber glass containers should be used to prevent photodegradation of the sample, except when samples are being collected for metals analysis. Containers used for metals analysis can be opaque or colorless, unless the sample will be analyzed for Silver or any other element which may be affected by light. If amber containers are not available, containers should be protected from light at all times when practical during shipping and handling. Laboratories often provide clear glass 40 ml vials for volatile organic aqueous analysis so that any air bubbles in the sample can be easily detected.

2.4.4 Container Closures

Container closures may be specified by method. Container closures should form a leakproof seal (e.g., screw caps or ground glass stoppers). Closures should be constructed of a material that is inert with respect to the sampled material as specified by the method. Alternatively, the closure may be separated from the sample by a closure liner that is inert to the sample material. Nothing should be added to ground glass stoppers to facilitate opening.

2.4.5 Sample Container Quality

Single-use containers with certification documentation should be used for trace and low-level analytes. These new precleaned commercial containers are batch-certified with appropriate documentation. The container type and preparation are dictated by the specific analysis to be performed on the sample.

2.4.6 Chain of Custody

To prepare for transport and/or shipment, the sample bottles should be accompanied by a hard copy of the chain of custody. In addition, custody of the cooler should be maintained. The completed and signed chain of custody form should accompany the bottles onsite during sample collection, and transportation back to the laboratory. This assures that the sample containers were not tampered with between preparation and arrival in the field. After sample collection, the bottles should be placed into the sample shipment container or cooler. Once the sample set is ready for transfer back to the analytical laboratory, the chain of custody must be signed manually by each party who takes control of the sample set. Refer to Chapter 11, *Documentation*, for additional information on chain of custody. Contact the laboratory provider for questions about the documentation.

2.4.7 Sample Bottle Storage and Transport

No matter where the sample bottles are, whether at the lab waiting to be packed for shipment or in the field waiting to be filled with sample, care should be taken to avoid contamination. Sample shuttles or coolers, and sample bottles must be stored and transported in clean environments. Sample bottles and clean sampling equipment must never be stored near running vehicular exhaust pipes, solvents, gasoline, or other materials that are potential sources of contamination. When under chain of custody, sample bottles must be in a secured area or in the presence of authorized personnel. Sample bottle storage on site should be kept to a minimum to avoid extraneous contamination.

The analytical methods specify minimum or maximum sample temperatures that are required to be met during transport of the samples to the field, while onsite, during shipment to the lab, and upon receipt of the samples at the laboratory.

2.4.8 Sample Preservation Requirements

Certain analytical methodologies for specific analytes require chemical additives in order to stabilize and maintain sample integrity and may include field filtration. Generally, this is accomplished under three scenarios:

- Preservative may be added to the sampling bottles by the laboratory prior to shipment into the field. This is preferred.
- Preservatives may be added in the field immediately after the samples are collected (i.e., within 15 minutes).
- Preservatives may also be added to the sample bottles after sample collection and upon arrival at the laboratory, for example, for unfiltered samples collected for dissolved metals.

Many laboratories provide pre-preserved bottles as a matter of convenience and to ensure that samples are preserved immediately upon collection. A problem associated with this method arises if insufficient sample volume is collected, resulting in excess preservative in the sample. More commonly encountered problems with this method include the possibility of insufficient preservative provided to achieve the desired pH level or the need for additional preservation due to chemical reactions caused by the addition of sample liquids to pre-preserved bottles. The use of pre-preserved bottles is acceptable. It is recommended that field-sampling teams check the pH and be prepared to add additional preservatives to samples if necessary.

When samples are preserved after collection, special care should be taken. The transportation and handling of concentrated acids into the field requires additional preparation and adherence to appropriate preservation procedures. The analytical methods should be reviewed to determine the correct grade of acid that are required for preservation. Please refer to Chapter 6 for greater detail.

The following guidelines are recommended to achieve safe and accurate preservation and transportation of samples in the field:

- Sampling teams should be properly equipped to conduct sample processing/preservation activities in the field (away from vehicle or other machinery exhaust). To accomplish this task the following items are necessary:
  - Graduated/Auto pipettes
  - Pipette bulbs
  - Preservatives of known quality with their content, concentration, and expiration date clearly labeled
  - Limited range pH paper (important that the sampler notes the "use by" date and that the paper is properly stored and maintained)
  - Carrying case clearly labeled and constructed of appropriate material to facilitate safe transportation of preservatives in vehicles and in the field
- Sampling teams should also be properly equipped with appropriate health and safety equipment. Below are a few examples of items that should be onsite:
  - Protective goggles
  - Disposable gloves
  - Lab apron
  - First aid kit
  - Portable eye wash station or eye wash bottle
  - Tap water for immediate flushing if spillage occurs onto clothing
- A level surface area should be designated to conduct preservation activities. A clean sheet of plastic sheeting should be placed over the area and secured.
- Personnel assigned to conduct preservation activities should be familiar with specified preservation requirements and verify that the necessary pH level has been achieved.
- Preservation requirements are method and parameter specific. Additional information may be found in Appendices 2.1 and 2.2 of this chapter. These charts may indicate any additional preservation required upon arrival of samples at the laboratory as cited in the specific methodologies. Under the Laboratory Certification Rule, N.J.A.C. 7:18, the laboratory and the samplers are required to comply with any additional preservation requirements. The source of preservatives is also of concern. Preservatives may be provided in bulk by the laboratory performing the analysis or purchased from a commercial laboratory supply vendor. All preservative containers must be labeled with respect to contents, concentration, laboratory grade, and the date of purchase or preparation. Again, under no circumstances should the test sample aliquot be returned into the container retaining the sample for analysis.
- For total metals analysis, preservation should take place prior to analysis of the sample. For dissolved metals analysis, preservation is conducted after filtration. Note that filtered samples are not acceptable for comparison to the Ground Water Quality Standards (N.J.A.C 7:9C).
- In rare cases, a chemical reaction between the preservative and an aqueous sample may induce

effervescence. If this is observed during sample collection, immediately notify the laboratory before continuing. A decision will have to be rendered in the field regarding whether to continue sample collection. If expeditious shipping and laboratory analysis of an unpreserved sample can be negotiated (based on analytical method requirements), to maintain sample integrity, the sample should be discarded, the interior of the sample container rinsed at least two times with the sample source, and an unpreserved sample volume collected. Make note in the chain of custody if the sample is unpreserved and why it was unpreserved. The laboratory must be notified that an unpreserved sample is being submitted.

- If a soil sample reacts with a required preservative, a new sample bottle or sampling device is required, an unpreserved sample must be submitted to the laboratory, and the laboratory must be notified that an unpreserved field sample is being submitted. For example, some methods, such as USEPA Method 5035, specify that if an unpreserved sample is submitted, it must be analyzed within 7 days of sample collection. Therefore, it is important that field personnel document the preservation status of samples submitted for analysis on the chain of custody.
- Samples should be placed into a cooler and maintained at 4°C immediately upon collection and preservation. Samples shall never be frozen unless specifically allowed by the analytical method.

Note: Certain methods, such as USEPA Method 1631 and 1630 (methyl mercury), allow samples to be optionally preserved at the laboratory, provided they are received at the laboratory within 48 hours of sample collection.

Information on required holding times can be found at the following USEPA websites:

- Requirements for samples collected under the Safe Drinking Water Act and the Clean Water Act are published annually in 40 CFR Parts 136 and 141 and may be found on the USEPA https://ecfr.io/Title-40/cfrv25#0.
- Guidelines for samples to be analyzed in accordance with the USEPA SW846 Methods are published in the latest final update of the USEPA SW846 *Test Methods for Evaluating Solid Waste - Physical and Chemical Methods 3rd Edition* issued 1996 and amended and may be found on the USEPA website at: https://www.epa.gov/hw-sw846.
- Requirements for samples to be analyzed in accordance with the USEPA Contract Laboratory Program are published in the latest version of the USEPA CLP SOWs. These documents may be found on the USEPA website at: https://www.epa.gov/clp.

2.5 Decontamination Procedures

An important aspect of quality control is the decontamination of field sampling equipment. Improperly cleaned and prepared sampling equipment can lead to misinterpretation of environmental data due to interference caused by cross-contamination.

In addition, sampling equipment left in-situ for purposes of obtaining multiple samples over a period of time (e.g., periodic sampling for permit compliance) will often need to be cleared of accumulated contaminants, silt, soot, dust, etc. This will assure that the samples are free of such material which may have accumulated on the sampling equipment between uses. See Chapter 5 for more information on equipment decontamination procedures.

2.6 Quality Control Samples

Quality Control (QC) samples are intended to provide control over the collection of environmental measurements and subsequent validation, review, and interpretation of generated analytical data. The various types of blank samples are designed to address QC concerns related to sample bottle and equipment preparation, packaging, handling, preservative purity, and sample collection techniques. Common terms used to reference various QC blank samples include trip blanks, field blanks, field rinsate blanks, equipment blanks, and field reagent blanks. Some of these terms may be interchanged based on definitions found in specific analytical methods. Clear definitions of these terms should be provided in the site specific QAPP.

For this manual, the definitions of trip blanks and field blanks are described below. Additional quality control samples are described in Appendix 2.6 of this chapter. A detailed description of the various types of quality control blanks is also available in a USEPA Fact Sheet at: https://www.epa.gov/sites/default/files/2015-06/documents/blanks.pdf.

Trip blanks are prepared by the laboratory and are used to measure possible cross-contamination of samples during shipping to and from the site. The analysis is typically for volatile organics and only when environmental samples are of an aqueous matrix. For aqueous sampling, the trip blank water should be from the same source as the method blank water used in the laboratory during analysis. Trip blanks are never opened outside of the analytical laboratory and travel to and from the site with the empty or full sample bottles to simulate sample-handling conditions. Contaminated trip blanks could also indicate inadequate bottle cleaning or blank water of questionable quality.

The primary purpose of the trip blank is to detect additional sources of contamination that might potentially influence contaminant values reported in actual samples both quantitatively and qualitatively. Potential sources of contamination include:

- Laboratory reagent water
- Sample containers
- Cross contamination in shipment, bottle handling and storage
- Ambient air or contact with analytical instrumentation during preparation and analysis at the laboratory
- Laboratory reagents used in analytical procedures

The purpose of a field blank is to place a mechanism of control on sample equipment and its related handling, preparation, storage, and shipment. The field blank water travels and is stored with the sample bottles, therefore, it is also representative of bottle shipment effects on sample quality. The field blank water should be from the same source as the method blank water used in the laboratory. By being opened in the field and transferred over a decontaminated sampling device (when applicable), the field blank is indicative of ambient conditions and/or equipment conditions that may potentially affect the quality of the associated samples.

A field blank also provides an additional check on possible sources of contamination beyond that which is intended for trip blanks. This includes potential contamination from ambient air as well as from sampling instruments used to collect and transfer samples from point of collection into sample containers.

The following is a breakdown by matrix of blank samples.

2.6.1 Aqueous Matrix

2.6.1.1 Field Blanks

2.6.1.1.1 Description

The performance requirement for field blank collection begins with two sets of identical bottles (method dependent). One set of bottles is filled with demonstrated analyte free water provided by the laboratory performing the sample analysis, while the second set of bottles is empty. The bottles should also be identical to those provided for aqueous sample collection. Field blanks must be analyzed for all the same parameters that the collected samples will be analyzed for. At the field location, in an area suspected to be contaminated, the water is passed from the full set of bottles through the dedicated or field decontaminated sampling device(s) and into the empty set of bottles. This will constitute identical bottle to bottle transfer. Field blanks must be preserved in the same manner as samples. On a site-specific basis, field QC sample requirements may be amended as documented in the project plans. Field blanks are generally not required for potable well sampling events or when a sample is collected directly from a source into a sampling container. However, field blanks may be required to detect cross contamination from ambient air during potable sampling events if known sources of contamination are in proximity or monitoring instruments indicate the presence of contamination above background levels.

2.6.1.1.2 Frequency

Field blanks for the aqueous matrix should be performed at a minimum rate of 5% per analytical parameter per sampling procedure. For sampling events lasting more than one day, field blanks associated with an aqueous matrix should be collected at a minimum of one per day. On a site-specific basis, QA field QC frequency requirements may be amended.

2.6.1.2 Trip Blanks

2.6.1.2.1 Description

Trip blanks are only required for aqueous sampling events, for volatile organic parameters, pursuant to the specific analytic method. Trip blanks are prepared by the laboratory, accompany sample bottles into the field, and are returned to the laboratory along with the collected samples for analysis. These bottles are never opened outside of the analytical laboratory. Trip blanks must be returned to the laboratory with the same set of bottles they accompanied to the field.

The trip blank is primarily used to measure possible cross-contamination of samples during shipping to and from the site. The QAPP should discuss the collection of trip blanks.

The primary purpose of this type of blank is to detect additional sources of contamination that might potentially influence contaminant values reported in actual samples both quantitatively and qualitatively. Potential sources of contamination may include:

- Laboratory reagent water
- Sample containers
- Cross contamination in shipment, bottle handling and storage
- Ambient air or contact with analytical instrumentation during preparation and analysis at the laboratory
- Laboratory reagents used in analytical procedures

2.6.1.2.2 Frequency

When sampling for volatile organic compounds, it is recommended trip blanks be included at a rate of one per sample shipment. However, USEPA has issued analytical methods that require additional trip blanks for each batch of twenty samples submitted to the CLP laboratory. Therefore, the analytical methods and data quality objectives should be evaluated to determine the required number and frequency of trip blanks. This information should be documented in a site-specific QAPP.

2.6.2 Non-Aqueous Matrix

2.6.2.1 Field Blanks

2.6.2.1.1 Description

The performance requirement for field blank collection begins with two sets of identical bottles (method dependent). One set of bottles is filled with demonstrated analyte free water provided by the laboratory performing the sample analysis, while the second set of bottles is empty. The bottles should also be identical to those provided for aqueous sample collection. For soil preserved in methanol, see Chapter 6 *Sample Collection*, Section 6.2.7.4 *Closed-System Vials, Chemical Preservation – Methanol* for more discussion on methanol preserved soil collection. At the field location, in an area suspected to be contaminated, the water is passed from the full set of bottles through the dedicated or field decontaminated sampling device(s) and into the empty set of bottles. This will constitute identical bottle to bottle transfer. Field blanks must be preserved in the same manner as samples. On a site-specific basis, field QC sample requirements may be amended as documented in the project plans.

2.6.2.1.2 Frequency

Field blanks for the non-aqueous matrix should be performed at a rate of one per day. For sampling events lasting more than one day, field blanks associated with a non-aqueous matrix should be collected at a minimum of one per day. On a site-specific basis, field QC frequency requirements may be amended.

2.6.2.2 Trip Blanks

Trip blanks are not required for the non-aqueous matrix unless specifically requested for by Special Analytical Services (SAS) consideration or when specifically required by the analytical method.

2.6.3 Air Matrix

Quality control blank sample collection and handling utilized during air sampling events should follow the specifications of the analytical method and/or applicable guidance document. Additional information on quality assurance/quality control of air emissions measurements is available at:

Stack Emissions: https://www.nj.gov/dep/bts/index.html

Vapor Intrusion guidance: https://www.nj.gov/dep/srp/guidance/#vi

Bureau of Stationary Sources: https://www.state.nj.us/dep/aqpp/

2.6.4 Blank Water Quality

Demonstrated analyte free water used in the field and trip blanks must originate from one common source and physical location within the laboratory and must be the same as the method blank water used by the

laboratory performing the specific analysis. The use of commercially prepared water or water not originating from the laboratory analyzing the samples is generally not permitted. An exception to this requirement is allowable if:

- It is the same water used for method blank analysis;
- The laboratory has analyzed that water and generated data from a specific batch/lot of containers; or,
- The blank sample is drawn from an unopened container from the same batch/lot thus documenting the water is free of contaminants (demonstrated analyte free).

For some regulatory programs, the source of field blank water may be different from the source of the trip blank water, however, it must also be demonstrated as analyte free water.

Laboratory certification requirements for the source of blank/method water can be found in *Regulations Governing the Certification of Laboratories and Environmental Measurements* at N.J.A.C. 7:18-3.3. Pursuant to N.J.A.C. 7:18, a source of water which meets the required standards of quality for each type of testing shall be available for use in the preparation of reagents, standards and for glassware rinsing. The laboratory shall maintain testing documentation on analyte-free water.

2.6.5 QC Sample Management and Holding Times

2.6.5.1 Sample Management

Blanks and other QC samples should be maintained in a similar manner as the environmental sample containers during shipment, storage on site, and return to the laboratory. Blanks and QC sample storage on-site should be kept to a minimum to avoid extraneous contamination and to ensure holding times are met. The Site Remediation and Waste Management Program recommends that quality control samples not be held on site in excess of 4 days.

An exception applies to storm water sampling events. The spontaneity of storm conditions precludes any possibility for preplanning sample shipment. Therefore, due to logistical constraints, trip and field blanks are not normally required. While this exception is understandable, the storage of these samples must be carefully controlled to prevent the possibility of cross contamination or degradation.

2.6.5.2 Holding Times

Holding times for individual parameters are dictated by the federal regulations and specified in the analytical method being used or under the regulated program.

Current requirements for samples collected under the Safe Drinking Water Act and the Clean Water Act are published annually in 40 CFR Parts 136 and 141 and are available from the Government Printing Office at: https://ecfr.io/Title-40/cfrv25#0.

Samples to be analyzed in accordance with the USEPA SW846 Methods are published in the latest final update of the USEPA SW846 *Test Methods for Evaluating Solid Waste – Physical and Chemical Methods* and amended and may be found on the USEPA Website at: https://www.epa.gov/hw-sw846.

Current requirements for samples to be analyzed in accordance with the USEPA Contract Laboratory Program are published in the latest version of the USEPA CLP SOWs. These documents may be found on the USEPA website at: https://www.epa.gov/clp. The clock governing laboratory contract holding times for samples and blanks analyzed by Contract Laboratory Program (CLP) methodologies begins when the sample is received in the laboratory as documented on the laboratory's external chain of custody form. This is known as the Verified Time of Sample Receipt (VTSR). Please refer to the tables at the end of this chapter for additional information.

The holding time clock for all other certified methods and parameters begins at the time of sample collection in the field.

Sample hold times include 2 components, the first is the preparation of the sample (i.e., extractable organics) and the second is the instrument analysis of the prepared sample (i.e., the extract).

2.6.6 Specialty Methods

Specialty methods refer to non-standard methods, which are methods that are not routinely used or not published by USEPA. Additional QC samples may be required for specialty methods. These QC samples should be defined and documented in the QAPP.

These methods are used for:

1. Emerging contaminants (e.g., Per- and polyfluoroalkyl substances (PFAS));
2. New Jersey defined methods, such as Extractable Petroleum Hydrocarbon and NJ Low Level TO-15; and
3. Modification to approved methods.

It is important to note that these specialty methods may include lab and field quality control provisions. The project manager may also determine the need to implement additional types of QA/QC blanks when initial sampling episodes produce blank contamination that cause the generated data to become suspect.

Examples may include additional blank samples prepared at the same time and in the same manner as the trip and field blanks, which are designated for placement in laboratory storage areas, sample preparation areas or perhaps at ambient air ventilators or other field locations. These additional blanks are then subject to the same analysis as the samples to determine if location specific cross-contamination during handling/storage may be occurring. Specialty methods may also include the use of alternative analytical methodologies for unique, site specific parameters of concern.

Many methods have additional quality control requirements that have evolved to monitor both storage and analytical procedures. All parties, including the laboratory, should be aware of these changes as new or revised methods are issued by USEPA or other governmental agencies in response to changes in regulation, contractual requirements, and instrumentation.

2.6.7 Additional QC Samples

Additional QC samples may be required in specific cases.

2.6.7.1 Duplicate Samples Obtained in the Field (Field Duplicates)

The collection of duplicate samples provides for the evaluation of the laboratory's and field sampling team's performance by comparing analytical results of two samples from the same location.

Duplicate samples, when required by the analytical method, are to be included for each matrix at a maximum rate of one for every twenty samples. If less than twenty samples are collected during a sampling episode, one duplicate should be performed. Duplicate requirements may be waived or expanded depending on the regulatory program or remedial phase. Keep in mind that various USEPA methods require a higher frequency of field duplicate samples. Therefore, the analytical methods should be reviewed to determine the appropriate number of field duplicates.

2.6.7.1.1 Aqueous Matrix Duplicates

Duplicate water samples (potable well, monitoring well, surface water) should be obtained by the collection of one sample and splitting it into separate sample containers. Note that sufficient

sample volume should be collected at one time in order to fill all of the necessary sample containers for each parameter. For example, samples for volatile organics analysis from monitoring wells should be filled from the same bailer full of water whenever possible and be the first set of containers filled. When other sampling devices are used, the vials for volatile organics should be alternately filled.

2.6.7.1.2 Non-Aqueous Matrix Duplicates

The collection of non-aqueous matrix duplicate samples for volatile organic samples should be taken from discrete locations or intervals, without using compositing or mixing (as described below for non-volatile organic analyses). This practice is necessary to prevent loss of volatile constituents and to preserve, to the extent practicable, the integrity of the volatile fraction (see Chapter 6 *Sample Collection*, Section 6.2.7 *VOC Sample Collection for Soils*, for further information).

Prior to the duplicate sample collection for non-volatile organic analysis, the soil or sediment sample aliquot requires homogenization. This is necessary in order to generate two equally representative samples. Note that sufficient sample volume should be collected at one time to fill all of the necessary sample containers. It may be necessary to co-locate or depth-integrate collection, so enough sample volume is available. A description of this process should be provided in the sampling plan. Moisture content, particle size, and adsorption properties of various soils, sediments, and waste materials may inhibit the ability to achieve complete mixing prior to filling sample containers.

Homogenization should be accomplished by placing the sample in a properly decontaminated tray or bowl and mixing it with a decontaminated instrument. The extent of mixing required will depend on the nature of the sample and should be done to achieve a consistent physical appearance and texture prior to filling sample containers. Exclusion of extraneous material is recommended.

Once mixing is completed the sample should be divided in half and sample material should be scooped alternately from each half to fill containers. Several laboratory methodologies for compositing samples published by the American Society for Testing and Materials (ASTM) and USGS have been suggested for use in the field; however, they were not specifically designed for homogenization of known or suspected hazardous materials and often must be "modified" to be useful. They tend to assume a uniform sample exists to begin with and their intent may be to calculate average grain size, predict weight to volume ratios, or to reduce the size of a sample to one more convenient for handling and analysis. They also tend to assume a much larger volume of material will be subject to the methodology. Therefore, these methods are not recommended for generating duplicate samples in the field.

2.6.7.2 Splitting Samples with Interested Parties

When various sites are under investigation, property owners and other interested parties may desire to obtain samples for analysis which are duplicates of those obtained by NJDEP personnel or contractors. If this becomes necessary, procedures for obtaining duplicate samples described above should be followed.

To maintain the integrity of any sample "split" between interested parties, the following procedures are recommended:

- A second set of sample containers, blank samples, preservatives, sample shuttles, chain of custody forms, etc., should be provided.
- Duplicate samples, trip blanks, and field blanks should be included for all interested parties.
- All interested parties desiring to obtain split samples during planned sampling episodes

should provide each other with sufficient notice. This is essential for planning purposes and to avoid confusion or delays in the field.

- All parties should use the same analytical methods to allow for comparability of data. Choice of analytical methodologies should be agreed upon prior to the sampling event.

2.6.7.3 Background Samples

When background samples are required for comparison of site conditions to the surrounding environment they should be collected and handled in the same manner as all other samples. Requirements for inclusion of background samples are determined on a program specific and/or case-by-case basis.

2.7 Quality Assurance for Emerging Contaminants

Quality assurance requirements related to emerging contaminants may require special attention during project planning and execution. It is critical for the investigator to work with a certified analytical laboratory to ensure that samples are collected in the appropriate containers, shipped to the laboratory within the required hold times, and analyzed with a method that will allow for the sufficient evaluation of analytical results. All of this should be considered and included as part of pre-sampling planning and site characterization.

New analytical methods are periodically developed by USEPA to detect and quantify unregulated or emerging contaminants. Selection of analytical approaches should be based on project data quality objectives. Special considerations may include different holding times and avoiding the use of materials such as certain clothing, gloves, sunscreen, field notebooks, sample containers, preservatives. Guidelines for sample collection and handling may vary by parameter, method, and analytical laboratory.

Timely information is available at: http://www.nj.gov/dep/srp/emerging-contaminants/.

For technical fact sheets on other emerging contaminants, please visit: https://www.epa.gov/fedfac/emerging-contaminants-and-federal-facility-contaminants-concern.

References

American Society for Testing Materials, *Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites*, ASTM D-5088-90.

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Mackiewicz, Michael C., *A Simple 11 Step Procedure to Document the Accuracy, Precision and Significance of Measurements by Field Instrumentation*, Proceedings of the Fourth National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods, Ground Water Management, 1990.

Parker, Louise V., *The Effects of Ground Water Sampling Devices on Water Quality: A Literature Review,*

Ground Water Monitoring Review, Spring 1994.

Parker, Louise V., and Ranney, Thomas A., *Decontamination Materials Used in Ground Water Sampling Devices: Organic Contaminants*, Ground Water Monitoring Review, Winter 2000.

Yeskis, Douglas, and Zavala, B., *Ground Water Sampling Guidelines for Superfund and RCRA Project Managers*, USEPA Report 542-S-02-001, May 2002.

USGS Handbooks for Water Resources Investigations, Book 9, *National Field Manual for the Collection of Water-Quality Data*, Chapters 1-9, 2003.

USEPA, *Immunoassay Guidelines for Planning Environmental Projects, Office* of Environmental Measurement and Evaluation, October 1996.

USEPA, *Field Analytical and Site Characterization Technologies Summary of Applications,* EPA-542-R- 97-011. November 1997.

URLs

https://www.epa.gov/quality

https://www.nj.gov/dep/enforcement/oqa/labcert.html

https://ecfr.io/Title-40/cfrv25#0

https://www.epa.gov/hw-sw846

https://www.epa.gov/hw-sw846/sw-846-compendium

https://www.epa.gov/clp

https://www.nj.gov/dep/srp/regs/

http://water.usgs.gov/owq/FieldManual/chapter3/Ch3_contents.html

Appendix 2.1
Sample Preservation, Container, and Holding Times
for
Drinking Water, Wastewater, Ground Water, and Surface Water
(Except Radiological Parameters)

Potable water samples shall be handled and preserved in accordance with the requirements in the Code of Federal Regulations (CFR) Title 40 Part 141. In addition, the *Regulations Governing the Certification of Laboratories and Environmental Measurements* at N.J.A.C. 7:18 shall be reviewed to ensure that requirements for sample handling and preservation for specific parameters are also incorporated when necessary.

Non-potable water samples shall be handled and preserved in accordance with the requirements in the Code of Federal Regulations (CFR) Title 40 Part 136.3 Table II- Required Containers, Preservation Techniques, and Holding Times and the corresponding Table II Notes at the bottom of the table. In addition, the *Regulations Governing the Certification of Laboratories and Environmental Measurements* at N.J.A.C. 7:18 shall be reviewed to ensure that, requirements for sample handling and preservation for specific parameters are also incorporated when necessary.

The regulation is available at: https://www.nj.gov/dep/rules/rules/njac7_18.pdf.

CFR Title 40 Part 141 is available at:
https://www.ecfr.gov/cgi-bin/text-idx?SID=bdceb25a993c314c50a0c73d852db2e3&mc=true&tpl=/ecfrbrowse/Title40/40cfr141_main_02.tpl

CFR Title 40 Part 136 is available at:
https://www.ecfr.gov/cgi-bin/text-idx?SID=05e16b47f48c318f64b0abfcaa2caf23&mc=true&tpl=/ecfrbrowse/Title40/40cfr136_main_02.tpl

Appendix 2.2
Sample Preservation, Container, and Holding Times
for
Radiological Parameters

In accordance with 7:26C-2.3(a)(3)(iii), remediation of radiologically impacted sites may not be conducted without prior NJDEP approval. Documents relating to remediation of contaminated sites shall be submitted for NJDEP review and will be referred to the Bureau of Environmental Radiation for review. This would include Quality Assurance Project Plans (QAPP) which a Licensed Site Remediation Professional (LSRP) should develop with input from applicable regulations, selected analytical methods, the contracted NJ OQA-certified laboratory, and other relevant guidance. For more information, refer to FSPM Chapter 12 which addresses radiological assessment in more detail.
https://www.nj.gov/dep/srp/guidance/fspm/pdf/chapter12.pdf

Regulations Governing the Certification of Laboratories and Environmental Measurements at: N.J.A.C. 7:18
https://www.nj.gov/dep/rules/rules/njac7_18.pdf

The Office of Quality Assurance provides a list of matrix specific parameters and methods which a laboratory can receive certification. https://www.nj.gov/dep/enforcement/oqa/docs/part3.pdf

Remediation Standards for Radioactive Materials may be found at N.J.A.C. 7:28-12:
https://www.state.nj.us/dep/rpp/rms/rad_cleanups.htm

The Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) provides detailed guidance on how to demonstrate that a site is in compliance with a radiation dose- or risk-based regulation.
https://www.epa.gov/radiation/download-marssim-manual-and-resources

The Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) provides guidance for the planning, implementation and assessment phases of projects that require laboratory analysis of radionuclides. https://www.epa.gov/radiation/multi-agency-radiological-laboratory-analytical-protocols-manual-marlap

EPA Manual for the Certification of Laboratories Analyzing Drinking Water includes radiochemistry sample preservation. https://www.epa.gov/dwlabcert/laboratory-certification-manual-drinking-water

Potable and Non-Potable Water Samples

Parameter	Preservation	Container	Holding Times
Gross alpha	Conc. HCl or HNO_3 to pH 2*	P or G	180 days
48-Hour Rapid Gross Alpha*	Conc. HCl or HNO_3 to pH 2*	P or G	48-hours**
Gross beta	Conc. HCl or HNO_3 to pH 2*	P or G	180 days
Strontium-89	Conc. HCl or HNO_3 to pH 2	P or G	180 days
Strontium-90	Conc. HCl or HNO_3 to pH 2	P or G	180 days
Radium (total)	Conc. HCl or HNO_3 to pH 2	P or G	180 days
Radium-224	Conc. HCl or HNO_3 to pH 2	P or G	4 days (recommended)
Radium-226	Conc. HCl or HNO_3 to pH 2	P or G	180 days
Radium-228	Conc. HCl or HNO_3 to pH 2	P or G	180 days
Cesium-134/137	Conc. HCl or HNO_3 to pH 2	P or G	180 days

Iodine-131	None	P or G	8 days
Tritium	None	G	180 days
Uranium	Conc. HCl or HNO_3 to pH 2	P or G	180 days
Plutonium	Conc. HCl or HNO_3 to pH 2	P or G	180 days
Photon emitters (including Cobalt-60, Zinc-65, Ruthenium-106, and Barium-133)	Conc. HCl or HNO_3 to pH 2	P or G	180 days
Radon-222***	Cool 4°C	G	4 days (recommended)

Drinking water samples subject to radiological measurements shall be handled and preserved in accordance with the requirements presented in the table above and the requirements listed below. This table includes requirements from the USEPA's Manual for the Certification of Laboratories Analyzing Drinking Water, USEPA-815-B-97-001. If there is any conflict between the table and the USEPA publication (including any amendments or supplements) on which any part of the table is based, the USEPA rule or publication shall control, except in reference to 48-Hour Rapid Gross Alpha and Radium-224 Methods.

* If HCl is used to acidify samples that are to be analyzed for gross alpha or gross beta activities, the acid salts shall be converted to nitrate salts before transfer of the samples to planchets.

**48-hour Rapid Gross Alpha Method applies to (Community Water System (CWS) compliance monitoring, as well as testing under Private Well Testing Act (PWTA). Initial counting of the plancheted sample shall be initiated no sooner than 36 hours from sample collection and must be completed by 48 hours after sample collection (N.J.A.C 7:18-6.4(a)3ii).

*** The method for sampling described in EPA/600/2-87/082-1989 "Two Test Procedures for Radon in Drinking Water" shall be followed.

Sample shall be acidified at the time of collection, in accordance with the requirements listed under "Preservation" in the table above. A minimum of 16 hours shall elapse between acidification and analysis. If suspended solids activity is to be measured, then a second unpreserved sample shall be taken for this measurement; and if the sample is shipped in its original container to a certified environmental laboratory or storage area, acidification of the sample (in its original container) may be delayed for a period not to exceed five days.

Appendix 2.3
Sample Preservation, Container, and Holding Times
for
Solid/Hazardous Waste Samples, Aqueous, Soils, Liquids, Sediments, Sludges, and Air

Information listed in the table below was based on the following references. For the most current requirements go to the link provided below.

SW-846 Method Compendium:

https://www.epa.gov/hw-sw846/sw-846-compendium

NOTE: Sample hold times include 2 components, the first is the preparation of the sample (i.e., extractable organics) and the second is the instrument analysis of the prepared sample (i.e., the extract).

Parameter	Preservation	Container	Holding Times
Volatile Organics for soil/ sediment, sludge	Cool to 0-6° C	Glass Teflon®-lined cap (septum lid)	14 days until analysis
VOAs for Soil by 5035	Refer to Container details, Cool to 0-6° C	Encore™ or equivalent field coring device (3 x 5-grams) plus total solids jar (1 x 2-oz)	14 days until analysis
VOAs in Soil by 5035	Refer to Container details, Cool to 0-6° C	Terracore or equivalent field preserved 40-ml vials (2 x 40 ml vials with MeOH; plus 1 x 40-ml DI water vial; plus 2-oz total solids jar; plus plastic 5-gram coring device)	14 days until analysis
VOAs in non-potable water by 8260 See entries below	HCL, pH<2, Cool to 0-6° C	Amber Glass, Teflon Lined, 3 x 40-ml Vials with HCl, pH<2	14 days until analysis
VOAs by 624 in non-potable water	Na2S2O3, Cool to 0-6° C	Amber Glass, Teflon Lined cap, 3 x 40 ml Vials	7 days until analysis
Acrolein and Acrylonitrile in liquid samples	Adjust to pH 4-5, Cool to 0-6° C These compounds are highly reactive and should be analyzed ASAP per SW846 Methods 5021, 5030, 5031, 5032.	Glass, Teflon®-lined cap 3 x 40-ml vials with PTFE-lined septum caps	7 days until analysis

Appendix 2.3 (continued) Required Preservation, Container and Holding Times for Solid/Hazardous Waste Samples (Soils, Liquids, Sediments, Sludges, and Air)

Parameter	Preservation	Container	Holding Times
SVOC by 8270, Organochlorine Pesticides by 8081, PCBs by 8082, and Herbicides by 8151 for soil, sediment, sludge, solid waste	Cool to 0-6° C	Amber Glass, Teflon®-lined cap, 1 x 8-oz wide mouth jar	14 days until extraction
SVOC by 8270s, Organochlorine Pesticides by 8081, PCBs by 8082, and Herbicides by 8151 for non-potable water	Cool to 0-6 C	Amber Glass, Teflon®-lined cap, 2 x 1,000-ml wide mouth	7 days until extraction
SVOCs by 625; OC-Pesticides and PCBs by 608 in non-potable water	Na2S2O3, Cool to 0-6° C	Amber Glass, Teflon Lined cap, 2 x 1,000 ml	7 days to extraction
NJ-EPH in non-potable water	HCl, pH<2, Cool to 0-6° C	Amber Glass, Teflon Lined cap, 2 x 1,000 ml, HCl, pH<2	14 days to extraction
NJ-EPH and TPH-DRO by 8015M in soil, sediment, solid waste	Cool to 0-6° C	Amber Glass, Teflon Lined cap, 1 x 4-oz jar	14 days to extraction
TPH-GRO by 8015M in soil, sediment, solid	MeOH, Cool to 0-6° C	Amber Glass, Teflon Lined, 15 grams placed in 40 mL Vial, MeOH, 4° C	14 days to extraction
TPH-GRO by 8015M in non-potable water	HCl, pH<2, 0-6° C	Amber Glass, Teflon lined cap, 2 x 40 ml VOA Vials	14 days to extraction
TPH-DRO by 8015M in non-potable water	Cool to 0-6° C	Amber Glass, Teflon Lined cap, 2 x 1,000 ml	7 days to extraction
Metals, Total by 200.7, 200.8, 6010, 6020 (except Cr VI and Hg) in non-potable water	HNO_3 to pH < 2	P, G, 1 x 500 ml	180 days
Metals, Dissolved by 6010, 6020 (except Cr VI and Hg) in non-potable water (field filtered)	Filter on-site, HNO_3 to pH < 2	P, G, 1 x 500 ml	180 days
Metals, Dissolved by 6010, 6020 (except Cr VI and Hg) in non-potable water (lab filtered)	None (Filtered and preserved by lab upon receipt)	P, G, 1 x 500 ml	180 days
Metals, Total by 6010, 6020; in Soil, sediment, solid samples	None	Amber Glass, Teflon Lined, 1 x 4-oz. jar	180 days

Appendix 2.3 (continued) Required Preservation, Container and Holding Times for Solid/Hazardous Waste Samples (Soils, Liquids, Sediments, Sludges, and Air)

Parameter	Preservation	Container	Holding Times
Chromium VI by 7196A in Soil, Sediment, Solid samples	Cool to 0-6° C	Amber Glass, Teflon Lined, 1 x 4-oz.	30 days to digestion; analysis 168 hours (7 days) after digestion
Chromium VI by 7196A, SM3500Cr-D in non-potable water samples	Cool to 0-6° C	Plastic, 1 x 500 ml	24 hours to digestion
Mercury, Total by 245.1, 7470A, 7474 in non-potable water samples	HNO_3 to pH < 2	P, G	28 days
Mercury, Dissolved by 245.1, 7470A, 7474 in non-potable water	Filter on-site, HNO_3 to pH < 2	P, G	28 days
Mercury, Total by 7471A in Soil, sediment, Solid samples	Cool to 0-6° C	Amber Glass, Teflon Lined Lid, 1 x 4-oz.	28 days
Ambient Air Analysis			
TO-15 VOAs in Air by Canister with Pressure Gage and Regulator Flow Controller	None	Canisters (1-L, 2.7-L, 6-L	30 days from sample collection to analysis
NJDEP-SRP TO-15 Low Level Method for VOAs in Air by Canister with Pressure Gage and Regulator Flow Controller	None	Canisters (1-L, 2.7-L, 6-L)	30 days from sample collection to analysis
TO-13, TO-17 for SVOCs and PAHs in Air by Active Sampling (Pump) onto Sorbent Tubes (PUF-XAD)	Cool to 0-6° C after sample collection and in refrigeration unless samples are analyzed the same day of collection. The samples must be stored in an organic solvent free environment. Small packages of activated charcoal/silica gel must be with each shipment container of multiple tubes.	Sorbent Tubes (PUF-XAD)	7 days to extraction
Mercury in Air by NIOSH 6009 Modified	No ice, room temperature (25° C), and keep dry	Hopcalite Sorbent Tube	21 days to analysis
Metals (Arsenic, Lead, Nickel) in Air by 6010, 6020	None	Filter	180 days to analysis

Appendix 2.4
Sample Preservation, Container, and Holding Times for the Analysis of BIOLOGICAL Samples for Freshwater, Estuarine and Marine Samples

Parameter	Sample Container	Container Volume	Preservation[1]	Holding Times	Analytical Methodology	Sample Container Cleaning
PHYTOPLANKTON FRESHWATER						
Live samples; including harmful algae identification	P, G	250 ml	Refer to individual method	24 hours	SM 10200	Warm detergent solution wash, thorough rinse in tap and distilled water
Preserved samples; including harmful algae identification	P, G	1000 ml	50 ml neutralized formalin store/transport in dark, cool container	1 month	SM 10200	Warm detergent solution wash, thorough rinse in tap and distilled water
Chlorophyll a/ Pigment analysis	P, G	500 ml	Refer to individual method store/transport in dark	24 hours	SM 10200H EPA 445.0	Warm detergent solution wash, thorough rinse in tap and distilled water
Cyanotoxins	G (amber) Plastic (PET or HDPE only)	250 ml	Refer to individual method store/transport in dark	24 hours	EPA 546, 544, 545.	
MARINE AND ESTUARINE						
Live samples	P, G	250 ml	Refer to individual method	24 hours	SM 10200H	Warm detergent solution wash, thorough rinse in tap and distilled water
Preserved samples	P, G	1000 ml	10 ml or more Lugol's solution to maintain weak tea color. Store/transport in dark, cool container.	48 hours	SM 10200H	Warm detergent solution wash, thorough rinse in tap and distilled water

Appendix 2.4 (continued) Sample Preservation, Holding Times, and Methodologies for the Analysis of BIOLOGICAL Samples for Freshwater, Estuarine and Marine Samples

Parameter	Sample Container	Container Volume	Preservation[1]	Holding Time	Analytical Methodology	Sample Container Cleaning
PHYTOPLANKTON MARINE AND ESTUARINE						
Chlorophyll a	P, G amber or foil-covered	250 ml	Refer to individual method store/transport in dark	48 hours	SM 10200H	Warm detergent solution wash, thorough rinse in tap and distilled water
ZOOPLANKTON						
Freshwater	P, G	6,000 ml	300 ml neutralized formalin. Store in cool container	1 month	SM 10200	Warm detergent solution wash, thorough rinse in tap and distilled water
Marine & Estuary	P, G	6,000 ml	5% formalin (5 ml neutralized formalin/100 ml tap water), store and transport in cool container	1 month	SM 10200	Warm detergent solution wash, thorough rinse in tap and distilled water
PERIPHYTON DIATOMETER SLIDES AND ROCK SCRAPINGS						
Species Composition	125ml jar polyseal cap	N/A	Lugol's solution (4% buffered formalin, "M3" fixative, or, 2 % glutaraldehyde), store and transport in iced container in the dark	1 month	SM 10300+ EPA99 Periphyton.6	Warm detergent solution wash, thorough rinse in tap and distilled water
DIATOMS (Sediment Core) Species Composition	sealed plastic bag	N/A	Refer to individual method Store and transport in dark container	N/A		
PERIPHYTON						
Chlorophyll a	P, G	30 ml	90% neutralized acetone, Refer to individual method For cooling, store and transport in dark container	48 hours	SM 10300 EPA Method 445.0	Warm detergent solution wash, thorough rinse in tap and distilled water

Appendix 2.4 (continued) Sample Preservation, Holding Times, and Methodologies for the Analysis of BIOLOGICAL Samples for Freshwater, Estuarine and Marine Samples

Parameter	Sample Container	Container Volume	Preservation[1]	Holding Time	Analytical Methodology	Sample Container Cleaning
MACROINVERTEBRATES						
Species composition	P, G	N/A	5% neutralized formalin (5 ml neutralized, formalin/100 ml sample water [95% ethanol, 70% isopropyl alcohol])	N/A	SM 10500 EPA99: Macroinvert-ebrates 7	Warm detergent solution wash, thorough rinse in tap and distilled water

[1] Neutralized formalin = 100 % neutralized formalin with sodium tetraborate to pH 7.0 – 7.3

Appendix 2.5
Sample Preservation, Container, and Holding Times for Estuarine and Marine Samples

Parameter	Sample Container	Container Volume	Preservation[1]	Holding Times	Analytical Methodology[2]
Ammonia	Polypropylene	50mL	2mL 3.5% phenol added to 40mL, Cool to 0-6° C	14 days	EPA 350.1 Modified
Nitrate + Nitrite	Polypropylene	50mL	Freeze	28 days	EPA 353.4
Total Nitrogen	Polypropylene	50mL	Freeze	28 days	USGS I-4650-03
Orthophosphate	Polypropylene	50mL	Freeze	28 days	EPA 365.5
Total Phosphorous	Polypropylene	50mL	Freeze	28 days	USGS I-4650-03
Biogenic Silica	Polypropylene	50mL	Cool to 0-6° C	28 days	EPA 366.0 Modified
TOC	P,G	125ml	Sulfuric Acid to a pH < 2, Cool to 0-6° C	28 days	SM 5310B

[1] All samples are placed in a cooler filled with ice for transportation to the lab
[2] Methods recommended by the NJDEP Bureau of Marine Water Monitoring

Appendix 2.6
Table of Quality Control Samples

This table provides descriptive information about the various types of quality control samples often used during sampling events which support a variety of programs. This is not meant to be an all-inclusive list or description of the various types of quality control samples. Consult with the NJDEP program or analytical method for applicable requirements. A detailed description of the various types of quality control blanks is also available in a USEPA Fact Sheet at: https://www.epa.gov/sites/default/files/2015-06/documents/blanks.pdf.

Type	Description	Frequency	Purpose	Comments
Temperature Blank	Temperature reading measured from a bottle of water inside sample cooler upon receipt by laboratory.	One temperature blank per cooler measured and recorded upon receipt of sample coolers at laboratory.	To evaluate whether samples were adequately cooled during shipment.	Lab-provided, unopened in field
Trip Blank (TB)	VOC blank (unopened) used to evaluate contamination introduced during sampling, storage and transport.	Minimum one per shipment. Refer to analytical method for any additional trip blank requirements.	To evaluate contamination introduced during shipment.	Lab-provided, unopened in field
Field Blank (FB)	Collected as analyte-free water poured through sampling equipment prior to sample collection. If no equipment requiring decontamination is used in sampling, then analyte-free water is poured from bottle to bottle. This type of blank is sometimes referred to as an “equipment blank” or “rinsate blank”.	Minimum 5% (one per twenty) per analytical parameter per matrix per sampling procedure. Minimum of one per day. *	To assess contamination from field conditions during sampling and to evaluate the adequacy of the decontamination process if decontaminated equipment is used.	Lab-provided DI water and containers or reagent water of known quality
Field Reagent Blank (FRB)	Collected as analyte-free water poured from bottle to bottle as specified in certain drinking water methods.	See specific method.	To evaluate contamination introduced during sample collection, storage, and transport.	Lab-provided DI water and containers or reagent water of known quality

Type	Description	Frequency	Purpose	Comments
Field Duplicate (DUP)	A field duplicate is a sample collected at the same time and location in the field as the original sample by the same sampling team and submitted to the same lab for analysis. They are taken through all steps of the analytical procedure in an identical manner. These samples are used to assess precision of the total method, including sampling, analysis, and site heterogeneity. It can be collected as a sub-sample (in which one sample is collected and then split into two or more portions) or a co-located sample (in which two different samples are collected from the same location).	Minimum 5% (one per twenty) per analytical group per matrix per sampling procedure per sampling team. One per ≤ 20 field samples, if a site-specific MS/MSD was not collected. *	To evaluate errors introduced during sampling and other field activities, to measure precision.	Lab-provided containers
Field Split (Split)	Collected (as needed) as one field sample split (sub-sampled) into two samples shipped to separate laboratories.	As needed.	To evaluate interlaboratory comparability.	Lab-provided containers
Matrix Spike / Matrix Spike Duplicate (MS/MSD)	Matrix spike. A sample prepared by adding a known concentration of a target analyte to an aliquot of a specific homogenized environmental sample for which an independent estimate of the target analyte concentration is available. The matrix spike is accompanied by an independent analysis of the unspiked aliquot of the environmental sample. Spiked samples are used to determine the effect of the matrix on a method's recovery efficiency.	One per twenty per sample analytical group per sample matrix. As needed. *	To evaluate laboratory sample preparatory and analytical bias and precision for measurement of specific target analyte compounds in specific sample matrices.	Lab-provided containers

Notes:

* 5% or one per twenty, whichever is more frequent

Practitioners are advised to clearly identify both field samples and field QC samples when placing a project bottle order with the laboratory, and to collect sufficient sample volume to support the requested analytical parameters for each of the individual field samples and field QC samples. The laboratory will provide sample containers (with preservatives) and analyte-free water for the collection of field blanks, as well as containers (with preservatives) for site-specific MS/MSDs, DUPs, Splits, FBs, and TBs. Refer to NJDEP Analytical Methods QA/QC Technical; Guidance (2014) at: https://www.nj.gov/dep/srp/guidance/ .

Chapter 4
Site Entry Activities

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Chapter 4
Site Entry Activities

4.1 Introduction

Personnel performing sampling activities may encounter known and/or unknown hazards. When it is anticipated that potentially hazardous activities are to be conducted, or where there is a potential for contact with hazardous materials or contaminants, a health and safety program must be established, and a site-specific health and safety plan (HASP) must be developed prior to any hazardous site work. For site planning details see Chapter 1. Both the health and safety program and the site- specific HASP shall comply with 29 CFR1910.120 (b)(1)(iv) and (1)(v) of the OSHA Standard for Hazardous Waste Operations. For additional information not discussed in this Chapter please contact your Health and Safety Officer.

The NJDEP maintains a library of guidance documents on its website at https://www.nj.gov/dep/srp/guidance/. It is recommended the reader access the website and review the guidance manuals pertinent to the respective task. Additional guidance may also be found at websites of the EPA and the American Society for Testing and Materials (ASTM). Examples of some of the relevant guidance manuals and websites pertaining to this chapter are:

Soil Investigation Technical Guidance: https://www.nj.gov/dep/srp/guidance/#si_ri_ra_soils;

Ground Water Technical Guidance: https://www.nj.gov/dep/srp/guidance/#pa_si_ri_gw;

Ecological Evaluation Technical Guidance: https://www.nj.gov/dep/srp/guidance/#eco_eval;

Quality Assurance Project Plan Technical Guidance: https://www.nj.gov/dep/srp/guidance/#analytic_methods;

Vapor Intrusion Technical Guidance: https://www.nj.gov/dep/srp/guidance/#vi;

USEPA On Scene Coordinators Toolbox: https://response.epa.gov/main/healthsafety.aspx; and

OSHA: https://www.osha.gov.

4.2 Health and Safety Program Plans

Below is a summary of the information that shall be provided in a written health and safety program and/or a site-specific health and safety plan:

4.2.1 Organizational Structure

Pursuant to 29 CFR 1910.120(b)(2), a list, or organizational chart, of key personnel involved in all phases of on-site operations shall be provided. It should include the functions and overall responsibilities of each person identified. In accordance with 29 CFR 1910.120(b)(2)(i)(B), a Health and Safety Supervisor shall have the responsibility and authority to develop and implement the health and safety program and/or site-specific HASP and verify compliance with applicable safety and health requirements.

4.2.2 Hazard Analysis and/or Site Risk

Risks to consider for each location and the associated tasks to be performed shall be reviewed in advance by site personnel and available onsite in accordance with 29 CFR 1910.120(c)7. This should include, but not be limited to, the following:

- The site's historical use
- A preliminary evaluation of the site's existing characteristics
- An evaluation of the known or suspected contaminants and conditions on the entire site that may pose inhalation, skin absorption/contact, exposure, or ingestion hazards
- An evaluation of known or potential safety hazards associated with each task and area of concern (AOC)
- Size, location, and surroundings of the site
- Site topography, accessibility, and special features (e.g., structures, vessels, tanks, etc.)
- Description of the operation and tasks to be performed
- Approximate duration of each operation and task
- Known or suspected pathways of contaminant dispersion pertinent to the operations and tasks performed
- Safety and health hazards expected on the site (e.g., trip and fall hazards, natural hazards)
- Status and capabilities of emergency response teams that will be providing assistance during site emergencies, including those providing emergency medical treatment and transport of any contaminated injured persons.

4.2.3 Training Requirements for On-Site Personnel

Pursuant to 29 CFR 1910.120, et al, all workers that are engaged in on-site activities must have met one of the following requirements prior to the start of operations at the site:

1. General site workers (such as regulators, subcontractors, contractors, equipment operators, general laborers, and supervisory personnel) engaged in hazardous substance removal, or other activities that expose or potentially expose workers to hazardous substances and health hazards, shall receive a minimum of 40 hours of instruction off the site, and a minimum of three (3) days actual field experience under the direct supervision of a trained, experienced supervisor.
2. Workers on site only occasionally for a specific limited task (such as, but not limited to, ground water monitoring, land surveying, or geophysical surveying) and who are unlikely to be exposed over permissible exposure limits and published exposure limits shall receive a minimum of 24 hours of instruction off the site, and a minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.
3. Workers regularly on site, who work in areas that have been monitored and are fully characterized indicating that exposures are under permissible exposure limits and published exposure limits where respirators are not necessary, and the characterization indicates that there are no health hazards or the possibility of an emergency developing, shall receive a minimum of 24 hours of instruction off the site and a minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.
4. Workers with 24 hours of training who are covered by items 2 and 3 of this section, and who become general site workers or who are required to wear respirators, shall have the additional 16 hours and 2 days of field experience to gain the training specified in item 1.

In addition, pursuant to 29.cfr.1910.120(e)8, an annual 8-hour refresher course after the initial training shall be provided, to all site personnel in order to maintain field work employment eligibility.

On-site management and supervisors directly responsible for, or who supervise employees engaged in, hazardous waste operations, including the on-site HSO, shall meet the requirements of a general site work and have also received 8 hours additional training in managing such site operations prior to the start of

site activities as stipulated in 29 CFR 1910.120.

Employees who have been designated as responsible for responding to on-site emergencies shall have received additional training in how to respond to such emergencies prior to the start of site operations as stipulated in 29 CFR 1910.120.

Employees who have not received the required training prior to the start of site operations are not to engage in on-site operations until such training has been completed.

The employer must maintain an up-to-date summary list of the health and safety topics and elements administered to each employee.

A written certification statement of completed training and/or acquired experience for all employees designated to engage in on-site activities shall be provided. A member of senior management, a corporate officer, or the health and safety program manager shall endorse such certification.

It is recommended that site specific training and performance of daily safety briefings regarding planned operations, the site-specific HASP, the form and warning properties of potential hazards, work zones, locations of emergency/safety equipment, local emergency response procedures and any changes in site characteristics, levels of protection, communications, decontamination procedures, emergency facilities and signals, and evacuation procedures be conducted.

4.2.4 Engineering Controls and Personnel Protection

The need to apply engineering and/or work practice controls as a means of protecting personnel in the performance of site-specific tasks should be considered. When feasible and practicable, it is recommended that engineering controls be implemented to reduce and maintain employee exposures to or below OSHA permissible exposure limits (PELs) for those tasks demonstrating known or suspected hazards. Work practice controls should next be applied when engineering controls are impractical and should be incorporated as site-specific standard operating procedures (SOPs) for personnel precautions and routine operations.

4.2.4.1 Personal Protective Equipment (PPE) and Levels of Protection

Personal protective equipment (PPE) that will protect employees from the hazards and potential hazards they are likely to encounter as identified during the site characterization and analysis should be selected and used.

The selection of PPE should be based on an evaluation of performance characteristics, site-specific tasks and known, or suspected hazards. PPE should be assembled into Levels of Protection (LOPs), or ensembles appropriate for the site. Guidance related to the selection of respiratory equipment and appropriate PPE and a detailed description of ensembles by LOP (Level A through Level D) is provided in Chapter 13 - Personal Protection, this description is available at 29 CFR 1910.120 appendix B.

HASPs should include a list of components for each protective ensemble, the LOP selected for each task, the rationale for each task-specific selection, and any contaminant action levels to be followed in LOPs decision making.

If the site-specific HASP requires respiratory protection, per OSHA requirements, it should include a description of the respiratory protection program and the method of respirator fit testing employed.

Only NIOSH/MSHA approved respiratory protective equipment shall be used in accordance with 29 CFR 1910.134. Any other PPE selected shall be in conformance with appropriate ANSI standards for that equipment.

The PPE program shall follow the OSHA requirements at 29 CFR 1910.120(g)5 and address the following elements:

- Site hazards
- PPE selection
- PPE use and limitations
- Duration of site operations
- PPE maintenance and storage
- PPE decontamination and disposal
- PPE training and proper fit
- Donning and doffing procedures
- PPE inspection prior to, during, and after use
- Evaluation of program effectiveness
- Heat stress and temperature limitations, other medical considerations

For further information regarding PPE selection, use, replacement, donning, and doffing see Chapters 13 and 14.

4.2.5 Medical Surveillance Program

Per 29 CFR 1910.120(b) a medical surveillance program (MSP) for employees engaged in on-site operations must be implemented if any of the following criteria are met:

- Employees are, or may be, exposed to hazardous substances, or health hazards, at or above the permissible exposure limits, or if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year.
- Employees wear a respirator for 30 days or more a year or as required by 29 CFR 1910.134.
- Employees are injured due to overexposure from an emergency incident involving hazardous substances or health hazards.
- Employees are members of HAZMAT teams.

The employer shall retain all medical surveillance records and personnel exposure monitoring data for 30 years plus employment as described in 29 CFR 1910.1020(d)(1)(I).

The employer shall provide written certification of the medical fitness for work of all employees designated to engage in on-site operations prior to the start of those operations. A member of senior management, a corporate officer, or the health and safety program manager shall endorse such certification, and the certification shall be incorporated into the site HASP.

As dictated by seasonal conditions, it is recommended that heat and/or cold stress monitoring be incorporated into the health and safety program and into the site-specific HASP. The program should include employee awareness of the signs and symptoms of heat and/or cold stress, preventive measures, and employee and/or environmental parameters that will be measured. The employer should maintain a daily heat and/or cold stress log on all employees wearing protective ensembles onsite and should describe the log in the site HASP. Specific work/rest schedules with consideration for workers fatigue should be maintained. In addition, adequate fluids and a sheltered area for breaks should be designated. For additional information on protective ensembles please see Chapter 13 of the FSPM.

4.2.6 Air Monitoring

4.2.6.1 Site Specific Monitoring

An air monitoring program must be implemented to identify areas of elevated airborne contaminant concentrations and to determine the level of the concentrations relative to background. The employer shall provide the personnel, instruments, and materials necessary to perform such air monitoring and identify the individual responsible for administering the program. The air monitoring program shall be included in the HASP and contain the following information:

- Type, make, and model of instrument(s) selected for use
- All instrument settings for each instrument used
- Method of instrument calibration, including calibrant and sample calibration data sheet
- Method of field checks, including field check materials and record of checks
- Manner and frequency of calibration and pre- and post- (or greater) field checks
- For all types of air sampling and monitoring the limitations and cross reactivities of the instruments or sampling media should be identified to understand the limitations of the methods being used
- All alarm setting should be verified to be at the appropriate action level

4.2.6.2 Area and Personnel Air Sampling

The need to develop and implement area and personnel air sampling programs during the project should be evaluated and included in the site HASP. Special considerations should be given to intrusive or high-risk tasks, indoor or outdoor tasks and the potential for exposure to those performing such tasks.

All necessary sampling devices, pumps, collection media, and support equipment to perform the air sampling should be provided and identified in the HASP. The sampling devices and pumps should bear all approvals necessary for use in combustible or flammable atmospheres. In addition, the sampling devices, pumps, collection media, and any necessary support equipment shall be appropriately calibrated according to the manufacture's specifications and field checked on a regular basis to ensure it is functioning properly.

A daily sampling record should be established as part of the air sampling program. Depending on the contamination present and the complexity of the sampling event, the record shall include the following:

- Collection date
- Sample identification number
- Location and/or task monitored
- Wind speed and direction during each sample collection period
- Duration of each sample collected, including the start/stop times of each sample
- Ambient temperature and humidity of sampling period
- Pre-and post-sampling train flow-rate checks
- Instrument readings, calibration, and field checks
- Any pertinent comments

When required, the laboratory selected for sample analysis should be accredited by the AIHA for the

analysis required. Sampling and analytical methods of NIOSH then alternatively OSHA, should be used preferentially when such methods are available for the samples collected. All appropriate QA and QC provisions regarding sample collection, transport, and holding times should be followed.

4.2.6.3 Records Retention and Data Reporting

The employer shall retain all personnel exposure sampling results and monitoring data in accordance with the requirements set forth in OSHA, 29 CFR 1910.120(c).

A daily air monitoring log shall include, as a minimum, the following information:

- Monitoring date
- Location and/or task monitored
- Wind speed, direction, ambient temperature, and humidity
- Instruments used, including make and model and all instrument settings
- Instrument readings and units
- Pertinent comments or information
- Results of instrument calibration checks, including date and time of each check, the calibration agent used, and its concentration, for each instrument employed

4.2.7 Site Control

For additional information on establishing work zones please see applicable OSHA guidance. It is recommended that work zones be divided into areas where specific operations, or tasks will occur. This is done to minimize cross-contamination and/or to keep impacted materials from leaving the site. Site entry and decontamination procedures are completed at separate designated control points. Three work zones should be established to perform this work: an exclusion (contaminated) zone, a contamination reduction (decon) zone and a support (clean) zone. A map or diagram showing the specific work zones and a description of the site control plan should be included in the HASP. Each of the zones should be clearly demarcated using fencing, flags, cones, or similar devices. An access control point should be maintained to ensure that personnel are directed through the contamination reduction zone when entering or leaving the exclusion zone. For additional information on establishing work zones please see applicable OSHA guidance available at: https://www.osha.gov/sites/default/files/enforcement/directives/CPL_02-02-071.pdf.

A daily site entry control log shall be kept. The log shall include:

- Personnel visiting the site
- Affiliation
- Date
- Arrival time
- Departure time
- Purpose of visit and locations visited

All unauthorized personnel must be prevented from entering exclusion zones of the site.

4.2.8 Decontamination

All contaminated personnel and equipment exiting the exclusion zone, or other potentially contaminated areas, must be decontaminated prior to entering the support zone, or leaving the site. This will be done in

the contamination reduction zone which should be set up for the proper removal of PPE and properly staffed prior to any exclusion zone activities. This decontamination must be performed in order to prevent contamination from being transferred into clean areas and contaminating or exposing unprotected personnel. Refer to Chapter 14, *Personnel Contamination Reduction,* for measures for workers to take when leaving contaminated areas at hazardous waste sites and on properly doffing PPE.

Personnel and equipment decontamination procedures appropriate for the site shall be included in the site HASP. The procedures shall include the necessary equipment and number of steps to achieve the objective, provisions for any personnel protection, and a diagram outlining the steps or stations in the procedures. Example diagrams summarizing the contamination reduction zone extents and the order of PPE removal based on the selected LOP are provided Chapter 14. The procedures must ensure adequate containment and removal of any decontamination solutions and spent disposable protective apparel.

Provisions should be made to facilitate personal hygiene at breaks and following daily operations. Where decontamination procedures include shower usage and change rooms away from the exclusion zone, they shall meet the requirements of 29 CFR 1910.141 and 1926.51.

4.2.9 Emergency Contingency Planning

Emergency Response Plan, (ERP) to handle anticipated on-site emergencies, must be developed prior to the start of site operations.

The ERP shall be incorporated into the site HASP as a separate section of that document and shall be periodically reviewed and amended, as necessary, to keep it current with new or changing site conditions or information.

The ERP shall address, as a minimum, the following:

- Preplanning of site operations to prevent emergencies
- Personnel roles and lines of authority
- Key personnel at the site authorized and responsible for implementing the plan
- Emergency recognition and control measures
- Evacuation routes and procedures, and the frequency of emergency drills
- Safe distances and places of refuge
- Emergency security and site control measures
- Decontamination measures not previously listed in the HASP and specific for all anticipated emergencies
- Emergency medical treatment and first aid
- Emergency alerting and response procedures
- Site communications
- Site diagrams showing general layout, work zones, and prevailing weather conditions
- Procedures for reporting incidents to pertinent local, state, and Federal agencies
- A list of emergency telephone contacts including the name, location, telephone number, written directions and a route map to the nearest medical facility that will provide emergency medical services
- Measures to review and follow up on site responses
- Emergency and personal protective equipment kept at the site for emergencies, with an

equipment list and a drawing indicating their on-site location

Prior to startup of site operations, it is recommended that local officials and/or those responsible for local emergency management and public safety shall be notified. These agencies include but are not limited to:

- Fire
- Ambulance
- Police
- Local/County health officials
- Utility company

First Aid/CPR/AED Training – At least one person holding valid certifications in basic first aid and CPR/AED is present at the site during all site operations pursuant to 29 CFR 1910.151 and 29 CFR 1926.50(c).

Verification of Medical Facility Preparedness – A local medical facility shall be selected for inclusion into the ERP to ensure that said facility is willing and is capable of providing that medical support necessary to satisfy those anticipated hazards and emergencies detailed in the ERP. Safety Data Sheets (SDS), product information, or any technical information on hazard, exposure and treatment of anticipated/known hazards should be provided to the medical facility.

4.2.10 Confined Space Operations

Should site operations include activities within confined spaces, a confined space entry program and relevant SOPs shall be incorporated into the HASP pursuant to 29 CFR 1910.146.

If the confined space entry meets the OSHA definition of a permit required confined space entry, then a section addressing such entries shall be included in the HASP.

An Entry Permit System must be developed to ensure that the following are addressed and complied with:

- A confined space entry training program
- Identification of all confined spaces to all employees to limit unauthorized access
- Identification of hazards in the confined space
- A system of monitoring for atmospheric hazards
- A system of calibration of monitoring equipment
- A system of barricades, to prevent unauthorized entry
- A system of identifying authorized entrants, attendants, rescuers and those authorized to sign the entry permit
- A procedure for emergency evacuation
- Emergency rescue procedures
- Procedures to test the program to ensure effectiveness

Pre-entry briefings shall be held prior to initiating any confined space entries and at other times as necessary to ensure that employees are aware of the HASP provisions governing such activities and that the special provisions are being followed. The completed permit shall be made available at the time of entry to all authorized entrants, by posting it at the point of entry or by any other equally effective means, for assurance that the pre-entry preparations have been completed.

Inspections shall be conducted by a Health and Safety Officer or, in the absence of that individual, another qualified individual acting on behalf of the HSO as necessary to determine the effectiveness of the confined space SOP with regard to those confined spaces identified on site.

A qualified individual shall test the atmosphere of the confined space prior to entry and during work to ensure that all measures necessary to protect the health and safety of employees entering have been taken. Monitoring shall be appropriate for the contaminant(s) that are known or suspected of being present in the space.

The employer shall provide appropriate protective and entry equipment for all entrant personnel necessary for the Permit Required entry. On site rescue personnel must be present or off site rescue must be able to respond to the site within 3 minutes of notification. Equipment necessary for a rescue must be identified and present at the point of entry.

Federal OSHA training requirements at 29 CFR 1926 subpart AA for all personnel involved in confined space entry must be met. A training program must be administered to all personnel involved in confined space entry before entrance can be initiated. Rescue teams shall practice at least annually at the confined space or at representative openings having the same size, configuration, and accessibility as the confined space from which an actual rescue would be performed. A record of training and authorized personnel shall be kept on-site and listed in the HASP.

4.2.11 Other Special Operations

4.2.11.1 Spill Containment

A written spill containment program shall be developed to handle the possibility of a spill or leakage of drummed or containerized hazardous materials. The contractor shall identify the following on-site and off-site personnel and equipment or services necessary to isolate, contain and mitigate the spill:

- Clean up contractor or personnel
- Estimate of response time of off-site contractors
- Spill containment procedures (diking, over pack, etc.)
- Special safety precautions (fire, corrosive, radioactivity, etc.)
- Equipment and supplies on hand at site or readily available to respond to contain and clean up the spill

4.2.11.2 Excavations and Trenching

All excavation work shall comply with 29 CFR 1926, Subpart P and other state and federal regulations governing excavations and trenching. The need to perform any excavations or trenching as part of the site operations must be described in the HASP. Information shall include, but not be limited to:

- detailed methods of preparing the trench or excavation including descriptions of sloping, shoring, and guarding;
- observation of proper equipment spacing, use of barriers, means of exit, and placing of machinery and spoils;
- training of personnel working around and in trenches and excavations in such operations to assure knowledge of hazards, safe operations, and procedures to be followed in the event of an emergency; and

- measures to be taken to avoid overhead electric lines, underground utilities, storage structures, and service passageways and include in the HASP drawings, measurements, and descriptions. All pertinent sections of 29 CFR 1910, Subpart S and 29 CFR 1926, Subpart K for electrical safety must be complied with and identified in the HASP.

4.2.11.2.1 Underground Utilities

No ground intrusive work (including excavation, trenching, digging, probing, boring and drilling) is to commence without a current underground utility mark out as per N.J.S.A. 48:2-73, in compliance with OSHA Regulation 1926.651 and in compliance with N.J.A.C. 14:2. This includes all private utilities lines which would not normally be marked out.

NJ One Call is a free service and can be contacted at 1-800-272-1000 (out of State call 908-232-1232), dial 811 or https://www.nj1-call.org. They will contact all utility companies that may have services in the area of investigation. Calls must not be made less than 3 full working days and not more than 10 working days prior to the planned work. If work is delayed past the 10 days, you are required to renew your ticket. "One Call" legislation mandates that all owners of underground infrastructures become New Jersey One Call members. The "One Call" will require the following information:

- County
- Municipality
- Street address
- Nearest cross street
- Type of work being performed
- Extent of work
- Name of caller and title
- Start date of work

The caller will receive a "ticket" number for the mark-out locations. If you must contact the "One Call" system regarding a mark-out, you must supply them with your ticket number.

The mark-out methods used by the utilities will include flags, stakes and color-coded paint. In many cases these are not permanent. It is requested the mark-outs be refreshed if work is completed past the 10 business days. Utilities are marked by the uniform color code recommended by the American Public Works Association. The mark-out color and associated utility are as follows:

RED	– electric
YELLOW	– gas, oil, petroleum products
ORANGE	– telephone, cable TV, communications
BLUE	– water
GREEN	– sewer
PINK	– temporary survey marking
WHITE	– proposed excavation

This is by no means an all-encompassing list of utilities that may be present at a site targeted for a soil gas investigation. Historical and/or current commercial process may include unlisted buried utilities. Therefore, such underground utilities should be thoroughly identified and located.

It is also important to contact the municipal utility authority in the town in which you will be performing work. There may be "road-opening" permits that must be obtained prior to the start of

the investigation. Police departments and emergency services often wish to know if a roadway is going to be partially blocked or detoured, and may require that a traffic safety officer be present during any road work.

The utility companies are only obligated to mark-out the utility lines on public property. They are not required to mark out the utility lines on private property. The property owner or a private company must complete utility mark-outs on private property.

Other means of locating underground utilities must be identified for utilities not covered by NJ One-Call. The NJ One Call Markout Ticket Confirmation Number(s) should be recorded in the HASP, or at a minimum, be kept at the site for the duration of any ground intrusive work during the project. All markouts must be maintained during the course of the work.

Above all, if it is suspected that a utility line is present, move the sample location. A few feet in a soil gas survey won't have a great impact on the results in lieu of possible injury or death.

4.2.11.2.2 License Requirements

A brief overview of the license requirements for the construction of borings and monitor wells in New Jersey is available at: https://www.state.nj.us/dep/watersupply/g_boards_le.html. Consult N.J.A.C. 7:9D-*Well Construction; Maintenance and Sealing of Abandoned Wells* for further information. A copy is available through the Bureau of Water Allocation at 609-984-6831 or online at: http://www.state.nj.us/dep/watersupply/.

4.2.11.3 Hot Work

The performance of Hot Work such as welding, cutting, etc. during site operations must be addressed in the HASP. A Hot Work "Permit" procedure must be included in the HASP if hot work is performed and must comply with the sections of OSHA 1910.119(k), OSHA 1910.146, and OSHA 1926.64 (k) et al as they apply to these operations.

All hot work procedures should be outlined and shall comply with both state and local fire codes as well as with OSHA regulations.

All electrical supply wiring and distribution shall comply with the local and National Electric Codes, as well as any state and OSHA 1926.400 Subpart K, governing such installations.

Proper utilization and storage of flammable cutting gases and other compressed gases shall comply with the requirements of OSHA 1926.350 et al. All gas cylinders shall be secured to prevent falling or potential damaged.

An appropriately rated fire extinguisher should be available.

4.3 General Safety Measures

4.3.1 Personal Practices

Levels of protection shall be established for a given site and shall be based upon the best available information regarding known or suspected hazards and the type of planned activity. Activities shall then be performed in accordance with those site-specific levels of protection. Changes in levels of protection should be made based on the actual conditions at the site. When sufficient information is lacking or when the conditions of a site are unknown, or in doubt, all site entries and on-site activities will be performed in at least Level B protection, as a minimum, until the knowledge on site-specific hazards has improved.

The use of respiratory protective equipment shall be in accordance with OSHA requirements. A schedule

should be developed for changing air purifying respirator cartridges in accordance with the manufacturer's instructions, based on actual concentrations, and at least once each workday on-site. Only NIOSH/MSHA approved respirators shall be used. (See Chapter 13, *Personnel Protection.*)

Eating, drinking, chewing gum or tobacco, smoking, vaping, applying cosmetics or any other practice which increases the tendency for hand-to-mouth contact shall be prohibited within the exclusion zone(s) and prior to washing hands and face within the contamination reduction corridor or decontamination line.

Medicines and alcohol can intensify the effects of exposure to toxic chemicals. Alcohol, caffeine products and certain medications can contribute to and exacerbate the effects of heat stress. Personnel during site activities should not take prescription and non-prescription drugs when the potential for absorption, inhalation, or ingestion of toxic substances exists, unless specifically approved by a qualified medical provider.

Contact with surfaces known or suspected of being contaminated should be avoided during on-site activities. Avoid walking through puddles, mud, or discolored surfaces; kneeling on ground; leaning, sitting, or placing equipment on drums.

All personnel connected with a site and engaging in field activities must be familiar with standard operating safety procedures and any additional instructions contained in the Site Safety Plan. Further, all personnel, upon their initial visit to a site, shall read the HASP before performing any site related activities, have an opportunity to ask any questions, and shall confirm that reading with their signature in accordance with 1910.120(b)(1)(v).

4.3.2 Operations Management

For sites where entry/work is to be conducted in contaminated areas, a scaled site map designating work zones must be established prior to any site entry and all individuals involved must be familiar with it. The zones are to be connected by access control points to restrict entry and exit. Work zones can be adjusted as more becomes known about the site. The designated work zones include:

- **The Exclusion or Contamination Zone**
  The area suspected to contain contamination, or uncontrolled hazardous substances. This zone may be divided into subsets based upon varying levels of hazard and/or the nature of the tasks to be performed. All personnel entering the Exclusion Zone must wear the required level of protection based on the HASP and site-specific conditions and must exit through the decontamination zone.
- **The Contamination Reduction Zone**
  This area serves as a buffer between the exclusion and support zones. All decontamination activities occur in this area. It should be a suitable size to efficiently decontaminate workers, instruments, and equipment. Adequate supplies of materials and decontamination fluids should be available. All materials associated with the decontamination process must be properly managed.
- **The Support Zone**
  This area should be free from any hazardous materials. This zone is the location for command posts, offices, storage, and site support facilities. It should be positioned upwind of the Exclusion Zone, when possible.

Communications using radios, cellular phones or other means must be maintained between entry team members and the support zone at all times. Emergency communications should be prearranged in case of radio failure, necessity for evacuation of site or other reasons.

Consideration must be given to the staffing requirements necessary for the job. Due to the nature of

hazardous materials, especially materials of unknown concentrations, a minimum of two persons should be present. Under no circumstances should field personnel go on site alone. In extremely hazardous situations, two teams of personnel should be employed: one sampling team and one backup/rescue team. Personnel on-site must use the "buddy system" see 29 CFR 1910.120(a)3. At a minimum, a third person, suitably equipped, as a safety backup is required during initial entries. Visual contact must be maintained between "pairs" on site and safety personnel. Entry team members should remain close together to assist each other during emergencies. During continual operations, on- site workers act as safety backup to each other. Off-site personnel provide emergency assistance.

A Pre-Work Safety Meeting must be conducted among personnel present at a site prior to:

- the start of each day's activities;
- changes in shift;
- the arrival of new or additional personnel to a site; or
- the further performance of site activities following the occurrence of any significant changes on site. Topics to be covered should include the use of necessary protective clothing and equipment, chemical and physical hazards, tasks to be performed, special equipment or procedures, and emergency contacts and procedures to be followed.

4.4 Site Entry and Reconnaissance

4.4.1 Objectives

- Characterize the hazards that exist or potentially exist and may affect the public health, the environment, and response personnel
- Verify existing information and/or obtain data about the site
- Evaluate the need for prompt mitigative action
- Collect supplemental information to determine the safety requirements for personnel initially and subsequently entering the site
- Perform simple or immediate mitigative actions when necessary
- Create maps and capture images of areas of concern, document locations of hazards and confined spaces.

4.4.2 Preliminary Off-Site Evaluation

The need to enter a site must be based on some type of preliminary hazard evaluation. Prior to performing any initial site entry, an effort should be made to collect and examine as much information (records, off-site studies, shipping manifests, transportation placards, container types, and labels, etc.) about the site as possible. The information should primarily concern real or potential hazard(s), degree(s) of severity, and the associated risk(s). Subsequent site entries should only be made after examining similar information gathered during previous entries.

Off-site (peripheral) atmospheric monitoring must be conducted prior to any initial site entry and must be incorporated into plans for any subsequent on-site activities. Individuals performing such monitoring should maintain upwind positions when possible and utilize proper personal protective equipment. When off-site readings exceed pre-established levels, the site Health and Safety Plan must be adjusted to maintain safety.

4.4.3 Preliminary On-Site Evaluation

The initial site entry process is to be considered a rapid site screening procedure for the collection of preliminary data on any immediate hazards. Fire, explosion, oxygen-deficient atmospheres, ionizing radiation, airborne contaminants, containerized or pooled hazardous substances could affect workers during subsequent operations. For the purpose of monitoring, on-site hazards may be placed into several groups (see Table 4.1 at the end of this Chapter).

4.4.3.1 Combustible Gases

The presence or absence of combustible vapors or gases must be determined. If readings approach or exceed 5% of the lower explosive limit (LEL), extreme caution should be exercised in continuing the investigation. If readings approach or exceed 10% LEL, personnel should be withdrawn immediately. Before resuming any on-site activities, project personnel, in consultation with experts in fire or explosion prevention, must develop procedures for continuing operations.

4.4.3.2 Oxygen Concentrations

At sea level, ambient air typically contains about 19.5% by volume of oxygen. At lower percentages, air-supplied respiratory protective equipment is needed. Oxygen measurements are of particular importance for work in confined spaces, low-lying areas, or in the vicinity of accidents that have produced heavier- than-air vapors, which could displace ambient air. These oxygen-deficient areas are also prime locations for taking organic vapor and combustible gas measurements, since other substances have displaced the air. Oxygen-enriched atmospheres (>23.5%) increase the potential for fires.

4.4.3.3 Organic gases and vapors

If the type of organic substance(s) present at a site is known and is volatile or can become airborne, air measurements should be made with one or more appropriate, properly calibrated survey instruments or established sampling techniques.

When the presence, or identity of organic vapors/gases are unknown, instruments such as a portable photoionization detector and/or, flame ionization detector should be used. The readings obtained from these devices indicate total atmospheric concentrations. Identification of the individual components may permit some instruments to be specifically calibrated and used as analytical tools.

Sufficient data should be obtained during the initial entry to evaluate the site for various levels of organic vapors. These measurements can be used on a preliminary basis to: 1) determine levels of personnel protection, 2) establish site work zones, and 3) select candidate areas for more thorough qualitative and quantitative studies. Readings in excess of background concentrations may indicate toxic levels as well as the displacement of oxygen or the presence of combustible vapors.

Additional field instruments (Miran Saphire, GC/MS etc.) and techniques (detector tubes air sampling devices) should be used to identify the contaminants so that the proper level of protection can be developed based on actual materials present.

When the type of contaminant present is known, the Levels of Protection utilized can be based on OSHA regulated Permissible Exposure Limits (PELs).

4.4.3.4 Inorganic gases and vapors

The ability to detect and quantify nonspecific inorganic vapors and gases is extremely limited. If

specific inorganics are known, or suspected to be present, measurements should be made with appropriate instruments.

4.4.3.5 Radioactive materials

Radiation monitoring should be incorporated in the initial survey where radioactive materials may be present, for example, fires at warehouses or hazardous material storage facilities, transportation incidents involving unknown materials, or abandoned waste sites.

Normal gamma radiation background is approximately 0.01 to 0.02 milliroentgen per hour (mR/hr) on a gamma survey instrument. Work can continue with elevated radiation exposure rates, however, if the exposure rate increases to 3-5 times above gamma background, a qualified health physicist should be consulted. At no time should work continue with an exposure rate of 0.1 mR/hr or more above background without the advice of a health physicist.

The absence of gamma readings above background should not be interpreted as the complete absence of radioactivity. Radioactive materials emitting low-energy γ (gamma), α (alpha), or β (beta) radiation may be present, but for a number of reasons may not cause a response on the instrument. Unless airborne, these radioactive materials should present minimal hazard, but more thorough surveys should be conducted as site operations continue to completely investigate the presence of any radioactive material.

4.4.3.6 Direct Reading Instruments

A complex variety of toxic air pollutants (including organic and inorganic vapors, gases, or particulates) can be produced at hazardous waste sites. Direct-reading field instruments will not detect or measure all of these substances. Thus, negative readings should not be interpreted as the complete absence of airborne toxic substances. Verification of negative results can only be done by collecting air samples and analyzing them in a laboratory or in an off-site location using portable analyzers.

4.4.3.7 Visual Observations

While on-site, the entry team should make visual observations to help evaluate site hazards, for example: dead animals, stressed vegetation, wind direction, labels on containers indicating explosive, flammable, toxic or corrosive materials, conditions conducive to splash or contact with unconfined liquids, sludges, or solids, and other potentially hazardous conditions.

Although the initial entry is considered a rapid activity, its duration can be quite variable. The time needed to conduct the initial survey depends on the urgency of the situation, type of incident, information needed, size of site, availability of resources, level of protection required for site entry personnel, etc. Consequently, initial surveys may need hours or days to complete and consist of more than one entry. Because of this variability, priorities must be established for atmospheric monitoring during a given initial entry operation.

The immediate concern to initial entry personnel are atmospheric conditions that could affect their safety. These conditions are airborne toxic substances, combustible gases or vapors, lack of oxygen, and to a lesser extent, ionizing radiation. Priorities for monitoring these potential hazards must be established after careful evaluation of known or suspected conditions before initiating entry.

When the type of material(s) involved in an incident are identified and release into the environment is suspected or known, the material's chemical/physical properties and the prevailing weather conditions may help determine the order of monitoring. An unknown substance(s) presents a more difficult monitoring problem.

In general, for poorly ventilated spaces (e.g., buildings, sewers, boxcars, or bulk tanks) which must be entered, combustible vapors/gases and oxygen- deficient atmospheres should be monitored first with team members wearing, as minimum, Level B protective equipment. Toxic gases/vapors and radiation should be measured as the next priority. Further, such spaces may be confined spaces and, therefore, special confined space entry procedures must be followed.

For open, well-ventilated areas, combustible gases and oxygen deficiency are lesser hazards and require lower priority. However, areas of lower elevation on-site (such as excavations, ditches, and gullies) and downwind areas may have combustible gas mixtures, in addition to toxic vapors or gases, and may lack sufficient oxygen to sustain life. Entry teams, therefore, must exercise caution by approaching and monitoring from upwind areas.

Any indication of atmospheric hazards (toxic substances, combustible gases, and lack of oxygen, radiation, and other specific materials) should be viewed as a sign to proceed with care and deliberation. Readings indicating non-explosive atmospheres, low concentrations of toxic substances, or other conditions may increase or decrease suddenly thereby changing the associated risks. Extreme caution must be exercised in continuing site entry activities when atmospheric hazards are indicated. Table 4.1 provides some guidelines for use during preliminary on-site evaluations.

Table 4.1 Atmospheric Hazard Guidelines

Monitoring Equipment	Hazard	Level	Action
Combustible Gas Indicator	Explosive atmosphere	<5% LEL	Continue investigation.
		5%-10%	Continue on-site monitoring with extreme caution as higher levels are encountered.
		>10% LEL	Explosion hazard: withdraw from area immediately.
Oxygen concentration meter	Oxygen	<19.5%	Monitor wearing SCBA. NOTE: Combustible gas readings are not valid in atmospheres with <19.5% oxygen.
		19.5-23%	Continue investigation with caution, SCBA not needed, based on oxygen content only.
		>23.0%	Discontinue inspection; fire hazard potential. Consult specialist.
Photoionization Detector	Organic vapors/gases	Depends on species	Consult standard reference manuals for air concentration/toxicity data.
		Total response mode	For unknown contaminants, use strict guidelines to determine level of protection
Flame Ionization Detector	Organic gas/vapor	Depends on species	Consult standard reference for air concentrations/ toxicity data.
		Total response mode	For unknown contaminants, use strict guidelines to determine level of protection
Radiation survey	Radiation		Consult Radiation Protection Program for information regarding hazard levels. https://www.state.nj.us/dep/rpp/rms/rad_cleanups.htm

4.4.4 Other Considerations

Atmospheric hazards in off-site areas peripheral to the on-site zone must be periodically monitored with direct-reading instruments. Peripheral monitoring should include upwind readings within any established decontamination areas as well as within and near any command post. It is suggested that no fewer than four (4) readings be taken in each designated off-site area for each eight- (8) hour workday. Non-hazardous readings off-site should not be considered a definite indication of local atmospheric conditions, but only another piece of information to assist in the preliminary evaluation. When possible, atmospheric samples should be collected before the initial site entry is begun.

Because monitoring performed during the initial site entry produces only a preliminary evaluation of atmospheric hazards; a program for periodic on-site evaluation must be established. Materials detected during the initial entry survey require a more comprehensive examination of on-site hazards and analyses for specific components. Since site activities and weather conditions change, a continuous program to monitor atmospheric changes must be implemented utilizing a combination of monitoring and sampling techniques.

It is imperative that personnel using monitoring instruments be thoroughly familiar with their use, limitations, and operating characteristics. All instruments have inherent constraints in their ability to detect and/or quantify the hazards for which they were designed. Unless trained personnel use the instruments and assess data readout, airborne hazards can be grossly misinterpreted, endangering the health and safety of response personnel. In addition, only safety tested, and approved instruments should be used until the absence of combustible gases or vapors can be confirmed.

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